

THE STATE AGRICULTURAL COLLEGE
OF COLORADO

The Twenty-Eighth Annual Report

OF

**The Agricultural Experiment
Station**

For 1915



The Agricultural Experiment Station

FORT COLLINS, COLORADO

THE STATE BOARD OF AGRICULTURE

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LETTER OF TRANSMITTAL

To His Excellency, Geo. A. Carlson, Governor of Colorado :

In accordance with the law of Congress, I have the honor to transmit to you herewith the Twenty-eighth Annual Report of the Colorado Agricultural Experiment Station.

The financial statement is for the Government fiscal year ending June 30, 1915. The other portions are reported substantially for the state fiscal year of 1914-15.

C. P. GILLETTE,
Director.

Agricultural Experiment Station,
Fort Collins, Colorado,
December, 1915.

**FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION
FOR THE FISCAL YEAR ENDING JUNE 30, 1915.**

Dr.	Receipts					Total	
From the Treasurer of the United States as per appropriation for the fiscal year ended June 30, 1915, under acts of Congress approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund).....	Hatch Fund	Fund Adams	State Fund	Sales Fund	Special Fund	Horse Fund	Total
Balance on hand July 1, 1914.....				258.67	5,570.97		5,829.64
Other sources than U. S.....	\$15,000.00	\$15,000.00		389.25	7,135.77	2,950.19	26,134.16
Total Receipts							\$61,963.80
	Disbursements						
By Salaries	9,762.44	11,888.17	7,740.35		196.00	495.81	30,082.77
Labor	808.03	641.68	899.05		985.76	199.36	3,525.28
Publications	1,768.69		1,237.53		432.59	30.06	3,468.87
Postage and Stationery.....	421.11	37.44	74.07		140.69	42.11	715.42
Freight and Express.....	92.96	82.56	43.72		17.13	11.99	248.36
Heat, Light, Water and Power.....	92.75	278.06					370.81
Chemicals and laboratory supplies.....		339.03	114.55		101.41	10.50	565.49
Seeds plants and sundry supplies.....	205.74	72.08	107.11		5.75	125.71	516.39
Fertilizers		44.90					43.90
Feeding stuffs	3.19		2,208.55		405.64	1,666.13	4,278.51
Library	340.94	19.04	4.00		3.80	5.00	372.78
Tools, machinery and appliances.....	163.09	268.74	256.75		37.50	152.84	878.42
Furniture and fixtures.....	203.30	56.10			2.00	7.80	269.20
Scientific apparatus and specimens.....	170.46	608.27					778.73
Livestock.....			105.00		4,642.80		4,747.80
Traveling expenses	316.52	132.80	240.03		41.19	12.55	743.09
Contingent expenses	20.00					55.80	76.80
Buildings and land	630.78	532.13	2,642.31		172.50	18.50	3,996.25
Transfer to Horse Fund					700.00		700.00
Total expenditures	\$15,000.00	\$16,000.00	\$15,658.95	647.92	\$7,884.76	\$2,834.16	\$56,377.87
Balance					4,821.98	116.03	5,585.93
					\$12,706.74	\$2,950.19	\$61,963.80

REPORT OF THE DIRECTOR

To the President:

I have the honor to present the following brief report covering the work of the Experiment Station during the State fiscal year closing November 30, 1915. The financial statement covering the expenditures upon the Hatch and Adams funds is for the Government fiscal year ended June 30, 1915.

The station work in general has progressed rather satisfactorily during the year, with very few changes in the personnel of the workers. One section, that of Forestry, has been added to the divisions of the station work, and we have not discontinued work in any of the sections reported one year ago.

The co-operative work with Government bureaus has progressed with perfect harmony so far as I am aware. During the year we have taken on a small amount of co-operative work with the Bureau of Plant Industry for the purpose of improving alfalfa seed production. This work is being carried on under the immediate direction of Mr. P. K. Blinn at the Rocky Ford Alfalfa Station.

We have also been able to co-operate with the Bureau of Plant Industry, in its efforts to determine the causes that have been responsible for failures in the potato crop, that have been more or less prevalent in some of the important potato-growing sections of Colorado during recent years. The bureau established a station in the Greeley district, where, through an appropriation of \$5,000 made by the Twentieth General Assembly, we have been able to contribute \$2,313.62 to the support of the work this year. The College Farm Department has also loaned the Greeley Station the use of a farm team and harnesses during the entire growing season, and the Experiment Station has furnished a Ford automobile for the use of the Government men in charge of the Potato Station. It is expected that the balance of the appropriation will be available for the work during the next fiscal year.

The work in co-operation with the Office of Public Roads and Rural Engineering has made good progress during the year, and promises to give us data for valuable bulletins to be published in the near future in addition to those already

issued. I am very much in hopes that we shall be able to take up a thoro survey and efficiency study of the Poudre Valley irrigation system before the end of another year.

The co-operative work with the Bureau of Animal Husbandry, for the purpose of developing an American heavy harness carriage horse, has made excellent progress during the year. Horses of this type seem to be growing in popularity and are likely to do so for years to come. I would specially call your attention to Mr. Little's report upon this work.

For the first time in several years, the entire state appropriation for the work of the Experiment Station has been made available, and with our .025 mill appropriation for station work in the future, we shall no longer be hampered by uncertainty as to whether or not funds will be available to carry on the experimental work. It should be noted, however, that the total funds that are likely to become available in the immediate future for station work will not be very much in excess of the average appropriations that have been received for ten years past. The main advantage will be in the certainty that the levy will be promptly received for the work.

The total amount expended by the Experiment Station during the past year is \$56,377.87, which is approximately the amount that we expect to receive from all sources next year and in the years following, unless changes in the appropriations are made. This amount of money will not enable us to materially broaden or extend the work that has been carried on in the past although there are many other lines of investigation that should be taken up by the station as soon as funds can be made available for the work.

The last session of the Legislature made an appropriation of \$5,000 for the drainage of the Teller Indian School land. Nothing has been done towards the drainage of this property to the present time, on account of our having to wait for the location of the main drains in the government reclamation project covering the portion of the Grand Valley where the school is located. I am advised that these surveys are not likely to be made until early next spring. Just as soon as these main drains are determined upon, it will be the purpose of the station to contract for the drainage of the school grounds as early a date as possible.

We have published fourteen bulletins containing 502 pages during the year. This is a larger number than we have published for several years past. Their publication was made possible because of the special appropriation made by the last

General Assembly which could be used for this purpose.

Following is a list of the bulletins published during the past year:

BULLETINS

203.—Farm Costs on the Colorado Agricultural College Farm, by Alvin Kezer.

204.—Brisket Disease (Dropsy of High Altitudes), by G. H. Glover and I. E. Newsom.

205.—Yellow-berry in Wheat. Its Cause and Prevention, by Wm. P. Headden.

206.—Spur Blight of Red Raspberry caused by *Sphaerella* Rubina, by Walter G. Sackett.

207.—The Colorado Statute Inch and Some Miners' Inch Measuring Devices, by V. M. Cone.

208.—A Study of Colorado Wheat. Part 1, by W. P. Head- den.

209.—Irrigated Agriculture in the San Luis Valley, by V. M. Cone and Alvin Kezer.

210.—Insects and Insecticides (Being a revised edition of Bulletin 114), by C. P. Gillette and Geo. M. List.

211.—Colorado Plants Injurious to Livestock, by W. W. Rob- bins and Geo. H. Glover.

212.—Fungous Diseases of Colorado Crop Plants, by W. W. Robbins and Otto A. Reinking.

213.—Poultry Raising in Colorado, by W. E. Vaplon.

214.—Forage Crops for the Colorado Plains, by Alvin Kezer.

215.—The Dethridge Meter, by V. M. Cone.

216.—Studies of Health in Potatoes, by C. L. Fitch.

The total number of Station projects that were active during the past year is thirty-six, a full list of which is given below.

STATION PROJECTS IN FORCE DURING THE YEAR

Chemical Section

A Study to Determine the Factors Causing the Softening of Wheat. Adams Fund.

Bacteriological Section

A Bacterial Study of Alkali Soils. Adams Fund.

Nitrifying Efficiency of Some Colorado Soils. Adams Fund. (Completed).

Spur Blight of the Red Raspberry. Hatch and Adams Funds. (Completed).

Value of Certain Carbon Compounds as a Source of Energy for *Azotobacter*. Adams Fund.

Soil Algae. Hatch Fund. (In abeyance).

Bacterial Disease of the Field Pea. Adams Fund. (Approved June 1, 1915).

Entomological Section

- Plant Louse Investigation. Adams Fund.
 Syrphus Flies in Relation to Plant Lice. Hatch Fund.
 Control of Insects by Egg Treatment. Hatch and Special Funds.
 Life Habits of Lady Beetles. Hatch and Special Funds. (Completed).
 Insect Investigations, General. State Fund.

Irrigation Investigations

- Experiments with Flow of Water. Adams Fund.
 Drainage of Farm Crops and Drainage Factors. Adams Fund. (In abeyance).
 Water Requirements of Crops. Adams Fund.
 Weir Construction. Adams Fund.
 Current Meters. Adams Fund.
 Evaporation Experiment. Hatch Fund.
 Concrete. Hatch Fund. (Dormant).
 Tank Experiments. Hatch Fund.
 General Meteorology. Hatch Fund.
 Pump Irrigation. Hatch Fund. (Dormant).
 Seepage. Hatch Fund. (Dormant).

Agronomy Section

- Correlation of Characters in Grain. Hatch Fund.
 Alfalfa Breeding. Hatch Fund.
 Methods in Selection Breeding. Special Fund.
 High Altitude Crops. Special Fund.
 Feed Crop Improvement. Special Fund.
 Rotation of Crops for Colorado. Special Fund.

Horticultural Section

- Hardy Stock of Apples. Hatch and Special Funds.
 Pear Growing in Eastern Colorado. Hatch and Special Funds.
 Management of Nitre Soils. Hatch and Special Funds.

Veterinary Section

- Brisket Disease. Hatch and Special Funds.
 Sore Mouth Disease. Hatch and Special Funds.
 Infectious Anemia. Hatch and Special Funds.
 Animal Disease Investigation. General and Special Funds.

Horse Investigations

- To Establish an American Breed of Carriage Horse. State Appropriation Fund, in co-operation with Bureau of Animal Industry.

Animal Husbandry Section

- Ration Experiments With Steers. Special Fund.

Irrigation Engineering Section

Duty of Water Upon the College Farm. Special Fund.
Sub-Irrigation Investigations. Special Fund.

Forestry Section

Dandelion Studies. State and Special Funds.

Following are brief reports of the work of the year from the heads of sections.

Very respectfully submitted,

C. P. GILLETTE,

Director.

REPORT OF THE CHEMIST

To the Director:

The Chemical Section has prosecuted during the months since my last semi-annual report the one project which we briefly designate the "Wheat Project".

The scope of the work prosecuted is the same as for the two preceding years. This statement requires some modification, for, during the season of 1914, we were so far behind with our analytical work that it was impossible for us to carry on the work on the moisture and nitric nitrogen in the soil during the growing season as we did during the season of 1913, nor did we do any analytical work on the composition of the plant. Both of these lines of work were resumed in 1915. The analytical work has been completed but the soil investigations are being continued, though we are now taking soil samples at intervals of four instead of two weeks. We shall take one set in December, if the weather permits, when these observations will be discontinued.

We have already begun the analytical work on the wheat produced in 1915. We may be able to finish this by April though we have not, heretofore, been able to do this, and the work on the samples collected for the different years has overlapped. This accounts for the fact that we have not yet done any work on the flours, so we have the flour samples made during the three seasons awaiting our attention and also all of the samples of wheat preserved for milling on a small scale. We had hoped to be able to use the results obtained by milling samples of 200 pounds each in Mr. Hoffman's mill, but while this gives us some very useful data, the plant is too big for the handling of even such small quantities as 200 pounds of wheat with the certainty of results demanded by the work that we are doing. These mill results, however, are worth more than they cost and give us real

commercial flour with which to do our baking and for analytical purposes.

We regret that these samples of flours have had to be allowed to age at the risk of their deterioration, but this has been unavoidable.

The season of 1915 has been a rather unfavorable one for us, owing to the unusual amount of rain that has fallen and its still more unusual distribution. These weather conditions were responsible for the very severe attack of rust suffered by the wheat, particularly by the Defiance, which was so badly affected that the grain was shrunken to such an extent that I could sell it only as chicken feed. The other two varieties experimented with, Red Fife and Kubanka, were also injured, but to a very much less degree.

The weather was not the only untoward event of the year. Wild oats took possession of our plots to such an extent that I was inclined to plow up some of the plots before the oats matured, but better counsel prevailed and all the plots were harvested as though the oats were not present. I am fully convinced that these oats were applied to the plots with the water used in our fall irrigation. The ground was thoroughly infested. The south and southeastern plots were the worst. These plots were planted to Kubanka but all of the plots were very bad. In selling the Kubanka a reduction of five cents per hundred in the price was necessary owing to the large amount of oats present.

These conditions very probably influence the composition and character of the wheat grown, and are actual factors in our experiments. I wish that these factors had not occurred, but it seems improper to eliminate this series of experiments, even though we may be in doubt about the interpretation to be given to the results. Our interpretation of these, however, will be just as much entitled to consideration as our interpretation of the results of any other series. In some respects these unfavorable conditions seem favorable to us, as the results obtained seem less dependent upon these conditions than I supposed them to be. For instance, the effects of the nitrates upon the character of the berries persists in spite of these conditions, at least in those cases in which we made two applications of the nitrates. Concerning the effects produced by the occupation of the ground by the wild oats, I do not as yet see what weight is to be given to this factor.

As the ground used in these experiments is now well seeded to wild oats, I do not think it wise to continue these field experiments the ensuing year, but plan to turn the ground over to the farm department with the understanding that they will plant it to a cultivated crop. The only land that we desire is enough to grow some seed wheat for the years following. We should look to the nurifying of our seed, as it has become somewhat mixed. This will require some care, but will present no great difficulty.

as the characters of the plants of these three varieties are very distinct.

As soon as the work on this year's wheat samples is completed, we can take up work on the flours, which will occupy us for the year intervening between our field experiments, if, after the expiration of this period, it should seem advisable to continue this line of work for another year. Personally, I would like to go to the next step and arrange for growing our samples under more fully controlled conditions. While fully convinced, by the results observed in field culture, of the truth of my fundamental assumption of the importance of the function of the soil bacteria in determining the character of the wheat kernels, it still remains for me to furnish definite proof which will satisfy others, especially as the role played by the biology of the soil is not specifically recognized as being important in the measure that I am here claiming.

I do not see how we can do anything that will be satisfactory in this line with our present facilities. Whatever is done is evidently not worth doing unless it can be done in a conclusive manner.

I again urge the needs of this section for a separate building, with more room than we have at present. I have endeavored to set forth the needs of the college in my report to the President, and I call your attention to the subject from the side of the station. The college needs the space that we occupy in this building and we need considerably more space than we have.

We have confined our efforts wholly to the lines of investigation indicated in this report, though the general question of nitrate formation, of which this project is only a special phase, is becoming more general and I earnestly wish that we might study its general features as presented elsewhere. The fact is that I have given attention so exclusively to the project in hand as to exclude the greater question in our State.

Respectfully submitted,

WM. P. HEADDEN,

Chemist.

REPORT OF BACTERIOLOGIST

To the Director:

I have the honor to submit herewith the annual report of the Bacteriological Section of the Experiment Station for the year 1915.

Under the provisions of the Adams Fund, three projects have been under investigation, and one has been completed. Of those now in progress, two have been carried over from last year, and one new one has been taken up. One additional line of re-

search, to be supported from State and Hatch funds, has been inaugurated.

The preparation and distribution of pure cultures for vinegar making has been continued, and a limited amount of extension work has been engaged in.

PROJECT I. Bacteriological Studies of Alkali Soils

Under this project we have continued our studies upon the pigment of *Azotobacter chroococcum*, extending the investigation to include an examination of both the factors which limit pigment formation and the solubility of the pigment in different chemical compounds. The results of a portion of this work have been published in the "Proceedings of the Thirty-fifth Annual Meeting of the Society for the Promotion of Agricultural Science, 1914".

Some attention has been given to the isolation and systematic study of the nitrifying organisms present in certain niter soils.

A limited amount of time has been devoted to a study of the relation of certain metals to biological soil processes.

PROJECT II. *Azotobacter* Energy Studies

Pure cultures of *Azotobacter chroococcum*, isolated from both normal and niter soils, have been inoculated into solutions containing different organic compounds whose respective energy values had been previously determined, and the value of these materials as a source of energy for the nitrogen-fixing organisms has been noted. The project is not sufficiently far advanced to warrant any conclusions as yet.

PROJECT III. Raspberry Diseases

Our study of the spur blight of the red raspberry has been completed, and the results have been published as Bulletin 206, "Red Raspberry Injury caused by *Sphaerella rubina*". By the use of Bordeaux mixture, we were able to increase the yield on sprayed canes 245 per cent. over unsprayed, or 375 crates per acre, which represented a net gain of \$167.26 per acre in 1914.

PROJECT IV. A Bacterial Disease of Field and Garden Peas

Early in June of this year, my attention was called to a very severe blight of field peas prevalent in the San Luis Valley, and of garden peas in the vicinity of Longmont. Peas at this time were from four to eight inches in height and in some of the badly affected fields one-third of the stand was dead. The stems from about one inch above ground appeared watery and olive-green in color. These later became brown, shriveled, and died. The leaves and bracts exhibited the same watery, bruised aspect, and the areas involved soon took on a characteristic yellow color. A microscopic examination of the affected tissue showed it to be swarming with bacteria, and pure cultures of a motile organism were readily obtained upon agar plates.

The disease was confined almost entirely to early plantings and early varieties, the later plantings being practically free

from trouble. This suggests late planting, possibly two weeks later, as the most feasible means of control for the present.

Variety tests seem to indicate that certain peas are immune to the disease, and if, at the same time, they prove to be desirable forms, we shall probably be able to introduce resistant varieties as a remedial measure.

PROJECT V. A Bacterial Disease of the Wragg Cherry

This investigation is being carried on State and Hatch funds. The disease is very limited in distribution, altho serious where it occurs. The first complaint of the trouble was received the last of June and appeared to have followed hail injury. The half-grown green cherries exhibited watery spots from the size of a pin-head to the whole side of the cherry, which increased in size and ultimately caused the affected portion to turn black and shrivel, producing a mummified fruit.

Bacteria have been found to be associated with the disease, but just what their action would be independent of the hail injury, we cannot say at present. The leaves and twigs are also affected, the former having the characteristic shot-hole appearance similar to that produced by *Bacterium pruni*.

It is our purpose to carry on systematic spraying experiments for the control of this trouble next season.

From time to time, during the year, I have been called upon to give lectures before college classes along lines of soil bacteriology, dairy bacteriology, and sanitary science.

In the way of extension work, I have attended one farmers' institute and written five articles for "News Notes".

I have under consideration a project which is fundamental to our knowledge of the susceptibility of plants to bacterial infection. Studies, in a way comparable to this, have been undertaken with the lower animals, but, to the best of my knowledge, nothing has ever been done along this line with plant life. It is of primary importance, if we are going to attempt to control disease among plants, that we should know first something of the predisposing factors. The project which I have in mind has this for its aim.

Now, if this experiment is to succeed, and if the results are to be depended upon, it is of utmost importance that I have greenhouse facilities at my disposal which will be absolutely under my control.

I feel that this matter of a greenhouse is of vital importance to the pursuance of my work, not only for the experiment in contemplation, but also for the pea and cherry projects which are now under way, and I sincerely trust that you will give this request your very serious consideration.

Very respectfully submitted,

WALTER G. SACKETT,

Bacteriologist.

November 20, 1915.

REPORT OF THE BOTANIST

To the Director :

I am submitting herewith the annual report of the Botanical Section of the Experiment Station for the year 1915.

The following projects have been worked on during a portion of the past year:

- (1) Poisonous Plants.
- (2) Fungous Disease Investigations.

Two bulletins were published:

- (1) Bulletin 211—Colorado Plants Injurious to Livestock.
- (2) Bulletin 212—Fungous Diseases of Colorado Crop Plants.

The first was prepared in cooperation with Dr. George Glover, veterinarian; the second with Mr. Otto A. Reinking, assistant botanist. Mr. N. Lee Foster did the delineation for Bulletin 212.

The Fungous Disease project is designed in a comprehensive way so as to permit the section to investigate promptly conditions that arise, without the necessity of making out separate projects for each subdivision of the work. Two problems are at present being studied under the heading of Fungous Disease Investigations:

- (1) Infection experiments with millet smuts.
- (2) Microchemical studies of the membranes of fungous spores, and the relation of these membranes to germination.

Yours respectfully,

(Signed) W. W. ROBBINS,
Botanist.

REPORT OF THE ENTOMOLOGIST

To the Director :

The project covering Plant Louse Investigations has received more attention than any other during the past year, tho all the projects of this section have been actively worked. Mr. Jones has gotten together a larger number of species of the Syrphus Flies than have been reported from any other state and has given considerable attention to their life habits from an economic standpoint.

An information bulletin on Insects and Insecticides has been prepared and published and sufficient data for two or three other bulletins has been accumulated. We hope to have this material in shape for publication the coming year.

The codling moth experiments carried thru this year by Mr. Wakeland in the Grand Valley prove to be of much interest and

are, in large part, confirmatory of conclusions reached from results of previous years. The experiments this year emphasize, among other things, the importance of the calyx spray and a second treatment made two weeks after the blossoms have fallen. Both egg and larval * parasites have been quite active in reducing the numbers of worms during the past season, but it is evident that even with the help of these parasites, it will not be possible to thoroly control the injuries of the codling moth by one or two sprays under present conditions in the Grand Junction district. In the keeping of the egg-laying records for individual moths, Mr. Wakeland obtained over 200 eggs from each of three female moths, and in one case the number reached 266 laid during a period of eleven days, 70 of which were deposited during the first 24 hours of this period.

For a few years past, very few complaints have come to the Experiment Station concerning grasshopper injuries, until the past summer. These ever present pests have increased in numbers very considerably during the past two summers on both the eastern and western slopes in this State. Farmers and fruit growers should be prepared to combat grasshopper outbreaks next year.

The old-time Army-worm, *Leucania unipuncta*, and the wheat-head Army-worm, *Meliana albilinea*, Hbn., were unusually abundant in the irrigated farming sections of eastern and north-eastern Colorado during the months of July and August of the present year. The worm was especially complained of on account of its pernicious habit of biting off the oat kernels and causing them to fall to the ground.

The Western Corn Root Worm, *Biabrotica virgifera*, is rapidly becoming a serious pest to corn in truck gardens and in large fields as well, where corn is grown year after year upon the same ground. A few very serious complaints of injury from this insect came to the office of the entomologist during the past fall.

The Harlequin Cabbage Bug, *Murgantca histrionica*, continues to do considerable damage to cabbage, cauliflower, radishes, horse radish and related plants in eastern Colorado. The area infested lies to the east of the mountains and extends as far north as Greeley and Fort Collins. This is a southern pest and we have no positive evidence that it breeds in Colorado. It seems probable that the infested areas are reached by this insect thru its northern migrations during the summer season.

Respectfully submitted,

C. P. GILLETTE,

Entomologist.

* The egg parasite was *Trichogramma minutus* Riley, and the larval parasite was *athrolytus apalelae* Ash. Determined by Mr. Girault through the kindness of Dr. L. O. Howard.

TWENTY-EIGHTH ANNUAL REPORT
IRRIGATION INVESTIGATIONS

To the Director :

The following is a brief report of the work done by the Co-operative Irrigation Investigations during the year 1915.

About 1200 experiments have been made in the hydraulic laboratory this season on the Colorado statute inch, the Dethridge meter, Venturi flume, Keeler automatic headgate, and devices for dividing the flow of water in a ditch among two or more users. There have also been made some 300 experiments with current meters.

The field work has been confined to a preliminary investigation leading to an extensive study of the use of water in the Cache la Poudre valley.

Bulletins have been published by the station on the following subjects: "Some Miners' Inch Measuring Devices", No. 207; "Irrigated Agriculture in the San Luis Valley," No. 209; "The Dethridge Meter," No. 215. Manuscripts have been prepared for several bulletins on weirs and orifices.

The most promising result of the season is a measuring device which we call the Venturi flume, which has been developed and rated in the hydraulic laboratory. Field tests have been made with this device in several parts of the West, and though it is still somewhat in the experimental stage, it appears to fill a decided need.

Respectfully submitted,

V. M. CONE,

U. S. Engineer in Charge Irrigation Investigations.

REPORT OF THE AGRONOMIST

To the Director :

In the absence of Professor Kezer, I herewith submit the annual report of the Agronomy Section of the Experiment Station. This report will be made up of several divisions, each being a report of the man actively in charge of a particular line of work.

The principal projects which have been carried on the Hatch fund are the Alfalfa Project and the Correlation Project. In the former the work is being handled primarily by Mr. Blinn, while in the latter Mr. Boyack has had active charge of the work.

In addition to these Hatch fund projects, considerable work has been done on the State appropriation for dry land investigational work. In this work a survey was made of different localities in the Plains section which are characteristic of differ-

ent types of farming. In all, 227 farm records were obtained. These records consist of a complete farm management survey and a detailed report showing the methods used in planting crops, together with acreage, yield, variety, date of planting, etc. This investigation will show the relation of different factors to the farm and labor incomes in different localities. From 25 to 30 factors will be correlated with the labor incomes. The average of the different factors will be tabulated and the most profitable method of growing crops in different areas will be worked out as far as the data at hand will permit. This information will be a guide to use in giving advice to prospective settlers and to farmers in general in the Great Plains area. It will also give us a definite basis for certain phases of our experimental work.

A bulletin, "Forage Crops for the Plains Region", has been prepared. A circular entitled "The Treatment of Seed Grain to Prevent Smut" has been published recently.

The reports of Mr. Breeze Boyack, Mr. P. K. Blinn and Mr. J. W. Adams are appended hereto.

Respectfully submitted,

JAMES D. MARSHALL,

Acting Agronomist.

REPORT OF THE ASSISTANT AGRONOMIST

To the Agronomist:

The experimental work during the last year resolves itself into two projects: Selection of promising strains from wheat and barley crosses, and variation and correlation studies. Originally, the first mentioned project constituted a study in inheritance, but this was nearly completed a year ago. The present phase is an endeavor to secure improved strains from several crosses. From two winter wheat crosses, 750 selections are now growing in the nursery. From one barley cross, 800 selections are ready for planting next spring. These selections are the remainder of an elimination from over 7,000 selections of last year. Time of maturity and stiffness of straw have been the criteria. Next year, in addition, yield and quality of grain will be considered. The inheritance of color in a wheat and black winter emmer cross is the phase of inheritance studies actively pursued.

The value of several mathematical methods for the study of variation has been reported heretofore. We have commenced the application of these methods to the study of variation as influenced by the factor—time of irrigation. The material for this work consists of several varieties of oats, barley, and wheat, so grown this last summer that the factor—time of irrigation—was varied considerably. The obtaining of the data is pro-

gressing rapidly and enough results are already in hand to show that a considerable change in method of planting should be made next year. The variations induced indicate that a continuation of the work is fully justified. The complete results of this year's work will be ready by next summer.

The application of these methods to variation and correlation in hybrids will be commenced as soon as material now coming on is ready. Some of the hybrids made specifically for this purpose will furnish enough material this coming year.

The influence of many factors, as soil, rainfall, altitude and cultural methods, awaits the application of exact mathematical methods. Many important agricultural crops need further exact study. The means available for experimentation necessitate the present restriction to few crops and few factors.

Respectfully submitted,

Nov. 12, 1915.

BREEZE BOYACK,

Assistant Agronomist.

REPORT OF THE ALFALFA SPECIALIST

To the Agronomist:

I herewith submit the following report of the alfalfa work under my control.

The alfalfa investigations have been a continuation of a schedule that has been outlined for several years, namely;

1. Testing new strains of alfalfa secured from the U. S. Department of Agriculture or elsewhere.
2. Improving alfalfa by systematic seed selection.
3. Experimenting and taking observations on cultural methods for alfalfa hay production under irrigation and on dry land.
4. Investigating the factors that influence alfalfa seed production.

Under the last named topic, the U. S. Bureau of Plant Industry has entered into a co-operative agreement to furnish funds to carry on this investigation of alfalfa seed production in sections outside of Colorado, with a view to solving some of the problems of alfalfa seed growing and to encourage the alfalfa seed industry in the United States.

Unfortunately, we have had another season of unfavorable weather conditions for alfalfa seed production and the experiments with alfalfa in general. At Rocky Ford, destructive hail storms occurred on June 2, 29, and July 6, the seasonal temperature was exceedingly cold, and the rainfall for May, June, July, and August amounted to more than the average precipitation for a whole year.

Testing Out New Strains of Alfalfa

With one exception, there was no seed produced on our plats in 1914 with which to seed new nursery plats, but 24 new strains of alfalfa were received from the Bureau of Plant Industry. Among these strains were seed from Russia, Italy, France, India, China, Australia, and South America. A good stand of plants was secured from most of these strains of seed and a few produced seed in spite of the unfavorable conditions that prevailed. Some seed of the Grimm and Baltic varieties was sown at the same time, and again there was demonstrated the marked difference in type of crown that developed in the northern and southern strains of alfalfa, the northern strains producing the hardy underground stooling type, while the warm climate strains developed an upright, growing plant of few stems, and very few, if any, underground buds or shoots.

In addition to the nursery test started from seed, there was also a nursery of selected plants of different strains started from cuttings. From four to eight cuttings were made from each plant and set out in the open field early in the spring before growth had started to any great extent. Nearly all the cuttings grew and some very valuable contrasts developed. All the cuttings of a given plant developed into the same type of plant, in fact were identical, but the cuttings from different plants were as different, as the plants from which they were taken, yet all were grown under the same conditions. This plan of increasing select types of plants and comparing their traits, and then testing out in larger plats the progenies of the best, seems to promise a more rapid progress in improving alfalfa.

Improving Alfalfa by Seed Selection

For a number of years heavy forage types combined with good seed production have been the object of our selections, and results the past few years seem to indicate that at least one line of selection has established this desired combination.

This selection started from a plat of Baltic alfalfa seeded in 1907. Several generations have been selected and from these the highest hay-yielding plants have been secured, as well as the heaviest seed producers. The past two seasons have been very unfavorable to seed yields of alfalfa, yet this strain has been the only one out of a great many that has produced seed at Rocky Ford. The decided merit of this strain has seemed to warrant increasing the seed for field planting.

Early in April, 2,500 crowns of this strain, the product of one plant, were transplanted from a seed bed sown in 1914. Three hail storms cut down the growth, and grasshoppers invaded the plat, yet after all, late in the season, seed pods formed, and while frost cut short the filling of many of the late pods, there was a yield of 20 pounds of seed. Five pounds of this was produced from 150 plants that were selected because of their early heavy seed yield. It is planned that this seed will be used to start an increase field of an improved strain of alfalfa.

Cultural Methods for Hay Production

For four seasons, records have been taken of the relative yields of 10 different rates of seeding, varying in two-pound quantities from two to 20 pounds per acre. The test was made in duplicate, one test with Baltic alfalfa, the other with common or native alfalfa. The general results in hay yield of these tests have shown that there is very little difference in yields of the different rates of seeding in point of tons per acre, but that the quality of the hay was better in the thicker stands. On the whole, a medium rate of 10 to 12 pounds per acre seemed to give the best results. This test will be carried on another year before a detailed report is ready.

Cultural Methods and Factors that Influence Seed Production

As before stated, the weather conditions of the past season were very unfavorable to alfalfa seed growing. At the Rocky Ford Station the following experiments were attempted, but with no definite results.

1. Fertilizing with well-rotted manure cultivated into the surface.
2. Cutting the tap root to check too succulent growth, which is often considered a cause of failure to set seed.
3. Control of moisture by regulating irrigation.
4. Transplanting crowns and cuttings of crowns to induce seed production.

The last named has been the only method by which we have induced an increased seed production with any success, but this plan seems more adapted to small plat work than to field production.

Co-operative Work With the Bureau of Plant Industry

The co-operative work with the Bureau of Plant Industry was of two kinds: First, experiments in seed production at Rocky Ford: (a) a comparative seed-yielding test of five commercial varieties of alfalfa in 40 inch rows; (b) plat tests of different spaced planting of plants to determine its effect on seed production. Second, field observations on seed production in Colorado and some of the Western States. The planting of the U. S. experiment plats at Rocky Ford was very successful, a perfect stand and a very satisfactory development being secured.

Two trips were made at the expense of the Government funds. One to the northern part of Colorado to visit the alfalfa seed fields of Mr. M. D. Healy at Hereford, and that of Chas. Camp at Greeley, Colorado. The other trip was into Utah and Idaho, to visit the principal seed-growing sections of those States. These trips were made in late summer and a detailed report of them will be sent in later.

Respectfully submitted,

PHILO K. BLINN,

Alfalfa Specialist.

Nov. 14, 1915.

REPORT OF THE DRY LAND FARM

To the Agronomist:

I am submitting, herewith, a brief report of the work done at the Plains Sub-station during the past season.

The place has been farmed about as suggested in my last report. The season was very wet and cold throughout the spring and early summer.

By means of the contour system I have stored in the soil a considerable amount of moisture that would have otherwise been lost, but as for the present season's crops, the contouring was of little value as there was no time in the season that there was a shortage of moisture. In the case of corn, I think the contouring was a detriment, as the furrows remained wet and cold at the time of germination and while the corn was growing. However, this has been an exceptional season and I am more than ever convinced of the value of the system in a series of years.

The crops mentioned below were planted and the results estimated. It would be difficult to give the acreage of the different crops because of the varying length of rows in the contour system of farming, so I will estimate yield per acre.

Swadley Corn made four tons of ensilage, or 20 bushels of corn, per acre. The stalks were small and the stand was poor but the ears were very good. The portion put in silos made very rich feed. It would seem that almost half the weight was ears.

Flint Corn made five tons of ensilage and 25 bushels of corn per acre.

Kafir made eight tons of ensilage or two tons of fodder per acre. The portion put in the silo made good ensilage. The fodder is also good. The seed did not quite mature.

Milo made ten tons of ensilage per acre or two tons of very poor fodder. The seed did not mature. The ensilage made from milo is about the same in quality as that made from kafir.

Orange Cane made 20 tons of ensilage or three and one-half to four tons of fodder per acre. The ensilage made from the cane was not relished by the cows. The fodder is excellent. The seed did not mature.

Feterita. The feterita seed did not germinate.

Sudan Grass made one and one-half tons of fairly good fodder per acre. Seed did not mature.

Pop Corn made seed at the rate of 30 bushels per acre of good corn.

Spring Rye was cut twice and made one and one-half tons of hay per acre. The first crop was damaged by hail.

Oats made an estimated yield of 12 bushels per acre. It was cut with mowers and put away for horse feed.

Hog Millet was cut and stacked for chickens.

Beans. We had about an acre of beans of the following varieties: Mexican, Tepary and navy. They all did fairly well.

The Mexicans did best and the Tepary second. We find the work attached to harvesting and threshing beans is all out of proportion with the price received for the beans. We shall probably raise beans for our own use only hereafter.

Alfalfa. The three acres of alfalfa seeded three years ago made two good cuttings. One acre seeded last year gave one cutting. Two acres seeded this spring produced a very good stand. Altogether we now have six acres of alfalfa, most of which has a very good stand.

Garden. We had an excellent garden, consisting of all the ordinary garden vegetables. We sold \$50 worth of garden truck after using all we could for the family's needs.

Potatoes were hit by blight. They made about 30 bushels per acre.

Fruit. Plums, apricots, currants and gooseberries were killed by late frost. Cherries did fairly well, but were injured by frost. We have only a few cherry trees left. Most of the peaches were killed, but we had two bushels of very fine peaches. Apples set quite well but most of them fell because of the codling moth. Those that matured were all wormy. The strawberries did not bear this season because of the severe drouth last year.

Silo. We filled the four silos, mostly with corn and milo, but used some kafir and some orange corn. The cost of putting ensilage in silos averages 82 cents per ton. The cost of putting in the corn was much more than that of putting in milo, but the corn ensilage is very much more valuable this season, ton for ton, because of the large percent of grain. Acre for acre, it is probable that the sorghums are the most valuable. This would surely be true if it were to be fed to stock cattle. I plan to have one silo left over.

The Dairy

November 1, 1914, I had 31 head of cattle of all ages valued at \$55 per head	\$ 1,705.00	
Sold during the year six head		\$ 350.00
November 1, 1915, I have 33 head valued at \$55 per head		1,815.00
During the year we have sold of dairy products.....		506.08
We have paid out for feed, water and pasture.....	110.00	
Totals	\$ 1,815.00	\$2,671.08
Leaving a balance of.....		\$ 856.08

In this record I have made no accounting of feed raised on the place or of skim milk fed to pigs and chickens.

I have kept individual records of the 10 cows that I milked the past season. If none are sold, there should be 20 cows giving milk by June, 1916. I am contemplating installing a milking machine.

Poultry

November 1, 1914, we had 120 hens valued at	\$ 40.00	
We have sold during the year, poultry and eggs....		\$ 154.55
Eighty-eight hens on hand Nov. 1, 1915		26.00
Paid out for feed	7.00	
<hr/>		
Total	\$ 47.00	\$ 180.55
Balance		\$ 133.55

No accounting of feed raised on the place or of eggs and poultry used on the table has been made, but we think these will about balance.

Inventory of Station Property at Cheyenne Wells November 1st., 1915

160 acres of land	\$2,400.00
900 rods of fence	200.00
Dwelling house and horse barn.....	700.00
3,000 feet galvanized water pipe in ground	100.00
Adobe dairy barn and equipment	450.00
Adobe hen house	50.00
Adobe smoke house	50.00
Four pit silos with equipment	320.00
1 fanning mill	50.00
1 ensilage cellar	40.00
1 Babcock tester and accessories	10.00
1 hog house and one calf barn.....	20.00
Building for silos	60.00
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Total	\$4,450.00

Respectfully submitted,

J. W. ADAMS,
Superintendent.

REPORT OF HORTICULTURIST

To the Director :

I herewith beg to submit a brief report on the status of the experimental work in the Horticultural Section.

Project on Hardy Stock for Apples

This project was started two years ago, at which time about four acres were set to a number of varieties of apples, with the idea of determining what varieties are best adapted to the soil and climatic conditions of northeastern Colorado. Thus far, we find that the number of varieties that were originally set out will have to be reduced considerably, as many are not sufficiently hardy to withstand our severe winter conditions. An experiment of this kind will necessarily require a number of years to get definite results that could be embodied in a publication, yet it will be of great value to the fruit grower in showing him what varieties to plant and what not to plant.

Pear Growing in Eastern Colorado

This project was also started two years ago. Pears grafted on quince roots were used, and thus far we have not had a single case of blight, and only one tree has been lost out of the 60 planted. From every indication, this experiment gives great promise of success. Due to the fact that pears are on quince roots, the growth is very slow and hard, and to all appearances resistant to blight. Whether the roots will be able to withstand severe winters is yet to be learned, as the last two winters have not been sufficiently extreme to test the hardiness of many varieties. Yet, we have fair promise that this experiment will turn out to be a success and a valuable lesson to fruit growers in this section.

In this connection, it appears to the writer that the use of dwarf stock for pears might be extended to the pear-growing sections of the Western Slope. From all reports obtained from the east, the dwarf stock seems to be much more resistant to blight than the standard stock, and if this proves to be the case in Colorado, there is a great future for the pear-growing industry in Mesa and Delta Counties. In order to test this, some work should be started there, and I have made a tentative arrangement with Mr. Sweitzer at Delta, to plant from 50 to 100 pear trees on quince roots next spring to study their behavior and adaptability to the Western Slope conditions. On the whole, this project is progressing very satisfactorily.

The Niter Project on the Western Slope

I am pleased to report that we seem to be on the right track for the solution of the niter problem. We now have a good stand of winter rye on the Bain place, and by the end of another season we should have redeemed this land sufficiently so that all kinds of farm crops can be grown thereon.

In connection with this work, it must be urged upon the landowners that crops that require constant tillage must be abandoned for a number of years until the soil is completely restored. In other words, land subject to niter should be kept, if possible, in alfalfa for several years, and alternate later with grain until all signs of the trouble have disappeared. If the land is utilized for the growing of hoed crops, or for the growing of fruit trees, the land will sooner or later revert, and the work of reclaiming will have to be started over again. In connection with this niter subject, the cover crop problem was taken up. The object of it was to forestall the effect of niter accumulation and to improve the soil conditions generally in the orchards. The work has not been as successful as we had hoped, due to the difficulty of obtaining complete control over the orchards where the cover crops were grown. In order to thoroughly study this problem, it would be advisable to rent an orchard for a series of years so that we could control the work in such orchards. Otherwise, our data is apt to be open to criticism and to errors. Our experience last year show-

ed that the average fruit grower will not look after the cover crop, but leave it to grow the best it can. Irrigation is generally neglected and the stand of the cover crop is generally poor. Of the various kinds of plants used for cover crops, the hairy vetch has proven the best. The only difficulty lies in the fact that it does not do well during the hot season. For winter protection, it is undoubtedly the best crop that can be grown, but since it has to be plowed under in May and again in September, it leaves a gap in the season, and during the part of the season when the soil is in the greatest need of protection. Red clover promises to fulfill the need for summer cover, and from our work thus far, I believe that with proper care this plant will be used to a great extent in the future. The work will have to be continued for several years before we can say definitely what kinds of plants are best adapted for the different sections.

Plans have been made this season for some experimental work in the forcing of tomatoes and lettuce. No project was made out, but the work is on the way and we expect to have data by the close of the year to warrant a small publication.

The Orchard Survey of Mesa County

This work was undertaken with the idea in view of gaining exact information of the status of fruit growing in Mesa county. The field work is just about completed. The data obtained in the field work will be used for publication, the object of which is to show, if possible, the defects in the present system of fruit growing as practiced in that county, together with remedies which may be applied to overcome these defects.

In planning this work, it was found that the only way to get at the exact facts was to make a personal canvass or a personal visit to every orchard in the county. I have not the exact data on hand, but in the neighborhood of 1500 individual growers have been visited, and the number of fruit trees of different varieties recorded. General conditions of soils, of water and other economic factors have also been recorded. Blanks were made out, and these blanks have been filled out by the owners, or by the surveyor from the owners' answers to the questions asked.

We feel that this record is the most complete of any fruit-growing section in America, as previous surveys have only taken in occasional growers, leaving out the rank and file of those who are engaged in the industry, for only by knowing the whole field can reliable data and information be obtained.

Publications

The following publications are in process of composition: "The Orchard Survey of Mesa County" and "Apples and Apple Growing in Colorado", to be followed later in the winter by a publication on "The Winter Forcing of Tomatoes and Lettuce".

Respectfully submitted,

E. P. SANDSTEN,
Horticulturist.

Nov. 24, 1915.

REPORT OF THE VETERINARIAN

To the Director:

The work during the past year has been largely confined to the brisket disease. During the past 60 days some experimental work has been conducted on the sheep-feeding problems in the San Luis Valley and is now in progress. Little has been done on the Necrobacillosis project because of lack of funds to properly push all lines and because the other problems seem more urgent at this time. The Animal Disease project, at the expense of those calling for help, has continued as formerly.

We have published only one bulletin during the year, which was a preliminary report on brisket disease. Material for a more complete report on this malady has been gathered and should be ready for publication shortly. In the work on brisket disease we have visited diseased animals, making observations upon them at the altitudes where they became affected, and we have also shipped a number of animals to Fort Collins in order to see whether they would recover as well on their native hay as when the food is changed. With two exceptions, all such animals have recovered. A rather thorough laboratory study of the tissues from diseased animals has been made. It became of interest to know whether normal animals living at high altitudes had generally heavier hearts than those living near sea level. This data is now being collected and will be ready for publication shortly. This work has opened a wide field for investigation as to the various phenomena presented in the animal economy as the result of living at high altitudes. There are several lines that could be followed out with much scientific interest and doubtless with profit to stockmen. Several drugs have been tried out on animals affected with this disease with only partially satisfactory results.

Necrobacillosis seemed not to be as prevalent in hogs during the past year as formerly. This project as outlined would require considerable equipment, and it is not deemed advisable to proceed far until more money is available.

Such great losses of lambs have occurred in the feed lots of the State that a thorough investigation of the whole problem became necessary. During last year, 5,000 lambs were lost in the San Luis Valley alone, and doubtless as many in other parts of the State. While the work on this project is now beginning, it will probably take a considerable length of time before very definite results can be established. Funds allowing, we hope at some future date, by dividing sheep into a number of lots, to determine the exact condition under which they can be expected to die on the various concentrated foods.

Ninety-eight specimens for diagnosis have come to the laboratory during the past year, which indicates the necessity for more adequate provisions for this line of hygienic work. Many

states have established separate hygienic laboratories in order to take care of this material. It can become of great assistance to the sanitary authorities of the State in quickly and accurately diagnosing contagious diseases.

H. S. Eakins has been found very efficient in doing the routine work in connection with the laboratory, and in photographing microscopic sections, and it is recommended that he be added to the Experiment Station staff.

Respectfully submitted,
GEORGE H. GLOVER,
Veterinarian.

REPORT OF ANIMAL INVESTIGATION SECTION

To the Director:

A study of rations for fattening steers was carried on during the winter of 1914-1915. This work has already been noted in the Semi-Annual Report, covering a comparison of corn silage with beet pulp, a study of the value of molasses in cheapening grain rations, and a grain and silage ration, and a study of grain and hay alone, compared with grain, hay and the cheaper feeds—molasses, silage and pulp. This work will require duplication another season prior to publication.

Yours respectfully,
G. E. MORTON,
Animal Husbandman.

REPORT OF THE IRRIGATION ENGINEER

To the Director:

Following is the report of the Civil and Irrigation Engineering Section for the years 1914-15.

The only experimental work done by this department, not including the co-operative work upon which you will have a separate report, was carried on during the summer of 1915.

Work was done during the irrigation season on two projects, namely: (1) The Duty of Water On the College Farm; (2) Sub-irrigation By Means of Underground Pipes. Under Project 1 careful records were kept and the amount of water applied to each field was secured. Under Project 2 a crop of alfalfa and one of corn were grown. All water was applied through the pipes except that which fell as rain, and, as the summer was an exceptional wet one, the corn would have matured without any irrigation whatever. Nothing new was developed by this experiment during the summer. I am hoping for a dry summer next year. I can at this time only report progress on this work.

Respectfully submitted,
E. B. HOUSE,
Irrigation Engineer.

REPORT OF THE FORESTRY SECTION

To the Director :

I herewith submit the annual report for the Forestry Section. Two projects have been carried on during the latter half of the year. The first project deals with the study of the dandelion, as to its life history, its habits as a weed, especially in lawns, and its eradication.

Experimental plats of 100 sq. ft. each, were laid off on the lawn in front of the experiment stables. The dandelions growing upon each plat were counted at the beginning and at the end of each experiment. The control measures employed were hand digging, treating each plant with gasolene, using dry iron sulphate scattered evenly over the plat, and spraying with a solution of iron sulphate containing one and one-quarter pounds to the gallon.

In the case of plants dug or cut off from one to three inches below the crown, they were found to be sprouting at the end of four or five weeks. Gasolene is effective in killing the plants but it is slow work where many plants are present, and each application kills a small spot of grass in addition to the weed. Spraying was found to be effective in reducing the plants to a little over one per cent, where three sprayings were given.

Studies in blooming and seed ripening show that about nine days from the first day of blooming are required for complete ripening of the seed. A small per cent of seeds capable of germinating were found at the end of seven days. Flower heads picked when in bloom and left on the lawn will not ripen seeds. Seeds will germinate in five days after they are fully mature.

Further observation and experiments extending over another season are needed to complete this work, and should be followed by a publication of the results.

The second project deals with the rate of decay in woods of different species. A preliminary experiment along this line, begun a year ago and carried on for six months, showed results which seemed to justify continuing it as a station project on a more extensive scale.

The experiment consists in submitting a large number of uniform pieces of wood from each species of tree in the experiment, to conditions of rapid decay by planting them in a large metal box of moist soil. Each piece is kiln-dried and carefully weighed before being planted. At regular intervals one or more pieces of each species are removed, dried, and re-weighed. The loss in weight is taken as the index of the progress of decay. Each piece is then subjected to a breaking test to determine the loss of strength in relation to the progress of decay. Our native

species of timber will receive attention first, after which other woods are to be used.

Much labor is required in preparing the wood specimens so as to get them as uniform in quality and size as possible, and this part of the work is now in progress. At least six months for short-lived timbers and one or two years for the more durable woods will be needed to secure the desired data.

Some of the work connected with these two projects, and with others which may be taken up later, should be done under greenhouse conditions. It seems that the only satisfactory plan will be the erection of a greenhouse to be devoted strictly to Experiment Station projects and available for the use of such workers as do not have access to a greenhouse.

Respectfully submitted,

B. O. LONGYEAR,

Forester.

November 20, 1915.

HORSE-BREEDING INVESTIGATIONS

To the Director:

I beg to submit the following annual report of the horse-breeding work which is being conducted in co-operation with the United States Department of Agriculture for the purpose of evolving a type of horse suitable for carriage and general work purposes.

Animals in Stud

The following table shows the number of animals of various ages in the stud at this date, exclusive of those condemned to be sold at auction during the coming winter:

	Stallions	Mares	Geldings	Total
5 year old or over.....	5	21	0	26
4 year old	0	3	0	3
3 year old	0	4	0	4
2 year old	3	4	0	7
Yearlings	2	10	2	14
Weanlings	6	8	0	14
Total	16	50	2	68

Sale of Condemned Animals

At the annual meeting of the board of survey held November 10, 1915, it was recommended that the following animals be disposed of: Five aged mares, one six-year-old mare, one four-year-old mare, one two-year-old stallion, one two-year-old filly, six yearlings, and three weanling foals. Of the above, 13 are

the property of the Experiment Station, and five are the property of the Department of Agriculture.

During the past year two deaths occurred in the stud. The valuable brood mare Indiana was lost as a result of an internal hemorrhage; a weanling colt by Albion died as a result of the rupture of a blood vessel due to the presence of a parasite.

General

Those having the experiment in charge are more firmly convinced as time progresses, that the universal need of a general utility horse will be great. Steady progress of the experiment in the production of that type of horses can be noted. By the process of selection for size and type, and by the use of suitable stallions for breeding purposes, the desired end can be attained.

There is still a demand in the State and throughout the country for breeding stallions. This year only one horse has been sent out for service and it is standing at Carbondale, Colorado. Negotiations are now under way for the placing of the only two available three-year-old stallions for the next breeding season.

No desirable stallion has yet been procured for mating with the Carmon mares. There is great difficulty in obtaining such a horse possessing the necessary size, quality, type and breeding. It is probable that by spring such a horse will either be purchased or leased for our work here. In the meantime, we hope to accomplish good by inbreeding to some extent in order to fix type.

In the near future, a bulletin will be published giving information on the horse-breeding experiments to date. This work will be well illustrated and will satisfy many throughout the country who have been calling for information on this experiment.

As has been previously mentioned, experimental work on the comparative efficiency of the pulling power of light and heavy horses is contemplated. It has been a difficult task to obtain apparatus necessary for carrying on such a work, but within the next few months it is hoped that the required appliances will be decided upon.

Expenditures and Receipts

For the information of those interested, the receipts from service fees, sale, and other outside sources, and the expenditures made by the Experiment Station for the horse work during the year ending November 30, 1915, are here given:

Total expenditures Dec. 1, 1914, to Nov. 30, 1915,	\$5,254.59
Total receipts Dec. 1, 1914, to Nov. 30, 1915 (exclusive of Government returns)	1,413.90
Total returns from U. S. Department of Agriculture.....	1,446.03
Balance from Horse Cash Fund, 1914.....	700.00

Respectfully submitted,
WM. P. LITTLE,
U. S. Expert-in-charge.