

THE STATE AGRICULTURAL COLLEGE
OF COLORADO

The Twenty-Sixth Annual Report

OF

**The Agricultural Experiment
Station**

For 1913



The State Board of Agriculture

	Term Expires
HON. F. E. BROOKS	Colorado Springs, 1915
*HON. J. L. BRUSH	Greeley, 1915
ⁱ HON. J. S. CALKINS	Westminster, 1915
HON. J. C. BELL	Montrose, 1917
HON. WILLIAM HARRISON	Clifton, 1917
HON. CHAS. PEARSON	Durango, 1919
HON. R. W. CORWIN	Pueblo, 1919
MRS. J. B. BELFORD	Denver, 1921
HON. A. A. EDWARDS	Fort Collins, 1921
[§] HON. T. J. EHRHART	Centerville, 1919
GOVERNOR E. M. AMMONS, PRESIDENT CHAS. A. LORY, } <i>Ex-Officio.</i>	

EXECUTIVE COMMITTEE IN CHARGE

A. A. EDWARDS, *Chairman*

J. S. CALKINS

E. M. AMMONS

*Deceased.

ⁱAppointed June, 1913.

[§]Resigned June, 1913.

STATION STAFF

OFFICERS

CHAS. A. LORY, LL.D.	<i>President</i>
C. P. GILLETTE, M.S.	<i>Director</i>
L. M. TAYLOR	<i>Secretary</i>
MARGARET MURRAY	<i>Executive Clerk</i>

C. P. GILLETTE, M.S., Director	<i>Entomologist</i>
WM. P. HEADDEN, A.M., Ph.D.	<i>Chemist</i>
G. H. GLOVER, M.S., D.V.M.	<i>Veterinarian</i>
W. G. SACKETT, B.S.	<i>Bacteriologist</i>
ALVIN KEYSER, A.M.	<i>Agronomist</i>
J. O. WILLIAMS, B.S.A., U. S. Expert-in-charge	<i>Horse-Breeding</i>
*E. R. BENNETT, B.S.	<i>Horticulturist</i>
B. O. LONGYEAR, B.S.	<i>Botanist</i>
G. E. MORTON, M.L., B.S.A.	<i>Animal Husbandman</i>
E. B. HOUSE, B.S. (E.E.) M.S.	<i>Irrigation Engineer</i>
V. M. CONE, B.S.	<i>Irrigation Investigations</i>
†E. P. SANDSTEN, Ph.D.	<i>Horticulturist</i>
R. E. TRIMBLE, B.S.	<i>Assistant Irrigation Investigations</i>
P. K. BLINN, B.S., Rocky Ford	<i>Alfalfa Investigations</i>
EARL DOUGLASS, M.S.	<i>Assistant Chemist</i>
S. ARTHUR JOHNSON, M.S.	<i>Assistant Entomologist</i>
*G. P. WELDON, B.S.	<i>Assistant in Entomology</i>
L. C. BRAGG	<i>Assistant in Entomology</i>
*C. L. FITCH	<i>Potato Investigations</i>
*W. E. VAPLON	<i>Poultry Investigations</i>
J. W. ADAMS, B.S., Cheyenne Wells, Agronomy Assistant, Dry Farming	
ELLWOOD D. ROOD, A.B.	<i>Assistant Chemist</i>
W. W. ROBBINS, M.A.	<i>Assistant Botanist</i>
PAUL S. JONES, B.S.	<i>Assistant Irrigation Investigations</i>
†RALPH L. PARSHALL, B.S.	<i>Assistant Irrigation Investigations</i>
†JAMES D. BELL, B.S.	<i>Assistant Irrigation Investigations</i>
†I. E. NEWSOM, B.S., D.V.S.	<i>Veterinary Pathologist</i>

*Resigned 1913.

†Appointed 1913.

LETTER OF TRANSMITTAL

To His Excellency, E. M. Ammons, Governor of Colorado:

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

The financial statement is for the Government fiscal year ending June 30, 1913. The other portions are reported substantially for the state fiscal year of 1912-13.

C. P. GILLETTE.
Director.

Agricultural Experiment Station,
Fort Collins, Colorado,
December, 1913.

FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1913.

RECEIPTS.						
Dr.	Hatch Fund.	Adams Fund.	State Fund.	Sales Fund.	Special Fund.	Total Fund.
From the Treas. of the United States, as per appropriation for the fiscal year ended June 30, 1913, under acts of Congress approved March 2, 1887 (Hatch fund), and March 16, 1906 (Adams fund) ..	\$15,000.00	\$15,000.00				
Balance on hand July 1, 1912			\$14,129.61	\$ 30.00	\$8,668.09	\$ 5,431.52
*Transfer			5,358.38		5,358.38	
Other sources than U. S.			11,250.00	254.00	5,471.35	16,975.35
Total receipts						\$41,543.83
DISBURSEMENTS.						
Cr.						
By Salaries	\$ 9,341.13	\$11,055.65	\$ 1,516.65		\$ 867.48	\$22,780.91
Labor	1,311.48	137.87	525.06		793.61	2,768.02
Publications	1,355.11		182.00		22.45	1,559.56
Postage and stationery ..	511.08	84.77	41.91		212.66	850.42
Freight and express	124.75	149.08	164.24		138.27	576.34
Heat, light, water and power						
Chemicals and laboratory supplies	7.25	845.39	3.75			856.39
Seeds, plants and sundry supplies	119.73	70.94	146.28		198.37	535.32
Fertilizers	43.31					43.31
Feeding stuffs	4.00		1,790.98		1,720.53	3,515.51
Library	239.93	50.43	.98			291.34
Tools, Machinery and appliances	52.74	114.70	425.00		140.00	732.44
Furniture and Fixtures ..	431.20	64.45			10.35	506.00
Scientific Apparatus and Specimens	317.86	1,028.95			3.15	1,349.96
Live Stock	30.00				8.00	38.00
Traveling expenses	423.14	654.85	140.37		437.12	1,655.48
Contingent expenses	20.00					20.00
Buildings and land	667.29	742.92	866.81		644.48	2,921.50
Total expenditures	\$15,000.00	\$15,000.00	\$ 5,804.03		\$5,196.47	\$41,000.50
Balance					284.00	3,588.59
Overdraft			3,325.26			3,325.26
			\$2,478.77		\$8,781.06	\$44,869.09
						3,325.26
						\$41,543.83

*At the close of the State fiscal year (Nov. 30, 1912), the overdraft then in the State Appropriation fund was closed into the Special fund.

REPORT OF THE DIRECTOR.

To the President:

I am presenting herewith the Annual Report of the Agricultural Experiment Station for the year 1913. The financial statement of the Station and the reports from heads of sections are attached hereto.

The personnel of the Station has changed much during the past year, partly because of failure to receive State appropriations for certain lines of work, and partly because we have been unable, with our shortage of funds, to pay the salaries that have been offered some of our men from other institutions. For this latter reason we lose a few of our best workers every year, which, I believe, is a condition to be deplored. We have lost from the Station work during the past year, from the causes above mentioned, E. R. Bennett, Horticulturist; B. F. Kaupp, Veterinary Pathologist; George P. Weldon, Assistant in Entomology; R. S. Herrick, Field Horticulturist; C. L. Fitch, in charge of Potato Investigations, and W. E. Vaplon, in charge of Poultry Investigations. No Station can do its best work and lose so large a percentage of important workers during a year. Every one of these men had work in progress that must be dropped, or picked up by someone else who is called to the work at a later date. It is very seldom that an experiment station worker will pick up the threads of an investigation that has been planned and conducted by someone else and carry the work to a profitable conclusion.

I am glad to call attention to the completion of the hydraulic laboratory and the excellent service that it has given since it was ready for operation on the 31st of May. The laboratory has been very efficient, and I believe will furnish much important data upon which to base water measurements whenever such measurements are needed, and in this way will furnish a basis for the most successful and intelligent use of water for irrigation purposes.

I wish again to call attention to the great importance of securing continuous appropriations from the State for the support of the Experiment Station work, and also the importance of making some arrangement by which the appropriations which we receive may be used to cover the period elapsing between the end of the second fiscal year and the time when the appropriations made by the legislature will become available. Two years ago and again this year we have passed the first year of the biennial period without receiving any of the money that was appropriated for experimental purposes, and neither two years ago nor at the present time has it been

possible to get any information as to whether or not the total appropriation, or any considerable part of it, would become available for our use.

Because of the failure in State funds we have been unable during the past year to carry on in any satisfactory manner, the projects that are being supported by the State appropriations, except the work of the horse-breeding station, which we have been compelled to continue because of our contract with the Department of Agriculture. The money spent in this work, however, we have had to take from other funds, hoping that we shall be able to replace it when the State appropriations become available.

Aside from the experimental work carried on by the Irrigation Investigations and the Horse Breeding Sections, both of which are in co-operation with the United States Department of Agriculture, the Station has received a small fund from the Colorado Flax Development Bureau, which enabled us to carry on an investigation for the purpose of determining the value of flax as a crop to be grown in our unirrigated sections in Eastern Colorado, and to publish a report (Press Bulletin No. 57) on the same. The Stock Growers of Jefferson County have also been supporting the investigation of a peculiar malady among cattle in high altitudes in this State, which is commonly called the "brisket disease," the work being in charge of the Veterinary Section.

The Costilla Estates Development Company in the San Luis Valley has also been co-operating with the Station in an investigation to determine what crops are best suited to the conditions found in that Valley, and also to determine the duty of water. Costilla Estates Development Company has furnished the land for this investigation and borne all the expenses, the Experiment Station directing and planning the work, which is in charge of Mr. V. M. Cone and Professor Alvin Keyser.

PUBLICATIONS

The publications of the past year are as follows:

BULLETINS

- 186—The Fixation of Nitrogen in Colorado Soils, by W. P. Headden.
- 187—Feeding Experiments With Lambs, by G. E. Morton.
- 188—Ration Experiments With Swine, by G. E. Morton.
- 189—Beef Production on Enclosed Range, by G. E. Morton.
- 190—Variation Studies in Brome Grass, by Alvin Keyser.
- 191—Alfalfa Seed Production, by P. K. Blinn.
- 192—Home-made Cider Vinegar, by Walter G. Sackett.

PRESS BULLETINS

56—The Potato in Colorado, by C. L. Fitch.

57—Flax Seeding, by Alvin Keyser.

Aside from the above, manuscripts are in the hands of the Director for a bulletin on the "Nitrifying Efficiency of Certain Colorado Soils," by Professor Sackett, and one on "Frictional Resistance in Artificial Waterways," by V. M. Cone, R. E. Trimble and Paul S. Jones, besides several manuscripts for information bulletins which we have been unable to publish on account of not having funds available for this purpose.

The following are brief reports presented by the heads of the various Sections of the Station.

Respectfully submitted,

C. P. GILLETTE,

Director.

REPORT OF THE ENTOMOLOGIST

To the Director:

The following is a brief report of the Entomological Section for the past year.

The Plant Louse investigation has received the greater part of our attention during the year. Most important data has been accumulated, the results of which are being published in entomological magazines, partly because of the shortage of Station funds, and partly because the matter has been rather technical.

The project on "Insect Control by Egg Treatment" has been given some attention, most of the work being with the eggs of plant lice and egg patches of the fruit tree leaf-roller, *Archips argyrospila*. The results of the work with the leaf-roller, as announced in Circular No 5 of the Office of State Entomologist, last year, have been confirmed the past season by observations upon the results of practical work in the orchards. The conclusions, as published in the circular just mentioned, were as follows:

"1. The leaf-roller eggs may be killed by a very thorough spraying with a soluble oil while the trees are dormant. This spray should probably be applied prior to, but as near hatching time of the eggs as possible."

"2. Very careful and heavy spraying with arsenicals early in the season will result in almost complete control. The first application should be made shortly after the eggs begin to hatch, which will be when the first green foliage is showing on the trees, and the

second as soon as the blossom buds have separated in the clusters. A blossom spray is, in all probability, not necessary, and is dangerous, in that it poisons the bees."

"3. Black Leaf 40, carefully and thoroughly applied about the same dates as the first two sprayings with arsenicals, will give good results."

"4. A mixed spray of Black Leaf 40 and lead arsenic is little more satisfactory than either one of the insecticides used alone. Furthermore, the cost of such a spray would be too great for practical purposes."

"5. Three pounds of lead arsenate to fifty gallons of water is sufficient for successful control, and there is no advantage to be derived from mixing paris green with it, as many have done."

"6. Not less than twenty gallons of spray, on an average, should be applied to trees from twelve to twenty years of age. Very large trees may require even more."

"7. Failure to control this pest with arsenicals has been due in most cases, either to a failure to spray early enough and at the correct time, or to put enough of the liquid on the trees."

"The experiments by Mr. George P. Weldon, carried on in the City of Denver, for the purpose of testing the efficiency of lime-sulfur, tobacco extracts, kerosene emulsion and other miscible oils for the destruction of the eggs and young larvæ of the locust borer, *Cylenc robiniae*, gave negative results in every case. We are forced to conclude, therefore, that none of these substances can be relied upon to control the locust borer when applied during the fall and winter months.

The life history studies of the *Syrphus* flies in Colorado, with special reference to their importance for the control of plant lice, was begun by Mr. Weldon, and since his leaving the Station the work has been continued by Dr. C. S. Mead, who has already made substantial progress in the work.

Respectfully submitted,

C. P. GILLETTE.

REPORT OF THE CHEMIST.

To the Director:

In my last annual report I gave the work of the Chemical Section of the Station in some detail, up to and including a portion of the year of 1913. The work on the phase of our sugar beet problems, which we then had under consideration, was completed and an account of the results obtained given in Bulletin 183. The ob-

ject of that work was to determine what relation existed between the supply of nitrates in our soils and the quality of our sugar beets, particularly in the Arkansas valley. These results are fully set forth in the bulletin just indicated.

Bulletin 179, which was the last preceding bulletin presented by this Section, gave the results of our further study of the occurrence of nitrates in the soils of some sections of our State, their effects upon vegetation and their origin. We had presented the fact of their occurrence in the so-called "brown spots," their absence from the waters usually used for irrigation, and had also discussed some of the conditions under which they may be found in ground-waters. The work done up to this time made it plain that it was desirable to extend the study so as to include the distribution of these salts through the soil, vertically and also laterally, including some of these brown-spots. It was evident that we would have to confine ourselves to a few chosen places and content ourselves with these. It was necessary to exercise care in selecting these localities in order that they should represent our varied conditions as completely and as satisfactorily as possible. The choice of the localities at which to do this work was made with these considerations in view. The occurrence of the nitrates and their distribution were not the only questions which seemed to require further consideration. A very important one was their relation to the ordinary so-called alkalis which, as is generally known, are abundant in our soils. This work has been completed and our results presented in Bulletin 186.

On the completion of the work done in Bulletin 183 two things presented themselves, i. e., to take up the question of how to bring back the quality of our sugar beets, or to take up some other subject for investigation. To undertake remedial work of the former character meant to undertake field culture under studied or known conditions extending over a period of years. I did not believe that this was advisable, for I was strongly impressed with the idea that the conditions themselves must change. They had changed from favorable to unfavorable, and had already continued unfavorable for a series of years—some seven years at least—but if they did not change it was purely an economic problem to the solution of which we believed the way to have been indicated, i. e., green-manuring, rotation of crops, careful irrigation and good cultivation, a course of procedure easily followed by anyone having the inclination to do so.

The development of wheat plants in many sections of our State is such as to attract the attention of even a casual observer. In studying the occurrences of the nitre-areas I often had occasion to

note the luxuriant growth of the wheat and to note some peculiarities of its ripening on such nitre land. These observations, together with the fact that the kernels of our wheat grown under irrigation are large, light in color, and soft, led me to believe that it might be worth the while to study the conditions under which our wheats are produced in an endeavor to determine, if possible, which of the factors are determinative of these properties. That the nitrates formed in our soils, at times very abundantly, may play a big part has been assumed to be the cause, at least of some of the facts observed, and may very probably be closely related to, perhaps dependent upon, the amount of water applied.

We are fully aware that the study of the composition of wheat has been made the object of much endeavor, and also that the effects of environment have been made the subject of extended experimental investigations. We do not propose to go into these broader questions, except in so far as it may be necessary to establish data for our conditions. It appears, however, that it will be necessary to repeat much of the work done by others for there are so good as no data pertaining to our Colorado wheats. Such data as I can find consists of some analyses made by Mr. Clifford Richardson in 1883 of samples furnished by the late Professor Blount. I have been unable to find any analyses or other data pertaining to our wheats of more recent date than this. An occasional analysis of one or more samples furnished by the farm department have been made in our laboratory, but these are of no value to us in judging of the properties and quality of our wheats. These samples were not accompanied by any cultural notes, and the analyses served no other purpose than to satisfy a curiosity in regard to the nitrogen content of the wheat. The absence of data may not be a very regrettable loss, for while it necessitates us to do much work which is incidental rather than necessary to the real subject of our investigation, it will make the whole work, when, completed, uniform both in regard to time and the quality of the work. The study of wheats grown in various sections of the State, with and without irrigation, is necessary for the prosecution of our object only in order to establish, within reasonably narrow limits, how the wheats grown in different sections of the State vary in quality. We assume that the climatic and soil conditions in these sections are either known or can be ascertained with reasonable accuracy. The main study will, of course, be made on wheats grown by ourselves both in field culture and in cylinders of soil in which we can control the moisture and the soil flora, at least to a very great measure, and we believe that these two are the most important factors of all those that determine the quality of our wheats.

The quality of our wheats, by the way, seems never to have been determined beyond taking into consideration the opinion current among us that our wheats are soft and yield a flour which is not acceptable to the baker for making the bread, for which purpose they use a stronger flour.

The work of the present year has been, in a large measure, directed toward answering general questions and to finding out more definitely the most advantageous way of attacking our problem. We have grown twelve plots of each of three varieties of wheat, or thirty-six experimental plots in all. We have taken many samples of soil for the determination of moisture, total nitrogen, and nitric nitrogen, also many samples for the determination of phosphoric acid and potash. Samples of the plants from the various plots were taken at regular intervals during their growth, and either analyzed immediately or preserved for future analysis. Near the end of the season a sample was taken daily from one of the varieties, the Defiance. It is scarcely probable that, with the help at our command, we shall be able to carry out in detail the analytical work as planned. It will probably be necessary to unite some of our milling samples, for instance, to unite all of the samples of a variety grown with the application of sodic nitrate into one sample; those grown with the application of phosphoric acid into another, and so on. In this way we will reduce our thirty-six milling samples to twelve, and reduce our work by that much.

The space at our command is now decidedly restricted. The College classes have no more, and even not so much room as they could use and that advantageously. The Station could use as much space as we have on the first floor of our building and a good portion of the basement. At the present time I do not see how we can all of the floor space on the first and second floors, and a large portion of the basement. At the present time I do not see how we can do some of our work till the College is closed next summer. Of course, we are pleased with the increased demands of the College classes due to the very great increase in their numbers, and it is also a satisfaction that the work of the Chemical Section of the Station is becoming more conservative, broader and more important in its scope, but this growth brings with it certain demands, among which, in this case, is one for more room. This is a present need, not one which we are anticipating. I have called attention to this fact in several of my recent reports, and asked that every proper means be used to obtain a separate laboratory building for the Chemical Section of the Station. In making this suggestion, I am mindful of the fact that this cannot be accomplished immediately.

but I hope that the matter will be kept in mind, so that it may be accomplished at the very earliest possible time.

There have been no changes in the personnel of the Section and our work is progressing as well as we could expect.

The inventory has been made out in the Secretary's office and brought up to date. Under these conditions I suppose that our duty ends with checking it over to see that we have at least had the articles inventoried, though some of them may be of less value than shown by the bills, due to use, etc.

Respectfully submitted,

WM. P. HEADDEN.

REPORT OF THE VETERINARIAN

To the Director:

The Veterinary Section has received *small support* from the Hatch fund; and the special appropriation for animal diseases, made by the last Legislature, has not become available. The principle work done in the Veterinary Section has been the visiting of outbreaks of animal diseases, when the owners have been willing to pay the expenses, and in cursory examination of material that has come to our laboratory.

Hog Cholera.

Hog cholera has become a serious economic factor in Colorado and the laws we have do not adequately define the authority nor provide any means for its control. By the request of Mr. L. M. Winsor, Agriculturist for the San Luis Valley, I was authorized to visit that section of the State last winter and investigate the reported serious losses of hogs throughout the valley. Several days were given to holding autopsies and otherwise thoroughly investigating conditions on the farms. The claim, quite generally voiced, that the disease in question was not hog cholera was without foundation. Several meetings were held in different sections of the valley and organizations effected for the purpose of systematically combating the disease.

In Monte Vista a strong organization was formed and Dr. P. C. Guyselman was employed to devote most of his time to "cleaning up" hog cholera. He was given the authority of a deputy sheriff and instructed to proceed with quarantine, disinfection, the use of serum and such other sanitary police measures as he might deem necessary. The same action was taken in the La Jara district, with Dr. J. F. Meinzer in charge. The results have been even more sat-

isfactory than we had anticipated and indicates what can be accomplished in hog cholera control by a united systematic effort.

Our efforts in this instance were centered largely in burning the carcasses of dead hogs, cleaning yards and pens regularly, disinfection, close quarantine of infected herds, and the use of antihog-cholera serum. The virus with the serum was not used for immunizing purposes in any instance.

It seems that authority, wisely and diligently exercised, is necessary to the control of hog cholera, otherwise direction and co-operation are impossible. The serum is a certain and valuable preventative if used intelligently, but the farmer is usually at fault in placing relatively too much importance and reliance upon it, in the interest of leaving his own hogs, and neglecting to protect his neighbor by exercising care against disseminating the disease in the community.

"Brisket Disease."

For several years a disease affecting cattle, known among stockmen as "brisket disease," has been reported from the high mountain ranges. The disease is evidently becoming more common, and while it does not constitute a serious menace, the loss in the aggregate is considerable.

The Experiment Station not having the money to pay for the necessary expenses of an investigation, Mr. Lew Robbins and Mr. David Collard, prominent cattle men of Park County, advanced two hundred dollars (\$200.00), (later endorsed and taken over by the Park County Cattle Growers Association) to support an investigation of this disease, and the work has progressed as fast as cases have been reported from that particular locality. These gentlemen have promised to send two or more diseased animals to the college, in the near future, that we may have the opportunity to study the disease as it progresses from day to day.

It appears from inoculation experiments that "brisket disease" is not contagious and the experience of stockmen is that animals removed to lower altitudes, early in the course of the disease, frequently recover. Medicinal treatments appear to have been without success in all cases.

Necrobacillosis.

Canker or "sore mouth" (*necrobacillosis*) in hogs affects pigs mostly under one year old and the losses have been heavy, especially during the winter months. The disease among hogs in Colorado is second in importance only to hog cholera.

Canker is known to be caused by *Bacillus necrophorus* and this organism appears to have acquired a virulency in this region

which is unusual and unaccountable. It is the specific cause of "lip and leg ulceration" in sheep, "calf diphtheria" and is an invader in all cases of hog cholera. To what extent it exists separate from hog cholera has not been determined. The relation of necrobacillosis to hog cholera is a matter of much scientific interest and in Colorado has an economic significance which warrants a thorough investigation.

Animal Diseases.

"Animal Diseases" as a project was allowed to cover in a general way, outbreaks of animal diseases that we might be called upon to investigate in the field and render temporary assistance in matters pertaining to control.

The diseases that are now causing the heaviest losses in the State are: Hog cholera and anthrax in the Arkansas Valley; necrobacillosis in hogs, dietetic diseases in lambs, tuberculosis in hogs and cattle, and contagious abortion in cattle.

Respectfully submitted,

GEO. H. GLOVER.

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 1913.

Under the provisions of the Adams fund, two lines of investigation have been carried on during the year which is about to close. Both of these are projects which have been continued from last year, one of which has been completed, while an additional phase of the other is ready to be reported upon. One new project has been inaugurated, but the work has not progressed far enough yet to warrant a detailed report.

In addition to the research conducted by this section, it has continued the commercial work of supplying pure cultures for vinegar making.

Project I. Bacteriological Studies of Alkali Soils.

Throughout this investigation, we have been seeking, primarily, some satisfactory explanation of the high nitrates which we find in our soils. In previous reports, we have referred to their nitrogen-fixing power and ammonifying efficiency, by virtue of which atmospheric nitrogen has been converted into proteid nitrogen, and that, in turn, into the ammonia salts of the soil. These studies have been published as Bulletins 179 and 184.

Before we could state with certainty that the excessive nitrates resulted from the oxidation of these ammonium compounds, it was necessary to show, first, that the specific micro-organisms were present to accomplish the nitrification, and second, that our soils were suited to their rapid development (nitrifying efficiency). This has constituted the current phase of the investigation.

We have examined twenty-three soils from Colorado and twenty-two from outside the State for this property. The local soils represent both cultivated and barren lands in the niter district and outside of it; the foreign soils have been collected from a wide range of territory and have come, for the most part, from cultivated tracts. The latter include samples from Georgia, North Carolina, Virginia, Ohio, Arkansas, Kansas, Texas, Oklahoma, California, and Washington.

In our experiments we have employed ammonium sulfate, ammonium chlorid, and ammonium carbonate as sources of ammonia nitrogen for nitrification; dried blood has been used also to determine whether the ammonium compounds resulting from its ammonification would respond to nitrifying agents to the same degree as the inorganic ammonium compounds.

The results of the investigation may be summarized as follows:

1. The power to transform ammonia nitrogen into nitrate nitrogen is a property common to many cultivated Colorado soils.
2. Niter soils in the incipient stage of the trouble as well as our normal soils possess this power in a very marked degree.
3. Niter soils in an advanced stage where the nitrates have become very concentrated show less nitrifying efficiency than other soils. This may be due to the presence of high chlorin which appears to have a marked retarding action on nitrification.
4. Compared with the soils from the East, Southeast and South, those from Colorado, Kansas, Arkansas and Southern California excel in nitrifying efficiency.
5. The excessive nitrates present in certain Colorado soils appear to be the result of the combined action of nitrogen-fixing, ammonifying and nitrifying bacteria.

The detailed report of this work is ready for the press and will be published as Bulletin 193.

Soil Algae.

Professor Robbins has continued his studies of soil algæ, directing his efforts for the most part toward the isolation of pure cultures free from bacteria and protozoa. He has employed a number of different mechanical, physical, and chemical means to this end, and while some of his cultures are promising, nothing entirely

satisfactory has been obtained. I believe that this is a very important line of work and that it should be pursued diligently until we are able to get pure algæ for future use.

Project II. Raspberry Disease.

The spraying experiments on raspberries for the control of spur blight caused by *Sphaerella rubina* have been continued at Loveland another year. This season we have changed the formula somewhat from that used two years ago. In place of a 6-5-50 Bordeaux, with home-made resin soap as an adhesive, we have employed a 3-2-50 with 2 pounds of resin fish oil soap, with equally good results. On unsprayed canes, the infection was very general and severe, while with canes sprayed two times before the picking season and once afterwards, less than seven per cent developed the disease. It was our purpose to spray three times before picking began, but the berries matured so rapidly that only two early sprayings were possible.

We expect to publish the results of this work as a semi-technical bulletin as soon as we are able to see the spring condition of the canes that were treated this season.

Vinegar Cultures.

Since we began supplying pure cultures for vinegar making, one year ago, exactly fifty requests for these have been received. From the letters that have come to us from persons who are ordering cultures a second time, we have every reason to be pleased with the way the cultures are working out in practice. Had we some better means of advertising them, the demand would probably be greater.

In response to the numerous inquiries that are received for information on vinegar making, we have prepared a popular bulletin entitled, "Home-made Cider Vinegar." This is now in press and will appear as Bulletin 192.

In conclusion, I wish to express my sincere appreciation of the generous support and hearty co-operation which has been accorded by the Director in all of my work at all times.

Very respectfully submitted,

WALTER G. SACKETT.

REPORT OF AGRONOMIST.

To the Director:

I am submitting herewith my Mid-year Annual Report.

Since June, when the last report was made, changes in the conduct of the work have been made which materially improved the

quality and quantity of our work. Mr. Breeze E. Boyack was employed, beginning July 1. He is working on a part time basis with the expectation of procuring an advanced degree. His services have been highly satisfactory in that he was able to be on the ground at all times when the condition of the work demanded. Owing to his presence we have this year placed our work in much better shape for the advancement of the season than in any previous year.

The work in correlation has progressed to a point where a mass of data is ready for the construction of correlation tables and curves. The related work in crossing which is being carried at the same time, has progressed so that over 14,000 barley plants of the F₂ generation were harvested. Careful notes were taken. These show striking Mendelian ratios. In the barley cross of eight possible combinations, all are represented in the F₂ progeny.

We also have slightly over 4,300 F₂ generation winter wheat hybrids from which similar data has been recorded and in some cases tabulated results completed.

The correlation work has resulted in the measurement of about 7,800 oat plants and about 1,600 winter wheat plants. These will be divided into classes and groups for correlation purposes.

Upon my return from Washington, D. C., during the present month, I spent two days going over the correlation work being carried on by Dr. Harry Love of Cornell University. In certain phases of correlation, the Cornell Station has piled up a large mass of data and have worked out many methods of handling the same. It was my purpose on this visit to get somewhat familiar with these methods in order to expedite the work on our own station.

There is a considerable mass of data on the hybrids which could be published as a scientific bulletin of progress at the present time.

I am appending herewith a report of Mr. P. K. Blinn, Alfalfa Specialist, on the progress of the work at Rocky Ford. In addition to what Mr. Blinn brings out in his report, I wish to call attention to one feature which seems to have been brought out by Mr. Blinn's work and which he has not mentioned with enough emphasis perhaps to call attention to its importance.

It was noticed that plantings made from crown, root or plant cuttings, seeded very much more heavily than seedlings from the same parent plants. An investigation of the root system showed that these cuttings all developed a very much more branched surface root system than the seedlings. This feature led to a trial of field methods of producing surface branched rooting. Trials were made this year of cutting off by means of a beet or tree plow, the

established root system 15 to 18 inches below the surface. It was found that this cutting caused a very heavy branching near the surface and indicates a similar seed production to those plants produced from cuttings. While the evidence is not conclusive, it would seem that the production of seed in our territory is dependent upon a surface root system or a set of soil conditions which will produce surface rooting and feeding. This habit or characteristic of the plant probably causes a dearth of moisture at certain periods in the development of the alfalfa plant. The dearth of moisture possibly makes conditions just right in the plant for seed production. The indications then are, that to successfully produce seed, soil treatment or plant treatment must be so adapted as to produce shallow root systems. We have found the equivalent of this shallow root system in many dry lands where dry subsoils practically always prevail.

REPORT OF ALFALFA SPECIALIST.

The general plan of the work during the past year has not materially changed from previous years. There have been four lines of investigation, namely, Improvement by seed selection; Determining the factors of seed production; Increasing the yields by improved cultural methods; and Investigating the growing of alfalfa on the dry lands.

THE IMPROVEMENT OF ALFALFA BY SEED SELECTION.

We have increased our alfalfa nursery by seeding thirty-six new selections from the plants that have shown from our previous work to be the highest producing seed and forage types. Included in this new seeding are two strains of alfalfa that we received from Mr. S. McIntosh, Commissioner of Agriculture for Australia. These strains of alfalfa are known as "Hunter River Alfalfa," and are said to be the best of a large number of alfalfas tested in Australia. From the development made by the seedlings, it seems to be a promising strain to test.

The 1912 nursery of about 150 selections comprised only ten families that seemed to be the best from all our previous nursery tests. A careful hay test was made of the first crop during the past season. The second crop was left to produce seed for increase work.

The average yield of green hay from the whole nursery, all families included, was about fifteen ounces per plant, the average of the different families ranging from ten to nineteen ounces per plant, while the five families selected for future breeding work averaged as follows:

Baltic.....	70 plants, average 19.3 oz. per plant.
Grimm's.....	60 plants, average 19.3 oz. per plant.
Turkestan ...	40 plants, average 19.1 oz. per plant.
Nameless	60 plants, average 18.4 oz. per plant.
Argentine ...	140 plants, average 17.2 oz. per plant.

About two hundred heavily seeded plants of these best families have been selected for future nursery breeding work.

A test of the results of tripped and untripped flowers of alfalfa was made with the following results:

On two plants the stems were divided. Plant No. 1 had 782 flowers hand tripped and the same number untripped. Plant No. 2 had 686 flowers hand tripped, and the same number untripped; total flowers tripped 1468, amount of seed produced 3 grams.

Untripped flowers on the same plants produced the same amount of seed. The seed seemed to have blasted in each case.

Determining the Factors of Alfalfa Seed Production.

Bulletin 191, Alfalfa Seed Production, submitted during the past season outlines the general results of this line of investigation.

In addition, some unexpected results were secured from alfalfa plants started from root and crown cuttings. The purpose primarily was to start a strain of alfalfa with as little cross-fertilization as possible. About six hundred cuttings were made. But the cuttings from some plants rooted more readily than others, consequently more plants resulted in some of the plats than others.

The inherent tendency of the plants in regard to seed yields was very evident. Some were very heavily set with seed while others were not. Yet, each plant in each plat was identical in all of its characters, color of flowers, type of plant, and the tendency to form seed. Owing to the damp weather conditions and the late maturing of the seed from these plats, only one of the best has been cleaned up. From nineteen plants started from crown cuttings from a Baltic plant, thirty-four ounces of clean seed were secured, that is, over two pounds from one plant in a single season. The plats occupied ten square feet each, thus producing a yield at the rate of eight bushels per acre from plants developed from small cuttings in one season. Plants developing from seed seldom yield seed the first season. It would seem that the shallow branched root system developed from the cuttings might have something to do with the results. It seems evident that it will be worth while putting some effort in future work of this kind.

An attempt was made to produce seed from fall seeded plants. Ten plats of some of the best Baltic and Grimm alfalfa were seeded

the 10th of September, 1912. The plants made a good growth but did not set seed satisfactorily.

Increasing the Yield of Alfalfa by Cultural Methods.

The hay tests on the different rates of seeding and the different methods of seeding have been made for the four cuttings. While the report can only be a progress report, the results were in favor of better yields from the heavy stooling type over the common alfalfa. The results of the different rates of seeding seem to indicate that there is little difference in the different rates of seeding in units of weight, but the quality of the hay was in favor of the thick seedings. The growing of alfalfa in rows for intertillage seems to be well adapted to seed production, but not for hay production as the field does not mow off so cleanly. The rowed alfalfa was much more lodged from winds and rain.

Alfalfa on Dry Land Conditions.

The investigations of alfalfa on the dry lands has been somewhat handicapped by the lack of funds. Some very encouraging results have been secured from some of the tests that were started some time ago. One trip was made during the summer to the Divide and to the region around Grover, Colorado. Forty acres of alfalfa in forty-inch rows on the Keen Brothers' ranch at Eastonville made nearly two tons of good hay per acre. Mr. Keen is now planning to seed eighty acres more in the spring. The prospects for seed growing were not very encouraging on the first crop, but the second crop of hay had a good set of seed pods, although too late to mature, according to Mr. Keen's report.

In the vicinity of Grover, Colorado, there are nearly a thousand acres of alfalfa on dry land, seeded in rows about three feet apart. The reports we have had are to the effect that the yield of hay has been about a ton to the acre for each crop, usually two crops per season. We have little to report on commercial seed growing on dry land as yet, as few of the farmers on the dry land farms seem to appreciate the fact that the plants must be thin on the ground, and well cared for to set and fill with seed.

(Signed) PHILO K. BLINN,
Alfalfa Specialist.

I asked Mr. J. W. Adams, who is operating our farm at Cheyenne Wells, Colorado, to report to what use he had put the station land.

Mr. Adams reports that the season of 1913 has been a very bad one for crops at Cheyenne Wells. He put out one acre of potatoes, one acre of beans, one acre of popcorn, twenty-six acres of

corn, seven acres of oats, three acres of hog millet, ten acres of cane, ten acres of milo and ten acres of kafir. The season was so dry that the milo did not germinate. Owing to later rains, the milo land was planted to cane.

Three acres of the station property is seeded to alfalfa and six and one-half acres are occupied by orchard trees, garden, buildings and lots, commonly designated as the "farmstead." Twenty acres are in pasture.

The potatoes, beans and popcorn were complete failures. The ten acres of oats made three tons of fine hay. The millet made a small amount of chicken feed. The garden raised an abundance of early peas, lettuce, radishes, tomatoes, cabbage and melons. There are only a few cherry trees left on the farm, but these gave a fairly good crop.

Six acres of corn was pastured by dairy cows. Twenty acres was put into the silo about August 15. The corn stalks were small but nearly all bore a small ear or nubbin. Mr. Adams estimated four or five bushels per acre. There were about forty tons of silage taken from the twenty acres. About thirty tons of silage was cut from the cane and kafir. Only a part of these crops made growth enough to be cut with a sled cutter.

Mr. Adams has kept a daily record of the 8 to 16 cows which he has kept through the year. A detailed report has been submitted for our inspection. The detailed record will enable Mr. Adams to weed out some of the less profitable cows.

Mr. Adams submits a statement of the products sold showing for the eight months there were sold from the farm \$663.85 worth of produce, mostly dairy produce, although poultry and farm crops entered into the list to a slight extent. Calves raised, \$195; skim milk unsold, estimated value, \$40; total, \$898.85. Feed pasture and water consumed, \$360, leaving a total of \$538.85.

Mr. Adams appends the following, which I quote:

"We have succeeded in making a living and possibly a little to the good in this extremely bad season, so we are encouraged to believe that in a series of seasons, by the use of the silo to tide over bad years such as this, we can make reasonable returns for our labor in the dairy business with common cows. We believe also that by careful breeding and culling we could make a profit."

Mr. Adams also reports that the pit silos built in 1912 have been very successful and have resulted in the erection of over twenty-five similar silos in Cheyenne County.

Respectfully submitted,

ALVIN KEYSER.

REPORT OF HORSE BREEDING INVESTIGATIONS.

To the Director:

I beg to submit the following annual report of the carriage horse breeding work which is being conducted in co-operation with the United States Department of Agriculture.

Animals in Stud.

There are at present in the stud the following animals:

- 1 Aged stallion—Carmon.
- 1 Aged stallion—Loyal.
- 1 Eight-year-old stallion—Albion.
- 1 Six-year-old stallion—Carnegie.
- 1 Five-year-old stallion—Defender.
- 1 Five-year-old stallion—Davenport.
- 18 Aged mares.
- 5 Seven-year-old mares.
- 3 Six-year-old mares.
- 2 Five-year-old mares.
- 3 Four-year-old mares.
- 5 Two-year-old fillies.
- 4 Yearling fillies.
- 18 Weanlings.

67 Total number in stud.

Condition of Experiment.

The work is progressing nicely, the 1913 crop being up to the standard of previous years. Of the eighteen foals dropped, eight are fillies and ten are colts, all being quite uniform in type.

Sale of Condemned Animals.

The Board of Survey met on November 4, 1913, and condemned twenty-two animals, including five brood mares, two three-year-old stallions, two two-year-old stallions, four yearling fillies and five yearling stallions. One foal was ordered destroyed on account of deformities.

General.

Plans have been completed for the placing of at least two, and possibly three, stallions for the following season. The plan adopted is that of a lease of services of the stallion for the season. Upon the outcome of this season's results will depend greatly the continuance of the policy adopted.

Respectfully submitted,

J. O. WILLIAMS.

REPORT OF ANIMAL HUSBANDMAN.

To the Director:

Three lines of work have been completed and bulletins published during the past year.

Bulletin 188, subject, "Ration Experiments With Swine," 1909-1911, covers three series of experiments. All were designed to continue the work of determining or demonstrating the most economical protein supplement for grain, particularly barley and corn. Selected tankage, fertilizer tankage and alfalfa meal were used.

Bulletin 187, "Feeding Experiments With Lambs," 1909-1911, includes three winters' work with lambs, covering the following points:

1. Alfalfa hay, whole, compared with alfalfa hay cut, using corn as the grain ration.
2. Scotch (hulled, or brewing) barley compared with corn, using alfalfa as the hay ration.
3. The self-feeder for alfalfa hay compared with the panel method of feeding, using alfalfa hay and corn for the ration.
4. Scotch barley, California feed barley, and corn compared, using alfalfa as the hay ration.
5. Cut alfalfa hay and fine alfalfa meal compared with each other and with whole hay, using corn as the grain ration.
6. Loss caused by dogs gaining entrance to corrals and worrying fattening lambs.

Bulletin 189 covers Ration Experiments with Steers and Cost of Beef Production. The cost of beef production experiment was aimed to determine the cost of producing marketable yearling steers at a killing weight of about 1,100 pounds under semi-range conditions. Ration experiments with steers covered the use of barley as a grain feed in connection with alfalfa hay, the use of molasses in connection with corn and barley, and the use of finely ground alfalfa meal and cut alfalfa hay as against whole alfalfa hay.

No experimental work has been carried on during the present year, as no funds were available.

Respectfully yours,

G. E. MORTON.

REPORT OF THE IRRIGATION ENGINEER.

To the Director:

The following is the annual report from the Irrigation Section, exclusive of the work being done under the Hatch and Adams funds for the current year.

The only experimental work that has been attempted by this Section has been along two projects. One of these is irrigation of the College farm and campus by means of wood fibre pipe. Some 600 feet of this pipe was purchased and has been in use during the summer for campus irrigation purposes. It has proven itself to be efficient in every way and seems to be exactly the thing needed for this kind of work. There is absolutely no reason why this could not be applied with profit for the irrigation of any farm land which is inclined to be rough or which contains knolls or ridges. The pipes are easily put together and taken apart, are easily transferred from place to place and the time required for irrigating a field has been cut down by their use.

I have also to report on the second project, namely, the sub-irrigation experiment, that the porous tile was secured for, from the Hardin Porous Tile Company and installed on the west farm. A tract of three acres was tiled and the system put in according to the plans of the inventor of the system, Mr. Hardin. There were three crops tried on this ground, alfalfa on the south side, and barley and potatoes on the north side. Water was started in this system about the middle of July. The alfalfa did very well indeed, but the barley and potatoes were failures, at least partially so, because of the seeming refusal of the water to penetrate laterally, the tendency being a downward movement of the water after it gets into the ground rather than side percolation. The crop shows this feature very markedly, being excellent along the lines of the tile and gradually decreasing as we approach the middle of the spaces.

So far, I would say that the system is a success for deep rooted crops, but a failure for shallow rooted crops, at least in such soil as we have here. Complete data has been kept of the work during the summer and I am looking forward to the next irrigation season to give us enough data so that we can draw some definite conclusions.

I may add also, that the duty of water experiments on the different fields of the College farm were taken care of this past summer and a record kept of the amount of water applied to each field.

Respectfully submitted,

E. B. HOUSE.

REPORT OF IRRIGATION INVESTIGATIONS.

To the Director:

I have the honor to submit herewith the report of the Co-Operative Irrigation and Drainage Section of the Station.

The working arrangement has remained practically unchanged during the past two years. The work is supported by the Adams Hatch, State Appropriation and Government Appropriation funds. The last named fund equals the amount of the other three. In addition to this the Government is contributing about one thousand dollars for certain expenses in the hydraulic laboratory because of the general nature of the experimental work.

The hydraulic research work is now on a quite firm basis, and a sufficient number of problems need to be investigated to keep the new hydraulic laboratory in practically constant operation for several years. This research work was commenced on the thirty-first day of May, 1913, practically all of the previous year having been spent in the design and construction of the plant. Of course it will not be possible to operate the plant during the very cold weather when ice will interfere with the flow of the water.

At the beginning of the season it was anticipated that some four hundred to five hundred tests could be made during the five or six months of its operation, but during the first season nearly thirteen hundred tests have been completed, which is sufficient proof that the new plant is working even more efficiently than was anticipated.

The work during this season has been confined to the measurement of water over weirs, under various conditions, and although it has been prosecuted in a scientific manner, all of the data has a practical application to the measurement of irrigation water on the farm. There is in course of preparation a bulletin, or series of bulletins, on the measurement of water, which will be published in the near future by the United States Department of Agriculture.

During the past two summers considerable work has been done by Mr. Trimble and Mr. Jones on the co-efficient of friction in empirical formula. This has called for travel over the State for the measurement of frictional factors in canals, siphons, chutes, flumes and various irrigation carrying channels. The data is now in course of preparation and it is expected to be in form for a Station bulletin within a short time.

The Adams fund project on Drainage Factors has been continued, but it will require some two or three years for its comple-

tion. Owing to the shortage of State funds, the drainage of the Grand Junction Indian School lands has been postponed.

The co-operative experimental farms on the Costilla Estates Development Company's lands near San Acacio, Colorado, have been in operation during the past season and have produced some interesting and valuable results. There are two forty-acre farms in the Culebra River bottoms and one forty-acre tract on the mesa adjoining, upon which duty of water and methods of irrigation are being experimented with. This work also includes crops and cropping, being a co-operation with the Station Agronomist.

The general field investigation of irrigation conditions in the San Luis Valley is being completed by Mr. Hemphill. This work has been carried through two seasons and a quite complete knowledge of conditions in the Valley has been obtained.

A considerable portion of the funds available have been of such a nature as to compel their use in the more scientific work. Lack of State funds for general investigation has compelled a decided curtailment of this feature. It is hoped that much of the field work can be resumed in the near future. It is fortunate, however, that the hydraulic laboratory was completed, and even this would not have been possible had it not been for the very generous interest displayed by the Director, President and the members of the State Board of Agriculture.

Respectfully submitted,

V. M. CONE.

ANNUAL REPORT OF BOTANIST.

To the Director:

I herewith submit the Annual Report of the Section of Botany and Forestry.

Soil Algae.

The investigations of soil algae during the past fiscal year in co-operation with the Bacteriologist are a continuation of those started in 1911. Two lines of investigation have been followed: First: Systematic study of soils as to the algal content; and, second, establishing pure cultures of some one or more of the forms prevalent in our soils.

Systematic study. This was concerned with the question, "How do other soils compare with ours as to algal flora?" Sam-

ples of soil from states both east and west as well as additional ones from our own State were secured. All samples were treated essentially in the same manner as described on page 26, Bulletin 184. As compared with the majority of samples of Colorado cultivated soils examined, the development of algae in the soils from foreign localities was weak.

In January, 1913, a number of soil samples taken by Dr. Headden on the College farm were examined as to their algal content. In all of these there was a good growth of algae, *Microcoleus vaginatus*, being dominant in each.

It is worthy of mention that niter infected surface soil had a very feeble or no algal growth.

Pure Cultures.

Difficulty has been experienced in getting the forms prevailing in our soils in pure culture. This difficulty may be due to the presence of a gelatinous sheath, of varying thickness, about them, which harbors bacteria and fungi. Up to date, none of the methods tried have yielded pure cultures of these forms.

Cabbage Breeding.

When Mr. S Van Smith left the institution, this department took up the cabbage breeding experiment he had in progress. The original method of procedure has been modified to some extent. A crop of Winningstadt and Flat Dutch cabbage was grown the past summer. Some of these are buried for spring planting, others were set out in pots in the greenhouse.

The work has been in charge of Prof. W. W. Robbins.

Respectfully submitted,

B. O. LONGYEAR.

REPORT OF HORTICULTURIST.

To the Director:

I herewith submit the following statement of work in the Horticultural Section for the year ending November 1, 1913:

Due to the resignation of the horticulturist and the assistant horticulturist in the early spring, the Experiment Station work in horticulture was practically abandoned. The extension work in horticulture was also discontinued from lack of funds. This condition caused a serious break in the work and will necessitate new plans

for the coming year. The two vacancies in the Department were filled too late to permit any experimental work for the year; hence this report will briefly summarize some of the results obtained in former years and which were in part reported on in 1912.

Cover Crops.

The experiments with cover crops on the western slope during the years 1911 and 1912 brought out many interesting features which should be of value to the fruit growers of the State. From the experiences of fruit growers in the older fruit-growing sections of the west and the east, we are certain that a continuous cropping of our orchards without returning any fertility to the land will sooner or later show itself in decreased size of the fruit, if not in the productiveness of the trees. This is especially true on our lighter soils, which as a rule are deficient in vegetable matter and, therefore, do not hold moisture and frequent irrigation become necessary. The benefits derived from the use of cover crops or shade crops are three-fold:

First: It gives a protection to the soil both during the winter and the hot portion of the summer, provided the cover crop is planted early.

Second: By plowing under the cover crop instead of harvesting it, considerable vegetable matter is added to the soil, making it more retentive of moisture and more suitable for tree growth.

Third: Considerable fertilizing materials are added, especially in the form of nitrogen, if leguminous plants are used.

The object of the fruit-grower should be to conserve the fertility of his soil and to keep it in a perfect tilth. No fruit trees can be permanently fruitful unless they make normal wood growth each season.

It has been demonstrated that constant use of a cover crop in an orchard tends to reduce the bearing of the trees and to stimulate excessive wood growth. This is apt to be the case in moist climates. The wood growth in our western orchards can be controlled in a large measure by judicious irrigation and the western fruit-growers as a rule are more troubled with excessive fruitfulness than barrenness.

From the results of these experiments, the annual and biennial crops have given the best results, though alfalfa has proven a good crop on heavy lands. Alfalfa, while an excellent cover crop on

some soils, is objectionable because it utilizes too large an amount of moisture at the season of the year when that moisture is needed by the tree for the full development of the fruit and, further, alfalfa must be sown in the spring and cannot be removed in less than two years, while annual and biennial crops can be sown in the spring and turned under the same season, and a biennial crop, like the crimson clover and the hairy vetch, can be sown in July and form a complete covering by the time the frost sets in, remaining green over the winter and starting a vigorous growth in the spring and can be plowed late in May or in June.

The greatest drawback to the use of a cover crop is our dry autumns, making it difficult to obtain a good stand of crops like the hairy vetch and crimson clover. Annual crops like cow peas and Canada field peas are excellent, but they die in the fall and there is little or nothing to turn under in the spring. To get the most advantage out of these crops they should be plowed under while in the green stage.

Winter Protection for Strawberries.

From experiments carried on during the season of 1911 and 1912, we are convinced that winter protection for most varieties of strawberries is necessary if a full crop is to be obtained. While it is true that some varieties, noticeably Senator Dunlap, Enormous, Parson's Beauty, Crescent, Glen Mary, and possibly Sample, would stand our average winters without protection, yet to insure a full crop, protection should be practiced. Many varieties, like the Bederwood, Splendid, Klondike, Aroma, Gandy, and Chesapeake, showed a loss of from twenty-five to fifty per cent when not covered.

The best material for covering is clean oats straw, reasonably clean from weed seed and chaff. It should be applied in the fall after the ground is frozen to the depth of about six inches. In our windy climate it is necessary that some poles or boards be placed across the straw to prevent it from blowing away. The covering should not be removed until rather late in the spring or until the time when the strawberry leaves show signs of yellowing. The larger portion of the straw should be removed, but sufficient amount should be left to work in among the plants, thus aiding in keeping the fruit from coming into contact with the soil.

It was hoped that these experiments could have been continued for a series of years, as seasons vary so much that few trials do not present sufficient evidence for a positive conclusion.

Respectfully submitted,

E. P. SANDSTEN.