THE STATE AGRICULTURAL COLLEGE

OF THE STATE OF COLORADO.

SIXTH ANNUAL REPORT

OF

The Agricultural Experiment Station,

FORT COLLINS, COLORADO,

For the Year 1893.

FORT COLLINS, COLORADO.
THE EXPRESS PUBLISHING COMPANY.
1894.

OFFICERS AND MEMBERS

OF

The State Board of Agriculture.

HON. A. L. EMIGH, ... PRESIDENT.
HON. DANIEL W. WORKING, . . . SECRETARY.
HON. CHARLES H. SHELDON, . . TREASURER.

		TERM EXPIRES.
HON. CHARLES H. SMALL,	Pueblo,	1895
HON. FRANK J. ANNIS,	Fort Collins,	1895
HON. JOHN J. RYAN,	Loveland,	1897
HON. A. L. EMIGH,	Fort Collins,	1897
HON. J. E. DuBOIS,	Fort Collins,	1899
HON. JOSEPH S. McCLELLAND,	Fort Collins,	1899
HON. JAMES L. CHATFIELD,	Gypsum,	1901
HON. A. LINDSEY KELLOGG,	Rocky Ford,	1901
GOVERNOR DAVIS H. WAITE, } *ex officio.*		
PRESIDENT ALSTON ELLIS, }		

THE STATE EXPERIMENT STATION.

The State Agricultural College.

TREASURER'S FINANCIAL STATEMENT

FOR THE FISCAL YEAR ENDING
JUNE 30, 1893.

EXPERIMENT STATION FUND.

RECEIPTS.

United States Treasurer	$15,000 00	
Sales at Arkansas Valley Station	1,276 13	
Sales at San Luis Valley Station	30 07	
Sales at Divide Station	34 25	
C. H. Sheldon, Treasurer, advance to meet indebtedness	736 62	
		$17,077 07

EXPENDITURES.

Salaries, Station Staff, Officers, and Assistants	$10,106 47	
Agricultural Section, labor and supplies	318 84	
Stationery and postage	142 80	
Horticultural Section, labor and supplies	276 14	
Divide Experiment Station	735 45	
Chemical Section, chemicals and apparatus	14 25	
Printing Bulletins	462 74	
Meteorological and Irrigation Eng. Section	85 08	
San Luis Valley Experiment Station	1,630 46	
Arkansas Valley Experiment Station	2,147 99	
Entomological Section	200 59	
Buildings at Stations	634 23	
Printing Annual Report	322 03	
		$17,077 07

Fort Collins, Colorado, November 30th, 1893.

Experiment Station Inventory,

1893.

SUMMARY.

Agricultural Section, Fort Collins	$	644 05
Horticultural Section, Fort Collins		219 16
Irrigation Section, Fort Collins		1,093 16
Entomological Section, Fort Collins		697 30
Total Home Station	$	2,653 67
Arkansas Valley Station, Rocky Ford		14,711 50
San Luis Valley Station, Monte Vista		5,346 95
Divide Station, Table Rock		1,700 00
*Rain-Belt Station, Cheyenne Wells		625 00
Total of Experiment Station Property	$	25,037 12

* Not yet in full operation.

Letter of Transmittal.

HON. DAVIS H. WAITE,

Governor of Colorado:

SIR—I have the honor to transmit herewith the Sixth Annual Report of the Agricultural Experiment Station, conducted in connection with The State Agricultural College, as required by law.

Respectfully submitted,

DANIEL W. WORKING,

Secretary of The State Board of Agriculture.

THE STATE AGRICULTURAL COLLEGE,
FORT COLLINS, COLORADO.
December 30th, 1893.

REPORT OF THE DIRECTOR.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I herewith present a brief report of some matters connected with the work and duties of the Director of the Agricultural Experiment Stations of Colorado:

At a meeting of The State Board of Agriculture, held in April, 1893, a *Special Committee* was appointed to make investigation into, and report upon, the workings of the various College departments as well as the Experiment Stations under the direct control of your Committee. The report of this special committee was presented at the regular semi-annual meeting of the Board, June 8th, 1893. The report was quite lengthy and contained a number of important recommendations which were acted upon by the Board seriatim. One of these recommendations was as follows: "From a careful examination of the work performed, the Committee has reached the conclusion that the duties of the Director of the Experiment Stations may be discharged by the President of the College, and an annual saving thereby effected of $750. The Committee would therefore recommend that the President of the College perform all the duties ap-

pertaining to that office, upon the express understanding that he shall receive no extra compensation therefor." The minutes of the Board, under date of June 9th, show the following action: "The recommendation that the President of the College perform the duties of Director of the Experiment Stations was, on motion, adopted."

The records of the office did not come into my possession until the latter part of August. Then the records and the Station library were transferred from Agricultural Hall to a room, connected with the President's office, which had been fitted up for their reception. Since then an important part of my work, as Director, has been to secure from other stations bulletins, reports, and other printed matter needed to complete our files, and the arrangement of these files for ready reference. Very satisfactory progress has been made in this work. Our Station library is in a condition, as to location, arrangement, and matter, that makes it of real service to the members of the Station staff and others interested in the special literature it contains.

With considerable effort, I have secured seven complete sets of our Station bulletins. The Station library, as it came into my hands, did not contain a complete set of these publications.

The first bulletin of the Station was issued in August, 1887, and the last in October, 1893. These bulletins cover a wide range of important and practical topics. Their number and scope are herewith given:

No.	Subjects.	Authors.
1.	Report of Experiments in Irrigation and Meteorology	Elwood Mead.
2.	Report of Experiments with Grains, Grasses, and Vegetables on the College Farm.	A. E. Blount.

3.	Concerning the Duties of the Secretary of The State Board of Agriculture, and Distribution of Seeds	Frank J. Annis.
4.	Report of Experiments with Potatoes and Tobacco	James Cassidy.
5.	Experiments in Apiary	C. M. Brose.
6.	Notes on Insects and Insecticides	James Cassidy.
7.	Potatoes and Sugar Beets	James Cassidy and David O'Brine.
8.	Alfalfa: its Growth, Composition, and Digestibility	A. E. Blount. James Cassidy. David O'Brine.
9.	Soils and Alkali	David O'Brine.
10.	Tobacco	C. L. Ingersoll. James Cassidy.
11.	Sugar Beets	David O'Brine.
12.	Some Colorado Grasses and their Chemical Analysis	James Cassidy. David O'Brine.
13.	On the Measurement and Division of Water.	L. G. Carpenter.
14.	Progress Bulletin on Sugar Beets	David O'Brine.
15.	The Codling Moth and the Grape-vine Leaf-hopper	C. P. Gillette.
16.	The Artesian Wells of Colorado and their Relation to Irrigation	L. G. Carpenter.
17.	A Preliminary Report on the Fruit Interests of the State	C. S. Crandall.
18.	Index Bulletin	W. J. Quick.
	Special Bulletin "A." Concerning Subjects Investigated by the Experiment Station.	
19.	Observations upon Injurious Insects, Season of 1891	C. P. Gillette.
20.	1. The Best Milk Tester for the Practical Use of the Farmer and Dairyman.	
	II. The Influence of Food Upon the Pure Fat Present in Milk	W. J. Quick.
21.	I. Sugar Beets. II. Irish Potatoes. III. Fruit Raising	F. L. Watrous.
22.	A Preliminary Report on the Duty of Water.	L. G. Carpenter.
23.	Colorado Weeds	C. S. Crandall.
24.	A Few Common Insect Pests	C. P. Gillette.
25.	Progress Bulletin on the Loco and Larkspur	David O'Brine.

The last four bulletins were issued in the year covered by this report. The edition of each of the first four bulletins is exhausted. A few copies of

the other bulletins are on hand and subject to call.

The report of the Director for 1892 and the accompanying reports of the members of the Station staff and the Superintendents of the three substations, are on file in my office in manuscript form. Their publication has never been authorized. Such publication is clearly required, as can be seen from the following extract from the Congressional Act, of 1887, establishing Agricultural Experiment Stations: "It shall be the duty of each of said Stations annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said Stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States." In commenting, by letter of date Nov. 27th, 1893, upon the provision of the law above quoted, Director A. C. True, of the Government Experiment Stations, says: "In my opinion, the publication of a report of the operations of the station for each year is clearly required by the act of Congress establishing the stations. While it is not expressly stated in the act that this report must be *printed*, this would seem to be implied in the requirement that the report shall be sent to each of the stations as well as to the Governor of the State, and the Secretaries of Agriculture and the Treasury."

The publication of the reports for 1892 has not been ordered for the reason that it is the opinion of the Committee that some of them are of no particular value and that at least one lacks the

essential of reliability. This objection may or may not be valid. It is clearly the duty of the Committee to secure such revision of these reports as will put them in form for publication. Much useless matter can be eliminated; some statements can be condensed; and the publication of the revised and unobjectionable portions can be secured at a reasonable cost. I would recommend a careful editing of the reports for 1892 and their publication, thereafter, in connection with the reports for 1893. A volume containing the reports for both years would not be unusually large.

Early in the present year the Station Council adopted a plan for experimental work for each of the sub-stations. This plan is comprehensive, and is thought to be of enough value to be herein reproduced:

SAN LUIS VALLEY STATION, MONTE VISTA, COLORADO.

I.—GRAINS, GRASSES, ETC.

1. *Wheat:*
   - (*a*) Testing varieties.
   - (*b*) The trial of light and heavy seeding, ranging from three to six pecks on plats of one-half or one acre each, using the same variety of seed.
   - (*c*) Comparing broadcast with drilling.
2. *Oats:*
   - (*a*) Testing four varieties.
   - (*b*) The trial of light and heavy seeding in four plats; 3, 4, 5, and 6 pecks being sown respectively.
   - (*c*) Sowing three plats of the same variety of oats; one being treated with the Jensen hot-water process; another with sulphate of copper; the third not to be treated. Notes to be taken on the

percentage of smut present in the ripened crop.

(*d*) Comparison of two plats sown to the same kind of oats; one plowed deep, the other shallow.

3. *Flax:*
   (*a*) Testing three varieties.
   (*b*) Noting quality and yield; the straw being preserved for retting.

4. *Buckwheat:*
   (*a*) Testing two varieties.
   (*b*) Noting yield and quality. Plats not to exceed one-half acre.

5. *Forage Crops and Grasses:*
   (*a*) Rye to be cut for hay.
   (*b*) Field peas alone and with oats, for hay.
   (*c*) Testing varieties of Millet.
   (*d*) Alfalfa alone and with Orchard Grass.
   (*e*) Testing several varieties of grasses in plats.

6. *Barley:*
   (*a*) Variety tests.

II.—VEGETABLES.

1. *Sugar Beets:*
   (*a*) The Government directions to be followed in a small plat with seed from the Department.
   (*b*) One-quarter acre drilled with wheat drill twenty to twenty-four inches apart. Horse cultivation to be used.

1. *Potatoes:*
   (*a*) Testing varieties.
   (*b*) Comparing plat fertilized with barnyard manure with a plat not fertilized, three acres in all.

3. *Tomatoes:*
   (*a*) Testing varieties as to early maturity.

(*b*) Fertilizing alternate rows for comparative results.

(*c*) Comparing pruned and unpruned plants.

4. *Table Beets, Celery, Cabbage, Cauliflower, Peas, Beans, Melons; or any other garden vegetables instead, depending on seed procurable.*

(*a*) To note time of maturing.

(*b*) Notes on yield and quality.

(*c*) General observation.

III.—CO-OPERATION WITH SECTIONS.

1. Collections of and reporting observations on weeds and native grasses to College Botanist.
2. Observations of injurious insects and prompt report to the College Entomologist at the time of depredations.
3. Meteorological observations and measurement of water applied to crops, following the directions given by the College Meteorologist and Irrigation Engineer.

ARKANSAS VALLEY STATION, ROCKY FORD, COLORADO.

I.—GRAINS AND GRASSES.

1. *Wheat:*

(*a*) Test of one dozen varieties.

(*b*) Comparing broadcast with drilling.

(*c*) Test of light and heavy seeding on five one-half acre plats sown to 2, 3, 4, 5, and 6 pecks of the same variety; preparation to be identical.

(*d*) Sowing shrunken and plump grain for comparison of product. Both classes of seed to be taken from the same stock. It is recommended that each quality be tested as to germination, and that the miller's test be placed on each; and further, that from the count of a small amount an estimate be made of difference in the number of berries per peck.

(*c*) Top dressing of a portion of a field with well-rotted barn-yard manure after the crop is up, in comparison with the undressed portion.

2. *Oats:*

(*a*) Test of variety.

(*b*) Trial of light and heavy seeding, sowing 3, 4, 5, and 6 pecks.

(*c*) Comparing treated with untreated plats for smut (Jensen and sulphate of copper), noting the percentage of smutted heads in the ripened crop.

(*d*) Comparison of deep and shallow plowing.

(*e*) Comparison of early and late sowing.

3. *Corn:*

(*a*) Comparing yield with two, three, and four cultivations.

(*b*) Comparing deep and shallow preparation of soil.

(*c*) Comparing the cultivation of two plats: one to be harrowed three times --first, soon after planting; second, after the corn is up from one to two inches; third, when from four to six inches; and the other plat to be cultivated three times with plow. Figures to be kept as to the expense of each mode of cultivation, and notes taken as to quality and yield.

(*d*) Check row three plats, of one acre each--one plat to be planted two grains to the hill, another three, and the other four. These are all to be treated the same; quality and yield compared.

(*e*) A comparison of the plat under "d" which has received an amount of seed nearest to that planted in an ordinary drilled acre. Corn of Colorado White

variety to be used in all these experiments.

4. *Flax:*
   (*a*) Two varieties grown in half-acre plats to test yield and quality.
   (*b*) Straw to be preserved for retting.
5. *Buckwheat:*
   (*a*) Two varieties grown in half-acre plats to test quality and yield.
6. *Forage Crops and Grasses:*
   (*a*) Rye to be cut for hay.
   (*b*) Field peas alone, and with oats, for hay.
   (*c*) Testing varieties of millet.
   (*d*) Alfalfa alone and with orchard grass.
   (*e*) Testing of several varieties of grasses in plats.
   (*f*) Trial of mixtures of grass seeds for pastures.
7. *Barley:*

   Variety tests.

II.—VEGETABLES.

1. *Potatoes:*
   (*a*) The trench method compared with the ordinary drill culture.
   (*b*) Five plats to be treated respectively with coal ashes, cob ashes, barn-yard manure, straw as mulch, and on native soil. Same variety of seed in each case with same cultivation.
   (*c*) Value of seed from a low altitude in comparison with that from a high — sowing the same variety.
   (*d*) Test of varieties.
2. *Sugar Beets:*
   (*a*) Test of varieties.
   (*b*) One plat of quarter acre, following Government directions.
   (*c*) One-half acre to be planted in rows twenty to twenty-four inches apart with

wheat drill; to be cultivated with horses.

(*d*) Two plats in comparison—rows in one to be eighteen inches apart; the other rows alternating twelve and twenty-four inches apart; all other conditions to be the same.

(*e*) Plats to be grown comparing the results of deep and shallow planting; deep and shallow plowing; different quantities sown and thinning to different distances in the row.

(*f*) Comparison of two small plats with irrigation between the rows and in the rows.

3. *Cabbage:*
   (*a*) Testing varieties.
   (*b*) Cost of raising one-half acre of a late variety to be marketed in the spring.
4. *Tomatoes:*
   (*a*) Rows north and south compared with rows east and west. Note time of maturing.
   (*b*) Pruning alternative rows for comparative results.
   (*c*) Fertilize alternate rows.
5. *Celery:*
   (*a*) Comparing trench with surface planting.
   (*b*) Comparing mulching and blanching with straw and boards.
   (*c*) To compare with "b," self-blanching by the "New Process" of planting, 7 inches in checks each way.
6. *Melons:*
   (*a*) Comparing the planting in hills made of well-rotted barn-yard manure with ordinary modes of planting. Size, earliness, and productiveness to be noticed.
   (*b*) Comparative test to be made with "a" on the clover sod in the orchard.

7. *Cauliflower, Peas, Beans, and other Garden Vegetables, as seed can be procured.*
   (*a*) To note time of maturing.
   (*b*) Notes on yield and quality.
   (*c*) General observations.

III.—CO-OPERATION.

1. Collections of and reporting observations on weeds and native grasses to the College Botanist.
2. Observations of injurious insects and prompt report to the College Entomologist at the time of depredations.
3. Meteorological observations and measurement of water applied to crops, following the directions given by the College Meteorologist and Irrigation Engineer.

IV.—FRUITS.

Orchard and Small Fruits:

Notes to be made on fruits now bearing.

DIVIDE STATION, TABLE ROCK, COLORADO.

GRAINS AND GRASSES.

1. *Wheat:*
   (*a*) Testing varieties.
   (*b*) The trial of light and heavy seeding.
2. *Oats:*
   (*a*) Testing four varieties.
   (*b*) The trial of light and heavy seeding.
   (*c*) Sowing of three plats of the same variety of oats; one being treated with the Jensen hot-water process; another with sulphate of copper; the third not to be treated. Notes to be taken on the percentage of smut present in the ripened crop.
   (*a*) Comparison of two plats sown to the same kind of oats; one plowed deep, the other shallow. Size of plats to be governed by ground available.

3. *Flax:*
   (*a*) Testing three varieties.
   (*b*) Noting quality and yield; the straw being preserved for retting.
4. *Buckwheat:*
   (*a*) Testing two varieties.
   (*b*) Noting yield and quality. Plats not to exceed one-half acre.
5. *Corn:*
   Testing early varieties for both forage and grain.
6. *Forage Crops and Grasses:*
   (*a*) Rye to be cut for hay.
   (*b*) Field peas with oats, rye, and Polish wheat for hay.
   (*c*) Testing Millet varieties.
   (*d*) Alfalfa to be sown early and late; to be drilled three to five inches deep, also with orchard grass and Bromus inermis and with oats and rye.
   (*e*) Variety testing of grass, plats to be relocated on the potato ground of 1892.
7. *Barley:*
   Variety tests.

II. VEGETABLES.

1. *Potatoes:*
   (*a*) Testing such varieties as gave promising yield in 1892, and adding other varieties on new location, but with the same arrangement of plats.
   (*b*) Comparison of a fertilized plat with an unfertilized plat, two varieties.
2. *Tomatoes:*
   (*a*) Testing varieties as to early maturity.
   (*b*) Fertilizing alternative rows for comparative results.
   (*c*) Comparing pruned and unpruned plants.

3. *Table Beets, Celery, Cabbage, Cauliflower, Beans, Melons; or any other garden vegetables instead, depending upon seed obtainable.*
   (*a*) To note time of maturing.
   (*b*) Notes on yield and quality.
   (*c*) General observations.

III.—CO-OPERATION.

1. Collections of and reporting observations on weeds and native grasses to the College Botanist.
2. Observations of injurious insects and prompt report to the College Entomologist at the time of depredations.
3. Meteorological observations, following directions given by the College Meteorologist.

A word of caution is needed regarding the preparation of most schedules of work and experiments such as that just given. The tendency is to cover too wide a range of work. Effort is unwisely spent in an impossible attempt to do everything thought of, and nothing is pushed to a satisfactory conclusion. Much of the work outlined ought to be taken up in detail and several years given to the lines of work mapped-out for one. It is probable that future efforts will be restricted to more modest limits and, let us hope, with more definite outcome.

At a meeting of the Station Council, held April 24th, 1893, the work of the different sections for the year was reported and approved as follows:

CHEMICAL SECTION.

The following work for the Association of Official Agricultural Chemists of the United States:

I. Analyses of cattle foods high in fiber:
   1. Unhulled German millet seed.
   2. Vine of the whippoorwill pea.

3. Seed of the red clover.
4. Choice timothy hay.
5. Corn bran.
6. Corn husks.

G. L. TELLER, *Reporter.*

II. Analysis of wine for alcohol and extract; two samples, claret and angelica.

C. A. CRAMPTON, *Reporter.*

III. Nitrogen determinations in,

1. Sample cow pea.
2. Mixture of fertilizers.
3. Comparison of Ulrich with Schulze-Tieman method.
4. Strength of acids used.

C. L. PARSONS, *Reporter.*

IV. Sugar determinations:

1. Drying in air.
2. Drying in vacuum.
3. Determination of water from density.
4. Ash method of Alberti and Hempel.
5. Reducing sugar, Formaneck and Ross.

G. L. SPENCER, *Reporter.*

V. Cheese analysis:

1. Determination of water by drying in hydrogen.
2. By drying in air.
3. Short's method.
4. Babcock's method.
5. Calculated by formula.

A. L. WINTERS, *Reporter.*

VI. Feeding stuffs low in fiber:

1. Hornig's method.
2. Patterson's animal charcoal method.
3. Ether extraction without previous drying.

F. W. WOLL, *Reporter.*

VII. Determination of phosphoric acid, moisture, iron, and alumina:

1. Mixed fertilizers.
2. Native Florida rock phosphate.

RUDOLF DE ROODE, *Reporter.*

VIII. Adulteration of honey with various substances.

IX. Soil analyses—sample from each County in Colorado.

X. Preserving milk with different substances.

XI. Water before and after irrigation, with different kinds of soils and crops.

XII. Co-operative work with other departments of the College.

SECTION OF BOTANY AND HORTICULTURE.

I. The study of the *flora* of the State:
   1. The weeds of the farm and garden.
   2. Grasses, native or introduced.
   3. Study of the various species and varieties of the genus *Astragalus Oxytropis.*

II. Further introduction of wild fruit plants into the garden.

III. Observations and record on:
   1. Leafage and rate of growth of trees and shrubs.
   2. Small fruits.
   3. Culinary vegetables.

IV. Root growth of alfalfa.

V. Grafting experiments.

VI. Crossing and hybridizing with a view to the production of new varieties.

VII. Report on the fruit interests of the State.

SECTION OF METEOROLOGY AND IRRIGATION ENGINEERING.

I. Duty of water:
   1. With the co-operation of canals.
   2. On individual crops.

II. Continuation of irrigation survey of the State.

III. Investigation of losses by seepage and evaporation.

IV. Investigation of the reproduction of waters in the Poudre Valley.

V. Minor experiments; modules, etc.

VI. Meteorology as hitherto.

SECTION OF ENTOMOLOGY.

Work with insecticides:

1. Testing the effects of arsenical combinations upon insects and foliage.
2. Testing the effects upon bees and honey of spraying arsenical mixtures upon fruit trees in bloom.

II. Work with injurious insects to determine methods of prevention and remedy:

1. By using insecticides.
2. By studying habits and life histories.

The latter will be done by making collections and by receiving such species as can be obtained in the preparatory stages.

III. Testing insecticides and insecticide machinery.

IV. Experiments in the apiary:

1. Testing the "K. D." hive and its furniture.
2. Experiments to determine the best method of applying foundation to sections.
3. Experiments to determine the best method of using separators.
4. Experiments to determine the best method of wintering bees.
5. Collecting, and taking notes on, flowering plants for the purpose of determining their value as forage plants.

V. The preparation of a list of Colorado insects for publication.

> The plan is to make as complete a systematic list of insects known to exist in the State as possible, and give, in each case, along with the name of the insect, the name of the collector, the date and particular location of capture, the altitude, and, as far as known, its food habits and life history.

In the plans for experimental farm, garden, and laboratory work, as well as in those by which the personal investigations of the members of the Station staff were to be governed, as hereinbefore given, nothing is reported, in the record, from the head of the Agricultural Section.

The successful completion of the work planned in the foregoing schedules would mean a great deal to the agricultural and horticultural interests of the State. The members of the Station Staff are fully aware that the lines of work indicated in these schedules can not be followed out to satisfactory results in a single year. Many of the topics named have been made subjects of investigation and experimentation in previous years and nothing but *progress* work has as yet been reported. The centering of time and effort on fewer topics for invesigation would undoubtedly bring results which, if not so numerous as those previously held in view, would be more definite and farther reaching. The best idea would be worked out in the better cultivation of a smaller field.

Within the year some requests for the presence of our specialists at farmers' institutes were received. I believe that in all cases these requests

were favorably acted upon by the College Faculty. There is wide room for future effort in this particular line of work. Farmers' institutes in Colorado are not so numerous as they should be. The State Board of Agriculture could help on the work of organizing farmers' institutes in the State were it given the financial support that is usually voted for such purposes in other states. As it is, no money is available for paying the expenses of Faculty members who are willing to attend such institutes and are desirous of so doing. To provide in part for the want of scientific instruction among those interested in agriculture and kindred pursuits which the failure to inaugurate a well-planned series of farmers' institutes has left unsupplied, the Station Council, at the suggestion of the Executive Committee, has completed arrangements to give a *short course* in agriculture in January next at the College. To this special school, which will open in Agricultural Hall on January 8th, 1894, and continue four weeks, all persons fitted for its work are cordially invited. No fees of any kind will be required, and all students of this practical, special course will have all the library, reading-room, museum, and laboratory privileges enjoyed by other students. The following is the *Course of Instruction* as heretofore published: Instruction will be given by lectures and by work in the shops and laboratories. The regular daily programme will consist of three lectures, and two hours in the laboratory, shop, or greenhouse.

STOCK FEEDING By Professor W. W. Cooke Twelve Lectures.
The relative value of stock foods; feeding standards; feeding for beef, mutton, pork, milk, butter, etc.; ensilage and the silo; win-

ter shelter for stock; preparation of food—cutting, steaming, grinding, etc.

DAIRYING—By Prof. W. W. Cooke—Twelve Lectures.

Selection and care of dairy stock; dairy breeds; composition and secretion of milk; care and handling of milk; butter and cheese making; milk testing; paying by test at creameries and cheese factories; profitable use of skim milk and buttermilk.

IRRIGATION HYDRAULICS—By Prof. L. G. Carpenter—Twelve Lectures.

Water supply; measurement of water; duty of water; storage of water; reservoirs; methods of irrigation; irrigation in other countries.

HORTICULTURE—By Prof. C. S. Crandall—Eight Lectures.

Grasses and forage crops; orchard crops and small fruits; grafting; other methods of propagation; improvement through seed selection; cross fertilization; variation.

ENTOMOLOGY—By Prof. C. P. Gillette—Six Lectures.

Insects injurious to farm and garden crops; insect enemies of orchards and small fruits; parasites of domestic animals; methods of preparing and using insecticides; beneficial insects.

AGRICULTURAL CHEMISTRY—By Prof. Wm. P. Headden—Five Lectures.

Soils and their formation; the nutrition of plants; manures, natural and artificial; fertilizing value of feed stuffs; green manuring.

FARM MACHINERY AND TOOLS—By Prof. J. W. Lawrence—Three Lectures.

Care and use of wood-working tools; care of farm machinery; repairing farm machinery.

THE SCIENCE OF GOVERNMENT—By President Alston Ellis—Two Lectures.

AFTERNOON WORK.

The practical work in the afternoon will be devoted to the subjects of Milk Testing and Detection of Adulteration; Irrigation; Horticulture; and to work in the Mechanical Department.

It suggests itself to me, in connection with this short course in agriculture, that it would be well to secure the attendance, upon its lectures and work, of all the Superintendents of the sub-stations. These gentlemen could receive and give important information regarding the work they have in charge. In the absence of each from his accus-

tomed place, his work could be left in charge of some one of the farm employes. The time appointed is the most favorable one of the year to leave the work of the sub-stations in charge of persons other than their regular heads. Before leaving his station, each Superintendent ought to be instructed to confer with his local advisory committee, and others, as to the special needs, along his lines of effort, of the section of the State he represents and to come to the College prepared to give a well-digested outline of the work thought to be most profitable and practical for his station for the coming year.

At appointed times, in January, meetings of the Station Council ought to be held, and the Superintendents of the sub-stations, the members of the Farm Committee, and others immediately connected with station work invited to attend. The conferences had at these meetings would do much to methodize and define all the experimental work to be conducted under the authority of the Board of Control, in the year 1894.

There would be, it seems to me, great advantage in having some clearly defined lines of work established for the guidance not only of the heads of the sub-stations, but for the members of the Station Staff as well. Let the beginning of the new year see us with definite plans in the way of experiment and work ahead of us; let the succeeding months witness an honest and intelligent effort put forth to accomplish what is specified in the plans adopted; and let the close of the year find us prepared to report the results of our labors.

The acreage of land upon which our farm and garden experimental work is conducted is of large

extent. Herewith is given some items that may be of interest in this connection:

Station.	County.	Acres Cultivated.	Acres Uncultivated.	Value of Land.
College	Larimer	200	40	$26,750 00
Arkansas Valley	Otero	188	0	9,400 00
San Luis Valley	Rio Grande	125	35	2,400 00
Divide	El Paso	76	4	400 00
*Rain-Belt	Cheyenne		160	400 00

It is apparent, upon consideration, that the Board of Control can not successfully keep under cultivation nearly 800 acres of land, made up of farms located in five different sections of the State, with the annual income of $15,000.00 received from the Government under the provisions of the "Hatch Act." A large portion of the land is operated upon experimentally; and experimental farm and garden work is far from profitable in a financial sense. No work other than *experimental* ought to be attempted, further than is necessary to provide feed for the animals needed on the Station grounds. It is no part of the Station work to raise products for sale.

An increase of revenue is an imperative demand if all the Stations now in operation are maintained in anything like an efficient condition. A poorly-managed station is worse than none—brings the whole experimental work into disrepute and places the farmers of the State in an indifferent or hostile attitude not only towards the other Stations, but also towards the College by which they are fostered and directed. It is a fact worth noticing that the College has not, for years, had a student from the vicinity of any of the sub-stations.

The present experiment station fund is not sufficient properly to operate more than the home

* Opened in summer of '93

station and one sub-station. If the policy of having stations in a number of localities is to be continued, it becomes necessary for us to secure funds from the State to supplement those now received from the United States. If the people in the vicinity of our sub-stations are duly interested in them, they will unite in an appeal to the General Assembly for some appropriation for their more adequate support, and it is probable that the appeal will be heeded; but if they are indifferent to the welfare of these stations, it might be proper to consider the advisability of discontinuing such of them as seem to be less securely rooted in public favor.

All these sub-station farms ought to be surveyed and platted. This is a pressing need if experiments are to be properly planned and effectually carried out. A map of these surveys ought to be easily accessible to the Director, the Professor of Agriculture, and the members of the Farm Committee.

At my suggestion, the reports from the various sections and sub-stations have been made brief. Usually they have contained matter better suited for bulletin use than the pages of a report. My thought is to incorporate in this report a *general* statement of what has been done by the sections and at the sub-stations, leaving details of experimentation and work to be given in bulletin matter. There are now promises of four new bulletins; all to be ready in the early months of 1894:

1. "Garden Notes for 1893," by Prof. Crandall.
2. "Farm Notes for 1893," by Prof. Cooke.
3. "Observations on Farm Operations in the Arkansas Valley," by Superintendent Huntley.

4. "Meteorological Observations in 1893, with Comments," by Prof. Carpenter.

I heartily recommend to your favorable consideration the desire of Professor Crandall to prepare a complete *flora* of the State; that of Professor Gillette to secure the proper classification of the *insects* of the State; and that of Professor Carpenter to complete the *irrigation survey* of the State. I believe that the specialists of the College Faculty are the best-equipped persons in Colorado to prosecute the different kinds of work indicated in these desires. They have a laudable pride to be *first* in these enterprises, and their positions in the only thoroughly scientific institution in Colorado seem to require that they should lead the way in such matters.

I hope, with the hearty co-operation of all concerned, to be helpful in the work of making the experiment stations of the State a potent factor in the better development of our agricultural and horticultural interests.

Respectfully submitted,

Alston Ellis.

Director.

FORT COLLINS, Colorado, November 30th, 1893.

REPORT OF

THE EXECUTIVE COMMITTEE.

To The State Board of Agriculture:

GENTLEMEN—Your Committee on Experiment Stations has the honor to report the following condition of the sub-stations:

An additional tract of land containing 80 acres has been secured for the San Luis Valley Station. This additional tract adjoins the Station on the west and gives us much needed and valuable land for further experiments. It was secured from the State, without expense. A good frame barn 29.4 x26.5 feet, costing $371.00, has been built the past season. Wire has been purchased to fence the new tract, and the fence is now in course of construction. Forty-five acres of the new tract have already been broken and fifty acres of stubble have been fall-plowed, thus giving us ninety-five acres ready for spring seeding.

The needs of this Station for the coming year will be a few farm implements, painting of house and barn, and the laying out of drives through the farm for the accommodation of visitors. No items of considerable expense are now anticipated. As this Station is short of water for irrigation, we recommend that seventy-five inches be rented for the year.

No permanent improvements have been made at the Divide Station, and the only implement purchased was a fanning mill, at a cost of twenty-five dollars. The entire arable land of this Station is now under cultivation and during the past season presented a very creditable appearance to the many visitors. The well does not furnish sufficient water for stock and domestic use during such dry seasons as the past, and we recommend that it be sunk deeper now while it is almost dry. The sale of products now stored upon the farm will furnish sufficient funds for this purpose.

At the Arkansas Valley Station, wagon scales have been put in, at a cost of sixty dollars. Three registered Jersey cows and one bull have been purchased, at a cost of two hundred dollars, as a nucleus for dairy experiments. Some additional implement sheds have been erected, a root cellar built, and the cellar, owing to its caving in, has had to be rebuilt. A severe hailstorm destroyed many of the crops, but the alfalfa was very heavy and yielded more than five tons to the acre upon fifty-five acres. If a stacker were procured for this farm, so that the alfalfa could be secured entirely by horse power, we believe it would effect a considerable saving over the present system. Several fences have been built the past season to enable us to dispose of the pasturage, and notice has been served upon the tenant who has for some years occupied the tract of land north of the railroad, that we will not lease again after his present time expires.

In obedience to your instructions, your Committee visited Cheyenne Wells, and located a Station within a half mile of the railroad depot. One

hundred and sixty acres of land were secured. This tract has now been fenced and forty acres have been broken, at a cost of $451.18. A house and barn should be erected in the immediate future, and we recommend that buildings similar to those at the San Luis Valley Station be erected. They will probably cost from one thousand to twelve hundred dollars. The Legislature, it will be remembered, appropriated $2,500 for the equipment of this Station, and the people of Cheyenne Wells gave $1,200, making a total of $3,700, which sum, less the amount already expended, is now in the hands of the local treasurer.

Your Committee visited all the sub-stations the past summer and the Chairman advised with the Superintendent of each several times. All the Stations are in better condition for effective work than ever before, and if they are not again burdened with innumerable impractical experiments, but are required to proceed along a few leading and promising lines, valuable results may confidently be expected from each. For the first time they are all now ready to make such experiments as will be a benefit to the farmers of the State, and especially of the localities in which they are located.

For a financial statement of the receipts and expeditures, we would respectfully refer you to the reports of the Secretary and Treasurer.

Respectfully submitted,

J. S. McCLELLAND,
JOHN J. RYAN,
A. L. KELLOGG,
A. L. EMIGH,
ALSTON ELLIS,
Committee.

Fort Collins, Colorado, December 14, 1893.

AGRICULTURAL HALL.

ANNUAL REPORT OF

THE AGRICULTURAL SECTION.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor to present the following report of the Agricultural Section:

My connection with the College dates only from last September, so that the plans of the work for the season had been made, the crops planted, and most of them harvested before my arrival.

The general scheme of experiments was much the same as in former years. Many varieties of cereals were grown and also plats of corn, potatoes, sugar beets, sorghums, dhouras, flax, hemp, and several new forage crops, such as rape, sandwick, soy bean, and serradilla. In general, these forage crops have not been a success, owing to lack of water during the latter part of the season and to cool nights. While they might and probably would do well at the Arkansas Valley Station, Fort Collins is too close to the mountains for these crops from a warmer climate to do well. One of these crops, sandwick, I have lately tried in Vermont, and it bids fair to be a valuable soiling crop or more particularly a pasture crop

on grain stubble. This Section has also secured seeds and roots, for next season's planting, of some new fodder crops, for which marvellous things are claimed by their introducers. So important is it that a good forage crop be found for this section, that especial pains will be taken in this direction the coming summer.

Though this section is not considered a good corn country, yet the crop this year contained 5,500 pounds of dry matter per acre, or the equivalent in feeding value to about three and a half tons of alfalfa hay. This crop will be used this winter in testing the value of corn stalks when whole and when cut, as compared with alfalfa hay. Three fields of sugar beets of several leading varieties were grown experimentally. The crops have all been weighed and analyses made by the Chemist of the Station. The yields are very uneven, from six to eighteen tons per acre, and from four to sixteen per cent. of sugar. The yields were fairly satisfactory, though the average per cent. of sugar in the beets is lower than in 1892.

An extensive test of commercial fertilizers on potatoes was undertaken, but the failure of the water supply completely ruined the test and cut down the yield to but little more than the seed.

Some feeding experiments with sheep were conducted the past winter, but the figures are not in shape for a report of the results. The same may be said of the dairy tests of last winter.

A great deal of time was spent by the officers and employes of the Section in preparing an exhibit for Chicago. A very full showing was made of the farm products, especially the cereal crops of the Central Station and the Sub-stations.

When this exhibit is returned, it will form an excellent basis for an extended Agricultural Museum. A little time and labor put on this matter would change one of the rooms in Agricultural Hall into an exhibit of agricultural material that would be interesting to visitors and very instructive to the students. The principal cost of such collection is in the freight and express bills. We have already been promised by Cornell University a full duplicate set of its exhibit at Chicago of feeding stuffs, if we will pay the freight.

During the past few weeks preparations have been made for conducting this winter some experiments in pig-feeding, particularly to test the value of wheat as a pig feed. Experiments are contemplated to test alfalfa, sugar beets, and various grains as cattle foods. Experiments are under way to determine the adaptability of ensilage to this country. The full report of the crops of the year that has usually accompanied the report of the Agricultural Section, and formed its largest part, is here omitted because it is expected to publish them in a special bulletin soon to be issued. This bulletin will also contain a summary of the crops grown on some of the plots from the beginning of the College to the present time. Full records have been kept, but they have never been brought together. It is expected that such a summary will be both interesting and instructive.

As a preparation for this work, an excellent map of the farm has been completed, and blue print copies made of it for illustrating the crops of each year.

Little has been said of the needs of the Section, because the funds at its disposal are so exceedingly small. But there are two things that seem to call for careful consideration: All experiment plots on the farm at present are open to the depredations of roving stock. It is not practicable to keep the gates of the main drives shut, nor is it advisable, since the town people find the College grounds the most agreeable driving place in the vicinity, and they should be encouraged to bring guests and friends to see the buildings and grounds. Most of the smaller plots and the more important experiments can be brought upon the southeast corner of the farm, and a suitable fence to turn stock could then be made to inclose it.

The other need is facility for more chemical work in connection with the crops of the farm and the feeding experiments at the barn. The particular advantage that an Agricultural College has over the ordinary farmer is not that it can raise better crops or raise a steer with less feed, but that it can keep exact records of what it does do, and that by means of its laboratories it can attempt the solution of various problems that are beyond the reach of any but the trained scientist. Almost no attempt has been made so far at this College to have the Chemical Department aid the Farm Department. It is not difficult to find the reason. The two departments are co-ordinate and any work done by the Chemical Department for the Farm Department, would redound to the credit of the latter department; and, while taking a very large amount of time, would never receive from any source any adequate return of credit, and no reputation. The Farm Department can

profitably employ the time of one assistant chemist throughout the year. The actual value to the farming interests of the State of such work as supplementary to the usual experimental work of the College is second to no work that can be done. As an example of what I mean, I desire very much to make a thorough test of the feeding value of wheat as a cattle and hog feed. Though the problem seems so simple, yet to obtain any *new* knowledge, to obtain any results that are worth striving for, will require a very large amount of chemical work. In like manner, to obtain exact information as to what part alfalfa can play, either green or dry, in pig feeding, will require many long and difficult analyses.

I do not intend in this any criticism of the Chemical Department. It has made for me, with perfect willingness, every analysis I have asked of it; but my requests have not been a tenth of what they should be if the Farm Department is to obtain the best results.

Respectfully submitted,

W. W. COOKE,

Agriculturist.

FORT COLLINS, Colorado, November 30th, 1893.

REPORT OF THE SECTION OF

BOTANY AND HORTICULTURE.

To The Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor to submit the following report from the Section of Botany and Horticulture of the Experiment Station:

Work has been carried on as nearly as was possible in accordance with the schedule submitted last spring. During the early part of the season, having no Assistant, it was necessary for me to assume entire charge of the details of out-door work—the supervision of student labor, and of the men employed, in addition to my class-room and laboratory work. This left little time to devote to particular lines of work. But few additions have been made during the season to our flora of the State. This locality has been quite thoroughly worked, and naturally the additions are not frequent. The undetermined material which has accumulated, and which includes about 250 species, I have recently arranged systematically, and have commenced the task of determination, devoting to it occasional hours that can be spared from other duties. I hope to finnish this work before spring and classify the species in the herbarium.

During my absence last summer, I spent considerable time in the National Herbarium, at Washington, D. C., and the Gray Herbarium, at Cambridge, Mass., studying the types of Colorado species. By this work I was enabled to clear up many doubtful points concerning plants already collected, and to gain information which will greatly aid future work. At the herbaria visited, every facility for study was placed at my disposal, and I feel under many obligations for courtesies extended.

It appears to me very desirable that the next flora of the State of Colorado should emanate from this Station or College; only one flora of the State has ever been published—that of Porter and Coulter, published by the United State Government in 1874; it is now out of print, and was, at best, very incomplete. No other institution in the State is attempting any systematic botanical work; the field is left to us, and with the material at present in hand it would not take long to complete the work. A complete flora arranged in our herbarium would be of great advantage to the Station in making it the botanical headquarters for the State, and its value would rapidly increase as extended correspondence added new facts regarding the distribution and habits of the species represented; such a collection would greatly facilitate replies to inquiries, and enable us to give more extended information. The increasing number of plants sent to the department for determination and the numerous inquiries regarding plants, demonstrate a desire for information, and show that the department can be of use in this direction.

Opportunity for making collections in those portions of the State not yet visited will be necessary in order to complete our work on the flora; the expense for such work would be mainly for transportation, but it would not require a large expenditure to complete the whole work.

Observations on the weeds of the State have been continued, and a preliminary bulletin treating of a few of the worst has been issued. I have in preparation a list of weeds which will be ready for publication before spring; it is my purpose to accompany the list with notes on the characteristics of the more important species, on the distribution, and on the insect and fungus enemies. The distinctive weed flora of the ditch banks and the transportation of seed by water in ditches, will also receive attention. The preliminary bulletin has called forth many letters of inquiry, accompanied by information from various portions of the State, and in several cases by specimens of weeds that were troublesome. I do not consider our present list complete for the State, but belive that its distribution will quickest call forth mention of noxious species not now included.

Observations and notes upon the native grasses have been continued during the season. The species represented on the garden plats made good growth; cuttings were made and records kept of the weight of product, both green and dry. Some of the species have now been under observation for three seasons.

The accumulated records, together with the observations recorded when collecting for the World's Fair, in 1892, it is my purpose to present in bulletin form early in the coming year.

The failure of our water supply again caused serious injury to late maturing garden crops, notably to potatoes, cabbage, cauliflower, and celery. Tomatoes, beans, peas, and other vegetables maturing earlier were successfully grown. The records concerning the varieties tested are now being tabulated and placed in form for publication as a bulletin. I feel assured that, with the well to supplement our ditch supply, we will not again encounter the annoying difficulty of shortage of water.

Arrangements are being made for a spring planting of fruit trees and plants. I desire to purchase about 200 apple trees, representing the newer varieties, with which to fill out the northwest corner of the garden. In addition, we will make during the winter, about 10,000 root-grafts; for this purpose we have in store 5,000 yearling apple stocks, and 500 plum stocks, to which we hope to add a few pear stocks. We also have scions of 120 varieties of apples, 15 varieties of plums, and several of pears and cherries. I have the promise of other scions of hardy varieties from the Canadian Experiment Station, and from the Division of Pomology of the Department of Agriculture. These, with such local varieties as I can secure, will give us a fairly complete collection of varieties worthy of trial. There is also a number of new and promising varieties of strawberries, and other small fruits, which I desire to add to those we already have.

I have had a number of inquiries during the year regarding the report on the fruit interests of the State which was promised when the preliminary report was made in the fall of 1891. My effort

to obtain information by correspondence has been unsuccessful, and I have reached the conclusion that the data from which to compile a report can only be obtained by personal visits to the fruit districts. Fruit growers, when personally questioned, have very readily responded; and I think the failure to respond to tabulated inquiries by mail is due more to neglect than to unwillingness. Fruit planting has increased very rapidly and the industry is assuming large proportions. It is my belief that a full report upon its present status would be well received and of use to those interested.

Mr. M. J. Huffington, my new Assistant, who began work June 13th, is giving entire satisfaction. He is careful and thorough in his work, a good observer, and fully competent to carry out the details of experiments in progress.

Respectfully submitted,

CHAS. S. CRANDALL,

Botanist and Horticulturist.

Fort Collins, Colorado, November 30th, 1893.

REPORT OF THE SECTION OF

Meteorology and Irrigation Engineering.

To the Executive Committee of the State Board of Agriculture:

GENTLEMEN—During the past year the work of the Section of Meteorology and Irrigation Engineering has proceeded according to the plan submitted in the spring, and which is a continuation of the work of the past five years, with no important modifications. The results of some of the investigations have before been given in previous reports and in bulletins. Data have been accumulated in several lines of investigation that will soon be presented for publication. In some other lines it is still desirable to continue the collection of data before deductions can be considered reliable.

A preliminary report on the Duty of Water was issued in the spring, forming bulletin No. 22.

The same investigation has been continued during the year. As the rainfall has been exceptionally small, the results, which are as yet but partially reduced, may be expected to differ materially from those of previous years. In some cases seven irrigations have been given where before two have sufficed. The same series of meas-

urements needs to be continued for several years, so that the effects of varying conditions may be quantitatively determined, so far as the nature of the investigation will permit. Self-recording instruments which record at all times the amount of water passing in the measuring flumes or over wiers have been used. One has been kept at the gauging station of the Poudre river, and one at the rating wier of the Cache-la-Poudre Canal No. 2, with the consent of the officials. These instruments have shown the amount of water entering the valley from day to day, and the total amount used by the lands both of the whole valley and under the one canal.

Other instruments were used for the whole or part of the irrigating season to measure the water applied to a wheat crop of Walter Campbell; a native meadow of Capt. Wm. Post; a series of crops on 160 acres of Hon. J. S. McClelland; and upon potato crops of S. A. Bradfield and Charles Mason, of Greeley. For the co-operation of all these gentlemen our thanks are due for what success there may be in the measurement. Also by the co-operation of J. C. Ulrich, Engineer and General Manager, and E. J. Gregory, Superintendent, of the North Poudre Canal Company, I was enabled to continue the measurement of the loss by seepage and evaporation from one of the laterals of this company which was exceptionally well suited for its determination uncomplicated by the uncertain losses from headgates between the points of measurement. The canal which was of small size, carrying only nine cubic feet per second, led from one of their reservoirs, and had no outlet in the course of the four miles between the two

measuring wiers which we used. Self-registers were placed at these weirs, and determined the loss between the two. The average loss for June on this distance, and with this small quantity of water, amounted to 19 per cent.

The clock works of these instruments needed to be wound and the papers changed once weekly, thus requiring a special trip for these purposes, as well as to inspect their condition each week. This involved travel amounting to 70 miles per week, even when several instruments were visited at the same trip, which was usually done. The instruments near Greeley were attended by those who furnished the ground for the measurement.

Early in the season we received from abroad an instrument designed to record the height of water at a distance. This had been ordered in the previous year but had not been constructed. When in Paris, in the summer of 1892, I visited the makers and gave some special directions.

Figure 1 shows the transmitter which is placed at the point where the discharge of water is desired to be known; figure 2 is the receiver which indicates on the dial and records by the pen below the depth of water at the transmitter. An instrument of the kind which will successfully transmit such indications is of considerable importance to the irrigation interests of this and adjoining states. It is becoming increasingly evident that for the complete utilization of our water immediate knowledge of the condition of the river above the heads of the ditches is needed. I had hoped to make a complete test of this instrument, with the aid of the Water Commissioner, on the ditches of the valley during the past season. The

telephone system of the ditches was extended to the gauging station 12 miles away by the Water Commissioner, but the system was not completed, owing to the financial stringency of the past summer. The transmitter was put in place, and for a day, when it was possible to cut out the intermediate telephones, a trial was made. While unsatisfactory from the conditions, the trial was sufficient to give confidence in one under more perfect arrangements.

Measurements of the seepage waters returning to the Poudre river were repeated this season, late, however, in the fall. The amount of water at the gauging station in the canon was determined, and from there to the mouth of the river where it flows into the Platte; all the water was taken out and all visible inflows were measured. This measurement was made this year by Mr. Trimble, with the aid of Water Commissioner, R. Q. Tenny. The return from seepage water is becoming of considerable importance, and is being extensively utilized for irrigation. The return waters amount on the average to not far from one-third of all the waters which enter the valley from the mountains.

In connection with several of these investigations a knowledge of the rainfall in various portions of the valley has been desirable. To throw light upon the conditions of many of these observations, as well as for itself, the co-operation of a number of observers has been secured, and from them reports of rainfall, and in some cases of other meteorological elements, have been secured. The College station is located at an elevation of 5,000 feet, close to the foot hills. The

highest station we have reporting to us is at an elevation of nearly 9,000 feet, at the foot of Long's Peak, with another about 8,500 feet above Manhattan. Several others in the mountains have reported to us, as well as several stations on the plains. The voluntary observers to whom my acknowledgments are due, are the following-named persons: Carlyle Lamb, Estes Park; S. J. Peery, Manhattan; C. Gilpin-Browne, Livermore; A. T. Gilkison, La Porte; E. F. Kerr, Fort Collins; Miss Ida M. Lewis, Timnath; Chas. Green, LeRoy; Rev. W. H. McCreery, Loveland; P. H. Boothroyd, Arkins; and J. S. McClelland, Fort Collins.

The meteorological observations have been continued essentially as before. Self-recording instruments have been used extensively, but checked by eye readings twice daily. A self-recording barometer, thermometer, psychrometer, pluviometer, and anemometer have been in constant use, besides registering thermometers. These instruments have given a continuous record for the year with no breaks except for a few hours at a time with the anemometer. The year has been an exceptionally windy one; and noted for its high temperature during the winter months and low rainfall. On many of the especially windy days and on the days of thunder-storms the peculiar variations of the barometer have been registered on a magnified scale by the statoscope, and some attempts made at studying them. There have been several days peculiar for their barometric changes and correspondingly high winds. Barograph records have been received for comparison and study from Denver, Cheyenne, and Livermore.

Attention has been called in previous reports to the difference in the winter temperatures between Fort Collins and Manhattan, the latter place being 3,500 feet higher than the former. During the month of January the average temperature at Fort Collins was the colder. During a portion of the season Mr. S. J. Peery, of Manhattan, who has shown much interest in our observations, has co-operated with us and has been furnished with a thermograph which could be spared for the purpose, and a continuous record of the temperature changes has been kept for comparison with our own. In case of cold waves the temperature in the mountains remains much higher than at this station, while in case of extreme falls of temperature due to local radiation, as in the case when the ground is covered with snow and the nights are clear, the thermometer descends lower than with us.

Soil thermometers have remained unchanged both in position and in method of observation. The principal set has been read twice daily; the other two sets have been read once weekly.

Observations have been made with both the maximum registering solar thermometers, and with the Arago-Davy conjugate thermometers which seem the most promising. I have been fortunate in selecting several cloudless days on which observations were made at short intervals. These will give the constants needed for reducing the records by this instrument. With a second set of thermometers now in order, I hope during the coming season to carry on a simultaneous series on one of the neighboring foot hills.

Evaporation measurements have been continued during the summer months, the temperature of the water and the height of the water surface being read twice daily. In the fall and early spring, when the hour of the daily observation is after sunset, one of these observations is omitted, and after the tank is frozen, readings are taken but once monthly.

The report of these observations will shortly be presented for publication in the form of a special bulletin, instead of forming a part of this report.

In all this work I have had the cordial co-operation of my assistant, Robert E. Trimble, who, after being shown once, could be depended on to carry out instructions faithfully and carefully.

Thanking you for the cordial support which has always been given to the work of this Section, I respectfully submit this report.

L. G. CARPENTER,
Meteorologist and Irrigation Engineer.

FORT COLLINS, Colorado, November 30, 1893.

ANNUAL REPORT OF

THE ENTOMOLOGICAL SECTION.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor to present herewith the third annual report of the Entomological Section of the Experiment Station:

Bulletin No. 24, "A Few Common Insect Pests," was issued from this Section in July, last, and treated of the Imported Cabbage Worm, (*pieris rapæ*,) the Southern Cabbage Butterfly, (*pieris protodicæ*,) the Cabbage Plusia, (*Plusia brassicæ*,) the Cabbage Plutella, (*Plutella cruciferarum*,) two Flea-beetles, (*Systena tæniata* and *Phyllotreta albionica*), and the Onion Thrips, (*Thrips striatus?*). There were several species of insects that did serious harm to crops in different parts of the State last summer, and far more inquiries concerning insect injuries were received at the Station during the past year than ever before Judging from the letters received, and my own observations, the following insects are those that attracted most attention because of their depredations:

GRASSHOPPERS—Although Colorado has not suffered from a visitation of the Rocky Mountain Locust for a number of years, there are several species of locusts that are abundant every year over large portions of the State, and occasion heavy losses, especially to the grazing and fruit

interests of the State. Most of the complaints concerning grasshopper ravages the past summer came from the vicinities of Fort Collins, Greeley, and Grand Junction, Colorado. The species doing most harm are the Red-legged Locust, (*M. femur-rubrum*,) the Two-lined Locust, (M. *bivittatus*,) and the Differential Locust, (*M. differentialis*). The free use of some form of hopper-dozer, and the plowing of the ground where most eggs are deposited in fall or early spring will keep these insects in check.

CODLING MOTH—This omnipresent pest has made its way into the orchards west of the Range, and is causing severe losses now in nearly all the orchards of the State where the arsenical sprays are not faithfully used.

LEAF ROLLERS—(*Cacoccia argyrospila* and *C. semiferana*). These two leaf-rollers, the former attacking especially apple, plum, and other fruit trees, and the latter the box-elder, were very abundant again in parts of the State the past summer. Thousands of fruit and box-elder trees were completely defoliated by them. Many trees have been cut and destroyed because of their being so badly infested by the rollers year after year. All these injuries could have been very easily averted by timely applications of the arsenical sprays.

The eggs of both the leaf-rollers are deposited on the trunks and limbs of the trees, and I found by experiments early last spring that a strong kerosene emulsion (33 per cent. kerosene) will completely destroy the egg-patches to which it was applied. The application may be made any time after the leaves drop in the fall and before the buds begin to swell in the spring.

It is encouraging to note that two Chalcid parasites have been active in destroying large numbers of the rollers the past summer, and there is good reason to hope that within a few years they may almost rid us of this pest.

THE GARDEN WEB-WORM (*Loxostege cerealis?*)—This insect was reported by Professor Jas. Cassiday, in Bulletin No. 6, of the Experiment Station, as being very abundant in Colorado in 1888. I do not know of its having appeared in injurious numbers in any part of the State since then until the past summer. Fruit bloom was visited by enormous numbers of the moths, and, for some time afterward, they swarmed on the flowers of the dandelion, loco weed, and other plants. The worms were reported as attacking chiefly alfalfa and lamb's quarter (*Chenopodium*). This insect was abundant in Larimer County and was reported as far south as Table Rock, Pueblo, and Rocky Ford.

THE ARMY WORM (*Leucania unipuncta.*)—This insect was abundant enough to attract attention in several places in this State last summer, but I am not aware that it did serious harm anywhere. The oat crop was injured to some extent about Fort Collins. The larvæ were very little parasitized in this vicinity and the moths flew very freely to light all the fall, so it seems that the conditions are favorable for a worse outbreak of the worms in 1894. People in neighborhoods where the worms were noticed last summer should be on the watch next July and prepare to intercept the onward march of any army of these worms by means of ditches, kerosene emulsion, or a line of coal tar.

THE CORN WORM (*Heliothis armigera*) —This worm does a large amount of injury to corn, es-

pecially to sweet corn, every year in Colorado, and there seems to be almost no practical remedy for it. Black birds are very fond of these worms, and they should not be frightened from cornfields, but encouraged to visit them.

CUT WORMS—The larvæ of some large noctuid moth, very likely *Agrotis saucia*, which is very abundant here, were very commonly associated with the corn worm in this vicinity last summer. The worms eat holes through the husks of the ears and feed upon the kernels of corn. It was not uncommon to find as many as a half-dozen feeding together in a single ear. I desire to know if they have been noticed in other parts of the State.

Until more is known in regard to the habits of this insect, no remedies can be given further than what is above mentioned in regard to the Corn Worm.

THE WOOLLY APHIS (*Schizoneura lanigera*)—The woolly aphis, or root-louse of the apple tree, has attracted considerable attention in fruit growing districts of the State the past season. We have had complaints concerning it from orchardists across the Range, at Canon City, Denver, and in various places in Larimer County. It usually attracts most attention when above ground upon the trunks and limbs of the trees during summer and fall, but does its chief harm during winter and spring, while feeding upon the roots.

The lice may be destroyed by thoroughly applying kerosene emulsion to them while upon the trunks and branches, or by applying kerosene emulsion, tobacco decoction, or hot water to the roots about the base of the trees while they are feeding upon the roots. When an application to the roots is made, the earth should be partially removed from over the roots about the base of the tree.

THE ONION THRIPS (*Thrips striatus?*)—This very minute onion pest was exceedingly abundant again last summer, in the vicinity of Fort Collins and Denver, and probably in other places in the State. Its attack causes the onion tops to turn white and wilt, as if struck by a blight. The remedy is a timely application of kerosene emulsion.

POTATO-SCAB WORM—For two years, at least, there has been much injury done to the potatoes in the vicinity of Table Rock, Colorado, by a minute Coleopterous larva, apparently one of the flea-beetles. The injury is done by the larvæ boring into the surface of the tubers to the depth of about one-eighth of an inch, and the potatoes, in consequence, becoming rough and scabby and requiring deep peeling to remove the injured portions.

The injuries of this insect were first reported to the Station by Mr. Geo. F. Breninger, in 1892, and during the present year the injuries have been studied and the scabby potatoes with the depredators in them have been sent to the Station by Mr. J. H. McClelland, the present Superintendent of the Divide Station.

This is, undoubtedly, a new potato pest. The mature insect has not yet been determined.

Some of the other insects that have attracted attention during the year are, the Two-stripped Flea-beetle (*S. taeniata*), upon potatoes, sugar beets, and alfalfa; a small black Flea-beetle (*P. pusilla*), feeding on cruciferous plants, as cabbage, radishes, and beets; the Bee Moth, (*Galleria mellonella*), and two other species of wax or pollen moths (*Plodia interpunctella* and *Ephestia sp.*); the 8-spotted Alypia (*Alypia 8-maculata*), feeding upon the leaves of grape and Virginia creeper; the Buffalo Tree-hopper (*Ceresa bubalus*), injuring apple twigs; the Red Spider, and several species of plant lice.

Respectfully submitted,

C. P. GILLETTE,
Entomologist.

FORT COLLINS, Colorado, November 30th, 1893.

REPORT OF

THE CHEMICAL SECTION.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor of submitting the following report upon the condition and work of the Station Laboratory:

The equipment of the Station is not separate from that of the College Laboratory, but the stock and most of the apparatus are held as property common to both; so all the stock and apparatus have been included in the general inventory attached to my report as Professor of Chemistry.

There is no distinction made between the work pertaining to the College proper and that pertaining to the Station, but the work of the latter is done, and the cost of all is borne, by the general appropriation made for the Department.

In looking over the papers of the office, I find that it has been the desire and aim of my predecessor to participate, as far as possible, in the work of the Association of Official Agricultural Chemists. This seems to me commendable, and a very excellent policy for the advancement of the interests of the Institution. The object of this Association is to investigate and establish methods for the examination of the various pro-

ducts, natural and artificial, which an agricultural chemist may be called upon to examine. Its reports are published under the auspices of the Department of Agriculture, at Washington.

I bespeak your approval and support in adopting and prosecuting this policy. To us it means a large amount of time-consuming and delicate work requiring continuous attention. I am, however, willing to bestow both upon it, believing that I can do the Institution greater good by placing our work in active co-operation with that of this larger body, thus receiving the benefits of its organization and work, than in any other way. I believe such a policy to be promotive of the interests which the State has in the work of the Department and that it will enable us to meet both the letter and spirit of the various legislative acts under which we receive aid.

The work done by the Department since the date of the last report is as follows: Thirty-one different samples have been received and analyzed, i. e., twenty-one samples of sugar beets, for determination of sugar; one sample of juice of the sugar beet, to determine its feeding value; four samples of corn fodder; three samples of alfalfa; one sample for the extraction of volatile oils (*pedes augustifolic*); and one sample of mineral for mineralogical determination.

Respectfully submitted,

WM. P. HEADDEN,
Professor of Chemistry.

FORT COLLINS, Colorado, November 30th, 1893.

REPORT OF THE

DIVIDE EXPERIMENT STATION.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—Although the past season has been unfavorable for the growing of crops, owing to the decreased rainfall, yet fairly good results have been obtained. The precipitation up to November 1st, was but 9.87 inches this year, as against 18.24 inches last year. Irrrigation is not possible at this Station.

Various experiments in wheat growing were made. The best results were obtained from seed sown broadcast, on the first of May. The extreme drouth caused both straw and heads to be short, yet the Ruby yielded 15½ bushels to the acre, and Eldorado 11 bushels.

Deep plowing for oats yielded four bushels to the acre more than shallow plowing. Excelsior oats yielded 19 1-5 bushels to the acre where 2½ bushels of seed were sown; 22 1-5 bushels with 2 bushels of seed; 25 bushels with 1½ bushels of seed; and 24 bushels when but one bushel was sown.

The experiments with flax were unfavorable and unsatisfactory.

Both Japan and Silver Hull buckwheat were sown June 9th, in adjoining plats. The crop was ripe in 71 days after germinating. Japanese yielded 23 bushels per acre and Silver Hull 26 bushels.

The early varieties of sweet corn yielded fairly well, but the season is short for field corn.

Various experiments were made with grasses and forage crops. Winter rye sown in the spring yielded 1,234 pounds of dry hay, at two cuttings, per acre. Rye and field peas yielded 1,742 pounds dry hay per acre. Polish wheat and field peas yielded 1,706 pounds poor hay. Oats and field peas yielded 2,468 pounds of excellent feed per acre.

Owing to the dry season, success with alfalfa sown was not encouraging. English rye grass, orchard grass, and canary grass made an abundance of fall pasturage the first year. Alsike, esparsette, red clover, alfalfa, white clover, timothy, yellow oat grass, tall meadow fescue, Italian rye grass, and awnless brome all headed out ripened seed the first season after planting.

Bromus inermis gives the best promise of success of any of the grasses. A small plat which had not heretofore been well cared for yielded dry hay of excellent quality at the rate of 1,700 pounds to the acre. In favorable seasons it is believed that two crops may be cut in a season. It spreads rapidly and will cover the ground even if but a poor stand is obtained. A single plant two years old will cover a space 22 inches square.

Experiments with barley were not very successful, although a yield of 31 bushels to the acre was obtained.

The principal crop of the Divide country is the potato. Of these one hundred and thirty-four varieties were planted in rows three feet apart and fifty feet long, on May 12th. The ground was furrowed with the plow and the seed dropped by hand 16 inches apart, and covered with a harrow. The

nine varieties which yielded more than 6,000 pounds marketable potatoes, per acre, are as follows, given in the order of the heaviest yield, commencing with Late Ohio, which yielded 7,562 pounds large and 1,512 pounds small potatoes per acre. The list is as follows:

	Large, lbs.	*Small, lbs.*	*Total, lbs.*
Late Ohio	7,562	1,512	9,074
American Wonder	7,507	2,581	10,188
P. E. Island Rose	6,586	2,737	9,323
Dictator	6,568	1,340	7,908
Bonanza	6,555	1,539	8,094
Late Puritan	6,452	1,935	8,387
Triumph	6,416	2,942	9,358
Early Beauty of Hebron	6,129	1,594	7,723
Everett	6,022	1,072	7,094

On June 12th another lot of potatoes was planted, in which the Rochester Rose yielded 10,343 pounds large and 983 pounds small potatoes per acre, and was closely followed in their order by Vick's Perfection, People's, Freeman, Late Beauty of Hebron, Pearl of Savoy, Empire State, and Green Mountain.

Experiments were also made with steamed bone and ground bone as fertilizers for potatoes. No particular benefit could be discerned in the use of these fertilizers, the acre upon which no fertilizer was used, yielding fully as well as those acres whereon they were applied. The fertilized ground yielded the larger tubers.

Several varieties of turnips were sown June 8th. October first the crop was dug. Many of the turnips weighed half a pound each.

Currants and gooseberries do well here, and promise to bear good crops. Other fruits are more doubtful, however, and careful experiments will have to be made before a positive opinion can be formed as to their probable success.

Respectfully submitted,

J. H. McCLELLAND,

Supt. Divide Station.

MONUMENT, Colorado, November 30th, 1893.

REPORT OF THE

Arkansas Valley Experiment Station.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor to present to you herewith the Report of the Arkansas Valley Experiment Station for 1893.

The season in this vicinity has been a most exceptional one. An unusual scarcity of water in the irrigation canals during the early spring months, together with a prevailing dryness of atmosphere until midsummer, very much delayed the growth of crops. On the morning of July 8th, the most destructive hail-storm ever known in this Valley nearly destroyed all tender growth of vegetation, and grain crops almost ripe were a total loss. The Station rain-gauge indicated a precipitation of seven inches on that occasion. Most of the crop experiments in progress at the time were either wholly or in part rendered valueless; however I believe that subsequent observations are not without some interest and value. South and east exposures furnished some protection to crops, since the storm swept with fury from the northwest.

WHEAT:—This Station had twenty-one varieties of wheat in cultivation upon an area of twenty-one acres. The winter varieties, five in number,

were harvested with one exception the day preceding the hail-storm, though a considerable loss was sustained in consequence of the hail beating upon the shocks, which must be considered in addition to the reported yields. The spring varieties having been unharvested were all destroyed. All seed grains subject to smut infection were treated with a solution of sulphate of copper immediately before sowing, in the proportion of one pound of crystals to two and one-half gallons of water.

Clawson—This variety covered four and one-half acres of land upon a nearly level exposure, which had produced the same variety last year, but upon shallower plowing. The last plowing stirred the soil to an average depth of twelve inches. The seed was sown on the 19th of September at the rate of seventy-five pounds to the acre by means of an ordinary two-horse drill, and covered to a uniform depth of about three inches. The land had no cultivation other than plowing and harrowing before seeding, and one harrowing in the spring to break the crust formed after irrigating. The field was once irrigated in winter and once in the spring. The yield of thrashed grain measured 115 bushels or approximately 25½ bushels to the acre. In quality it is choice and much superior to the seed used. The purpose of the test was to show the value of shriveled grain for seed.

Turkish—The seed was produced in Kansas last year, and is a hard red variety. The kind of soil, treatment, and cultivation given in the foregoing will apply here. The area comprised two acres, and the total yield was 46 bushels. It is of excellent quality.

Red Russian—This is a plump, red, hard variety from seed raised upon the Station grounds. It had the same treatment and cultivation as Clawson except the use of sixty pounds of seed to the acre, upon a one-half acre plat; yield 12½ bushels.

Polish—This is a spring variety, and was sown in the fall to satisfy some inquiries concerning its possible value as a winter grain. The berry is of mammoth size; which necessitates the use of more than the usual quantity of seed. One-fourth of an acre was sown at the rate of ninety pounds to the acre. It had the same treatment and cultivation as Clawson, but wasted proportionately more at time of hail-storm. Fall sowing improved the quality as compared with a similar plat from the same seed spring sown. From this plat we have three and one-half bushels of plump grain.

Ruby—This was the only variety upon which could be traced the presence of smut, though it had been treated thoroughly with a strong solution of copper sulphate.

OATS—The total area in oats comprised 12¾ acres and six varieties, five of them having been upon trial plats. After the hail many farmers predicted that oats would come up and reproduce heads to the extent of making the crop a paying one, yet very little growth took place upon any of the fields in this neighborhood. As an experiment I thoroughly harrowed one portion of a field, and irrigated as much as seemed proper, but this had no beneficial effect.

BARLEY—Five varieties upon trial plats were cut down by hail, but later thickened in growth of blades, which indicated its possible value for pasture.

RYE—Two plats of winter grain, in area one-fourth and one-eighth acre respectively, produced at the rates of twelve and nineteen bushels per acre; the former from a rate of four pecks of seed to the acre, and the latter eight pecks. The thickly seeded plat could have been pastured profitably at any time after the middle of February.

FLAX—Of the varieties European, Belgian, and American, the first-named gave most promise over the other two. A rate of forty-five pounds of seed was sown upon each.

FORAGE PLANTS—Trial plats of Sorghum, Kaffir Corn, Millet, Soja Beans, Field Peas, and Oats and Peas mixed, did not make profitable growth after damage by hail.

CORN—Colorado White was planted in a field of 62½ acres in two adjoining divisions, east and west. The east division has a moderate descent eastward, which afforded sufficient shelter from the wind and hail to prove the location a decided advantage over the other portion. The east division has produced a considerable quantity of ripened grain, while the west division is almost valueless for anything except rough forage. Four and one-half acres of this field have been cut and shocked, and is in prime condition to be fed during the winter to the Jersey cattle upon the farm.

Golden Beauty covers an area of six acres west of the orchard. The row of cottonwood trees bordering the field on the north furnished some shelter from the storm, and the yield is estimated to be about seven bushels per acre of fairly good corn. Last winter this field received a good covering of 100 loads of well-rotted barn-yard manure. It was the original intention to make this a test of high culture in producing a crop of corn.

Three varieties of Sweet corn were planted, Egyptian, Evergreen, and Country Gentleman. The last named variety is of recent origin, and I think will prove a most valuable introduction. It produces from two to four good ears upon every stalk. The kernels are half an inch in length, growing compactly upon a small cob. The husks covering the ears have a close habit of growth to the very ends. Considering all the advantages of this variety, I believe it will be found well adapted to self protection against attacks of the corn worm, so harmful in this locality.

ALFALFA — The meadow comprises fifty-five acres in a nearly level location. Late in autumn of last year it received a copious watering, which proved of great benefit in making an early and heavy growth in the spring. The first crop had been stacked but a few days previous to the storm of July 8th, and was damaged to a considerable extent and reduced in bulk. The second crop suffered from an attack of the Army worm, and the tonnage thus became materially reduced. It was the habit of this pest to strip the lower stems clean of leaves.

Following is a carefully itemized report upon the three crops:

First crop harvested June 14th to July 7th; second crop, August 14th to August 30th; third crop, October 9th to October 20th.

Man labor on first crop, 64½ days, cost $106.42; team labor on same, 35 days, valued $21.00.

Man labor on second crop, 35 days, cost $57.75; team labor on same, 20 days, valued $12.00.

Man labor on third crop, 30½ days, cost $50.32; team labor on same, 18 days, valued $10.80.

Total of three crops, 275 tons and 205 pounds.

Total value of three crops: 1st crop @ $2.00, 2d crop @ $3.00 and 3d crop @ $4.00 per ton, $779.30.

Total cost of harvesting three crops, $258.29.

Net gain, $521.01.

The first two cuttings have been measured and computed, and 512 cubic feet allowed to make a ton. The results are 110 tons and 360 pounds of the first crop; 100 tons and 1,500 pounds, second crop; and 64 tons, 345 pounds actual weight of third crop. For the purpose of assisting in the solution of a question upon which facts are wanting, that of measuring alfalfa in the stack, two stacks of known weights have been set aside to be measured at regular intervals during the winter and spring, and re-weighed in the spring, one after having stood four months, and the other one after six months. This, it is hoped, will furnish a beginning of rules by means of which some degree of accuracy can be shown in the measurement, and guidance in the sale, of alfalfa in the stack.

GRASS PLATS—Upon plats of two years' growth it is observed that orchard grass does fairly well, with the exceptions that it produces but very little seed, and the blades dry out and contract near the tips. It seems to require a more moist atmosphere.

Bromus inermis—This grass has given the best results of any on trial at this Station. It produced two full crops this year, both after showing an abundance of seed. An immediate test of its value as a pasture grass for cattle should be made, and thus satisfy many inquiries.

Red Top made an effort to prove itself worthy of cultivation, but evidently needs perpetual moisture to promote thrift.

The foregoing are the only grasses of last year's planting worthy of note this season.

A mixture composed of four pounds Bromus inermis, three pounds Kentucky Blue grass, two

pounds Timothy, and one pound White Clover, was sown the 9th of May upon one-third of an acre, broadcast. The ground had been well prepared by irrigating just before plowing, harrowing, and planting, and the seed were covered with a light harrow. The season being dry and windy, a proper amount of moisture could not be maintained upon the surface, and all failed, except *Bromus inermis*, which made a very good stand.

Legumes—Esparcette furnished two heavy cuttings and two crops of seed. Alsike clover gave two full crops of hay and seed, but indicated light tonnage. Red clover did fairly well, with a liberal supply of moisture, as likewise did White clover.

POTATOES—The area in ten tests, five variety tests and five fertilizing tests, comprised two and three-fourths acres. A half-acre test of Early Ohio on a continuous test plat fertilized yearly with burned litter and barn-yard manure, was not only hailed out, but a ditch break on the date of the storm flooded the ground for two days following. This plat produced 210 pounds of very fair tubers. Contiguous to this plat, upon the same kind of soil, was an acre plat of the Mammoth Pearl variety. Previous to the storm, there appeared a good stand of about ten days' growth. Recovery was sufficient to yield 374 pounds of small, unripe potatoes.

Four varieties on alfalfa sod produced excellent returns, from the recovery of a small per cent. of the planting. Upon three-fourths of an acre the product was 374 pounds.

A comparative test of plats fertilized with bone meal and one not fertilized, is as follows: The situation was a gentle slope to the north-east upon

land having never been manured, and each plat contained one-fourth of an acre. Land was plowed to a depth of twelve inches, furrows made thirty inches apart to receive the seed, and irrigated thoroughly a few days before planting. Immediately before planting, the furrows were subsoiled to an additional depth of twelve inches. On first division was distributed 185 pounds of raw bone meal in the bottoms of the furrows, and upon this was dropped 158 pounds of quartered seed, spaced to ten inches. The second division was likewise planted by the use of steamed bone meal, and the third division thus planted received no fertilizer. The seed were covered to a depth of about four inches by means of a small plow. The results were 430 pounds yield on first division; 352 pounds on second division; 71 pounds on third division. This experiment gave much promise to date of storm, when the tops were entirely cut off. Potatoes were very small, and did not mature.

Sugar Beets—Six variety and nine culture tests were included in the experiments undertaken in sugar beet culture this year. At an early date they flourished remarkably well, with the exception of one test made with no irrigation. But very little growth took place after the hail. The crop on the total area, one and one-fourth acres, weighed 8,140 pounds.

After Planting—As soon as the ground could be put in order to receive the seed, previous to July 15th, the following are recorded as successful: Eight varieties of beans ripened seed, which shows that the crop can be made successful even when planted at so late a date.

Two plats of buckwheat produced at rates of 430 and 780 pounds of seed per acre, both the Sil-

ver Hull variety. The difference in yield was due to methods of preparing the ground, the 430 pound rate having been upon plowing done before the storm, and the 870 pound rate upon land well plowed and prepared on date of planting.

Cucumbers matured after date above mentioned.

Turnips made a good crop. From four-fifths of an acre, the yield weighed nine tons and forty-two pounds.

ORCHARD—No orchard trees have been planted this year, and there has been no loss, with the exception of severe damage by hail. Renewed growth next spring will determine to what extent recovery may be expected.

VINEYARD—A very large crop of fruit set on the vines this year. Hail destroyed the fruit, foliage, and new growth of wood, and the old wood was much injured. Close pruning and winter protection with earth will, no doubt, save the vigor of the vines.

SMALL FRUITS—But very little has been done in the small fruit culture at this Station, more than to demonstrate that they can be grown successfully. A larger undertaking in this line would be received with much interest in southern Colorado.

FORESTRY—Two hundred trees were transplanted from nursery rows in the spring to a small tract of land across the ditch in the south-west corner of the west Station farm. These comprised Elm, Ash, Black Walnut, and Sycamore. The most of them grew. The plat was planted to corn.

JERSEY CATTLE—The four splendid Jersey animals recently purchased for this Station, through

your Committee, by an action of the Honorable Board of Agriculture, are all valuable, and possess high individual qualities. These animals are all registered in the American Jersey Cattle Club Herd Register, excepting the bull, who is eligible to register therein. They are:

Delight's Pansy ..... No. 29,514
Ace's Pogis' Queen ..... No. 54,061
Gildana ..... No. 80,745

A milk test covering a period of ten days was begun November 7th, and finished November 16th, by means of the Babcock tester, recently purchased for this Station. The results are as follows:

DELIGHT'S PANSY.

Date.	—PERCENTAGE OF FAT.— *Morning Test.*	*Evening Test.*	*Total Average.*
November, 7	4.80	5.00	
" 8	5.40	5.60	
" 9	5.60	3.60	
" 10	5.90	4.60	
" 11	6.10	4.20	
" 12	5.60	5.40	
" 13	5.50	4.40	
" 14	6.30	3.10	
" 15	6.10	3.90	
" 16	6.60	4.00	
	5.79	4.38	5.08

ACE'S POGIS' QUEEN.

" 7	4.80	4.60	
" 8	3.20	6.10	
" 9	4.20	3.90	
" 10	4.10	4.50	
" 11	4.20	5.50	
" 12	4.80	5.00	
" 13	3.40	5.40	
" 14	4.70	4.00	
" 15	3.60	4.20	
" 16	4.00	5.20	
	4.10	4.84	4.47

GILDANA.

" 7	5.00	4.40	
" 8	4.40	4.80	
" 9	4.60	4.80	
" 10	5.10	4.30	

"	11	5.50	4.60	
"	12	4.60	5.20	
"	13	5.00	4.80	
"	14	4.90	4.90	
"	15	4.80	4.80	
"	16	5.00	4.60	
		4.99	4.72	4.85

The above tests were performed for the purpose of finding out something of the capacities of the animals with good, regular care, and in no way to prove the value of certain rations or methods of operating. Their feed has been plenty of good alfalfa hay, a little corn fodder without grain, twenty pounds of turnips per day to each, and two quarts per day of chopped wheat and corn. The long period of lactation of all the cows will not admit of strictly reliable proofs of their capacities by these tests, though they indicate an unmistakable high standard of value.

IMPROVEMENTS—These consist of a manure pit 30 by 70 feet, and four feet deep, made with plow and scraper, a four-ton scale, 20 lateral irrigating gates, root-cellar, flume over main ditch, 125 rods wire fence, three farm gates, entrance driveway south of residence, stone and gravel walk front of residence, hitching posts with rail, four bridges across ditches, 150 dressed and painted plat stakes, and windows in stables. I papered two rooms, built cabinet for the safe keeping of Station documents, and rebuilt implement shed, coal house, and house cellar. In addition, the Rocky Ford Ditch Co. replaced the three old headgates with new ones. Respectfully submitted,

FRED A. HUNTLEY,
Superintendent.

REPORT OF THE

San Luis Valley Experiment Station.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—I have the honor of submitting to you the following report of the work carried on at the San Luis Valley Experiment Station during the past year:

Much work of the Station has been given to making the soil tillable. I was unable to select as desirable ground for experiments as I wished. The supply of water for irrigation was insufficient in the early part of the season, and the crops suffered in consequence. From May 13th to July 10th, no rain fell. The strong winds from the southwest soon made the ground as dry as powder; while the grass on the prairie did not assume its accustomed green throughout the whole summer.

The soil of the valley is characteristic: For a depth of one foot, on the Station grounds, it consists of a sandy, gravelly loam. Below this is pure gravel, which extends to a depth of three feet from the surface. Then pure sand is found. Below the sand are various layers of sand and gravel until *hard pan* is reached, at a depth varying from five to thirty feet. If this sub-soil be filled with water, the surface of the ground will become saturated with moisture. The soil is then said to be

sub-irrigated. Until the gound does sub-irrigate, the soil absorbs moisture rapidly. To illustrate: I turned 100 miner's inches of water on the prairie on the west of the Station grounds, for the purpose of producing sub-irrigation. This water was allowed to run ten days. At the end of that time the water had spread over less than an acre of ground, but the effects of the water in sub-irrigation were seen for three hundred feet east of where the water stood. When we are compelled to practice flooding, it is almost impossible to obtain sufficient water to spread over five acres of ground. The water disappears through the porous soil like water thrown upon a sand pile.

The fall plowing has in all cases produced the best crops. This is due to the soil's being more firm—thus retaining its moisture longer—than spring-plowed soil.

The Station has one hundred and sixty acres on which to demonstrate the fertility of the San Luis Valley soil.

A barn of ample size has been built, and another team of horses procured, and now the Station is in better condition to do good work than ever before.

POTATOES—The San Luis Valley has a soil and climate naturally adapted to the growth of potatoes. Three acres of potatoes were planted for a comparative test. 1. Of the native untreated soil. 2. Of soil treated with 400 pounds of Swift's raw ground bone. In the application of the fertilizers, the ground was furrowed out and the potato dropped and covered to the depth of one-half inch with the moist earth. The fertilizer

was then placed on top, and the potatoes were covered with a common two-horse walking plow. A portion of the acre treated with Swift's raw ground bone had to be thrown out of the experiment. I tried to cover the potatoes with a hoe, but found that the strong southwest winds dried out the ground so fast that sufficient moisture was not left to sprout the potato.

One-fourth of an acre of potatoes was treated with partially rotted manure, at the rate of thirty wagon-loads per acre.

Two 1-25 acre plats were treated, at the rate of 600 pounds and 800 pounds per acre, with Swift's steamed bone meal.

The bone fertilizers contained, according to the printed analysis, the following substances:

	Ammonia.	*Bone Phosphate.*
Raw Ground Bone	4½ to 5½ per cent.	50 to 60 per cent.
Steamed Bone Meal	4 to 5 per cent.	52 to 58 per cent.

TABLE NO I.

NAME.	Rate of Application.	Area, Acres.	Yield per Acre.	Marketable Yield Per Acre.
Untreated	.....	1	75.7 bu.	50.0 bu.
Swift's Steamed Bone Meal	400 lbs.	1	101.9 bu.	68.9 bu.
Swift's Raw Ground Bone	400 lbs.	.77	57.9 bu.	40.2 bu.
Manured	30 wagon l'ds	.25	81.4 bu.	47.8 bu.
Swift's Steamed Bone Meal	600 lbs.	.04	209.0 bu.	151.9 bu.
Swift's Steamed Bone Meal	800 lbs.	.04	210.3 bu.	153.0 bu.

The potato used for seed was the Burbank Seedling, and there were a great number of small ones among the yield. The two 1-25 acre plats were in a different portion of the field from the other plats, and received better attention than the other plats. The potatoes in the manured plat did not come up as soon as the others, owing to the dryness of the soil and the straw in the

manure. Many of the vines were still green and growing when the frost killed them. The large number of small potatoes in this plat is thus accounted for.

Thirty-three varieties of potatoes were planted in rows fifteen feet long.

TABLE NO. 2.

Variety.	Yield per acre in bushels.	Marketable Yield.	Variety.	Yield per acre in bushels.	Marketable Yield.
Green Mountain	167.0	...	Kosh Kongong	106.5	67.8
Late Ohio	223.8	204.5	Vick's Perfection	105.3	77.4
Seedling No. 33	163.3	100.4	Strawberry	103.0	87.1
Yankee Notion	251.7	200.9	Burbank Seedling	118.6	72.6
Early Northern	194.8	164.6	White Sport	234.7	203.3
Prince Edward's Is. Rose	226.3	196.0	Hoag's Seedling	111.3	55.7
Monroe Seedling	278.3	251.7	Sterling	179.1	130.7
Rubicund	229.9	209.3	Seedling No. 102	116.2	65.3
Oxford	167.0	118.6	Charles Downing	147.6	63.9
Early White Prize	140.4	101.6	Ohio Fancy	139.1	100.4
Snow Flake	125.8	106.5	Dunmore	174.2	135.5
Polaris	69.0	44.8	Barclay Prolific	186.3	116.2
Peach Blow	145.2	121.0	Seedling, 86	59.3	48.4
Plymouth Rock	121.0	101.6	People's Potato	136.2	116.2
Iron Clad	145.2	111.3	White Elephant	217.8	174.2
Minister	153.7	101.6	Mammoth Pearl	60.5	39.9
New Brunswick Belle	100.4	61.7			

CORN.

Field—Riley's Favorite, White Dent, Mastodon, and Colorado Yellow Dent varieties were planted on May 15th. The different varieties reached the roasting ear, and made a fair growth of fodder. The Colorado Dent came the nearest ripening.

Sweet—I planted Moore's Early, Concord, New Cory, Early Minnesota, and Stowell's Evergreen varieties. The New Cory was in roasting ear August 8th. The other varieties produced roasting ears later in the season. Stowell's Evergreen reached the edible state just before frost.

The corn is troubled with the cotton, or ball worm, which eats and entirely destroys the ears. From one to a half dozen worms are found in every ear. Roasting ears for family use were obtained by opening the ears as soon as the tips of the silk turned, and destroying the small worms in the silk and apex of the ear.

MILLET—The Hungarian, German, and common varieties were sown on May 15th. All made a good growth. The Common was the only variety that ripened its seed.

SUGAR BEETS—One-fourth acre was used for sugar beets, drilled in rows twenty-four inches apart, on May 15th. The ground had been previously plowed nine inches deep, and harrowed twice. Owing to insufficient water and the extreme dryness of the season, these beets made but a poor growth. They were cultivated with a one-horse cultivator. Specimens were analyzed by Prof. Headden, of the Agricultural College, and gave 11 per cent. cane sugar, and a co-efficient of purity of 57.89 per cent.

TABLE BEETS—The Early Bassam, Dewing's Early Blood Turnip, and Early Eclipse varieties were drilled in the ground on May 8th. They were soon up, and did well throughout the season, making fine large beets by fall.

TURNIPS, ONIONS, LETTUCE, AND RADISHES—All varieties of turnips planted produced excellent yields. The Giant Silver King onions made the best showing of the three varieties planted. The Boston Curled and the Early Ohio varieties of lettuce made a good showing. Three varieties of radishes were grown, with good results.

TOMATOES—The Favorite, Green Gage, Acme, New Stone, Dwarf Champion, Livingstone's Beauty, Optimus, and Fulton's Market varieties were tested as to early maturity. Specimens of the Livingstone Beauty were ripened. The plants of the tomato cannot be placed in the open ground, without covering, before June 6th, owing to the late frosts. It is only with extra pains that

tomatoes can be ripened, and these are not of a size and firmness, or of sufficient quantity, to pay for the trouble and expense in producing them.

Alternate rows of Livingstone's Beauty were fertilized. 1. One quart of well-rotted manure placed in the bottom of each hill. 2. Two heaping teaspoonfulls of Swift's steamed bone meal in the bottom of each hill. I was unable to detect any increase in the ripening of the tomatoes from the treated vines. The row treated with well-rotted manure made a little ranker growth. The untreated, and that treated with Swift's steamed bone meal, showed no perceivable difference.

PEAS—Peas thrive well in our soil and climate. Fourteen varieties were planted May 9th, in rows a foot apart. All the varieties planted possess qualities that recommend them to the grower.

The Premium Gem and the First and Best varieties ripened July 7th and July 9th, respectively. The G. F. Wilson became edible August 7th.

CABBAGE—Henderson's Early Summer, Jersey Wakefield, Vondergaw's Midsummer, Flat Dutch, Wonderful, and Sure Lead varieties were taken from the hot-bed and planted in open ground on May 9th. Owing to our short season, none but the early varieties made firm heads, and in quantity sufficient to pay for setting them out. The Henderson Early Summer and Jersey Wakefield are our best. Considerably over one-half of the others produced no heads.

OATS—This grain was planted in ground broken in the spring. Three half-acre plats were drilled with the same kind of oats, treated with sulphate of copper, untreated, and treated by the Jensen hot-water process. In treating the last, the temperature of the water used was 138 degrees F.

The grain was moved about in the water five minutes, then taken out and thoroughly dried before being used in the drill. Before harvest, ten observations, on each plat, to determine the number of smut stalks, were made with the following result: Sulphate of copper, 5.3 per cent.; untreated, 24.2 per cent.; and Jensen hot-water process, 25.2 per cent. The yield per acre, in bushels, in the order before named, was 10.7—9.2—12.1.

Light seeding and heavy seeding were tested with results herewith given:

Three pecks per acre yielded				13	bushels per acre.	
Four	"	"	"	10.4	"	"
Five	"	"	"	8.7	"	"
Six	"	"	"	12.8	"	"
Seven	"	"	"	10.7	"	"

Plowing to a depth of seven or eight inches gave a yield of 17 bushels per acre. The yield, per acre, upon land plowed three to four inches deep, was 18.4 bushels.

The ground was virgin soil, spring plowed.

Variety tests showed as follows: White Wonder, 15.4 bushels per acre; Excelsior, 11.1 bushels per acre; Welcome, 10.7 bushels per acre; and Austrian No. 2, 8.4 bushels per acre.

WHEAT—Water for sufficient irrigation was lacking. The following table gives some results:

Variety.	*Yield per acre in bushels.*
Niagara	12.6
Improved Fife	7.0
Sonora	3.2
Chili	5.0
Australian Club	10.0
Canadian Club	6.8
India No. 4	9.3
Polish	5.4

BARLEY—Guy Malye yielded 5 bushels per acre; Black barley, 8.5 bushels; Success, 10 bushels; and Trick's, 6 bushels. The yield, while small, was very superior in quality.

Respectfully submitted,

FRANK BEACH, *Superintendent.*

MONTE VISTA, Colo., November 30, 1893.

REPORT OF

THE VISITING COMMITTEE.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—The undersigned, members of a committee appointed to examine the work of The State Agricultural College and the Experiment Station connected therewith, at Fort Collins, Colorado, met, with that object in view, January 4, 1894.

We believe that some date early in the fall would be a more suitable time to make observations about the College grounds and Experiment farm, and are glad to learn that it is proposed hereafter to set an earlier date for the committee's visit.

The College grounds are conveniently adjacent to the City. The lawns are well arranged and well kept and the shrubbery and trees are both useful and ornamental. The architectural appearance of the buildings is very good. Altogether, the surroundings are such as to cultivate a taste for the beautiful in the minds of the students.

The buildings are heated by steam, lighted by electricity, and have connected with them the best

possible sanitary arrangements. A sewer has recently been completed more than a mile in length. With this, all the buildings on the College grounds have been connected.

Taking into consideration that the State is not yet out of its "teens," the College is fairly well supplied with the necessary apparatus to illustrate the work going on in the different departments. The class-rooms are commodious, well-lighted, and furnished with the best of seats. We find the instruction given by the members of the Faculty to be of a highly practical and a very thorough character. The students are studious and orderly. We found the government to be all that could be desired.

The present corps of instructors could impart instruction to many more students than are now in attendance. To secure an increase of students, the greatest need is that of a dormitory of sufficient size to accomodate all the students who may attend from a distance. Thus the cost of board and lodging would be materially reduced and students would be brought more within the immediate control of the Faculty outside of recitation and work hours. It is believed, by the committee, that dormitory accomodations of the right kind would be an additional inducement for parents to send their children to the College.

The Department of Horticulture and Botany stands greatly in need of a new building with greenhouse attachment. The building which contains the class-rooms and laboratories of the Chemical Department is in an unsafe condition and urgently calls for extensive repairs. The bet-

ter plan, doubtless, would be to tear down the building and build a better and larger one.

A building, with all necessary appliances, in which Domestic Economy could be taught, is a pressing need. Such instruction would be of prime value to the rapidly increasing number of young lady students. We recommend that such a building be put up at the earliest practicable time.

We believe that more attention should be given to the feeding and management of some of the best breeds of dairy cattle and mutton sheep, with a view of determining the best methods of condensing farm products for market.

Owing to the growing interest in orchard planting we commend to your favorable notice the field work in the Horticultural Department, to the end that practical illustrations be made of the effect of insecticides upon destructive insects.

The General Government has been liberal in its support of The State Agricultural College, but its financial support is given conditionally. The leading purpose kept in view, by the Acts of Congress relating to the support of agricultural colleges, is to provide means for teaching "such branches of learning as are related to agriculture and the mechanic arts in such manner as the legislatures of the states may respectively prescribe in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

In view of the fact that The State Agricultural College is well equipped to meet the requirements set forth in the Congressional act before quoted, we deem it unwise and injudicious for the State to grant appropriations of money to other institu-

tions to be used in duplicating departments of special instruction now in successful operation at Fort Collins.

We find all the departments of the College working in complete harmony, and believe that they are in better condition for effective work than ever before. The books and papers in the Secretary's office, as far as examined, are models of neatness and evince business ability. We further believe that The State Agricultural College is worthy of the confidence and support of the people of Colorado, and that it should be liberally supported by State appropriations.

All of which is respectfully submitted,

JAMES F. ROBINSON,
Representing the State Grange,
N. C. ALFORD,
Representing the State Bee-Keepers' Association,
JOHN TOBIAS,
Secretary of the State Board of Horticulture.

FORT COLLINS, COLO., January 6, 1894.

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