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ANNUAL REPORT

Mr. C. Larsen,
Dean of Agriculture,
College.

Dear Sir:

I have the honor to make the following report of the South Dakota Agricultural Experiment Station for the fiscal year ending June 30, 1924:

Organization

In 1887, Congress passed an act known as the Hatch Act, giving to each state and territory $15,000.00 for the establishment of an Agricultural Experiment Station. The members of the next South Dakota legislature accepted the provisions of this act and passed a law making the Experiment Station a part of the South Dakota Agricultural College located at Brookings.

In 1906, Congress passed another act known as the Adams Act, giving to these same stations additional money, and at the present time $30,000.00 is received annually from the federal government for the support of this station. Since that time, the legislature of the state has established and appropriated money for the support of sub-stations at Highmore, Cottonwood, Eureka, and Vivian. The soil and climatic conditions found at the five different stations are supposed to represent the different conditions found in South Dakota.

By executive order on February 7, 1924, the Experiment Station was made a department of the Division of Agriculture. This department has seven sub-departments, as follows: Agronomy, Animal Husbandry, Chemistry, Dairy Husbandry, Entomology, Horticulture and Veterinary. At the head of each is the professor of these subjects in the college and the employees are paid in proportion to the time they spend in teaching and in research.

The object of the station is to conduct experiments and investigations for the benefit of the farmers of South Dakota.

State Appropriations

The legislature of 1922-23 made an appropriation of $20,000.00 for experiments in horticulture, $20,000.00 for experiments in animal husbandry, $1,500.00 for printing popular bulletins, and $3,230.00 for the support of each of the
sub-stations previously mentioned. In addition to these appropriations, each division of the station has a local fund created from the sale of products.

A detailed statement as to how the funds were expended is found in the financial report of the Secretary, included herein.

Publications

There were seven bulletins printed during the year, as follows:

No. 204—"Varieties of Corn for South Dakota." This bulletin from the Department of Agronomy reports the results of trials with several varieties of corn for different years in the various sections of the state, calling attention to the adaptability of varieties to sections. Since corn is one of the most important crops in this state, the results of these trials should be of great value to the corn growers. In some sections it would mean the difference in value of a mature or an immature ear.

No. 205—"Some Tentative Statements Concerning Fowld's Hulless Oats." This bulletin is also from the Department of Agronomy and was written by A. N. Hume, the head of the department. The following is the summary of this bulletin:

"A hulless oat, but little known in this country, serves well for poultry and swine, while the varieties with hulls are preferable for other stock." Feeds and Feeding, Henry and Morrison, 1923, par. 222.

"We have had some pretty fair success, in the county, raising hulless oats. Yesterday a man asked me whether hulless oats had strong enough straws to put on summer fallow." County Agent W. C. Boardman.

"Comparative yields, secured at Brookings in 1923, indicate that hulless oats (Fowld's S. D. 1262) yielded a somewhat lower number of bushels per acre than the best standard varieties of ordinary oats. Page 617.

"The same comparative yields for this season indicated that a hulless variety yielded a lower number of bushels per acre than the best standard varieties, even when the latter were reduced to a hulless basis. Page 621.

"Samples of hulless oats contained a higher percentage of raw protein than the whole grain of ordinary varieties, but a lower percentage than the kernels (grain with hulls removed) of the same varieties, according to analyses made in agronomy laboratory by Professor Bushey. Table III."
“The higher yielding varieties of ordinary oats produced a larger yield of raw protein per acre than hulless oats both on a basis of the whole grains and on a basis of kernels (grains with hulls removed) as computed from analyses made in agronomy laboratory by Professor Bushey. Table III.

“The results of this one season, 1923, at Brookings would indicate that where hulless oats are produced they would be intended as a special feed for certain classes of animals, especially young animals, rather than as a general farm crop for all conditions.

“The experimental work in developing the best possible hulless oats will be continued and reports of progress made later.”

No. 206—“Purebred Dairy Sires—Their Value and Influence on Production.” This is one of the popular bulletins for the year and is issued for the purpose of calling attention to the importance of using purebred dairy sires. Results secured from the records of the college dairy herds extending over a period of several years are included. The bulletin is profusely illustrated and the information contained therein should be of immense value to the dairy industry in South Dakota.

No. 207—“Forage Crops for Lambs,” from the Animal Husbandry Department, is summarized as follows:

1. Lambs do a good job of picking in the cornfield.
2. They not only picked the silks of ears, leaves of corn, and shucks on ears, the parts of the corn plant that are usually wasted, but they made a tour of the field to find weeds for variety.
3. Results do not show that the soybean is superior to rape as a forage plant. When planted in the cornfield, the mixture, however, is superior to cornfield alone.
4. The feed the lamb secured for himself in the cornfield is evidently highly nutritious since the gains made are above the average reported for experiments.
5. The average of the gains made by lambs in sorghum lots was nearly as large as the average of the gains made by lambs in corn lots, but the waste in pasturing sorghum was greater than the waste in pasturing corn.
6. For rapid gains, both the rape and corn and soybean and corn lots proved superior to corn alone, showing the value of a forage of this kind with cornfield for lambs during a short feeding period.
7. A larger growth of rape can be secured in the short growing varieties of corn than in the tall growing varieties
of corn; hence the importance to the lamb feeder in furnishing an abundance of the best forage for "lambing-off" purposes.

No. 208—"Flowers Every Day in the Year." This bulletin, by N. E. Hansen, horticulturist, includes results of trials at this station with flowering plants and suggests varieties, both annuals and perennials, that could be planted with the assurance that they would grow, both in the house and outside. It is the result of 29 years of experimentation at this station and the facts stated therein should be of great value to the people of the state.

No. 209—"Potatoes as a Feed for Fattening Pigs," from the Animal Husbandry Department, is summarized as follows:

1. In two trials in which raw potatoes were fed, results were obtained which indicate that when new potatoes were fed in connection with tankage, 513 pounds replaced 100 pounds of yellow corn, but when old potatoes were fed in the same way it was necessary to feed 962 pounds of potatoes to replace 100 pounds of corn.

2. Raw potatoes are not palatable and it is difficult to get pigs to consume large quantities of them.

3. Cooked potatoes are palatable and in three separate trials during early summer, early fall and early winter conditions, pigs receiving cooked potatoes with corn and tankage made very satisfactory gains.

4. In three trials 326, 305 and 386, or an average of 339 pounds of cooked potatoes replaced 100 pounds of shelled corn.

5. For best results cooked potatoes should replace not more than one-half of the corn that would be consumed if corn alone were fed, or for each pound, the proportion of cooked potatoes to corn should not be greater than four to one.

6. If cooked potatoes are fed during the winter months when there is little sunshine and pigs are forced to remain under cover most of the time, it may prove advisable to feed alfalfa hay in addition to corn and tankage.

7. Whether or not farmers can afford to feed cooked potatoes to hogs depends on the market price of potatoes, facilities for cooking on the farm, the availability of cheap fuel and the cost of labor.

8. No farmer can afford to grow potatoes to feed to hogs, but under certain conditions hogs will furnish a home market for potatoes that are not salable and yield a small return from what would otherwise be a total loss.
No. 210—"Some Chemical Characteristics of Soft Corn," from the Agronomy Department, calls attention to the fact that soft corn might be avoided in many cases if suitable varieties were planted; that characteristics of frosted corn may be produced by hail, and that opinions of men in the state who have fed soft corn are not the same. The author also quotes results of other stations along this line. When hogs were fed soft corn with tankage they consumed 50 percent more than the lot that received the normal corn and tankage.

The bulletin list was revised during the year according to subjects and instead of sending all bulletins to addresses on regular list, several separate lists will be prepared and only bulletins pertaining to these subjects will be mailed. By this system smaller editions of some of the bulletins can be printed.

Since the introduction of agriculture in the high schools of the state, the demand for many of our bulletins to be used as texts has greatly increased.

Many letters are received and replied to promptly on the different phases of experimental work.

The practice is to send a single copy of bulletins to all who apply, but it is not the policy to distribute in quantities outside the state.
The following experiments were considered in the Department of Animal Husbandry:

No. 1—Baby Beef Production. The question as to what extent corn silage and oats could be used in fattening calves. This was the second year for this experiment and the results will be published in bulletin form during the coming year.

No. 2—Rye for Fattening Cattle. Many inquiries, especially from the west, north and central parts of the state, are received as to the comparative feeding value of rye as a fattener. This is the second year for this experiment and the results of the two years will be published soon.

No. 3—Potatoes for Fattening Hogs. The results of this experiment were printed in Bulletin 209 of this station.

No. 4—Factors in the Summer Feeding of Market Hogs. This experiment will be continued next year.

No. 5—Sheep Breeding with a View of Eliminating the Tail. The results of this experiment are very encouraging. Two lambs were born without any tails whatever, and it is possible that this is the first appearance of a strain that will establish the character sought.

No. 6—Sheep Breeding to Develop a Fur Bearing Sheep by Use of Karakul Blood. Some choice specimens were lambed in the spring and had they been slaughtered at two months of age the pelt would probably have been worth more than the carcass in the fall for mutton. By the use of the fat-rump breed, the aim is to get an animal that will fill the two purposes—fur and meat.

No. 7—Forage Crops for Lambs. The results of two years' work were published in Bulletin No. 207 of this station.

No. 8—A Cross-breeding Experiment with Dairy Cattle. This experiment is in co-operation with the Department of Dairy Husbandry and has just been started. The two breeds of cattle, Holstein-Friesians and Jerseys, will be used to ascertain whether percent of fat and amount of milk are
inherited separately, and the extent to which each of these is influenced by cross-breeding, line breeding and in-breeding; to ascertain inheritance of conformation, size, quality and color by crossing, line breeding and in-breeding; and to ascertain if fertility and hardiness are affected by cross-breeding, line breeding and in-breeding.

No. 9—Alkali Disease Project, in co-operation with Department of Botany, Agronomy and Veterinary. There are sections of this state where so-called alkali disease is found. The object is to ascertain the cause and find a remedy for the condition.

No. 10—Grazing Experiment with Cattle, Sheep and Swine. The object is to determine value per acre of alfalfa, yellow and white sweet clover and sudan grass, at the home station and the Cottonwood sub-station located in the semi-arid belt of the state.

No. 11—Tankage Requirements of Pigs When Fed Barley on Rape Pasture. Some valuable data is being secured along this line and results will be published during the coming year.

No. 12—Factors in Winter Feeding of Market Pigs. Some good results were secured by adding chopped alfalfa to winter grain ration; also choice alfalfa fed in racks with grain and tankage produced just as good gains as when chopped and mixed with tankage.

Following are the detailed reports of each departmental head of the work carried on in his department during the year. A financial statement is reported in the back of this bulletin.

Yours truly,

JAMES W. WILSON,
Director of Experiment Station,
Professor of Animal Husbandry.
Director J. W. Wilson,
Experiment Station.

Dear Sir:

In reply to your request for a report, I beg leave to submit the following in order to indicate the nature of projects now under way and the present status of the work.

**Adams Project No. 1**

A project on the influence of rotation upon the maintenance of soil fertility. This project, as the name implies, is essentially planned for the purpose of conducting specific rotations of crops in conjunction with very definite soil treatments and discovering the inherent effect of these several rotations and treatments upon the soil. Soil effects are discovered in part by means of making chemical analyses of soil samples taken from the several plots at intervals of seven years. Two series of plots totaling one acre each are especially involved in this project. Since the previous report, the plots have been cropped with common red clover in the rotation and hay has been taken from the plots in the present season. The yields correspond to the indication in the previous report, that phosphorus is the limiting element in the soil. The addition of nitrogen to phosphorus, however, has not increased yields of clover but has rather depressed such yields.

At the last report the second series of analyses on soil samples were practically complete and only a limited amount of chemical work has been undertaken on this project since that time. The summary of results is in progress for publication in a later bulletin.

**Adams Project No. 2**

A study of correlations between certain physical characters of plants and their capacity for yield. This project has been confined to a study of Marquis wheat and also within that variety confined to a narrow range. The purpose has been to find the correlation or lack of correlation between length of spike as occurring in original mother plants of wheat and the yield of progeny extending therefrom in suc-
cessive years. At the close of the previous growing season, yields were completed on four years of progeny plants. At the present time correlation tables have been computed for the four years, using the length of original mother heads as one coordinate and the yield of progeny rows for the other. The indication is that the two are not correlated. Certain correlations have likewise been worked out to find the relation between the length of culm in the original mother plants and the length of spike in progeny. It is indicated that the longer culms are correlated with longer spikes.

The four years results of this Adams Project No. 2 are considered complete and the report is now nearly ready to submit for publication. The nursery work has been accomplished by Mr. Fowlds and the report prepared by Messrs. Hume, Hardies and Franzke.

**Adams Project No. 4**

A project to determine definitely the effects of phosphorus in different forms on the growth of plants and the effect of sulphur in combination with calcium (gypsum, calcium sulphate) and as pure sulphur on the growth of plants and its effect—the availability of phosphorus in different forms. Investigations during the past year have been pursued according to the plan as outlined in the project. One new series of pot cultures designated as series 3 was added during the year. These pots contain sand like series 2, and receive nutrient solution. The growth of crops on this series was more consistent than on series 2. The crops have been harvested for the season of 1924 and will be threshed as soon as they are in condition.

The analyses of water soluble phosphorus have been made on the tumbler cultures as specified in the project.

**Hatch Projects**

Included under Hatch projects are experiments in cereal breeding. The following statement is made by Mr. Fowlds with regard to his progress in cereal breeding:

"The effort to secure an improved variety of hulless oats is continued. Crosses were made between several important hulled varieties and the better hulless selections from the previous year. The object is to secure a hulless variety which will yield as well as the hulled varieties on the basis of de-hulled kernels. The Kilby hulless oat was the variety used as the foundation stock at the beginning of this project. This variety has a number of undesirable characteristics such as weak straw and susceptibility to rust, smut, and
drought injury. Several of the characteristics have been to some extent eliminated in the hybrid selections, but further improvement should be possible.

"Crosses were made with the White Russian and the Richland varieties in order to secure rust resistance. Early maturing selections were secured from crosses with Sixty Day and Cole. These selections partly escape rust and drought injury through early maturity. After the selections reach the fourth generation, it is necessary to test them out carefully to determine their comparative yielding ability. The comparative tests have to be continued for a number of years to eliminate the errors due to soil and seasonal variations."

Variety Testing

Numerous varieties of cereals, wheat, oats, rye, barley, are tested annually in fiftieth acre plots. In connection with variety testing, it may be mentioned that varieties of alfalfa, flax, soybeans, as well as special crops such as sorghums are continuously under test for yield and quality.

Variety tests of corn, including especially the varieties most commonly grown in this locality are continued. Likewise comparative tests are made of the several varieties of potatoes.

Corn Breeding

Systems of corn breeding are continued in order to make comparison of several means for improving corn. These included two systems which employ continuous ear-to-row selection and likewise hybridization. These systems are being compared with a so-called remnant system of selection. Corn breeding is also being continued under a system devised by the writer which includes continuous selection, introduction of new strains, and hybridization. This is an attempt to make arrangement for these three requirements within one given corn breeding plot, and to do it in such a way that the plan can be recommended practically to growers for corn improvement.

Breeding corn for high protein and low protein is being continued not only for the purpose of securing strains of corn selected for chemical content but also for the purpose of securing material which is to be utilized in another project.

Corn breeding for high and low ears is likewise continued. Here again it is the purpose not only to secure strains of given characteristics but likewise to devise a possible method for securing hybrid strains on a practical basis.
Characteristics of Soft Corn

Some studies of soft corn in comparison with mature corn have been accomplished by the Agronomy Analyst. These studies were the outgrowth of reports which came from feeders to the effect that even though animals would consume quantities of soft corn, they generally did not thrive thereon. Bulletin No. 210, now in publication, makes some definition of the term “soft corn” and also reports chemical analyses of a number of samples of corn secured with reference to their condition in regard to this quality. After giving analyses in detail, Bulletin No. 210 states “it will be noted that there is little difference in total protein between frosted and normal corn. Frosted corn contains a higher percent of ash, similar starch, high crude fibre, and a varying oil (ether extract) content.”

Furthermore, after putting down results of analyzing characteristic proteins, the further statement is made: “It is evident that soft corn is high in amide, albumin, and globulin nitrogen; low in glutelin with a zein content which is variable.”

“It is also of interest to note that corn with some of the characteristics of frosted corn may be produced by hail.”

Selection of Seed Potato Tubers

A comparison of systems for selecting seed potatoes is continued. These systems include (1) tuber selection; (2) pedigreed selection by hills; (3) mass selection of high yielding hills, and (4) use of unselected tubers for seed. The present indications are that increased yields result from making hill selections, although pedigreed hills have not produced higher yielding progeny than mass selected hills.

Strain Tests of Potatoes

The State of South Dakota appropriated funds for conducting potato experiments. The nature of work undertaken in the last two years has consisted in making strain tests of varieties from several South Dakota potato growers. The manner of making tests consists in part of securing a half bushel of seed tubers from each of the several growers previous to a given date in the fall, storing them under uniform winter conditions and placing the strains in duplicate rows in a comparative growing test the following season. The final results will be subjected to careful analysis.

In the meantime the several strains are subject to inspection by growers and others and careful notes are being
made for appearance of disease and other special characteristics that may appear in the several strains. This work supplements that which it has been possible to do with the limited amount of Hatch funds at our disposal.

**Rotation Experiments**

The field trials with several successions of crops are continued. These include continuous wheat, rye, corn, alfalfa. They also include a number of two-year rotations consisting solely of a cultivated crop (corn) followed by a non-leguminous cereal crop. Furthermore, the rotation experiments include successions of the crops just mentioned with a further addition of a legume, whether red clover, sweet clover or soybeans or field peas. A number of these latter are three-year rotations, with the legume introduced for one year and others cover four years or longer. In addition to the several rotations just mentioned the usual farm crops are placed in succession with land where alfalfa crops are produced at stated intervals.

The plans of the department contemplate studies of yield of crops from these several rotations. Also the rotations which are being continued on the same land for many years will furnish material for technical investigations concerning their influence upon soil and crop.

Another important field project includes what is called a comparative grain system and livestock system of farming. The essential difference in these two systems consists in the fact that crop residues, such as corn stover, oat straw and clover haulm are turned under directly in the grain system, while in the livestock system these residues are assumed to be first fed to livestock and then returned to the soil in the form of stable manure. Present indications are that the grain system where the residues are returned to the soil directly is gradually surpassing the comparative system, so far as yield for crops is concerned. The indications thus being that crop residues returned to the soil directly can be gradually incorporated into the soil to take effect as fertilizer.

**Substation Projects**

A summary of experiments in soils and crops would be incomplete without noting the number of projects carried on at the experiment farms of the state substations located at Eureka, Highmore, Cottonwood, and Vivian. Trial fields for soil and crop experiments are laid out at these several places in order to get information about soil and crop con-
ditions of the localities represented. The range of experiments in soils and crops is similar to that carried out at Brookings with Hatch and Adams funds, with variations necessary to secure information as indicated about the different localities. It is found that farming on the different soil types calls for varying soil treatments in order to secure the best results. Likewise, crops which may be best adapted to certain localities may or may not be found best adapted to other localities at greater or less distance. The substations located as they are give opportunity for securing information about soils and crops that could not possibly be arrived at by carrying out experiments solely at one point, such as Brookings.

**South Dakota Soil Survey**

In conjunction with other research work the Agronomy Department has conducted the South Dakota soil survey. This work is done with state appropriation in cooperation with the United States Bureau of Soils. Soil types are surveyed and mapped with reference to the utilization of soil in the business of farming. At the present time the survey of the following counties has been completed: Beadle, McCook, Union, Douglas, Grant, Walworth.

In addition a detailed survey of six townships in Jackson, Haakon and Jones counties has been made and mapped, and at the present time the survey parties are working in Brown county. The publication of survey maps including results of soil and crop trials at Groton and Vermilion is going forward as rapidly as possible. Publication likewise will be completed in cooperation with the United States Bureau of Soils.

**Seed Laboratory and Weed Garden**

The legislature of South Dakota has appropriated a small sum for seed testing. This enables the Agronomy Department to respond to requests from farmers and seed growers for tests of commercial seed and also makes it possible to do a limited amount of experimental work with seed testing in the field and in the weed garden. During the year, about 2,000 samples of seed have been tested from various parts of the state; they were also inspected for weed impurities. The weed garden conducted by the department contains 200 species of weed plants which serve as a control for classifying weed impurities that appear in importations of seed or in growing farm crops throughout the state.

Very respectfully,

A. N. HUME,
Agronomist and Supt. of Substations.
Dear Sir:

The following report is submitted in resume of the work of the division of chemistry for the year ending June 30, 1924:

This division has cooperated with the division of animal husbandry and the dairy division, in the analyses which their several projects involved. These include the analysis of silage, dairy products, grains, feeding materials of other types, urine, feces—such analyses aggregating approximately two hundred in number. This work has also included analytical work covering butter and milk tests connected with the dairy department's projects having to do with digestion problems that have been continued from the past years.

Our own Hatch project having to deal with possible maxima of crop obtainable with minimum expenditure of plant food is still in progress. Owing to difficulties encountered in our preliminary work, the problem has been slow in working out. We intend to continue our work along this line and extend it to the ash-problem announced in our report of last year. This work is passing through the control period as yet and much is to be done before we can arrive at the crux of the problem in view. We have been handicapped through lack of greenhouse facilities and hope this may be overcome in the future attack upon the problem. We propose to determine, if possible, whether currently accepted methods of determination of plant food requirement of cereal plants are accurate and whether such methods actually show the food requirement, as has been accepted in our ash-analysis mode of attack.

Our most pressing need is more help for a mass of work that taxes our force to the breaking point at times. Our station assistant chemist should be so placed as to position and salary as to allow him full time service as station analyst. This can only be done when a bureau of analysis is established which may take care of strictly departmental analysis from outside parties. This will relieve our station analyst from the necessity of any part of his time having to be assigned to college analytical work.

Respectfully submitted,

B. A. DUNBAR,
Chemist.
Pursuant to your request of recent date, I beg leave to submit the following report of the experimental work of the Dairy Husbandry Department for the fiscal year ending June 30, 1924:

Adams Project

Title: Relative value of whole milk and skim milk for calves when supplemented with a free choice of six feeds in self-feeders, and alfalfa hay ad libitum.

This is the second trial with self-feeders for calves, and although the results have not been the same, the trials warrant the drawing of several conclusions.

Five calves were used in this trial, each calf having a separate pen with an individual feeder. The self-feeder contains six compartments, each compartment containing a different feed. The feeds used were whole yellow corn and white corn, ground oats, bran, oil meal and whole oats. The feed in each compartment was weighed in whenever needed. All feed was weighed out of each compartment bi-weekly and fresh feed put back. The calves were weighed and measured biweekly.

The data have not been completely compiled, but from daily observations the following conclusions seem justifiable:

1. Self-feeders for calves are not practical, nor economical. Too much of the high priced protein feed was eaten, and the calves were in too high a condition of flesh for economical growth. 2. The calves showed poor barrel development, indicating that very little roughage was eaten. This fact was verified by the amount of roughage consumed.

Two calves developed very crooked front legs, and prominent ankles and knees. One was unable to stand on its front feet at the end of the experimental period. This calf ate practically no hay and had so much difficulty with bloat that it was finally killed, to relieve its suffering. The condition of these two calves raised a question which will be further observed, during another trial.
Project 1—Hatch Fund

Title: Bacterial Flora of Normal Cows' Udders.

This project was supervised by Mr. Copeland. The data will be collected for one complete lactation period from each cow on trial, hence this experiment will not terminate until late in the fall.

Studies made of the udder flora of cows indicate that individual animals vary widely in respect to numbers of organisms contained in the milk. Udders apparently normal, show counts varying from none in exceptional cases to as high as 225,000 per cc. The counts of different quarters vary widely.

Cell counts of a large number of udders indicate some correlation to bacterial counts, especially where the bacterial count is high. The germicidal activity of milk from different cows varies greatly. Investigation of the importance of udder types in milk fermentations shows relatively low both total and volatile acid production. Curdling may occur with very noticeable, objectionable odors. Many types have been isolated which vary considerably in their fermentation of milk. From present data dextrose agar with 72 hours incubation at 37 degrees C seems to give the highest count and most rapid growth of the udder bacteria.

Project 2

Title: Cost of producing sweet cream as compared to sour cream.

There is more or less discussion at the present time about grading cream and the production of sweet cream. It is generally understood that the quality of butter is largely determined by the quality of the cream from which the butter is churned; however no definite information is available on just how much more should or could be paid for sweet cream and how much more it costs the farmer to produce sweet cream.

This experiment is organized with a view of gathering data on these matters. The experiment was started last fall and will continue for one year. This will give data covering the four seasons of the year. Ten farmers are delivering sour cream and ten are delivering sweet cream. Extended data from each farmer's cream are obtained. The sour and sweet cream are churned separately and scored. A 20 lb. sample is stored to be scored monthly for a period of six months. Other conditions resulting from the cream affecting the quality of the storage butter will be noted.
Project 3

Work has been done during the past winter with frozen cream and the plan is to continue this during the coming winter season. This experiment was supervised by Mr. Totman.

The object of the experiment is to determine what effects the freezing of cream has upon the physical character and the flavor of butter.

The cream as received from the farmers was practically all sweet and for the most part was received in an unfrozen condition. It was placed in 10 gallon milk cans and set out of doors in zero weather from 6 to 10 hours until it was nearly all frozen. The cream was allowed to thaw at room temperature in the creamery or placed in water from 90 to 100 degrees F. Several churnings were frozen once and then thawed, and pasteurized, after which it was churned. Several batches were frozen, thawed twice before pasteurizing and then churned. Observations were made during the churning process and complete churning records were kept. The butter has been scored the day following churning and once each month for 3 or 4 months from date of making.

The results so far noted have to do with the physical condition of both the cream and butter. The cream developed a curdiness or flakiness, resembling the appearance of sour cream. There was no noticeable difference in length of time of churning. Analyses of the butter showed the curd content to be the same as that of average butter. However, the butter showed a decided short grain as soon as massed from the granular condition and when the working was completed. At each succeeding monthly scoring the same short grained body defect was noted. Reports from the commission house buying the butter agreed with the criticisms made by various members of the dairy department. No particular odors or flavors were noted except that described as wintry.

Local Station—Project 1

Title: Soybean hay vs. alfalfa hay for milk and fat production.

Last year a trial was run in which soybean meal and oil meal were compared. This year the soybean hay was compared to alfalfa hay.

It is not assumed that soybean hay will ever replace alfalfa hay as a dry roughage for dairy cows, but there are
times when alfalfa hay cannot be had and other places where it cannot be grown. In these cases a good substitute is the next best hay to use. Soybean hay can be grown in most sections of South Dakota with comparatively small cost per ton.

The feeding trial, in which four cows were used, indicated that the soybean hay which was used was equal in feeding value to alfalfa hay. It should be noted, however, that the soybean hay was much inferior in quality, when compared to the alfalfa hay used. The results would probable have been in favor of the soybean hay if it had been of as good quality as the alfalfa hay used.

The results of these trials are being compiled and will appear in bulletin form.

Project 2

Title: Effect of silage on vitamin C potency of milk.

This is the second trial in which the milk from cows fed silage was compared with milk from cows receiving dry feeds only. The milk used was obtained from the college herd and from a farmer's herd whose cows did not receive any succulent feeds during the winter months. Both herds received a good quality of alfalfa hay.

The first trial indicated that the vitamin C content of milk from cows fed silage was much greater than the milk from the non-silage fed cows. The second trial indicated the presence of vitamin C content in milk from silage fed cows, but there was not as marked a difference as appeared in the first trial. A third trial will be run to verify these results.

Project 3

Title: Effect of methods of washing separators on the bacterial content of cream and skimmilk.

Trials were conducted comparing the frequency of washing the separator on the quality of cream produced. Farm conditions were maintained as far as possible. When the separators were only rinsed after use, cream from the following separation showed an average bacterial count of 10,800,000 per cc. Washing and scalding separators after each separation, resulted in an average count of 5,500,000.

The skimmilk showed even greater differences. The keeping quality of the cream was increased considerably when the separator was washed after each separation.
Project 4

Title: Breeding up experiment.

This work has been in progress since 1907. Cows of the fourth cross are now in milk. After securing three complete lactations on these animals, the work will be discontinued. Further progress in breeding up, will depend entirely on the merits of the sires used. The experiment proves that good purebred sires will increase the production in their grade offspring and also the type.

Respectfully submitted,

THOMAS M. OLSON,
Dairy Husbandman.
DEPARTMENT OF ZOOLOGY-ENTOMOLOGY

Director James W. Wilson,
South Dakota Experiment Station.

My dear Sir:

In reply to your recent request, I am submitting here-with the following brief reports of the Experiment Station work conducted by the Entomologists of the Zoology-Ento-mology department during the fiscal year just closed. Two projects, both financed through Adams funds, were carried on during the year; project 3 was carried on under the di-rec tion of H. C. Severin, while project 4 was conducted un-der the leadership of George Gilbertson. There were no changes in the staff of this department during the year.

Adams Project 3

Title: Distribution, life history, economic importance, natural enemies and control of the common field cricket (Gryllus assimilis Fab.).

During the past year, additional studies were made of the life history and habits of this pest under field conditions. These studies were made near Newell, South Dakota, a re-gion in which the crickets are exceptionally abundant and destructive. In this section of the state, it is not unusual for the crickets to destroy an alfalfa seed crop in a few days. We are indebted to the superintendent of the Belle Fourche Experiment Farm, Mr. Beyer Aune, for permission to work on the grounds of the station, and also for the many courtesies which he extended to us while we were thus engaged. Likewise, we are indebted to Mr. Oscar Mathews, upon whose farm we experimented.

During the past year, we again studied the influence of the natural enemies of the common field cricket to deter-mine if possible whether or not the enemies might ulti-mately so reduce the numbers of the crickets as to make them a negligible factor for a series of years at least. Our investiga-tions have shown us, however, that, at present, little faith can be placed upon the good work of these enemies, and that control measures must be instituted by man if relief is to be obtained.

With this conclusion before us, control measures for
the crickets were attempted on a large scale. The first of these dealt with a destruction of the eggs, the second, with a destruction of the immature and adult crickets.

To destroy the eggs of the crickets, it is only necessary that they be exposed to the air, sun and wind for three to four hours. At the end of this time, they are shrunked and dead. Since the eggs of this cricket are laid not deeper than one and one-half inches beneath the surface of the ground as a rule, and since they are laid singly and not in pods, and are not protected by any special secretion, any process that will disturb the soil so as to bring the eggs to the surface will serve our purpose. In alfalfa fields, a spring tooth cultivator run lengthwise and crosswise over the field late in fall and again early in the spring will do an immense amount of good. The edges of such fields, as well as the sides and tops of irrigation ditches, should also be gone over. Whenever grain fields become overrun with crickets, then these should also be worked.

In our work of last year, we found that the most effective poisoned bait to kill the common field cricket in any of its nymphal stages, and also in its adult form, was made according to the following formula:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bran</td>
<td>25 pounds</td>
</tr>
<tr>
<td>White arsenic or paris green</td>
<td>11/2 pounds</td>
</tr>
<tr>
<td>Black strap molasses</td>
<td>1 gallon</td>
</tr>
<tr>
<td>Water</td>
<td>3 3/4 gallons</td>
</tr>
</tbody>
</table>

During the past year, we tried out this bait on a large scale. It was put out after 6 P. M. on hot, sunshiny days, and after 4 P. M. on cool, cloudy days. The bait was broadcasted at the rate of 4 pounds of the dry bran per acre and in alfalfa fields was applied after the first cutting of hay had been made. In sections of the state where irrigation is practiced, the fields were first irrigated and then treated with the bait, while in the sections where irrigation is not practiced, the bait was applied shortly after a rain had fallen. At least 50 per cent of the crickets were destroyed by one application of the bait in each treated field. This estimate is undoubtedly too low, for an accurate count of the dead crickets is impossible because many of the dead crickets are carried away by ants and other insects, and because the poisoned crickets crawl into cracks in the ground and in between the stems near the crowns of alfalfa plants.

It is our plan to try to improve the efficiency of this bait next year.
Adams Project 4

Title: The wheat stem maggot (Meromyza americana Fitch), its distribution, food plants, economic importance, life history, habits, natural enemies and control.

As stated in our last report, the following data concerning the wheat stem maggot has been definitely worked out and is ready for publication: Distribution, host index, economic importance, life history, habits, parasites, and artificial control.

Since our last report, we have visited parts of the state hitherto unvisited by members of the department, and have added data increasing our distributional knowledge of this pest. As new localities were visited, host plants of the maggot were noted as well as percentages of injury.

No increase in percentage of injury was observed this past year, the average per cent of the year's injury comparing very closely to that of former years.

The work with the parasites of the wheat stem maggot has progressed nicely the past year. As indicated in our last report, we have determined the identity of the principal parasites and have ascertained to what extent they may be relied upon to aid in the suppression of the Meromyza. Our data at present, judging from comparisons of the past few years, would indicate a fairly constant balance existing between the Meromyza and its enemies, thus accounting for the constant injury of this species. This ratio is stable, with a small fluctuation between narrow limits.

During the past year, the bulk of the work done on this project has been along the lines of artificial control. From the study of the habits of this pest, it has been our contention that the fly, in its previposition period and its subsequent feeding during this time, would be attracted to a poisoned bait. A large number of attractants have been experimented with in various ways. During the past year, the following materials have been tried:

Oils—Citronella, cedar, lemon, bergamot, orange, birch, penny royal, thyme, cloves, fennel, tansy, anise, castor.
Molasses, dilute.
Molasses and vinegar.
Molasses plus yeast.
Alcohols.

These baits, in a first series of trials, were placed in shallow pans with tin umbrella covers to exclude rain and to prevent excessive evaporation, yet open enough to permit dissemination of volatile constituents and ingress of flies.
In a second series of trials, lamp wicks were placed in inverted corked bottles, allowing about 4 inches of the wick to protrude, the wick furnishing the evaporating surface kept moist by capillarity.

In a third series of trials, cloth screens, 2 feet square, were used and the bait sprayed upon them. These screens were exposed at different levels.

As to results, the oils were negative in their value as attractants, molasses alone negative, molasses plus vinegar fair, molasses plus yeast fair, several alcohols fair.

It has long been known that the adult flies feed upon freshly mown grass, visiting the cut ends of the leaves for the purpose of obtaining food. Through careful search, we have hit upon a material which gives us the odor of new mown hay. This material may be gotten synthetically as an ester ("new mown hay") or directly from the tonka bean in the form of coumarin. While it is still too early to predict positive results from the use of this substance, we are experimenting at the present time to determine the value, best formula for its preparation and best means of application. Our first few trials look very promising.

Our illustrations are prepared, and we await the outcome of the above experiment before we definitely conclude the project.

Very truly yours,

H. C. SEVERIN,
Entomologist.
DEPARTMENT OF HORTICULTURE

Director James W. Wilson,
South Dakota Experiment Station.

Dear Sir:

In reply to your inquiry, I have the honor to submit the following report for the fiscal year ending June 30, 1924:

Adams Fund

The horticulture project on the Adams fund is the breeding of hardy fruits, especially the apple, pear, plum, cherry, sand cherry, grape, gooseberry, currant, raspberry, blackberry, and strawberry.

Hatch Fund

One project on the Hatch fund is the variety test of ornamentals, including trees, shrubs, perennials and other flowers, with a view to determining what varieties are hardy without winter protection. The breeding of hardy roses is the main project, as there is great need of hardy roses for South Dakota.

The method of hybridizing is to grow the trees on dwarf stocks in tubs. These tubs are wintered in the cellar and brought into the fruit breeding greenhouse, a few at a time, especially during January, February, March, and April. This extends the work over a longer period of time. During May and June the work is done outdoors. This tub orchard method was devised at this station in 1897 and the results are shown in the new varieties offered in nursery catalogs of many states. Many thousands of new seedling fruits and ornamentals are coming on, and I believe many choice varieties will be found among them. There is no such a thing as completing the work, as it should be continued until we have a satisfactory list of fruits and ornamentals that will be hardy without winter protection anywhere on the Dakota prairies.

The old west greenhouse should be rebuilt and made twice as wide. This would make possible a great extension of the work in fruit breeding, since the present greenhouse is much too small. A tree storage cellar should also be built as the present cellar capacity is altogether too small. If no cellar is provided this coming season, the
future development of the work will be seriously hampered and many years of valuable time will be lost. Twenty thousand dollars was the estimated cost of this necessary cellar and cold storage building with fruit-breeding greenhouse and fruit laboratory in connection.

**State Orchards**

State orchards have been established at the following places:

- Sioux Falls—State rose garden, and small plum and apple orchard, 10 acres.
- Aberdeen—Apple and plum orchard, 3 acres; seedling apple orchard, 15 acres.
- Watertown—Apple, pear and plum orchard, 15 acres.
- Pierre—Apple and plum orchard, and roses, 7 acres.
- Philip—Apple and plum orchard, 3 acres; sand cherries, 7 acres.
- Eureka—General fruit orchard, especially Siberian pears, 20 acres plowed but not planted.

Experimental trees were also sent to Eureka, Hot Springs, Custer, Rapid City and Plankinton.

The object of the work is:

1. To test all the standard varieties.
2. To demonstrate the best systems of orchard management.
3. To test out many thousands of new seedlings which are being originated every year.
4. To establish stock orchards, especially for the Siberian wild blight-proof pears and wild apples, to grow hardy seedlings upon which to bud the new hybrids coming on.

There will be some income from the sale of the seedlings to nurserymen and others.

**New Fruits**

Many new fruits are sent out from this department each year, the following in the spring of 1924 for the first time:

**Chinook Apple.** The first of a series of hybrids of the standard apples with the wild crab in which the wild crab is the pollen parent. In this case the seed parent is the Baldwin apple, and the pollen parent is the wild crab of Elk River, about forty miles north of Minneapolis, Minnesota. It is of promise for the far north. The first gruits
of the Chinook apple are only two inches in diameter but this will probably increase somewhat on older trees. The fruit is oblate, of a fine dark red, subacid, season probably all winter. Named after an Indian tribe.

**Nertchinsk Crab Seedlings.** For the far north it may prove best in the long run to improve the Siberian crab by straight selection through several generations rather than by hybridization with the standard apples. The Siberian crabs vary considerably in hardiness. I believe the one from Nertchinsk, eastern Siberia, near the headwaters of the Amur river, is the hardiest one now available and will go farther north. They are very productive. The fruits make a beautiful sight on the tree and make as fine show as the common European Mountain Ash which is not entirely hardy here, often winterkilling after heavy fruiting. The fruits are mostly small, for ornament only, and for stocks.

**Saponsky Pear.** This is S. P. I. 20336, brought from Saponsky, Eastern Siberia, in 1906 by Frank Meyer as agricultural explorer for the U. S. Department of Agriculture. It has been given the name Saponsky to indicate its origin. This form of Pyrus Ussuriensis has proven very hardy, productive, and free from blight. The rounded leaves are characteristic. The fruit is valuable only for the hardy seedlings to grow nursery stocks and for hybridization.

**Sunset Gooseberry.** A few years ago the giant gooseberries of Western Europe were crossed with the wild South Dakota gooseberry. The pollen parent is a fifth generation seedling of the wild Sioux Valley gooseberry from Lake Oakwood and Gary, South Dakota. The fruit is seven-eighths by three-fourths inches in diameter and the bush is very fruitful. The name is given in allusion to the fine red color of the fruit.

**Horticultural Exploration**

In July, 1923, a tour was made by auto with several assistants to Manitoba and Saskatchewan to collect native seeds and plants of horticultural value. From southeastern Saskatchewan, the assistants were sent home through North Dakota, while I went north to Big River, Saskatchewan, to continue the work. Much seed was collected, especially of cherries, raspberries, currants and various small fruits. Seed from the western limit of the wild grape was obtained. Late in the fall a seed collecting tour was made to southwestern
Ontario. This makes the tenth trip to Canada in five years. In May, 1924, a tour was made to southwestern Iowa to collect apple pollen.

Yours truly,

N. E. HANSEN,
Horticulturist.

DEPARTMENT OF VETERINARY

Director J. W. Wilson,
Experiment Station.

Dear Sir:

The Veterinary Department of State College has been engaged for the past two years on but one research problem, known as our Hemorrhagic Septicemia project, on Adams fund.

As reported last year, this project includes a detailed study of various strains of hemorrhagic septicemia bacilli isolated from various species of domestic animals and fowls delivered to our Animal Health Laboratory for diagnostic purposes. This study includes a comparison of the various cultures isolated, especially in regard to their action on the rarer sugars and their pathogenicity for laboratory animals. During the first year about thirty different strains of the organism were examined and compared with each other. During the year just closing the work was continued, but on a considerably smaller scale due to the enforced absence of the assistant doing this work, on account of the serious illness of a member of his family.

The progress of the work is of necessity quite slow, because the funds available make only half time work on the problem possible. Many interesting features have been noted, but we do not feel justified in drawing conclusions until more work has been done. During the coming year, the work will be continued more vigorously than before, another assistant being assigned to this work. It is hoped that the close of the next year will find us in position to present some conclusions that will have a direct bearing on the practical handling of the disease on the farm or ranch.

C. C. LIPP.
Veterinarian.
# ANNUAL REPORT

## FINANCIAL REPORT

**Experiment Station Funds for 1923-24**

**United States Appropriation**

<table>
<thead>
<tr>
<th>Item</th>
<th>Hatch Fund</th>
<th>Adams Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received from U. S. Treasurer</td>
<td>$15,000.00</td>
<td>$15,000.00</td>
</tr>
<tr>
<td>Salaries</td>
<td>$8,594.93</td>
<td>$8,361.59</td>
</tr>
<tr>
<td>Labor</td>
<td>1,591.12</td>
<td>3,796.37</td>
</tr>
<tr>
<td>Stationery and office supplies</td>
<td>34.40</td>
<td>7.75</td>
</tr>
<tr>
<td>Scientific supplies, consumable</td>
<td>106.74</td>
<td>328.93</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>41.40</td>
<td>60.43</td>
</tr>
<tr>
<td>Sundry supplies</td>
<td>474.38</td>
<td>272.51</td>
</tr>
<tr>
<td>Fertiliers</td>
<td>16.00</td>
<td></td>
</tr>
<tr>
<td>Communication service</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Travel expenses</td>
<td>195.50</td>
<td>160.06</td>
</tr>
<tr>
<td>Transportation of things</td>
<td>173.50</td>
<td>16.79</td>
</tr>
<tr>
<td>Publications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furniture, furnishings, and fixtures</td>
<td>681.15</td>
<td>318.45</td>
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<tr>
<td>Library</td>
<td>187.90</td>
<td>1.80</td>
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<tr>
<td>Scientific equipment</td>
<td>421.57</td>
<td>1,054.16</td>
</tr>
<tr>
<td>Livestock</td>
<td></td>
<td>115.00</td>
</tr>
<tr>
<td>Tools, machinery and appliances</td>
<td></td>
<td>461.61</td>
</tr>
<tr>
<td>Buildings and land</td>
<td></td>
<td>45.54</td>
</tr>
<tr>
<td>Contingent expenses</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Totals**                                                                 | $15,000.00   | $15,000.00       |

**Substation Fund**

<table>
<thead>
<tr>
<th>Appropriations</th>
<th>Cottonwood</th>
<th>Eureka</th>
<th>Highmore</th>
<th>Vivian</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries</td>
<td>$2,384.68</td>
<td>$2,190.42</td>
<td>$2,281.57</td>
<td>$2,535.59</td>
<td>$9,992.26</td>
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<tr>
<td>Labor</td>
<td>295.01</td>
<td>911.50</td>
<td>775.93</td>
<td>515.40</td>
<td>2,471.84</td>
</tr>
<tr>
<td>Feeding stuffs</td>
<td>71.63</td>
<td>29.72</td>
<td>5.60</td>
<td>12.60</td>
<td>18.20</td>
</tr>
<tr>
<td>Sundry supplies</td>
<td>6.60</td>
<td>3.76</td>
<td>3.10</td>
<td></td>
<td>12.86</td>
</tr>
<tr>
<td>Communication service</td>
<td>32.09</td>
<td>40.34</td>
<td>97.25</td>
<td>76.68</td>
<td>275.28</td>
</tr>
<tr>
<td>Travel expenses</td>
<td>81.38</td>
<td>4.95</td>
<td>4.47</td>
<td></td>
<td>99.80</td>
</tr>
<tr>
<td>Transportation of things</td>
<td>9.40</td>
<td>23.91</td>
<td>18.18</td>
<td>58.28</td>
<td>109.77</td>
</tr>
<tr>
<td>Heat, light, etc.</td>
<td>349.81</td>
<td>20.40</td>
<td>2.25</td>
<td>19.45</td>
<td>49.55</td>
</tr>
</tbody>
</table>

**Totals**                                                                 | $3,230.00   | $3,230.00   | $3,230.00 | $3,230.00 | $12,920.00 |

**Horticulture Experiment**

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>Labor</th>
<th>Sundry supplies</th>
<th>Transportation of things</th>
<th>Tools, machinery, etc.</th>
<th>Buildings and land</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditures</td>
<td>$4,916.89</td>
<td>2,585.54</td>
<td>1,077.28</td>
<td>115.41</td>
<td>63.51</td>
<td>$10,000.00</td>
</tr>
</tbody>
</table>

**Livestock Experiment Fund**

<table>
<thead>
<tr>
<th>Appropriation</th>
<th>Salaries</th>
<th>Scientific supplies, consumable</th>
<th>Feeding stuffs</th>
<th>Sundry supplies</th>
<th>Communication service</th>
<th>Travel expenses</th>
<th>Transportation of things</th>
<th>Scientific equipment</th>
<th>Livestock</th>
<th>Buildings and land</th>
<th>Expenditures</th>
<th>Balance reverted to State Treasurer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditures</td>
<td>$1,416.66</td>
<td>165.14</td>
<td>2,288.05</td>
<td>3.03</td>
<td>227.49</td>
<td>1.28</td>
<td>470.00</td>
<td>4,650.00</td>
<td>153.30</td>
<td>$9,998.55</td>
<td>$9,998.55</td>
<td>1.45</td>
</tr>
</tbody>
</table>

**Total**                                                                 | $10,000.00   |
### Potato Experiment

**Expenditures:**
- Salaries: $678.40
- Labor: $268.40
- Sundry supplies: $52.20

**Total Expenditures:** $1,000.00

**Balance on hand July 1, 1923:** $4,709.84

**Receipts:**
- Land Endowment: $3,132.18
- Sales Cottonwood: $175.90
- Sales Eureka: $532.93
- Sales Highmore: $449.06
- Sales Vivian: $1,074.89

**Total Receipts:** $10,073.90

**Expense Substation Fund**

<table>
<thead>
<tr>
<th>Cottonwood</th>
<th>Eureka</th>
<th>Highmore</th>
<th>Vivian</th>
</tr>
</thead>
<tbody>
<tr>
<td>$604.34</td>
<td>$252.91</td>
<td>$312.09</td>
<td>$601.07</td>
</tr>
</tbody>
</table>

**Scientific supplies, consumable:** $5.11

**Total:** $1,143.95

**Balance on hand July 1, 1924:** $6,266.50

### Livestock Experimental Revolving

**Balance on hand July 1, 1923:** $148.20

**Receipts:** $6,466.36

**Total Receipts:** $6,614.56

**Expenditures:**
- Labor: $820.16
- Feeding stuffs: $2,251.12
- Sundry supplies: $87.68
- Communication service: $1.15
- Travel expenses: $53.89
- Transportation of things: $178.37
- Livestock: $2,250.99
- Buildings and land: $86.70

**Total:** $5,729.06

**Balance on hand July 1, 1924:** $875.50

**Sales Funds**

**Balance on hand July 1, 1923:** $688.98

**Receipts:** $656.76

**Total Receipts:** $1,345.74

**Expenditures:**
- Labor: $572.51
- Sundry supplies: $270.03
- Communication service: $2.00

**Total:** $844.54

**Balance on hand July 1, 1924:** $501.20

**Total:** $1,345.74