

13824

Eighth Annual Report
of
The Agricultural Experiment Station
of
Colorado
For the Year 1895

Home Station
Fort Collins, Colorado
December 31, 1895

The Agricultural Experiment Station,

Fort Collins, Colorado.

BOARD OF CONTROL.

THE STATE BOARD OF AGRICULTURE.

EXECUTIVE COMMITTEE IN CHARGE.

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C. S. CRANDALL, M. S. Horticulturist and Botanist
WILLIAM P. HEADDEN, A. M., Ph. D. Chemist
L. G. CARPENTER, M. S. Meteorologist and Irrigation Engineer
C. P. GILLETTE, M. S. Entomologist
DANIEL W. WORKING, B. S. Secretary
LATHROP M. TAYLOR, B. S., Stenographer.

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FRANK L. WATROUS. Agriculturist
JACOB H. COWEN, B. S. Horticulturist
CHARLES J. RYAN. Chemist
ROBERT E. TRIMBLE, B. S.
. Meteorologist and Irrigation Engineer
CARL F. BAKER, B. S. Entomologist

SUB-STATIONS.

PHILO K. BLINN, B. S. Superintendent
Arkansas Valley Experiment Station, Rocky Ford, Colorado.
J. H. McCLELLAND. Superintendent
Divide Experiment Station, Monument, Colorado.
CHAS. A. DUNCAN, B. S. Superintendent
San Luis Valley Experiment Station, Monte Vista, Colorado.
J. B. ROBERTSON. Superintendent
Rain-Belt Experiment Station, Cheyenne Wells, Colorado.

THE STATE AGRICULTURAL COLLEGE.

TREASURER'S FINANCIAL STATEMENT.

For the Fiscal Year ending June 30, 1895.

EXPERIMENT STATION FUND.

Receipts.

Balance on Hand, State Appropriation, June 30, 1894	\$	462.78	
United States Treasurer.....		15,000.00	
Sales at Arkansas Valley Station.....		1,588.37	
Sales at San Luis Valley Station.....		337.97	
Sales at Divide Station.....		326.49	
Cancelled Warrant.....		34.72	\$17,750.33

Expenditures.

Salaries, Station Staff, Officers, and Assistants..	\$11,249.19	
Agricultural Section, labor and supplies.....	270.33	
Stationery and postage.....	155.75	
Horticultural Section, labor and supplies.....	204.19	
Divide Experiment Station.....	566.11	
Chemical Section, chemicals.....	230.56	
Printing Bulletins.....	830.20	
Meteorological and Irrigation Engineering Section	153.10	
San Luis Valley Experiment Station.....	781.63	
Arkansas Valley Experiment Station.....	2,481.33	
Entomological Section.....	198.52	
Printing Annual Report.....	232.75	
Rain-Belt Experiment Station.....	391.67	
Annual Dues, Association of Experiment Stations	10.00	\$17,750.33

Letter of Transmittal.

HON. ALBERT W. McINTIRE,
GOVERNOR OF COLORADO.

Sir—Herewith is presented the Eight Annual Report of the Colorado Experiment Station, connected with The State Agricultural College and under the control of the Executive Committee of The State Board of Agriculture.

The work of the Experiment Stations is varied and wide-reaching. The members of the Station Council, at the College Station, are engaged in thorough, painstaking, scientific work connected with agriculture, horticulture, entomology, chemistry, and irrigation. The results of their investigations reach the public, from time to time, in the form of bulletins which are freely distributed to the citizens of Colorado.

Under the same authority that controls the work of the College Station, are four sub-stations which are engaged in farm work of a practical character. Your attention is respectfully directed to the reports of the Superintendents of these Sub-stations and to my suggestions as to their future management.

The State of Colorado is bearing no part of the cost of keeping up the experimental work in progress at the College or in meeting the running expenses of the Sub-

stations which have been located and established under State authority. The revenue for the prosecution of all Station work comes from the General Government, under the terms of the "Hatch Act" of 1887, made operative in 1888.

Respectfully submitted,

ALSTON ELLIS,

Director of the Agricultural Experiment Station of Colorado.

Fort Collins, Colorado,

December, 31, 1895.

Report of the Director.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—It becomes my duty, as the nominal head of the Experiment Stations under your control, to present at this time a report of station work for the year 1895. It is understood that my connection with station work is more clerical than executive in its character. The work of the Director's office is under my immediate control; but the supervision of sub-station work, after it is planned by the Station Council and approved by your Committee, is left largely to your Chairman. Sub-station work is inspected by your Committee, as a body, once a year and by your Chairman twice, usually in the early spring and fall.

STATION WORKERS.

Few changes have occurred in the ranks of the station workers. Fred A. Huntley, Superintendent of the Arkansas Valley Station, at Rocky Ford, resigned and the place thus vacated was filled by the appointment of Philo K. Blinn. M. J. Huffington, Assistant in the Department of Botany and Horticulture died, after a lingering illness, and Jacob H. Cowen was appointed to the place thus made vacant. Messrs. Huntley and Huffington were earnest and successful workers. They brought much more scholarship to bear upon their station work than that possessed by the average employes holding like positions. The loss of their efficient service may well be a matter of regret to those interested in our experimental work.

As a matter of record, more than for your information, the names of all persons regularly connected with station work, and some information relative to their positions and salaries, are herewith given:

<i>Home Station—</i>		Annual Salary From
Names.	Positions.	Station Fund.
Alston Ellis.....	Director	\$ 1,000
W. W. Cooke.....	Agriculturist	500
C. S. Crandall.....	Horticulturist	500
Wm. P. Headden....	Chemist	500
C. P. Gillette.....	Entomologist	500
L. G. Carpenter....	Meteorologist and Irrigation En- gineer	500
D. W. Working.....	Secretary Station Council.....	400
Assistants:		
Frank L. Watrous, Agriculture.....		1,000
Jacob H. Cowen, Horticulture.....		800
Charles J. Ryan, Chemistry.....		900
Carl F. Baker, Entomology.....		900
Robert E. Trimble, Meteorology.....		800
<i>Sub-Station Superintendents:</i>		
Philo K. Blinn, Rocky Ford.....		720
J. H. McClelland, Monument.....		800
Charles A. Duncan, Monte Vista.....		800
J. B. Robertson, Cheyenne Wells.....		600
Grand Total of Salaries.....		\$11,200

This salary total represents the sum paid to workers in regular service. The amount paid for farm labor upon the experiment grounds is about \$2,850 annually.

The Station Council, at the College, is an important body in its relation to station work. The Director is also the President of the Council. The agriculturist, horticulturist, chemist, entomologist, and irrigation engineer constitute the members of the Station Staff having to do with the experimental work. The Secretary of The State Board of Agriculture is also Secretary of the

Station Council. Bulletin matter, approved by the Station Council, is ordered printed by your Committee. An important work of the Council is, the preparation of a schedule of experimental work both for the home station and the sub-stations. The work for the past year was carefully outlined, submitted to your Committee for approval, and thereafter made operative in all departments of station work.

Heretofore, I have made the schedule, unabridged, a part of my report; but inasmuch as the one last prepared is in all essential points much like those hitherto published, I propose to save space and expense by omitting all that relates to sub-station work. The special work planned by each member of the Station Council is given:

AGRICULTURAL SECTION.

By W. W. Cooke.

Cereals:

The testing of a few new varieties of wheat, oats, barley, and rye.

1. Eastern varieties compared with Colorado corn.
2. Small varieties compared with large.
3. The effects of German potash salts on corn.
4. Methods of harvesting and curing fodder corn.
5. Losses in curing.
6. Best time to harvest corn.
7. Effect of frost on standing corn.

Potatoes:

1. Comparison of corn ground and alfalfa stubble for potatoes.

2. Value of German potash salts.
3. Use of Bordeaux mixture for potato blight.

Alfalfa:

1. Continuation of work of last season on comparative value of three or four cuttings; methods of harvesting and curing alfalfa; and losses in curing.

Sugar Beets:

1. Growth with and without irrigation.
2. Effect of subsoiling on both plots.

Sorghams:

1. Small plats of several varieties.

Forage Crops:

1. Small plats of many different varieties.
2. About twenty winter varieties, already sown.

Rape:

Several acres to test broadcast and drill seeding, with and without cultivation. To be used for summer and early fall pasture for sheep.

FEEDING TESTS.

Hogs:

1. Alfalfa pasture with and without grain.
2. Soiling with alfalfa as compared with pasture.
3. Sugar beets and pasture for hogs.
4. Winter feeding on wheat and sugar beets.

Steers:

The result of this winter's work will decide whether or not it is advisable to feed steers.

Sheep:

1. The feeding of sheep on pasture and grain to fit them for the Christmas market.
2. Heavy as compared with light feeding.
3. Various pasture crops for sheep.

SECTION OF BOTANY AND HORTICULTURE.

By C. S. Crandall.

1. The study of the *flora* of the State. Special attention being given to (a) Weeds of the farm and garden. (b) Grasses, native and introduced. (c) The various species and varieties of the genera *Oxytropis* and *Astragalus*.

2. The further introduction to the garden of such wild fruit plants as can be obtained.

3. Nursery tests of orchard fruits with a view to the study of the adaptability of varieties to this climate.

4. Tests of varieties of small fruits.

5. Tests of varieties of culinary vegetables newly introduced, together with such varieties as may be sent to the Station for trial.

6. The growing of shrubs and forest trees to determine their value for this climate.

CHEMICAL SECTION.

By Wm. P. Headden.

1. The completion of the work already in hand. Bulletin on "Alfalfa."

2. Co-operative work with other departments, particularly with the farm department.

3. Preparatory work on waters used in irrigation, including seepage. This work will extend over several years.

4. Co-operative work with the Association of Official Agricultural Chemists.

ENTOMOLOGICAL SECTION.

By C. P. Gillette.

1. Collecting and rearing insects for the purpose of determining food habits and life histories.

2. Experiments for the destruction of leaf-rollers.

3. Experiments for the destruction of insect eggs.

4. Experiments for the purpose of testing the strength at which it is safe to apply the various insecticides to plants.

5. Experiments for the destruction of miscellaneous insect pests.

6. Experiments in the Apiary: (a) To determine the rate of profitable increase. (b) To determine whether or not it would be profitable to winter on pure sugar stores. (c) To determine whether or not honey can be profitably made from sugar. (d) Testing apiary appliances. (e) Making a list of native forage plants.

SECTION OF METEOROLOGY AND IRRIGATION ENGINEERING.

By L. G. Carpenter.

For 1895 I propose a continuation of the collection of data and the preparation of reports on the following subjects, which have been under investigation for several years:

1. Duty of water.

2. Investigation of losses by seepage and evaporation.
3. Investigation of return waters.
4. Miscellaneous experiments; modules; steam and wind power for pumping.
5. Meteorology as hitherto, continuation of records, both maximum and minimum; barometric pressure; dew point; relative humidity; cloudiness; precipitation; solar and terrestrial radiation; evaporation; soil temperatures, together with continuous records of temperature, air pressure, sunshine, etc.

STATION LITERATURE.

The annual report for 1894 and three bulletins constitute the printed matter issued from my office within the year. A provision of the "Hatch Act" requires "that bulletins or reports of progress shall be published at said stations at least once in three months." It will be seen from the quotation that we have come short of our duty in the matter of the publication and distribution of bulletin literature. For this failure I do not hold myself in any way responsible. A list of all bulletin publications issued up to date is herewith presented:

No.	Subjects.	Authors.
1.	Reports 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 the Apiary.....	C. M. Brose
6.	Notes on Insects and Insecticides.....	James Cassidy
7.	Potatoes and Sugar Beets.....	James Cassidy David O'Brine
8.	Alfalfa: Its Growth, Composition, and Digestibility....	James Cassidy David O'Brine
9.	Soils and Alkali.....	David O'Brine
10.	Tobacco.....	James Cassidy C. L. Ingersoll
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 In- vestigated by the Experiment Station.....	
19.	Observations upon Injurious Insects, Season of 1891.....	C. P. Gillette
	I. The Best Milk Tester for the Practical Use of the Farmer and Dairyman.....	
20.	II. The Influence of Food upon the Pure Fat Pres- ent in Milk.....	W. J. Quick
	I. Sugar Beets.....	
21.	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
	{ Garden Notes for 1893.....	Charles S. Crandall Frank L. Watrous
26.	{ Farm Notes for 1893.....	W. W. Cooke Marion J. Huffington
	{ Seeding, Tillage, and Irrigation.....	Fred A. Huntley
27.	The Measurement and Division of Water. (Third Edition, Revised, of Bulletin No. 13).....	L. G. Carpenter
28.	The Russian Thistle.....	Charles S. Crandall
29.	Strawberries and Grapes: Notes on Varieties..	Marion J. Huffington W. W. Cooke
	I. Farm Notes for 1894.....	Frank L. Watrous
30.	II. Notes on Tomatoes.....	Marion J. Huffington
31.	Hemiptera of Colorado.....	C. P. Gillette Carl F. Baker
32.	Sheep Feeding in Colorado.....	W. W. Cooke

The Seventh Annual Report, for 1894, was issued in January, 1895. It contained 112 pages. One thousand copies were printed. The total expense of the publication is here shown:

Printing and binding.....	\$170.00
Photographs and engravings.....	62.75
Total.....	\$232.75

Bulletin No. 30 contains 32 pages. Its cost, for an issue of 7,000 copies, was \$112.

Bulletin No. 31—Technical Series No. 1—contains 138 pages, not counting cover pages. The total cost, for the issue of 2,500 copies, was for printing and binding, \$307; for engravings, \$38.70; total, \$345.70.

An addition of 8,000 copies of Bulletin No. 32 was issued. The bulletin contains 48 pages. The total cost was \$177.60.

SHORT COURSE—FARMERS' INSTITUTES.

I regret to report that the "Short Course in Agriculture" which opened, for a four weeks' term, on January 7, 1895, was in great part a failure. The course of study, lectures, and work was very carefully prepared and the whole was fairly well advertised. Every instructor was in his place on scheduled time, but the farmers, and others, for whom the course was specially prepared were conspicuous by their absence. The character of the work—and it was well done in every instance—may be seen from the following summary:

Subjects.	No. of Lectures.
Stock Feeding.....	8
Dairying	12
Irrigation Hydraulics.....	12
Horticulture	8
Entomology	6
Agricultural Chemistry.....	5
Farm Machinery and Tools.....	3
The Science of Government.....	2
Domestic Economy.....	8
Veterinary Science.....	4

The total attendance upon the various scheduled exercises was over *two hundred*, made up almost wholly of residents of Fort Collins drawn by the novelty of the work in domestic economy or by a morbid curiosity to see two horses dissected by the instructor in veterinary science. The work in these subjects, though eminently

practical, required no previous preparation on the part of those who engaged in it—or rather looked on while it was in progress. The solid work for which such earnest preparation had been made by the college instructors was not in demand. Surely not more than twenty persons attended any of the lectures given on the subjects which it was erroneously thought would prove of such great interest to our farmers. The ardor of the lecturers was chilled, yet they failed not in the service they rendered those who felt interested enough in the practical topics they discussed to give them a hearing. The short-course work is buried for the time at least. There may be a resurrection day—a day that will come when some effective missionary work shall have been done in our farming communities through the energizing, uplifting influences of the farmers' institutes taken into them by our station workers.

The farmers of Colorado, as yet, know but little of the advantages to be derived from that institution that is so well-known and highly valued by their brethren in some sister states, "The Farmers' Institute." Some states appropriate thousands of dollars annually to enable some appointed agency to organize such institutes and plan the very best instruction to be given in them. The winter season is chosen as the time when farmers can best leave home duties to attend the institute. Able lecturers on practical topics are sent to the institute and their work is supplemented by general discussions and the reading of papers prepared by capable and experienced workers from the locality in which the institute is held. In many cases, whole farming communities are made *alive* through institute influence. The work of the farmer is made more effective and profitable, and his social and educational life made brighter, whenever the local institute accomplishes its true mission.

The authorities of our Station look with interest and approval upon the organization of farmers' institutes throughout the State. Time and money for successfully organizing these institutes are not always at hand, yet something has been done to promote the good work

and to open the way for its extension, as opportunity will permit, hereafter. Successful institutes were held at the following-named places: Loveland, Longmont, Fort Lupton, Rocky Ford, Canon City, and Salida. Two or more of our Station workers attended each of these institutes and contributed greatly, by their practical work and ability as question answerers, to the value of the instruction received therein by those in attendance.

Our home station and some of the sub-stations made exhibits of farm products at fairs held in at least five portions of the State. These exhibits were, in the main, creditable; but they could be rendered much more valuable as evidences of improved methods of farming were they prepared with less haste. If our stations are to make such exhibits, it behooves all therewith connected so to plan in advance that a creditable showing can be made when all exhibits come before the public eye for inspection, comparison, and criticism.

ASSOCIATION OF AMERICAN COLLEGES AND EXPERIMENT STATIONS.

This well-known, progressive organization held its ninth annual convention in Denver, in July last. The attendance of delegates was largely beyond expectation, few of the agricultural colleges and experiment stations of the country being without efficient representation. The general meetings were held in the forenoon or evening; the sections, five in number, held afternoon meetings. The general and special exercises were highly instructive, exceedingly enjoyable, and characteristically practical.

Our College and Station were represented by the President of the Board, President of the College, Prof. W. W. Cooke, agriculturist, and Prof. James W. Lawrence, head of our department of mechanic arts.

Prof. C. P. Gillette, our station entomologist, was chairman of the section on entomology and as such read a well-prepared paper on station work in entomology as carried on in the experiment stations of the United States. The chairman of each of the other sections, viz.,

college, horticulture and botany, agriculture and chemistry, and mechanic arts, also presented a report replete with information connected with section work.

Some of the topics discussed were the following-named:

1. Methods of Instruction in European Industrial Colleges.
2. The Mission of the Agricultural College.
3. Teaching in Engineering Courses.
4. A Practicum in Stock Feeding.
5. Methods for Instruction in Teaching Agriculture.
6. Requirements of the Course Leading to the B. S. Degree.
7. Soil Moisture as Influenced by Local Factors.
8. The Distribution of Salts in Alkali Soils.
9. Methods for Studying Parasitic Fungi.
10. How to Teach Horticulture.
11. On the Study of Forest Tree Insects.

The naming of these topics may convey some idea of the work of the Association. Prof. L. G. Carpenter, our station meteorologist and irrigation engineer, addressed the section on agriculture and chemistry on "The Conditions of Irrigation which Prevail in Colorado." A proposition to form a new section to be called "The Irrigation Section" was laid over for future action.

On Friday, June 20th, a body of delegates, numbering about one hundred, and their friends, visited our College and Station and were hospitably received and given every facility for inspecting our numerous buildings and seeing irrigation as practically applied to large fields of growing crops.

One result of the Denver meeting is the giving of all connected with college or station a better idea of the nature and scope of their work—a work scarcely beyond the tentative or formative stage. Another result, and to us not the least important, will be the making known to the people of the older states the wonderful produc-

tiveness of Colorado soil under irrigation processes; our unparalleled home-giving advantages; and the hospitable, intelligent, and progressive character of our people.

Some quoted statements—Profit in attending the Association was not measured by what one saw or heard in general and special meetings. The informal discussions held whenever a few wide-awake delegates met in hotel corridors or at table were often surprising provocatives of thought. I quote a few sentences from reported discussions and conversations:

“Agricultural colleges are misunderstood. The idea that they are to teach farming is not well comprehended. They do this, but they do more. They fit their students for successful agriculturists, and in so doing equip them for other walks of life. The Morrill bill, which started these colleges, does not confine their operations to farming pure and simple, but to branches of it. I confess we find difficulty in obtaining students for our agricultural colleges. Farmers do not want their boys to be farmers, neither do clergymen, lawyers, or other professional people, particularly since the agricultural interests have become so depressed. The idea is that by teaching a student botany so that he may understand plant life; entomology, so that he may understand the insects which are incident to farming; chemistry, so that he may understand the nature and origin of our soils, the student becomes fitted for following agriculture.”—President J. K. Patterson, Lexington, Kentucky.

“The agricultural college course should not be cut down, but should be wisely extended in order to secure the education of the leaders and not of the rank and file. The rank and file do not take the full course anyway; it is the leaders who shape the policy of any community.”—Director E. W. Hilgard, Berkeley, California.

“The work of the school (engineering) should be in a measure to show the fact that what the mass of the working world call theory is essential to the advancement of the practical.”—Prof. L. C. Colburn, Laramie, Wyoming.

"I would prefer a man well educated in Greek to conduct a farm than one not familiar with agriculture as a scientific pursuit. The agricultural student needs above all things to be trained in habits of thought. The lack is here more than anywhere else. Books are necessary; accuracy and exactness are essential."—Prof. T. F. Hunt, Columbus, Ohio.

"The general conclusions reached were that the usefulness of the colleges to the people could be increased by holding farmers' institutes, by making the education practical, and by improving the scholarship so as to win the confidence of the masses in the capacity of these institutions to give thorough and practical instruction."—Reporter Daily Republican.

DIRECTOR TRUE'S VISIT TO THE HOME STATION.

In July last, immediately after the adjournment of the great convention at Denver, Dr. A. C. True, of the Office of Experiment Stations, Washington, D. C., visited the home station, at Fort Collins, and spent several days in a careful inspection of our station work—office, laboratory, and field. The visit, the first of an official kind we have received from anyone connected with the Department of Agriculture, was an event in our station life. The object of the visit, as stated in the last report of the Secretary of Agriculture, was "to make inquiries regarding the general management of the stations and their relations to the colleges; their methods of keeping accounts and records of their work; the lines and methods of work undertaken; and all other matters which might throw light upon the expenditures as reported."

After Dr. True had had time pretty thoroughly to inspect our work and become somewhat familiar with its character and aim, he appeared before the Station Council and some members of your Committee and gave some pertinent statements regarding station work. These statements were made in an informal manner. Some of them were taken down and preserved by the College stenographer. A few extracts are herewith given, as I believe the information and suggestions therein con-

tained are worthy of more than a passing notice: "One thing we are desirous of attaining is as much permanency as we can secure in this station work. I think in some respects you have a pretty good record along that line. I judge from the beginning of the station there has been, to a considerable extent at least, some definite plan of operations that you have followed over a series of years and that you have not just worked from hand to mouth or even from year to year. Of course, it comes out clear every day, as we examine the work of the stations, that the best results are not likely to be attained unless we have a thoroughly considered, permanent plan of operations, and that the work shall go on practically under the same management for a considerable period."

* * * "I have talked with the gentlemen here, and it is perfectly evident that they are keeping records of their work; yet I think, as I told the President the day before I had spoken to the gentlemen of the station about the matter, there is still an opportunity here for you to give the matter of keeping accurate records more attention than you have in the past."

In speaking of stations in general he said: "Their work has developed too largely in what I should call 'experimental farming,' rather than in investigations based upon scientific methods, with a view to helping agriculture. As I understand the matter, the experiment station is to be an organized effort of science to help the farmer, and that really its work should begin from the scientific rather than from the other end. It seems to me that it is the duty of the station to look carefully into the ways in which science may help the farmer and to plan its work accordingly."

Our Station work as he had time to study it made suggestion to his mind as follows: "As I consider the work of this station—to be perfectly frank—I should say that you have undertaken in the aggregate too much of what I should call farm work. I am taking into account now not only the work that is done at Fort Collins, but the work that is done throughout the State. About two-fifths of the money you have to spend goes into the work

of your outlying farms, and I should judge that the work there was of the more simple kind, the ordinary farm operations, including some testing of varieties. I can hardly see how with the money at your disposal for such work, you can put so much of it into that kind of work without, to a certain extent, crippling other work of far greater importance. Such work may be of value to these localities, but I can see that there is danger that in the course of a few years those experiments will have practically come to an end. You will have found out that certain things will grow and that certain things will not, and that will be about the end of it. I am convinced that when that time comes the people will feel that they are not getting what they should out of the experiment station work, and that these outlying stations will be a burden rather than a help to the general work. A great state like Colorado needs more than one experiment station to do what ought to be done. If we had as many experiment stations in this country as they have in France, Texas would probably have 60 or 70 experiment stations and Colorado perhaps fifteen or twenty. I don't think that Congress in passing the Hatch act ever intended to supply a state like Colorado with all the stations it needs, and I think in the long run it will be found much better so to concentrate the work under present conditions as to make your home station, which under the law must be at the College, as strong as possible, and then, if other stations are thought to be necessary, to try to persuade the good people of Colorado to put more money into the enterprise, enough to establish other stations at which to carry on good, thorough work."

Dr. True considered the subject of irrigation of prime importance in the station work that is to benefit the farmers of Colorado:

"Farming in this State is very largely based upon irrigation, and you have gone beyond the initial stage, that is, you have your system of irrigation worked out to a considerable extent and have a large amount of resources invested in it, so that questions pertaining

thereto are of immense importance and would interest everyone who has to do with the State. Now, speaking in an ideal way, my idea would be to devise some scheme of station work which would have its center in the working out of problems relating to farming as affected by irrigation."

The necessary co-operation of station workers in accomplishing satisfactorily some established line of work was alluded to:—

"While I am a great believer in ordinary scientific investigation and think that the individual worker should have a large liberty, and certainly that he should have full credit for everything he does, I also believe that the individual can, in most instances, do most for himself by co-operating with other people working along related lines.

"I think that one of the greatest dangers of our times as regards work in pure science is, that specialists will work without reference to related lines of work; so I am trying to formulate for these stations some plan of work which involves the co-operation of the different workers. This would benefit the individual workers and render the station more effective."

The concluding portion of the address referred to the growing importance or a more thorough, systematic, and scientific study of the soil:

"I am surprised that there is so little realization of the necessity for more thorough study of questions pertaining to the soil. The soil certainly has an agricultural flavor and sound to it, and it seems that a practical man should see that it was the business of an agricultural experiment station to study the soil, and yet in this country there are comparatively few thorough studies of the soil making at the different stations. I have had many men come to my office and say: 'How is it that when we go to your stations and ask about soils they don't seem to know much about them, even in their own localities? It seems clear that they are not studying soils there.' That is true; more thorough investigation

of our soils should be made and in that there would be work for the chemist, physicist, irrigation man and others."

FORESTRY EXPERIMENTS.

I have had correspondence with the Division of Forestry, connected with the U. S. Department of Agriculture, relative to tree planting experiments to be made, on some portion of our station land, under direction, and at the expense, of the authorities at Washington. I have not had opportunity heretofore to present this matter to you in a formal way. It seems very desirable that if the Division of Forestry is to enter upon such work in Colorado it should be identified in some direct manner with our Station.

Charles A. Keffer, Assistant Chief of the Division of Forestry, recently visited the College and delivered an instructive address on "The Forests of the United States." While he was here a portion of land on the farm was selected as the proper place for carrying on the experiments in tree planting. I respectfully ask your approval of an article of agreement made by and between the Secretary of Agriculture and The State Agricultural College of Colorado, to the end that said agreement may be submitted to The State Board of Agriculture for acceptance. The terms of said agreement are herewith presented:

I. "The College agrees that a parcel, or parcels, of land of said College, located as may be hereafter agreed upon and not exceeding twenty-five acres in the whole nor ten acres for the first year, shall be placed under the absolute control of the Secretary to enable him, acting through the appropriate officials of the Department of Agriculture, 'to experiment and continue an investigation, and report on the subject of forestry and timbers, for traveling and other necessary expenses in the investigation, and for the collection and distribution of valuable and economic trees, seeds, and plants'—in accordance with the provisions of an act of Congress of March 2, 1895, entitled 'An Act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1896.'

II. "The Secretary agrees that he will furnish suitable plans for the planting of trees as well as all material for planting; that he will direct the care and management of the trees so planted; that such planting and subsequent care and management shall be under the immediate supervision of an officer of the said College or of the Division of Forestry as the Secretary may determine, said officer to be under the direction of the Chief of the Division of Forestry; and that, the labor on said land being furnished by the said College as it is hereby agreed that it may be, the same shall be paid for by the Department of Agriculture on properly certified accounts in the manner provided for by the rules of said Department."

III. "This agreement is to continue in force until terminated by the Secretary, or, if not sooner terminated, until the experimental stage of said forest plantations is past, and, upon its termination all improvements upon the land covered by this agreement shall become the property of the College." *

SOME CRITICISMS AND SUGGESTIONS.

In what I shall present in this, the concluding, portion of my report, I shall endeavor to be fair and just to all parties, yet at the same time to discharge a part of my official duty as I see it.

Dr. True in his address, from which I have quoted so liberally, voiced many of my opinions about the work of our home and sub-stations. Some of these opinions were expressed in former reports from my office.

Dr. Charles W. Dabney, Jr., Assistant Secretary of Agriculture, writes as follows: "The greatest hindrances to successful work have arisen in those communities which have failed to appreciate the fact that the stations are primarily scientific institutions, and that while they should always keep steadily in view the practical results to be obtained, they render the most permanent benefits to agriculture when they make thorough scientific investigations of problems underlying successful agriculture and horticulture."

In the following excerpt he states a fact that should be brought directly to the knowledge of our people, particularly to their representatives in our law-making

*By action of the Board, taken December 13, 1895, the terms of the article of agreement were approved.

body: "In all the acts from the land-grant act of 1862, providing the first endowment for colleges of agriculture and mechanic arts, down to the act of August 30, 1890, making a handsome addition to the income of the same institutions, it is clearly implied that the States shall provide the necessary land and buildings for these colleges as well as the experiment stations connected with them. The United States has provided a part of the funds necessary for paying the current expenses of these institutions, but in so doing it places the obligation upon the States to provide the necessary land, buildings, and other things belonging to the plant. In all such cases this Department has sought to bring the local communities to realize more fully the importance of contributing from their own means to build up strong institutions for the benefits of agriculture."

The State of Colorado has done nothing worthy of credit in giving financial aid to the stations. It has, however, attached a number of these as leeches to the fund received from the United States Treasury. It has been easier for our law-makers to establish new stations than adequately to support those already in operation. The only money ever directly appropriated by the State for station support was the sum of \$2,500, in 1893, to aid in the establishment of a station at Cheyenne Wells. The State has failed to supplement the bounty of the General Government as was its plain obligation when it by acceptance thereof became a beneficiary under the terms of the Hatch Act. Some reference to our widespread area of station work will be made before the end of this report is reached.

It is easy to criticise; not difficult to find fault with almost anything on what appear to be just grounds. I want to be concise, intelligible, and faithful to my conception of official duty in what I say that smacks, possibly, of strong criticism.

I have before me, as I write, all the reports, save one, which it is the duty of station officers and employes to present to you by my hands. These reports will, no doubt, receive your attention at the proper time. I de-

sire at this point to refer to some of the recommendations therein contained—recommendations which if approved by you and thus made operative will greatly determine the nature and extent of future station work. Some of these recommendations I most cordially approve; others appear to me not well digested and therefore not best calculated to promote and popularize station work.

The bulletin on "Sheep Feeding in Colorado," prepared by the agriculturist, was a timely contribution to a subject interesting to ranchmen and sheep feeders. The bulletin has met with appreciative recognition from these people. A bulletin on "Cattle Feeding" is promised.

I question the propriety of giving the "livestock industry" the prominence, in the agricultural branch of station work, indicated in the agriculturist's report. We have a large College farm, immediately under the eye of over two hundred students, many of whom come to us as students of agriculture—not in a narrow sense. I do not believe in extensive station farming, but I do think it good policy at the College station to have a model farm, one helpfully instructive to students and not the target of just criticism by visitors and neighboring farmers. Let the experiments in stock-feeding go on; but let no thought that there is nothing more to do in other matters within the range of farm work be published to the world by our plan of experimental and other operations on the farm.

From the Section on Entomology, a bulletin entitled "A Preliminary List of the Hemiptera of Colorado" was issued in June last. This publication has a special value to the entomologist. Libraries where special collections are made and prized gladly welcome such original contributions to an important division of insect life. I approve of such work by the section if it is not prosecuted at the expense of more widely practical if not more interesting investigations. A knowledge of certain phases of insect life is of special value to the Colorado fruit-grower. Our orchards are yearly invaded

by a swarm of insect depredators, protection against the ravages of which means a saving of thousands of dollars annually to our people. Let our scientific zeal be moderated by wise and businesslike discretion.

Bulletin literature from the "Section on Meteorology and Irrigation" has been long expected; but its appearance has been delayed by causes that seem adequate. There is a large mass of meteorological data that ought to be worked up into form and made accessible to the people. The occasional publication of such data in some of the newspapers of the State is well enough as far as it goes, but it does not go far enough. There ought to be a summary, at least, of the observations made within the last four years, prepared for publication. The adjusting and reading of the different meteorological instruments, with the subsequent recording of data, have engaged a large part of the time of one of the assistants connected with station work.

There is a plan proposed whereby the head of this section is to give much more time than hitherto to out-of-door work, possibly to extend observation and measurements on the streams in the southern part of the State. It is claimed that early investigations of the nature proposed will furnish valuable data to be made serviceable in the event of inter-state or inter-national complications arising from a future adjustment of the question of water supply. As to the necessity, or even importance, of the work, I can not give an intelligent opinion. It suggests itself to me, that however valuable such work may be in view of the troubles anticipated, the station is neither able nor justly authorized to undertake it.

Such work, if prosecuted with any hope of profitable outcome, would cost the expenditure of much time and money, neither of which is largely in excess of station demands under present conditions. No bulletin, save a revision of Bulletin No. 13, has been issued by this section since January, 1893. There are, doubtless, good and sufficient reasons for this condition of things, but they are not strong arguments in favor of engaging

in new lines of investigation which may not properly be within the purview of our station work and of whose cost in time and money no trustworthy estimate can be made. Let us work up into bulletin form some part of the information we have, before time is too largely given to other effort.*

The Section of Botany and Horticulture has been crippled in its experimental work by reason of the resignation of one employe, the death of another, and the protracted illness of a third. The College work required of some of those connected with this section is heaviest in the Fall term, the one just closed. I think the wish of your Committee, hitherto expressed, that the work of experimentation in *horticulture* be pushed with more vigor will be realized in the future effort of this section.

In my opinion the Chemical Section is one of the most important—I was about to say the *most important*—of those engaged in station work. Its work is closely related to that of all the other sections, not so vitally with that of the Section on Entomology. Then, chemical analysis is the only true foundation to much knowledge of such prime importance to the farmer.

There has been an evident hesitation on the part of the section to do analytic work for the people. Requests come to us from all parts of the State for this work. Some of these ought to receive no serious consideration; others it would be proper and wise to heed. The belief that parties seeking information based on the results

*Since the above was written, Bulletin No. 33, "Seepage or Return Waters from Irrigation," has been issued from the Department of Irrigation Engineering. The head of the Department, in his outline of Section work for 1896, makes the following suggestions which met the approval of the Station Council and the Executive Committee of The State Board of Agriculture:

"Some work has been done in this line before, but it has had to give way both because of lack of funds and of time. My desire in this is to continue a systematic investigation of water resources of the State, their character, best mode of utilization; a study of the methods of irrigation, their faults and advantages. For this particular season, I propose to confine my work to the San Luis valley; the special effort being a study of the sub-irrigation and sub-surface waters. Nearly all the work so far done falls into a part of this general plan."

of chemical analysis would use it to prosecute a suit at law, should not deter us from making the analysis if it has anything like a public value.

Our Station can not make analysis of everything that people choose to send us; but it can do more than it has done to answer the not unreasonable expectations of the people. Is it well to wait to be urged by our people in such a matter? Can we not *seek out* some of this work and *voluntarily* do it? The important work will then be done and the people made aware of our existence.

I recognize the necessity of two kinds of station work: that which touches the present, and that which projects itself into the future. I believe Dr. True unduly emphasizes the value of the latter. It is well to look futureward, but in doing so our eyes ought not to be blind to the demands of the present. If work now in hand is permitted to drag, where is the assurance that work made to cover a series of years will be pushed with vigor? I look with misgiving, born of experience, upon any scheme of station work whose results are not to come to authority knowledge or public use before the expiration of years. Some work, in each section, requiring a long period for its accomplishment is not amiss; but such work should not constitute the larger fraction of all attempted. Each section should *begin* and *complete* something each year—so complete it that information thereon in printed form could reach the people interested.

Look on page 14 of my last annual report and see the titles of bulletin publications there reported as *nearly ready* for issue, and the force of some of the statements herein made will be better felt. If the desired work of the sections is retarded from lack of sufficient help to perform it more expeditiously, there is surely some way by which to overcome such a difficulty.

I share in the opinion, so fittingly expressed by Dr. True, that our sub-station work is not followed by highly desirable results. Here I wish to speak in plain terms. When we use the Hatch Act fund in supporting

a number of sub-stations, which receive no State support whatever, we are, according to authority worthy of respect, not making the use thereof contemplated in said act. If these sub-stations have reason for their existence at all, they should be supported almost wholly by money appropriated by the State.

No matter from what quarter their financial support is derived, they should, in every case, in the event of their continuance, be superintended by men of scholarship, of wide practical acquaintance with experimental farm work, and of power to adapt themselves readily and naturally to new conditions. They should be men whose practical and scientific attainments lift them, some degree at least, above the men engaged in farming in their vicinity. I inquire to provoke thought and perhaps action, Can service such as is desirable, nay *necessary*, be purchased at an annual salary of \$600 or \$800?

In an every-day, out-of-door fashion, our sub-station superintendents may be able to conduct farm operations with a fair measure of success, but it is believed by your Committee that any one of them is sufficiently equipped, either in general or special scholarship, to be a real power in the community about him? These men are my friends; they are in their way faithful workers; they use their talent as best they can, putting honor and conscience into that use. They are prompt in the preparation of required reports, therein giving strong evidence of faithfulness in performing other duties.

If a change in the policy of sub-station management is desired, the present is an opportune time to inaugurate it. My belief, again expressed, is that the money within our control is not sufficient for rightly carrying on all the farm and experimental work now attempted. The sub-stations, for reasons before stated, seem to have the least claim on the money now received for station support.

The farm and experiment station at Fort Collins and the sub-stations at Rocky Ford have best answered the purposes for which they were put in operation. The

other stations, in my opinion, have no high value to the State—perhaps not to the county in which they are located. Their support makes a draft upon a fund created, according to best advices, for a different purpose. Until the State comes to the financial support of these sub-stations, it would seem to be the part of wisdom for your Committee to cease farm operations at them and confine effort to *experimental* work upon a small, selected area.

The station property in Rio Grande, El Paso, and Cheyenne counties can be rented, temporarily, to persons who will occupy the buildings and carry on some experimental work upon the land upon terms to be stipulated. The results that the proposed plan will secure will not fall, in practical value, far below those heretofore reported; nor will the reports be of much less instructive value than those now presented for your consideration.

The stations located as above described have been a constant drain on our revenue. Sales of farm products within the year have brought but little money—\$356.48 from the Divide sub-station and \$431.96 from the sub-station at Monte Vista.

Farming operations at Rocky Ford might be discontinued advantageously, or at least brought within more modest limits. A 200-acre farm is not required for experimental work, such as is properly within the scope of station effort. A large portion of this land can be leased to responsible and capable farmers upon terms that will require them to cultivate it in a prescribed manner and to give yearly reports of crop yields and other matters connected with their farming operations.

I have faith in the feasibility and desirability of the plan herein suggested—for I but *suggest*; I shall not *urge*. In what I have written for your consideration, I have no purpose in mind other than the betterment of our station work. More concentration of effort seems to be a present want. While looking intelligently to the *future*, we must not forget that some practical results are expected from our work *now*. Life is uncertain.

tenure of office insecure; the work that requires an extended period for its accomplishment may never be completed. It is folly to give attention wholly, or almost so, to a line of work extending through years whose completion will be prevented by the death, resignation, or removal of the one in charge of it.

Respectfully submitted,

ALSTON ELLIS.

Fort Collins, Colorado, December 11, 1895.

ADDENDUM.

That portion of the Director's report that relates to sub-station management was considered at the annual meeting of The State Board of Agriculture held December 11, 12, 13, and 14, 1895. After discussion the whole matter was referred to the Executive Committee of the Board, in control of the Experiment Stations, with power to act after further investigation. At a meeting of this Committee, subsequently held, the question of the legality of taking such action as the Director's report recommended was considered and it was decided to defer definite action until some authoritative information on that point could be obtained. At the same meeting of the Committee, Mr. A. L. Kellogg was made a special committee to investigate thoroughly the workings of the sub-station at Rocky Ford and to report, as soon as practicable, what changes, if any, should be inaugurated in the plan of experimental work there in operation. At the regular monthly meeting of the Executive Committee, held January 31, 1896, the following letter was read:

Denver, Colo., Dec. 27, 1895.

HON. ALSTON ELLIS,

Fort Collins, Colo.

Dear Sir: I have read that portion of your report to the Executive Committee of The Board of Agriculture, concerning the proper manner of management and operation of the several agricultural experiment stations and I most heartily concur in the recommendations made by you.

There is nothing in the act of Congress which in my judgment contemplates the establishment of experimental stations

other than those in connection with the several agricultural colleges and on and in connection with the agricultural college grounds. I do not think there is anything in the act which prohibits the State Government from establishing several independent stations if it sees fit, but the purpose of the act of Congress seems to be to have such stations under the charge and control of thoroughly-educated and scientific men, and to have them operated for scientific purposes and not merely for ordinary farming. It would seem to be a diversion of the Congressional fund if the same were to be applied to any other than purely scientific purposes.

There is nothing in the Legislative act which requires that the experimental stations provided for should be operated in any particular manner, and I take it to be within the power of the Board of Agriculture to conduct them in such way as in its discretion would be for the best interests of science in accordance with the purposes of the Congressional act.

The Board, therefore, would be violating no law should it adopt the suggestions contained in your report. I am sir,

Very respectfully yours,

(Signed)

B. L. CARR,
Attorney-General.

The report of Mr. A. L. Kellogg, on the sub-station at Rocky Ford, was read and adopted. One of the recommendations therein contained is given herewith:

"Regarding the one hundred and sixty acres east of the road, I would recommend that, if it is thought best to rent any, you rent all but the northwest forty acres, as that tract contains all the alfalfa land needed to plow under for experimental purposes. It contains all the plowed land that will be needed for cereals and plat purposes. It can be the most easily and systematically irrigated. It furnishes a fine site for barn, sheds, and pens. The pasture can also be more conveniently arranged; and lastly, if for any reason the other portion of the farm should be wholly abandoned, or lost to us, the forty acres will contain all the permanent improvements."

The action of the Committee concerning the operation of the other sub-stations is shown in the following preamble and resolutions which were adopted after excepting the sub-station at Cheyenne Wells from their provisions:

Whereas, The superintendents of the sub-stations located at Monte Vista and Cheyenne Wells have signified their willingness to take charge of said stations, as tenants, for the current year, making use of the present equipment belonging to the Experiment Station and cultivating the land at their own expense and for their own profit, and in addition thereto making some experimentation as per the schedules by them submitted to this Committee; *therefore*,

Resolved, That the President of the Board, the Chairman of the Executive Committee, and the Director of the Stations be appointed a Special Committee with power to suggest and approve of the terms and conditions of leases to be drawn between The State Board of Agriculture and said superintendents of the stations at Monte Vista and Cheyenne Wells by the Secretary of The State Board of Agriculture, said terms to be in conformity as nearly as possible with the plan of station management outlined in the Director's last Annual Report and practically accepted by said superintendents in their letters now on file addressed to the Director of the Experiment Stations.

Resolved, That the Superintendent of the Divide Experiment Station, at Monument, be offered the use of the station premises and equipment, now occupied and used by him, on the same terms and conditions herein referred to in the cases of the superintendents at Monte Vista and Cheyenne Wells; and that, in the event of his refusal to accept said terms and conditions, then that the sub-station property known as the Divide Sub-Station shall be temporarily placed under the control of the Local Committee co-operating with this Committee in the management of said Sub-station, to be used by said Local Committee in such manner as its best judgment may approve.

Resolved, That in making the disposition of the sub-stations herein named, as herein provided for, it is in no sense the intention of this Committee permanently to abandon any of them, or to continue the plan of operation specified for a time longer than is necessary to secure from the General Assembly of Colorado an appropriation adequate to their proper support, a support that will increase the quantity and improve the quality of the experimental work for which they were established.

Resolved, That as a Committee, and as individuals, we stand pledged to an earnest effort to secure, at the next session of the General Assembly, such an appropriation; and that in that effort we cordially and earnestly invite the hearty co-operation of all citizens of Colorado interested in the agricultural prosperity of the State."

The superintendent of the Divide Sub-station, in El Paso county, having declined to accept the conditions named in the foregoing resolution, the equipment of that station was ordered removed to the Home Station. Temporarily, at least, the Divide Sub-station will be left in charge of the Local Committee. Legislative action will determine when, and to what extent, experimental work will be resumed at that station.

Report of the Agricultural Section.

To the Executive Committee of the State Board of Agriculture:

Gentlemen—I have the honor to submit herewith the report of the Agricultural Section of the Experiment Station for the past year.

The work of this Section is becoming more and more largely connected with the livestock industry in the wide sense of the term. Feeling that the growing of cereals in the State has passed its maximum, and that the future agriculture of Colorado would rest principally on animal products, the Board has done wisely in providing means for carrying on experiments relating to those problems.

Dairy work has been undertaken on a small scale, the past season, and experiments are now in progress in the feeding of milch cows, in the economical handling of milk, and in butter-making.

Since the report of a year ago, an elaborate series of feeding experiments with sheep have been brought to a successful close and the results, together with an inquiry into the general sheep industry of the State, published in Bulletin No. 32, of the Experiment Station.

At the same time an equally large series of experiments were made in the feeding to steers of alfalfa, corn ensilage, corn fodder, beets, wheat, and various mixtures of these foods. The results as a whole were very satisfactory. The steers were marketed in Denver at a good price and the financial side of the operation showed a return of over eight dollars a ton for alfalfa.

The full records of the tests have been worked up and are now on hand for a future bulletin on "Cattle Feeding."

During the summer, twenty-five Shropshire ewes and twenty-five Horned Dorset ewes were purchased, and experiments are now under way in the raising of early lambs for the Denver market.

The feeding experiments of last winter on sheep and steers are being continued this winter with two hundred and twenty southern lambs and twenty steers. The steers are probably the best bunch that is being fed in this vicinity this winter and we look for some excellent returns when they go to the Chicago market next spring.

The experiments begun two years ago on the breeding and feeding of pigs have been continued and material is accumulating for a bulletin.

The crops of the farm the past season were as usual grown experimentally and included tests of forage crops, corn, wheat, oats, barley, potatoes, and sugar beets. The returns were most gratifying and the results in detail will be published in a bulletin during the present winter.

Respectfully submitted,

W. W. COOKE,
Agriculturist.

Fort Collins, Colorado, November 30, 1895.

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 on work in charge of the Section of Botany and Horticulture.

The main effort of the Section has been directed toward the continuation of the test of varieties of orchard and small fruits, and to the trial of garden vegetables.

FRUITS.

Apples—During the month of October a careful inspection of our nursery stock was made and the trees graded and listed. Of the 165 varieties set in the spring of 1894, about 15 per cent. were entirely killed by the prevailing low temperatures of last winter. Only 15 varieties showed no injury; the others were injured in varying degrees from the loss of terminal buds to the loss of three-quarters of the growth of the season. A considerable portion of those injured made a good growth during the season, and now appear to be in good condition. Much the greater portion of the injury was to trees in the block on the flat land of the garden, and is attributed to insufficient ripening of the late growth induced by the naturally moist soil. Trees on the higher gravelly soil of the west garden made less

growth, but ripened better and show less injury. The trees graded into three classes on the basis of height show,

First class, over four feet, 1,641.

Second class, 3 to 4 feet, 2,696.

Third class, 2 to 3 feet, 606.

This division is arbitrary and many of the trees in class 2 are as good as the taller ones of class 1. There are about 2,500 trees that may be distributed or offered for sale the coming spring, as you may direct.

The grafts set last spring represented forty varieties; of these 2,988 have made a fair growth and enter the winter in apparently good condition. A schedule is now being prepared to show in detail the status of each variety under test; also a list of additions which it seems desirable to make.

Pears—Of two-year old pear trees we have but a small number, representing eleven varieties. There are twenty-seven first-class, eighty-seven second-class, and about thirty third-class trees. Those that escaped injury last winter have made a good growth; most of those that were frozen back have made but small growth. The Keiffer, Le Conte, and Longworth trees set in orchard last year were considerably injured and the growth produced this season is weak.

Cherries—Twelve trees representing four varieties were set last spring; all have made good growth.

Plums—We have now growing in the test orchard 426 trees, and in nursery rows 190 trees, together representing 84 varieties. Some are very promising while others give no evidence of adaptability to our conditions. A considerable number of varieties promise bloom the coming season and it is hoped that sufficient fruit may be matured for a fair comparison between them. Of the older trees those in fruit this season were the Forest Garden, Wolf, and Miner; the latter, however, did not mature its fruit.

Grapes—Eleven vines of four varieties were added to the vineyard last spring; all started well, but the frosts of May 10, 11, and 16 killed the new growth, and

the vines failed to recover from the frosts; their recovery from the injury was slow, and the wood formed later did not ripen.

SMALL FRUITS.

In the bearing plat of strawberries we had represented this season fifty-eight varieties. Nearly all were injured in some degree by the May frosts, the earlier varieties to the extent of from one-half to two-thirds of the crop. All varieties produced sufficient fruit for comparison of general characters, but no fair conclusions could be drawn regarding the relative values as to quantity of fruit. A new bed has been planted for fruiting in 1896, to which twelve varieties not before tested have been added.

Other small fruit plants set last spring have made a fair growth, and should produce some fruit next season. The number of plants of each variety is small for a just comparison, and we desire to increase the number in these plats.

The weather conditions for the season have been generally unfavorable to garden operations. The summer rains were excessive, the prevailing temperatures low, and the frosts unusually early.

Of garden vegetables the principal test attempted was with tomatoes. Fifty-five varieties were planted, and well grown plants were set out the first week in June, but, owing to the weather conditions, the results obtained were in the main negative.

The collection of herbarium specimens was limited the past season to one trip into South Park, a region not before visited. In company with Mr. Cowen a week was spent here, and although the work was seriously interfered with by frequent rains, we brought home about 2,000 specimens, many of them new to our herbarium.

During my leave of absence last summer I spent three weeks in the Gray Herbarium of Harvard University, in the work of comparing our plant forms with the type specimens there preserved. A large number of plants were thus compared, but the time was insuffi-

cient for the completion of the work. For the advantages offered, and the kind assistance rendered in the prosecution of this work I am greatly indebted to Dr. B. L. Robinson, curator of the herbarium.

An exchange of plants has been made with the Gray Herbarium by which a rich collection from Washington is added to our herbarium. Several other offers of exchange have been received, some of which we hope to accept before the winter is over. We have a quantity of exchange material in store, but the time for its arrangement has not been available.

Respectfully submitted,

CHARLES S. CRANDALL,
Botanist and Horticulturist.

Fort Collins, Colorado, November 30, 1895.

Report of the Section of Meteorology and Irrigation Engineering.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I have the honor of presenting the following report of the Section of Meteorology and Irrigation Engineering for the past year.

Since the last annual report the work of this Section has proceeded on the lines laid down in the outline of work. This outline is essentially that which has been followed since the organization of the Section, and we now have the advantage of the accumulated fund of fact upon which to draw.

On taking charge of this Section seven years since, I found work without precedent to guide, with almost no data available. One of the first lacks was of reliable data in all concerning irrigation. The questions pressing for solution are many, enough in themselves to keep a large force employed for many years. The question of the water supply and its economic use is at the foundation of the agriculture of this State. The customs are still in a formative period, but from the experience of other countries we know that what are now being settled as custom or as law bind the development in certain lines for centuries. The questions which I have felt were of the most importance in the continued development of the State were those which bore upon the fundamental problems establishing the ratio between the land and the amount of water which is needed for

it and those of water supply and the means of extending its usefulness. Most of the lines of investigation converge ultimately on these topics. We need to know the origin of our water supply; its development; the methods of its application; and of that water which is applied, to trace it through the canal or the soil or the plant until it passes beyond the reach of economic use or finally into the air. The lines of Meteorological work have been of Agricultural Meteorology principally, and most attention has been given to those which have also borne upon the questions of irrigation. These observations have been carried on regularly, and while more than we could correctly reduce, give us the data for a series of years on any particular point when they are needed. While making the observations it is but little more trouble or requires but little more time to take for a number of phenomena than for one. Such data become more valuable as the number of years of observation increases. While the collection of the data requires care, time, and labor, the reduction of such data is a work far more laborious. We now have seven years of observation and the results are sufficient to warrant a careful reduction for bulletin use. Among these which ought to be reduced are those on *evaporation*. A portion of these records was printed in the annual reports up to 1891. Almost weekly requests are still received for these reports. Since that time such matters have not been included in the annual report; and as we have not had the accumulation of sufficient length of record to warrant the reduction and collation of facts in special lines for bulletin form, there has been no place for the public to have access to them. We are in receipt of requests for the result and for the data. Those given in the annual reports have been, in several instances, reprinted.

In the work of this Section, the summer is the period of active investigation of questions pertaining to irrigation. Then we have the operations on an extensive scale all about us. It is particularly true of this Section that its laboratory extends over an extensive

area. For the most fruitful work it is necessary and best to use the appliances, experience, and aid of those under different conditions of soil, exposure, and crop, which we can not get in one small locality. We have heretofore carried on our observations over the whole valley, as far as circumstances would permit. From the first of May to the first of November it is especially desirable personally to visit our stations of observation. Some of the season's outside work begins as early as April and needs more attention at that time than can well be given.

During the past year a more complete and satisfactory investigation has been made of the question of the return of seepage waters. The year has been an exceptional one in the amount of rainfall and the results of the year as an extreme have been very desirable. The measurement of the Poudre river in October, and also that of the Platte, I personally made for the greater part of the way with the assistance of Mr. Trimble. The present Fall has been the first for several years when class duties were such that I could be absent without material detriment to College work. In previous years the observers were dependent for lodging and meals upon the settlers, who were not numerous on the route needed to be taken near the river. In consequence, the demands of the gaugings often had to give way to the needs for accommodation. The present season a camp outfit was taken along, with the advantage of better work with less expense. It may be said that these measures show that the amount of seepage waters coming into the Poudre river, which is typical of the streams of this State, in the course of the year amount to from one-third to one-fourth of the whole amount received from the mountains. The productive value of the waters from this one source in this single valley can not be far from \$3,000 per day; and on the Platte the productive value averages nearly three times as much. The measurements this year have also given reason to believe that the increase is due largely, if not entirely, to the waters applied to the land under irrigation.

In the observation on the Duty of Water, we have measured not only the amount which has been received in the whole valley, but also the amount received by one of the largest canals of the valley; and also the amount applied on several farms whose owners are known as skillful farmers. In this work we used all the instruments we had available. The clockworks need to be wound and the papers changed weekly. This in itself requires during the summer season something like 1,500 miles of driving. In connection with this the records of the flow of the river have been reported weekly to the press of this part of the State during the summer season.

Last summer I made a trip to the timber at the higher elevations personally to make a further study of the protecting influence of the forests on the preservation of snow. An earlier visit would have been more profitable. Observation has served to confirm the previous conclusions on the extreme value, in fact necessity, of the preservation of the forests to allow nature to aid in regulating the streams, and thus save a portion of the millions of dollars which are being expended for that purpose in the construction of reservoirs.

On the same trip opportunity was taken to visit Mr. S. J. Peery, who for several years has kindly taken observations at his home which is located some 3,500 feet above us. A subsequent trip was also made to Mr. Carlyle Lamb, who also has taken observations at his home at the base of Long's Peak. These two stations are of unusual value because of their high elevation. Their reports have shown that for several months of the winter the the average temperature is greater than at Fort Collins. Though the first year's observations indicated this the facts did not seem credible; but every year since has confirmed them. They show that the cold waves do not as a rule affect these high points.

In our evaporation measurements we have been aided for the past few months by the loan from the Weather Bureau of two anemometers. One of these has been connected so as to give the wind record from the

evaporation tank on the same sheet as our standard anemometer, and this enables us to determine a missing but necessary set of facts for the reduction of these observations.

Having noticed while testing some of the instruments on a well in the western part of the grounds, a connection between the rise of water in the well and the height of water in a neighboring canal, observations were taken on both because of the bearing on the seepage questions under investigation.

The observations in meteorology have been numerous. Besides including observations of temperature and of barometer, we have three sets of soil thermometers located in different places. The deepest thermometer is at six feet below the surface, at which point the temperature curve of the year lags nearly six weeks behind the air temperature. A set of solar radiation thermometers was observed daily, thermometers for measurement of terrestrial radiation and aiding to determine the conditions for frost and dew. Wind records were taken. Many of the instruments were self-recording. The meteorological reports from the sub-stations are also received monthly and require reduction, which is done in the winter months by Mr. Trimble. In order to make these observations of value, the conditions of exposure need to be good. The head of this Section ought to be able to visit these sub-stations at least once a year to inspect their meteorological conditions. Without such inspection the scientific value can not be relied on. Several voluntary observers have co-operated with the Section during the past year as well as previous years, and have given us much valuable data.

Weather telegrams have been received from the Weather Bureau for the greater part of the past year, weather flags shown here, and postal cards distributed to the post-offices in this part of the State.

Acknowledgments are due Mr. Trimble, assistant in the Section, to whose patient care and accuracy much of the value of the observations is due, and to whose reliability I am indebted for freedom from much time-

consuming detail. Mr. Stannard has aided by the making of various maps and diagrams, as well as in various computation work. For aid in the seepage measurements of this fall we are indebted to Professor Crandall for the use of a wagon; to Messrs. G. H. West and D. A. Camfield, of Greeley, for the use of a team for a fortnight during the progress of the measurement; to Receiver Trumbull, of the Union Pacific, Denver & Gulf Railroad Company, for transportation when needed; to Water Commissioners J. L. Armstrong, of Fort Collins, J. T. Hurley, of Orchard, and T. Patterson, of Sterling; to ex-Commissioner R. Q. Tenney, whose interest was sufficient to cause him to furnish us aid for a day in the Poudre measurement; to the managers of various ditches, especially to those of the Cache la Poudre No. 2 and the Water Supply & Storage Company for aid and data furnished; to Gov. Eaton and Supt. Pixler, of the Larimer & Weld Canal for maps and other data; to A. A. Edwards, of Fort Collins, for similar information; and to B. D. Sanborn, of Greeley, and others.

Capt. W. M. Post and Hon. J. S. McClelland permitted the use of their farms for experimental purposes, sometimes perhaps to their annoyance. P. H. Boothroyd, of Arkins, has furnished monthly weather reports, as also have W. H. McCreery, of Loveland, S. J. Peery, of Manhattan, Carlyle Lamb, of Estes Park, and others.

The current investigations have required Mr. Trimble to drive something like 1,600 miles. In addition to this I have driven some 700 miles in connection with the seepage and other measurements.

It is perhaps not our place to call attention to the need of more extended investigations. On the seepage measurements as well as on the Duty of Water there are needed investigations from the chemical side and of the flow of water through soils. An investigation of these questions, together with a careful study of the effect of irrigation on the river itself, is urgently needed in the Rio Grande valley of this State. There are certain possible, in fact imminent, complications because of the treaty obligations with Mexico. This country claims that

irrigation in our State is detrimental to its rights. The investigation does not affect the methods of agricultural practice but the question of water supply, without which agriculture is impossible.

Thanking the Board for past support, I respectfully submit this report.

L. G. CARPENTER,

Meteorologist and Irrigation Engineer.

Fort Collins, Colorado, November 30, 1895.

Report of the Entomological Section.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I have the honor to submit herewith the annual report of the Entomological Section of the Agricultural Experiment Station for the year just closing.

The work of the Section has been, for the most part, along the lines indicated in the schedule that was submitted to the Station Council at the beginning of the year.

Bulletin No. 31, "A Preliminary List of the Hemiptera of Colorado," was issued from this Section early in June. The bulletin is largely technical in character, but like all technical scientific work, it is necessary as a sure basis for economic labors.

The insects that have attracted attention for the past year have, for the most part, been those that have been complained of years previous, but there have been, as there are every year, a few additional ones, as if to remind the farmer, the fruit-grower, and the stock-raiser that the battle is still on and that they must not lay down their implements of warfare if they would continue to reap bountiful harvests.

Two of the most threatening new pests that have come under my notice the past year are a leaf-roller, *Gelechia* Sp., on cottonwood, and a small Lepidopterous larva burrowing into the flesh of ripening peaches, much as the Codling Moth larva does in the flesh of the apple.

The cottonwood leaf-roller was extremely abundant in Denver during the month of August when many of the trees had nearly every leaf rolled and the sidewalks under the trees were thickly strewn with the rolled leaves that had fallen upon them.

The peach worm was noticed by the writer in 1894 in orchards at Grand Junction and Fruita, Colorado. This year I received it from Mr. W. M. Hastings, of Delta, Colorado, who writes that it is becoming alarmingly abundant. Under date of August 10, last, Mr. Hastings writes of these worms as follows: "Last year we did not find more than 15 or 20 wormy peaches in all, but this year fully 1 in 20 of the early peaches is wormy."

Spraying for the destruction of the fruit-tree and box-elder leaf-rollers in this vicinity was more generally practiced last spring than formerly and, as a result, less injury was done to the trees. The College orchard was kept nearly free from these worms through an application to the trunks and large limbs of the trees, early in the season, of a strong kerosene emulsion for the destruction of the eggs, and later applications of Paris green for the destruction of the larvae upon the foliage.

Grasshoppers and the "Grasshopper Disease" attracted a large amount of attention in several localities on this side of the Range during the past summer and early fall.

Through the courtesies of the D. & R. G. and the U. P., D. & G. railroads in furnishing me passes, I was enabled to visit these localities where the grasshoppers were dying in largest numbers and collect a great deal of data concerning the supposed disease. The results of these investigations and the experiments that have been conducted and that must yet be conducted before practical and certain conclusions can be drawn, will be made known later. I might add that I am hopeful, but not at all certain, as yet, that the "Grasshopper Disease" can be used successfully for the wholesale destruction of the grasshoppers. So far as we know at present, the hopper pans and the arsenic bran mash are the two most reliable methods for the destruction of grasshoppers.

Experiments in the Apiary have been considerably interfered with on account of the light honey flow. Wet seasons are almost invariably poor for the production of honey on account of the lessened nectar secretion of flowers and the reduction of the number of days in which the bees can work. The experiments have been chiefly in continuation of the work of previous years. The Carniolan queens that were ordered for the purpose of comparing this race of bees with the Italians were not sent because of the cold backward season and the consequent inability to breed a sufficient number of good queens to supply the demand.

It often happens, especially in seasons like the past, when the honey flow is small, that a large number of sections are left in the supers imperfectly filled and consequently unmarketable. It occurred to me that if the beekeeper could feed his bees a cheap substitute for the plant nectar, and so enable them to complete these unfilled sections, they would then be marketable and give him quick returns, and often be greatly to his advantage. If the honey was in no way inferior to the ordinary honey, no injustice would be done. Without giving the details of the experiment, I will simply say, that a 100-pound sack of granulated sugar was dissolved and fed to three colonies of bees and thus used in completing partially filled sections. By this means they were enabled to increase in weight 88 pounds over similar colonies that were not fed. If this honey be valued at 8 cents a pound, it will considerably exceed the price of the sugar which was \$5.90.

I do not believe, neither do I wish to show, that honey could be produced in this way at a profit on a large scale; I only wished to find a way which would enable the apiarist to clean up his season's product and get immediate cash returns on the whole of it. I append an invoice of the property in the Section.

Respectfully submitted,

C. P. GILLETTE,

Entomologist.

Fort Collins, Colorado, November 30, 1895.

Report of the Chemical Section.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—The Station work has been prosecuted with all diligence, and while our progress has been slower than we had hoped, the work accomplished has been large considering our limited force, which is inadequate to perform the work before us.

I can not commend too highly Mr. Ryan's faithfulness, nor would I have it inferred that he lacks skill in the class of work which is assigned to him; still we can not keep up with the work, for everything undertaken leads to new work and we understand it to be the object of Station work and the desire of the Board, that the Station should be employed in original investigations, rather than in doing work which has already been done by able men with good facilities at their hands.

Our work on the "Alfalfa Bulletin" is approaching completion. There remains but one series of investigations to complete the first part of the bulletin, i. e., Alfalfa, its Growth and Composition; a detailed study of the soil it grows in; and the changes produced in the same, which was the primary object of this study and which will require a much longer time than the first part. Mr. Ryan has, by my advice, commenced a study of the effect of growing sugar beets on alkali lands. The starting point is the fact that, as soon as a new territory is brought under irrigation, certain low spots as a rule lack drainage and become alkalinized. It is proposed that Mr. Ryan study the following points: First,

the amount of water that finds its way into the basin, or alkalized area; second, the character of the strata through which the water moves together with the size of the area drained; third, to determine the change in the depth of the water level in alkalized areas by the irrigation of the drained area; fourth, the rate of evaporation from the surface of the soil and, with this, the amount of alkali deposited; fifth, the depth to which the alkalization takes place; sixth, the effect upon the composition of the soil; seventh, to determine the effect of growing beets upon the amount of alkali in the soil; eighth, the composition of the beets themselves, both as to feeding value and for sugar; ninth, whether a variety of beet grown entirely for the top would not be better to remove the soda from the soil than one grown primarily for the roots yielded.

I have outlined Mr. Ryan's work in order that it may be seen how much the work of the Department really involves. Mr. Ryan is willing to undertake the investigation, but several things are evident, i. e., that it will require much more than one year to accomplish it; that he ought to have a piece of ground at his disposal adapted to his object; that he can not do the manual work connected with it; and that he will have to ask for aid from other departments. The chemical work alone in such a study is very great, and a large portion of it would be a kind that requires much time to do properly. There would necessarily be a careful study of the water and the soil, each of which requires considerable time. We would probably publish a progress bulletin on this work yearly after the second year until the investigation was finished.

I suggested in my last annual report the desirability of my making a study of the waters used in irrigation, or rather of the chemistry of irrigation, including (1) the composition of the water as it flows from the ditches; (2) the amount that flows off the irrigated field; (3) the composition of this portion to see how much it takes up from the surface soil; (4) the amount that percolates to different depths and the composition of the

respective portions. This work can be done only by the aid and co-operation of the Department of Engineering, which should have charge of the drains and other devices which might be used to determine these points. I believe that the two departments are agreed as to the desirability of such a study. The amount of work which this would entail upon the Chemical Department is large and would extend over probably four or more years. We would have, however, as a result of such work, the satisfaction of having contributed to an important subject, one which has not yet been studied in detail by other stations. Such work will require money, men, time, and can not be accomplished without.

I have given expression to the desire of the Department as to the work to be undertaken in order to comply with the purpose of the Experiment Station, and I fully appreciate the magnitude of the work. If, however, adequate assistance be given me, I should be pleased to undertake the work.

This may be a proper opportunity to lay before the Board the peculiar position in which the Department is placed by individuals making application for analyses of water, also of other subjects. I would gladly comply with any reasonable request of this nature, recognizing the fact that the public believes that it has a claim on the College as a public institution. It seldom happens, however, that an analysis is requested by the State, but almost always by some individual who wants to bring a lawsuit, or make some other personal use of it. The other side of it is, that none of them knows what the request means to the Department. Already we have more than we can possibly do, and really have no time to give to these individuals; but, in order that the Board may be apprised of the matter, I will mention only the water analyses which have been asked for during the past year, numbering thirteen. We have complied with some of the requests; others we have had to put off until we should have more time. The Board will more fully appreciate what this means when it is informed that a water analysis requires from one week

to three weeks for its proper execution, according to the character of the water to be examined. If they should all come at once, we could make more than one analysis at a time, but they are scattered along through the year and the interference with our work is often a more serious matter to us than the actual labor put upon the analyses themselves.

The Department has participated in the work of the Association of Official Agricultural Chemists in soil and ash analyses. We have done so believing it to be advisable to keep in touch with the other stations as much as possible, and hope it will meet with the approval of the Board, even though it takes rather more time each year than we can afford. Between seven and eight weeks were given up to it this year.

Some idea of the work done by us may be conveyed to you by stating, in numbers, the quantitative determinations made by the Department from January 1st, to November 20th, 1895, which amount to nine hundred and fifty-three. To this is to be added the whole of our teaching work; also work done in collecting and preparing samples. The teaching requires the time of one man during the school months.

The Department has depleted, to a considerable extent, its supply of chemicals, as will be seen by reference to the inventory. No large orders have been placed during the year. This has happened from the fact that our appropriation for this year was nearly exhausted in paying for an order placed last November.

The condition of our building is known to the Board. As I am persuaded that the Board will do its best to improve our condition at the earliest convenience, I will dismiss the subject with this mere mention of it.

The inadequacy of the heating apparatus, however, is a serious matter, and if we are to remain in the present building for several years to come, it ought to be replaced by some more efficient one. During the winter of 1894-'95 I kept the classes a great many times with the thermometer below 50 degrees, and, in several instances, it was as low as 42 degrees. I consider this

too dangerous to the health of the students. We can not, even in moderately cold weather, heat the whole building at once; we have to turn the heat first into one room and then into another, and even then there is always one side of the building which we can not heat, i. e., the windward side. I have never found any occasion to blame Mr. Kelly, for the furnace and fire are kept in good condition.

I wish to acknowledge the uniform kindness of the President and Board, and, in closing, to state that I believe that the Department is in a more promising condition at present than it has been at any time during the past three years.

Respectfully submitted,

WM. P. HEADDEN,

Chemist.

Fort Collins, Colorado, November 30, 1895.

Report of the Divide Experiment Station.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I herewith present the Fifth Annual Report of the Divide Experiment Station.

The past season was somewhat exceptional, being wet and cold until August 1st and hot and dry until September 21st. On September 17th, the hottest day of the season, the thermometer registered 88 degrees in the shade. Five days later the ground froze to a depth of one and one-half inches.

Seldom, during the season, was the night temperature above 50 degrees; often running as low as 38 degrees. Conditions were favorable for early oats and for hay; but late oats and potatoes made poor yields. The potato yield, on the Divide, was less than 2,000 pounds per acre. The schedule of work, approved by your Committee, has been adhered to.

FARM DIVISION.

One row, ninety feet in length, was given to each variety of wheat, oats, barley, flax, and broom-corn. The flax and broom-corn were not grown successfully. The varieties planted were as follows:

Wheat—Amethyst, Australian Club, Blount's No. 10, Eldorado, India No. 5, India No. 11, Improved Fife, Marvel, and Niagara.

Oats—New Zealand, Black Tartarian, Excelsior, Monarch, Silesian, Chinese Hulless, White Russian, Common Black, and Yellow French.

Barley—Smooth Hulless, Winter, Guy Malye, Winipeg, and California.

Flax—Russian, White, Common, European, and Belgian.

Broom-corn—Improved Evergreen and New Japanese.

OATS:

Four acres were tested to light and heavy seeding, deep and shallow plowing, and treatment for smut. In smut treatment, the grain was dipped in a solution, made by dissolving one-half pound of blue vitriol in one hundred gallons of water, and allowed to remain fifteen minutes. The seeds were dried before they were planted. This treatment gave five per cent. smut; seed untreated gave ten per cent. smut. A heavier crop would have been secured had not ten per cent. of the heads blighted, and had not damage resulted from a heavy wind, September 2d, which blew down some heads which could not be gathered up. An August hailstorm destroyed some of the grain.

No.	Name.	Pounds of seed used per acre.	Yield per acre in bushels.	Pounds in bushel.
1.	Excelsior.....	30	52 7-8	37
2.	Excelsior.....	54 1-2	57 1-3	39
3.	Excelsior.....	72 3-4	56 3-4	40
4.	Excelsior.....	86 3-4	65 3-4	40
5.	Excelsior.....	62 1-2	63 3-5	40
6.	Excelsior.....	62 1-2	51 1-6	40

In the case of No. 5, the ground was plowed from 8 to 10 inches deep; of No. 6, from 3 to 5 inches deep.

Varieties were tested on four acres. The Chinese Hulless made a poor stand and was cut for hay.

Name.	Pounds of seed used per acre.	Yield, in bushels, per acre.	Pounds in bushel.
Golden Giant.....	80	52 1-3	32
New Zealand.....	72 1-2	44 1-2	36
Silesian	66 1-2	52 2-3	37

The new varieties, Yellow French and White Russian, were grown in rows 90 feet long. The seeds therefrom have been saved for future trial.

Oats were drilled in on April 17th and 18th. Excelsior, Nos. 2 and 4, was harvested August 26th; other varieties, except Excelsior No. 1, harvested September 7th, were harvested September 4th.

OATS AND PEAS:

Oats and Canada field peas were planted, on a four-acre tract, April 25th. Harvested August 27, the yield of dry hay of excellent quality was from 5,662 to 6,969 pounds.

BROMUS INERMIS AND OATS:

These were planted on one acre, April 25th. The oats were cut for hay on August 13th. A good stand of grass was obtained from the sowing of from 15 to 20 pounds of seed per acre.

BUCKWHEAT:

This grain was sown on two small plats on June 8th. Hail in July and storms in August did much damage to the plats. At harvest time but half a stand remained. The Japanese yielded 8 bushels and the Silver Hull 10 bushels per acre.

FORAGE CROPS AND GRASSES:

Crimson, medium red and white clover, redtop, and sandwick were added to the list of grasses. All did well, from seed, the first season.

OLD GRASS PLATS:

English rye grass, Kentucky blue grass, alsike clover, and mammoth red clover were killed and the plats upon which they grew were re-sowed. Orchard grass, tall meadow fescue grass, tall meadow oat grass, and timothy were half winter-killed. The plats were re-sowed. Bromus inermis, large canary grass, and esparcet stood the winter and now show good results.

BROMUS INERMIS:

This grass has been growing on the Station land since 1891. Spring sowings each year have been made. One plat, where the snow was blown away, yielded 211 pounds of seed and 3,000 pounds of hay per acre; another plat, upon which the sand drifted to a depth of from 6 to 8 inches, yielded 2,068 pounds, per acre, of excellent hay. The latter plat is the oldest one on the grounds. Still another plat has been pastured two seasons. In an exposed position, this plat has shown that bromus inermis grass can be pastured without injury to the sod. This grass grows from four to six inches the first year, producing very few seed stalks. At the end of the first season each seed will make a stool from two to six inches square. One seed produced a plant that in three seasons covered between 700 and 800 square-inches of surface. This grass is of high value for cow feeding, as but little grain is used in connection with it.

ALFALFA:

From one plat sown in 1893, 2,680 pounds of hay was harvested on July 16th. Last year this plat was not cut. Around the edges of the plat, the alfalfa was six inches high, while in the center it was not more than three inches in height. The good crop was, doubtless, the result of the snow held upon the plat by the grass growth mentioned. A second crop was not cut, in order further to test the value of the former experiment. Another plat, that has been cut every year, yielded 650 pounds of dry hay per acre. Other grasses yielded pounds of dry hay as follows: Yellow oat grass, 1,379; large canary grass, 2,238; esparcet clover, 2,038; Italian rye grass, 875; and timothy grass, 1,863.

POTATOES.

An unfavorable season caused slow sprouting, about 15 days later than usual. Slow growth was noted until August 1st, when a drouth set in. The number of potatoes was as large as usual, but the small size decreased

the yield. Work was planned to answer these questions: What varieties will give the best yield? What is the proper method of planting? What time of planting will insure the most desirable results?

Different localities and soils will require different methods to secure satisfactory results. These things are worthy of attention: good seed, proper cutting, well-plowed ground, planting in loose soil and covering well, and thorough cultivation with weeds kept out.

Results on planting, made May 6 and 7, 1895, are given. The figures represent pounds per acre. The average yield, Table No. 1, was 2,276 pounds of marketable and 1,792 pounds of small potatoes.

TABLE NUMBER ONE.

VARIETIES	PLANTED THREE INCHES DEEP ON FOUR-INCH PLOWING		PLANTED THREE INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON FOUR-INCH PLOWING		AVERAGE YIELD PER ACRE—EARLY PLANTING	
	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL
Pearl of Savoy	1,583	2,305	1,252	791	1,600	1,583	1,305	1,626	1,435	1,576
People's	4,151	1,191	4,004	1,235	2,891	1,696	2,679	957	3,432	1,270
Rose Seedling	1,353	2,497	2,627	2,557	3,016	3,593	4,410	2,923	2,851	2,992
American Wonder	2,888	2,009	3,680	1,679	2,897	1,966	2,122	2,444	2,867	2,024
Rochester Rose	1,914	1,975	2,253	2,462	2,292	2,205	1,096	1,114	1,889	1,939
Late Ohio	902	913	1,096	687	1,314	1,140	1,209	1,061	1,133	950
Average Yield per Acre	2,135	1,815	2,485	1,568	2,335	2,632	2,167	1,687	2,276	1,792

Table No. 2 gives the results of plantings on May 20 and 22, 1895. The figures represent pounds per acre, the average yield being 2,282 pounds large and 942 pounds small potatoes per acre.

Table No. 3 shows results of plantings on June 5 and 6, 1895. The average yield per acre was 1,280 pounds large and 865 pounds small potatoes.

Table No. 4 gives the results of testing different varieties on rows 90 feet long and 3 feet apart. The yield represents pounds per acre.

Table No. 5 indicates some results obtained by using seed of different sizes and planting different distances apart in the row. Late Ohio was used on first and People's on last part.

TABLE NUMBER TWO.

VARIETIES	PLANTED THREE INCHES DEEP ON FOUR-INCH PLOWING		PLANTED THREE INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON FOUR-INCH PLOWING		AVERAGE YIELD PER ACRE—PLANTING MAY 20 AND 22	
	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL
Pearl of Savoy.....	2,192	1,653	609	748	1,609	1,487	739	809	1,287	1,224
People's.....	3,245	809	1,218	809	2,888	1,054	1,896	704	2,312	844
Rose Seedling.....	3,001	704	2,636	765	3,158	896	2,157	1,574	2,738	985
American Wonder.....	3,828	1,948	3,654	1,522	4,332	1,914	2,888	1,740	3,650	1,531
Rochester Rose.....	3,591	1,795	1,896	1,322	2,279	2,261	1,966	1,331	2,433	1,655
Late Ohio.....	1,496	774	1,191	722	783	809	1,631	870	1,275	794
Average Yield per Acre.....	2,888	1,265	1,867	1,098	2,598	1,406	1,876	1,171	2,282	942

TABLE NUMBER THREE.

VARIETIES	PLANTED THREE INCHES DEEP ON FOUR-INCH PLOWING		PLANTED THREE INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON EIGHT-INCH PLOWING		PLANTED SIX INCHES DEEP ON FOUR-INCH PLOWING		AVERAGE YIELD PER ACRE—PLANTING JUNE 5 AND 6	
	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL	LARGE	SMALL
Pearl of Savoy.....	739	1,252	939	1,113	478	478	251	174	662	754
People's.....	2,314	1,104	2,784	1,157	1,792	1,566	739	705	1,907	1,123
Rose Seedling.....	3,427	817	2,209	991	1,392	704	922	696	1,987	802
American Wonder.....	1,531	974	3,158	1,357	2,362	1,148	460	451	1,853	980
Rochester Rose.....	1,479	1,531	1,096	1,104	974	878	261	696	956	1,052
Late Ohio.....	313	504	508	652	461	417	251	348	383	480
Average Yield per Acre.....	1,634	1,030	1,682	1,062	1,226	865	481	510	1,280	865

TABLE NO. 4.

Varieties.	Yield, large, per acre.	Yield, small, per acre.	Total yield per acre.
Carmen No. 1.....	2,440	3,160	5,600
Columbian	1,120	2,400	3,520
Delaware	2,600	2,640	5,240
Dictator	2,160	3,600	5,760
Dunmore	2,280	3,920	6,200
Early Sunrise.....	2,600	3,400	6,000
Early Ohio.....	2,160	2,040	4,200
Early Minnesota.....	2,200	2,200	4,400
Empire State.....	2,960	3,920	6,880
Green Mountain.....	3,360	3,440	6,800
Gold Flake.....	2,440	5,440	7,880
Ideal	2,600	1,960	4,560
Iron-Clad	3,320	2,760	6,080
Irish Daisy.....	3,320	3,080	6,400
Jumbo	3,520	3,120	6,640
Late Puritan.....	4,480	3,040	7,520
Mammoth Pearl.....	3,440	3,200	6,640
Martin's Seedling.....	3,800	3,200	7,000
Maggie Murphy.....	3,400	2,080	5,480
Manitoba Rose.....	2,440	3,760	6,200
Northern Spy.....	3,000	2,320	5,320
Ohio Junior.....	3,400	2,240	5,640
Ohio Fancy.....	5,120	3,680	8,800
Peach Blow (original).....	4,840	2,280	7,120
Pride of the West.....	2,880	2,920	5,800
Plymouth Rock.....	6,000	1,720	7,720
Prince Ed. Island.....	5,800	2,240	8,040
Potentate	4,560	2,400	6,960
Prize Taker.....	4,880	2,160	7,040
Rose's Beauty of Beauties..	5,440	2,920	8,360
Rural New Yorker No. 2.....	3,600	2,680	6,280
Red Snowflake.....	3,960	2,120	6,080
Seedling No. 75.....	6,080	4,440	10,520

Stanbury	3,160	3,640	7,800
State of Maine.....	4,080	2,680	7,760
Salt Lake Rose.....	3,240	4,000	7,240
Triumph	3,400	3,620	7,020
Vick's Champion.....	4,220	3,440	7,660
Winner	3,280	2,480	5,760
White Rose.....	3,320	4,080	7,400
White Elephant.....	3,480	2,720	6,200
World's Fair.....	4,720	2,880	7,600
Yucatan	2,760	2,200	4,960
Yankee Notion.....	2,320	2,480	4,800
Early Beauty of Hebron.....	5,040	4,220	9,260
Extra Early Vermont.....	4,640	1,741	6,381
Oxford	3,280	3,360	6,640

TABLE NUMBER FIVE.

LATE OHIO AT DIFFERENT DISTANCES IN ROWS.

SIZE OF SEED	12 Inches	16 Inches	20 Inches	24 Inches	28 Inches	32 Inches	36 Inches
	Whole..... { Large { Small Half..... { Large { Small Quarter..... { Large { Small Two Eyes..... { Large { Small One Eye..... { Large { Small PEOPLE'S One Eye..... { Large { Small	4,820 4,500 4,080 1,840 3,760 1,340 3,520 1,920 3,600 1,280	3,600 3,360 3,360 2,000 4,320 1,520 3,920 1,600 3,040 1,200	3,920 260 2,480 1,360 4,400 1,840 3,680 1,440 2,960 1,040	3,760 2,640 2,800 1,840 3,200 1,520 4,160 1,440 2,880 1,120	3,280 2,240 2,960 1,224 3,280 1,120 3,840 1,360 2,320 880	3,120 1,840 2,720 1,124 3,320 1,280 2,560 966 1,920 960
	2,929 1,565	3,263 1,697	2,347 1,320	2,263 1,174	2,169 565	2,935 943	1,320 472

Seed potatoes from Fort Collins were planted on plats adjoining those on which seed grown on the Station land were planted. The seed brought from the Home Station yielded one-fifth more potatoes. Further trial is necessary to test the advantages of changing seed from one locality to another. The varieties thus tested were the Rose Seedling and People's. The latter made the best result when cut in quarter pieces.

Tests were made by planting seed in furrows on well-plowed land and by dropping seed in every third furrow as the plowing progressed. The result was one-half more in favor of the first method.

A plat of bromus inermis sod was plowed under and the land prepared for potato planting. The purpose was to test the value of this grass as a fertilizer. A double yield was obtained.

ORCHARD.

Eighteen of the 20 trees planted grew fairly well. All trees previously planted are in good condition. Only six of the 12 plum trees planted grew and these made a poor growth. The Rocky Mountain cherry trees and the currant and gooseberry bushes were in full bloom when the freeze of June 9th came. The white ash trees were received in bad condition and in consequence made a slow growth. Those formerly planted did well. The cottonwood, green ash, and box-elder trees, planted in 1892, are in good condition.

GARDEN.

Beans, peas, table beets, carrots, turnips, parsnips, radishes, lettuce, cabbages, cauliflowers, and summer squashes did well although they came at a later date than usual. Sweet corn was not in silk when it was frozen, September 22d. The California tree bean yielded at the rate of 3 1-2 bushels per acre. Under different weather conditions the yield would have been several times greater.

CONCLUSIONS.

1. The best results follow sowing one and one-half bushels of oats to the acre.

2. Eight to ten-inch plowing is better for oats and potatoes than 4-inch plowing.

3. *Bromus inermis* is the best grass for the Divide region.

4. The American Wonder, People's, and Rose Seedling are the best varieties of potatoes for field culture.

5. Potatoes planted 3 to 4 inches deep, on soil plowed 8 to 10 inches deep, give better results than any other method tried.

6. The best results are secured when potatoes are planted between May 15th and May 30th.

7. The time to sell potatoes is when they are taken from the ground. Thus a loss of 16 per cent. in weight, in six months, is saved; also a loss, in size, the smaller potatoes shrinking below marketable size.

8. That a farmer can better afford to take 30 cents per 100 pounds for his potatoes in the fall than to keep them for a 40-cent price in the spring.

9. All ground should be well plowed before potato planting begins.

10. Field corn is an unprofitable crop at this Station.

11. Under proper care, cottonwood, box-elder, and ash trees do well.

12. Further experiments are necessary to give more definite information on all lines of experimental work undertaken at this Station.

Respectfully submitted,

J. H. McCLELLAND,

Superintendent.

Monument, Colorado, November 12, 1895.

Report of the Rain-Belt Experiment Station.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I have the honor to submit to you the following Annual Report, for the year 1895, of the Rain-Belt Experiment Station.

The year has been one of extreme changes, the early part being very warm and dry, followed later on by wet and extremely cold weather. The Station weather record shows a precipitation of over thirteen inches from April to September, nearly half of which fell in the month of July. On July 20th we had a hailstorm, lasting thirty minutes, which covered the ground to a depth of four inches and destroyed vegetation so that a great portion of the crops had to be replanted. Grasshoppers were an annoyance the entire season. The drouth of August and September together with cold nights and chinch bugs, so affected the crops that they failed to mature before they were killed by the frost of September 22d.

FARM DIVISION.

Four varieties of wheat were sown on March the 18th: Velvet Chaff, Saskatchewan Fife, Marvel, and Polish. These were sown broadcast and plowed under to a depth of four inches. On account of the dry spring only a portion came up. On April 26th, there was precipitation of about one inch which caused the ground to bake, thus preventing the grain from coming through.

On May 6th, the harrow was put on and the crust broken. This improved the stand very much, but on account of drouth and hot winds that followed the latter part of May and early part of June, the wheat was a failure and, by order of the Farm Committee, the ground was planted with corn.

Two varieties of oats were sown. One acre of Yellow French, sown April 9th on fall plowing was cultivated. The result was the same as in the case of the wheat. One acre of Excelsior was sown April 17th and plowed to a depth of four inches. The hail that fell on June 20th affected it badly. The rains that followed so improved it that it was thought best to let it stand and it was cut for hay on the 15th of August giving good results.

There were three varieties of barley. One acre of California was sown broadcast April 8th, and plowed under. One trial plat of Mansure and one of Black Barley were sown. On account of grasshoppers and hail the land was planted to corn June 22d.

One-half acre of rye was sown broadcast April 8th on corn stubble, and plowed under. It gave fair promise, but on account of the hail the land was planted to corn.

One plat of Canadian Field peas was planted April 8th and gave fair promise, but the hail destroyed all and the plat was planted to corn.

NON-SACCHARINE CANES.

On May 22d three acres of Kaffir corn were planted. The stand was poor and badly affected by grasshoppers. It was replanted June 14th to Kaffir corn. This failing to make grain was cut for feed September 25th and yielded 3,000 pounds to the acre.

Jerusalem corn, two acres; Russian maize, one acre; and Egyptian rice corn, one acre, were planted May 22d. All germinated but produced very delicate plants and were so affected by grasshoppers that the land was planted to Pride of the North corn, by the side of schedule rows, June 14th.

Two acres of Red Amber sorghum were planted May 25th at a depth of four inches; but on account of the cold weather at the time of planting, it failed to germinate and replanting was done June 15th with planter drill. Later in the season both plantings came up and grew to a height of six to ten feet. The most of this growth matured before the frost. The sorghum was cut September 25th and is now standing in the field in shock.

There were four varieties of broomcorn planted, to a depth of four inches: Missouri Evergreen, California Golden, Tennessee Evergreen, and New Japanese. The stand being poor, replanting was done June 15th. The first three varieties giving a stand were cultivated three times with cultivator and, up to the first of August, the prospects were good. In August the drouth nearly ruined it, but the rains in the latter part of the month so improved it on the low land that a portion of it was cut for brush,—a fair quality but somewhat affected by frost. On account of poor seed the New Japanese proved a failure at second planting and the plat was planted to corn June 29th.

The following varieties of corn were planted May 24th: Four rows Early Crosby, two rows Early Sanford, two rows Reiley's Favorite, two rows Heming Ninety-Day, two rows Goddard's King of the Earliest, and three rows Red Cobb Ensilage. All were planted in rows one-fourth mile long, north and south, on different depths of plowing done east and west. These varieties gave a good stand and were harrowed and cultivated before the hail cut them down level with the ground and put them back so much that the August drouth affected them so severely that they seemed almost a failure; but the rain in the latter part of the month started them growing again. While in this condition the frost of September 22d killed them. There were also planted at the same time, in the field crop, the Pride of the North and the Colorado White, treated the same as the above. The corn is soft and unfit to gather at this date, November 1st. The Pride of the North, planted June 14th where the non-saccharine canes were, was so affected by hot wind that I commenced to cut it

for feed September 5th. From June 18th to the 22d the small grain ground was planted to Colorado White corn, with planter drill, twenty inches apart in rows, at a depth of three inches, rows being three feet ten inches apart. This was cultivated and harrowed before it came out. The seed germinated and came up, was cultivated three times and gave fair promise of a crop; but owing to the protracted drouth through August, it was decided on the 26th of that month to cut it for feed. On the 27th an inch of rain fell. This improved it so much that it was not cut until the latter part of September.

Although the experiments with potatoes were not satisfactory, they may be of some value in showing the results secured under the conditions of this season. There were four varieties planted, one-fourth acre each. Vick's Perfection was planted April 20th in rows eighty rods long, north and south, at a depth of five inches, on spring and fall plowing, done at different depths from 6 to 8 inches. The vines made a vigorous growth, were in bloom June 20th, and had potatoes the size of walnuts; but the hail of that date destroyed them. The rains which followed brought them on again, but they did little good in forming tubers and none was fit for the table until August 1st. They were planted May 20th, Mammoth Pearl, Mammoth Prolific, and Late Ohio. At the time of the hail the growth was only about six inches high and was not so badly affected as the earlier one. Of the four varieties planted, the percentage of small potatoes was as follows: Vick's Perfection, 50 per cent.; Mammoth Pearl, 30 per cent.; Mammoth Prolific, 15 per cent.; and Late Ohio, 25 per cent. The following shows the marketable yield per acre in bushels.

Vick's Perfection, 16 1-2 bushels.

Mammoth Pearl, 32 1-2 bushels.

Mammoth Prolific, 36 bushels.

Late Ohio, 27 1-2 bushels.

On the rows planted north and south across spring and fall plowing done at different depths, the difference in the yield was not so perceptible at the different depths of plowing as in the different lay of the land. The south

half was rolling and north half level. The latter retained the water longer after the rain so that two-thirds of the potatoes were grown on less than one-half of the ground.

TRIAL PLATS OF GRASSES.

On May 13th there were sown one-half acre of alfalfa; twenty square-rods each of White Medium Red, Mammoth Red, Crimson and Alsike clover; and twenty square-rods of timothy. The seed germinated and came up but the growth was taken by grasshoppers. The ground was planted to corn June 27th. Yard plats in three sections were sown March 22d: East section, *Bromus inermis*; west section, *Holcus lanatus*; and south section, *Arcua flarescens*, but on account of the wind and sand storm, April 5th and 6th, the seed were blown from the ground. The plats were sown again May 6th, the east section to *Bromus inermis*, west section to *Holcus lanatus*, and the south section to *Panicum virgatum*. All germinated and gave promise of fair stand, but were taken by the grasshoppers. June 28th the plats were sown to English blue grass, red top, and orchard grass. These gave a good stand but were taken by grasshoppers, July 22d. Alfalfa was then sown. This gave a fine stand; the plants, although tender on account of their late start, are going into the winter in good condition.

A general line of vegetables, including melons, was planted in the garden, but it was so affected by grasshoppers that it was replanted June 10th. Then the hail so affected it as the plants were coming up, that the entire plat was planted to beans June 24th. These gave a good yield.

ORCHARD.

Trees set out last year are all alive and in fine condition. The cherries, Early Richmond and Rocky Mountain, bore some fruit.

Of the 77 apple trees, received in the spring, all but five are alive. One-twelfth of the Early Richmond and

five-twelfths of the English Morella were lost. The Rocky Mountain cherries proved the most hardy and all are in good condition.

Three trees were lost of the fifty ash, 50 black locusts, and 25 Russian mulberry planted. One-half of the Russian apricots died. Gooseberries, currants, grapes, blackberries, and raspberries, received in good condition, did not do well under the conditions before reported. Owing to the poor condition in which the plum trees reached the Station, fully one-half died. All trees received were at once planted with necessary care. Promising well at first, they were severely injured by the hail of June 20th. To this hail is due the most of the losses reported.

Respectfully submitted,

J. B. ROBERTSON,

Superintendent.

Cheyenne Wells, Colorado, November 4, 1895.

Report of the Arkansas Valley Experiment Station.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I take pleasure in presenting to you the Eighth Annual Report of the Arkansas Valley Experiment Station.

On assuming charge of the Station July 1, I found it in good condition with the work well under way. Owing to the lack of water in the early spring and other causes, some of the crops were put in very late, and, as a result, they failed to produce the best results. The schedule of experimental work has been closely adhered to. It is hoped that the results secured may be of real value to the interests for which the Station was established.

CLIMATIC CONDITIONS.

The season has been an exceptional one. In July and August there was an unusual fall of rain, amounting to six and eighty-five one-hundredths inches. For the same period the previous year, one and sixty-five one-hundredths inches fell. The total amount of rain for the season from March 1st to November 1st, was ten and fifty-five one-hundredths inches, which amount is above the normal. The temperature was much below the average of years; and the season was correspondingly late, the maximum temperature was not reached until the 13th and 14th of September, when the thermometer

stood at 100 degrees F., in the shade. The large amount of rain during the summer promoted the growth of alfalfa and grain. Corn grew to maturity without irrigation other than that required for plowing previous to planting. The several long periods of rainy weather and the accompanying low temperature were injurious to melons and tomatoes, causing many of them to rot on the vines. The only damaging storm of the season occurred on the evening of August 9th, at which time eighty-six one-hundredths of an inch of water fell in the space of fifteen minutes, accompanied by a very strong wind and with hail enough badly to damage fruit and vegetables. The wind overturned hay stacks and the rain at the time and that which followed the next day caused much of the hay to become wet and damaged.

CEREALS.

Red Russian (winter wheat). One and one-half acres of old wheat land were sown to Red Russian wheat, September 27th. The ground was prepared in the usual manner, by irrigating previous to plowing. The seed were put in with a drill and the land thereafter harrowed. The grain made a fair stand and was reasonably free from weeds. Three irrigations were made during the spring. The grain was harvested July 8th. When thrashed it gave a yield of 2,124 pounds of good wheat, or a rate of twenty-three bushels per acre.

Turkish (winter wheat). Four and one-half acres of old wheat land were sown to Turkish wheat, September 28th, the land being adjacent to that upon which the Red Russian had been sown. Both received practically the same care. It was harvested July 13th. When thrashed, it yielded 6,940 pounds of wheat, or at the rate of twenty-five bushels per acre. The berry of the Turkish was more plump than that of the red Russian.

Canadian Velvet Chaff (winter wheat). Two acres of alfalfa land were sown to Canadian Velvet Chaff wheat, October 2, 1894. It was put in with a press drill at the rate of five pecks per acre. The grain made a good stand. It had two irrigations during the spring.

It was put into the bundle July 13th. The result was a yield of 5,653 pounds or 47 bushels per acre. This wheat has a fine, large, beardless head and indicates a good yielder for this section.

Clawson (winter wheat). One acre of alfalfa ground was seeded to Clawson wheat, October 2, 1894, with five pecks of seed put in with a press drill. One-half of the area was covered with well decayed barnyard manure, in mid-winter, to test the value of top dressing. The high winds in February and March blew most of the top dressing away, and also blew much of the grain out by the roots. There was no perceptible difference in the two portions of the field. It returned a yield of 1,690 pounds, or at the rate of twenty-eight bushels per acre.

Amethyst (spring wheat, fall sown). One acre of alfalfa land was sown to Amethyst wheat, October 2, 1894, for test of a winter variety. The seed was grown as winter wheat the previous season. It suffered from the wind as did the Clawson wheat. Nineteen bushels per acre, or a total of 1,138 pounds, was the yield. The experiment proved nothing of value.

Amethyst (spring wheat). Four acres of old wheat land were sown to Amethyst wheat to test the merits of deep and shallow plowing and heavy and light seeding. The first two acres were planted April 16, 1895, with a hoe drill, at the rate of 140 pounds of seed per acre. Acre No. 1 was plowed eight inches deep, and acre No. 2 was plowed four inches deep. Acres Nos. 3 and 4 were planted April 23, 1895, and seeded in the same way, but at the rate of ninety pounds of wheat per acre. Acre No. 3 was turned under eight inches deep, and acre No. 4 four inches deep. All four acres received the same care. Harvest occurred August 7th. The yield from each acre was as follows: No. 1, 1,238 pounds or 20.6 bushels; No. 2, 1,068 pounds or 17.46 bushels; No. 3, 468 pounds or 7.8 bushels; and No. 4, 400 pounds or 6.16 bushels. The grain on the last two acres being planted later and with light quantity of seed, came up very thin and was almost choked out with sunflowers. The early sowing with heaving seeding was

nearly free from weeds. The indications are that it was the late seeding, rather than the thin stand that promoted the growth of weeds as, almost always, late crops are taken possession of by weeds.

Excelsior Oats. Thirteen acres of old corn land were sown to Excelsior oats April 10, 1895. A portion of the field was irrigated and, owing to lack of water, it received no more attention until the first week in July. The oats were cut August 8th and, when thrashed, gave a yield of 12,580 pounds, or at the rate of thirty bushels per acre.

Rye (winter). Three acres of winter rye were sown in October, with a view to sowing "bromus" in the spring. The rye grew well and, when harvested, July 8th, gave a return of 3,578 pounds of the very best quality of grain.

Silver Hulled Buckwheat. One-half acre was sown July 1st, and grew well until the hail in August almost destroyed it. The yield was 128 pounds.

Corn. A comparative test of listed and unlisted corn was made. The two fields were adjacent and under the same care. Both had two cultivations, but neither was irrigated after planting. An equal area of each field was gathered with the following results: weight of the listed corn, 240 pounds; weight of the unlisted corn, 252 pounds; or five per cent. in favor of the unlisted corn.

There are forty-five acres of corn standing on the Station land. It all received two cultivations, but no irrigation. The yield will be about 25 bushels of shelled corn per acre. The corn crop is composed of the following varieties: Six acres of Leaming, six acres of Improved Leaming, and thirty-three acres of Colorado White.

GRASSES.

Small plats. The following grasses have made a good showing the past season: orchard grass, bromus inermis, esparcet, and sandwick. Bromus inermis proved very persistent, as it has spread into all the ad-

joining plats. The half-acre of bromus inermis grew a very light crop of seed, forty pounds. The three acres sown to rye were also sown to bromus inermis, April 19th, with a view of making pasture. Twenty-six pounds of seed were used to the acre. It was harrowed and then irrigated after sowing. A good stand seemed to appear at first, but the summer heat seemed to kill it on those portions of the field that dried out quickly.

Alfalfa. There are seventy-three acres of alfalfa at the Station. Three cuttings were made. The hay was all stacked with a Dain horse stacker, with the exception of that which was stacked near the barn for the stock. The first crop dates June 12th. It was all raked into one stack-yard. The second and third crops were raked in from the windrow. The distant portion of the field was stacked in a separate yard, thus avoiding long hauls. A record was kept of all the labor put on the harvesting of the several hay crops. Exclusive of the cost of machinery, the cost of putting up the hay was as follows: First crop, 153.29 tons at a cost of \$175.59, or \$1.15 per ton; second crop, 83.9 tons at an expense of \$79.68, or \$0.95 per ton; third crop, 74.2 tons at a total cost of \$73.50, or \$0.99 per ton. A team and driver were paid \$2.25 per day. Labor was \$1.50 per day. Twenty-three tons were stacked by hand. This was weighed with a view to test shrinkage.

Clover. There are three acres of red clover growing. The first crop was cut for hay, and the second was left for seed. It set very full of seed.

HORTICULTURE.

Apples. Since the severe hail-storm of three years ago, the orchard has practically been at a stand still. A large portion of the bark that was exposed was split and beaten off. Some of these wounds have partly healed over, but in many cases the limbs have died. During the first part of July, the three north rows of the apple orchard were thoroughly pruned. The cut surfaces were covered with a preparation of oil and varnish. The reduced size of the trees caused a new growth in

every limb that remained. The only trees that yielded apples worthy of mention were Cooper's early white, about 250 pounds from eleven trees, and Tetofsky and Missouri Pippin gave a yield of 100 pounds each from eleven trees.

Insects have not seriously molested the trees this season. Aphis was found in the orchard for the first time.

Pears. The pear trees are in about the same condition as the apple trees. A few blooms appeared, but no fruit set.

Plums. The hedge row of Chickasaw plums around the barnyard bore much fruit. This was very irregular in ripening, beginning in July and lasting to the first of November. The Forest Garden and DeSoto plums had their limbs loaded, but they were so exposed that the hail destroyed most of the fruit.

Grapes. The vineyard made a good growth of wood, but the vines were attacked in great numbers by the grape-leaf hopper which sapped the life out of the leaves before the fruit was mature. The grapes were gathered during the first week in September. The following was the yield: Ten Delaware, 14 pounds; five Duchess, 15 pounds; ten Brighton, 50 pounds; five Empire State, 11 pounds; five Niagara, 5 pounds; five Moore's Early, 19 pounds; five Lady Washington, 10 pounds; and four Woodruff Red, 2 pounds.

Raspberries and dewberries were winter-killed, but the few that lived were full of fruit. The plants made a very large growth.

Strawberries. The only addition to the fruit list of the Station was two hundred and fifty strawberry plants received from the Horticultural Department of the College. They consisted of the following ten varieties. The figures accompanying each name indicate the number of plants that are alive at the present time. When set out there were 25 plants of each variety: Bederwood, 16; Timbrell, 25; Bubach, 24; Crawford, 15; Warfield, 24; Wolverton, 10; Parker Earle, 21; Gandy, 22; and Haverland, 21.

Currants and gooseberries were injured by insects and the fruit was worthless.

GARDEN DIVISION.

Sweet Potatoes. One-fourth of an acre was set to sweet potatoes. They were too late fully to mature. The weight of the total crop was 1,500 pounds. After sorting, for market, there were but 800 pounds of saleable potatoes.

Irish Potatoes. The early potatoes were a total failure. They grew large tops but no potatoes formed. The late potatoes did well. The first planting of late potatoes was made June 15th, on the old potato ground, one and one-tenth acres. The Mammoth Pearl variety was used. When dug they weighed 8,655 pounds, equal to 131 bushels per acre. About 60 per cent. were marketable. The second planting was made June 23d, on alfalfa sod. Two irrigations were given, August 25th and September 1st. The crop was cultivated three times.

Eight-tenths of an acre of Late Ohio potatoes yielded 8,089 pounds, or 131 bushels per acre. These were regular in size and of desirable quality. One-fourth acre of Blue Victor variety gave a return of 2,046 pounds, or 136 bushels per acre. People's variety, on nine-hundredths acre, yielded 850 pounds, or 156 bushels per acre. The Freeman variety made a very poor showing. One-fourth acre yielded 930 pounds, or 62 bushels per acre. The many failures in potatoes planted early would warrant a careful series of tests for several years to determine the varieties and methods of cultivation best adapted to this soil.

Sugar Beets. One and one-half acres were planted to sugar beets May 1st. The ground dried out so rapidly that it became necessary to irrigate. A fair stand was secured. During the press of work in June the thinning was neglected until late. The crop received but one irrigation. Harvest began the last week in October.

Blahoticer Kleinwanzlebener planted in double rows on .17 acre yielded 5,650 pounds, or 16 1-2 tons per acre, and .14 acre of the same variety planted in single rows yielded 4,480 pounds, or 13 tons per acre.

Knauer's Imperial, .33 acre, yielded 7,648 pounds, or eleven tons per acre; Vilmorin's Richest, .17 acre, yielded 5,480 pounds, or 16 tons per acre; Mette, .06 acre, yielded 1,010 pounds, or 8 tons per acre; and Vilmorin's Improved, .03 acre, yielded 1,000 pounds, or 16 1-2 tons per acre. Red Top, .23 acre, yielded 6,808 pounds, or 15 tons per acre; and Mixed beets, .18 acre, yielded 4,814 pounds, or 13 1-2 tons per acre.

COST OF HARVESTING SUGAR BEETS.

A record of all labor put on digging the beets was kept with the following result: 5 1-2 days' team work, at \$0.75 per day, \$4.12; 22 days' man labor, at \$1.50 per day, \$33, making a total cost of \$37.12 for digging 22.44 tons of beets, or \$1.65 per ton. The beets were taken from the ground by plowing a deep furrow with the landslide as near the beets as possible without cutting them. They were then easily thrown in piles.

Table Beets. The Long Smooth Dark Blood Beet deserves mention as an excellent table beet; 250 feet of row gave a yield of 830 pounds.

Hemp. Land covering 10,260 square feet was sown with hemp May 6th. One cultivation gave a yield of 185 pounds of clear seed. Volunteer hemp came up on a plat that contained 8,436 square feet. The seed grown from this plat amounted to 205 pounds. Hemp grows well here, but the seed ripen very irregularly, so that the immature seed injure the sale of the good, it being impossible to separate them.

Celery. Four varieties of celery were tried: White Plume, Paris Golden, Yellow, Golden Self-blanching, and Giant Pascal. The seed were sown in beds April 26th and set in the row July 8th. The White Plume variety was the most satisfactory.

Tomatoes. Seed were sown in hot beds March 27th. The plants were transplanted to the field the latter part of May. Close observations were made to record the date of first fruit; also an account of all weights of the fruit taken from the vines. The following twenty-four varieties are arranged according to their productiveness.

The date given is that of first fruit and the weights are pounds yield per ten plants: Early Advance, July 24th, 222 pounds; Ignotum, August 8th, 122 pounds; Royal Red, August 5th, 122 pounds; Acme, August 5th, 103 pounds; Terra Cotta, August 8th, 103 pounds; Red Plum, July 30th, 100 pounds; Livingston's Perfection, August 3d, 96.4 pounds; Chemin Market, August 3d, 90 pounds; Democrat, August 5th, 76 pounds; Puritan, August 15th, 74.6 pounds; Lemon Blush, August 12th, 70 pounds; Trucker's Favorite, August 12th, 68 pounds; Beauty, August 15th, 64 pounds; Aristocrat, August 3d, 60 pounds; Livingston's Beauty, August 8th, 52 pounds; Matchless, August 8th, 51 pounds; Long Keeper, August 5th, 50 pounds; Dwarf Champion, August 3d, 48 pounds; Potato Leaf, August 15th, 41 pounds; Autocrat, August 12th, 37 pounds; Peach Tomato, August 8th, 35 pounds; Golden Queen, August 15th, 31 pounds; Ponderosa, August 8th, 29 pounds; Buckeye State, August 12th, 20 pounds.

Cabbage. Seven varieties were set out but too late to mature. Early Express was set out early and was ready for market the first of July.

Beans. The following beans were grown with success. The hail so damaged them that the yields were not estimated: Black Wax, Golden Eyed Wax, Southern Prolific, Snow-flake, Field Bean, Early White Navy, Henderson's Bush Lima, White Kindey, Dutch Case Knife, Refugee Bean, and the Large Red Bean.

Soja Bean grew and matured seed for the first time in three seasons' tests.

Peas. The Profusion Pea, deserves to be mentioned as the paragon of excellence for a main crop pea. The Alaska is very early. Admiral, Nott's Excelsior, and the Champion of England are varieties that are worthy of cultivation for early peas.

Egg Plant. Of three varieties tried—New York Purple, Black Pekin, and White Pearl—the New York Purple did the best.

Miscellaneous. The following plants were grown with success: tobacco, okra, peppers, lettuce, cucumbers,

melons, cantaloups, parsnips, squashes, pumpkins, gourds, and sweet corn. The following were failures: onions, ground cherries, turnips, white sorghum, and early potatoes.

ADDITIONS.

A team of horses was received from the Monte Vista Station, July 10th; also a double set of work harness at the same time. An improvement was made in the horse-barn by adding hay shoots. The following tools and machinery were purchased: One 5-foot mower; one stacker and three rakes; one hoe and two harrows; one post-maul; one bush scythe; one screw driver; and one riveting set.

Respectfully submitted,

PHILO K. BLINN,

Superintendent.

Rocky Ford, Colorado, November 15, 1895.

Report of the San Luis Valley Experiment Station.

To the Executive Committee of The State Board of Agriculture:

Gentlemen—I have the honor to submit herewith the Eighth Annual Report of this Station.

The schedule, as approved by the Station Council, has been my guide throughout the season, and though the results have not been all that was desired, yet they are very encouraging in many respects.

GENERAL CONDITIONS.

The past season has been unusual on account of the limited amount of precipitation during the winter and early spring, and the heavy rainfall after May 29th until September 1st. The temperature during the spring and summer was below the normal and crops as a rule were late. The Station record shows a precipitation of one and sixty-seven hundredths inches for May; sixty-six hundredths of an inch for June; two and fifty-three hundredths inches for July; and two and eighty-three hundredths inches for August, making a total of seven and seventy-nine hundredths inches for the four months. Considerable damage was done by hailstorms which occurred on the 28th of June and the 4th and 21st of August. Three acres of low land, which had sub-irrigated in the potato plats, were almost totally destroyed by water standing over the ground after the heavy rain which came on the 30th of May. Some places in the wheat and oat plats were damaged in the same manner.

There has been very little damage done by insect pests. Sweet corn and cabbage were injuriously affected. The cotton or ball-worm is so destructive that it is almost impossible to produce sweet corn for roasting ears. This is the first season that the cabbage worm has done any damage in the vicinity of the Station.

WHEAT CULTURE.

Variety tests. Six varieties were sown on potato ground in half-acre plats, on the 29th of March. Owing to the condition of the soil the germination was very uneven, most of the seed not sprouting until after the rains in the latter part of May. A large amount of water had been used to get the ground to sub-irrigate, but there being no moisture at the surface no capillary action took place until after the rains.

Improved Fife matured September 17th and yielded 17 bushels per acre.

Chili matured September 12th and yielded 16 bushels per acre.

Niagara matured September 17th and yielded 19 bushels per acre.

Sonora matured September 20th and yielded 20 bushels to the acre.

Australian Club matured September 20th and yielded 15 bushels per acre.

Austrian No. 2 matured September 20th and yielded 14 bushels per acre.

Field test of wheat was made on summer fallowing, potato ground, and following peas. In this test the variety grown was the Defiance. Seed sown on the potato ground were very slow to germinate and did not mature until damaged by frost. The yield was 16 1-2 bushels per acre. The summer fallowing plat was also slow to germinate and was killed by frost before it matured. The yield was 16 bushels per acre. Growth on the plat which had been in peas the previous season was very uneven in germinating, but as a whole was much earlier than either of the others and matured before being damaged by frost. It yielded 24 bushels per acre.

OAT CULTURE.

Variety tests. The oats were sown March 30th, in acre plats, on summer fallowing. The condition of the soil was such that the crop was very uneven, some of the grain germinating soon after it was sown and some of it not sprouting until after the first of June. The hail-storm on the 21st of August did considerable damage to these plats. Lincoln oats germinated well and there was a good stand over a large portion of the ground. They matured September 11th and yielded 30 bushels per acre.

New Zealand oats were also a good stand and produced 30 bushels per acre. They matured September 13th.

American Banner oats were uneven in germinating and the stand was very poor. They matured September 17th, and yielded 27 1-2 bushels per acre.

Excelsior oats were a very poor stand over the whole plat, as it had been damaged by water standing over it before the grain was high enough to shade the ground. They matured September 17th and yielded 23 1-2 bushels per acre.

Chinese Hulless oats were sown on potato ground March 30th. This variety made a vigorous growth, producing an enormous amount of straw. The oats were harvested September 17th and yielded 30 bushels per acre.

Jensen's hot-water process *versus* sulphate of copper was tried for treatment to prevent smut. The oats used in this test were Austrian No. 2, as this variety was damaged by smut last season to a greater extent than any other grown at the Station. Two half-acre plats of potato ground were sown March 30th. Examinations were made on the following dates: August 1st, September 1st, and September 15th to determine the number of heads affected in each plat. The results of the examinations showed that twenty-three per cent of the heads were damaged in the plat sown with grain which had been treated by the hot-water process, and

twelve per cent. in the plat where the grain had been treated with copper sulphate. The yield in the former case was 17 bushels per acre and 19 in the latter.

Oats grown on summer fallowing, following peas, and on potato ground were compared. In this test the yield per acre was 27 bushels on summer fallowing, 25 bushels following peas, and 23 bushels on potato ground. The variety used in this test was the American Banner. The plat on potato ground was much riper than either of the others when the hailstorm of August 21st occurred and it was damaged to a greater extent.

BARLEY CULTURE.

No results were obtained in the variety tests as the crop had nearly matured on the 21st of August and was almost entirely destroyed by the hailstorm of that date.

California barley, which had been late in germinating and was not nearly so ripe when the hail occurred, yielded 28 bushels per acre. This was sown March 30th on potato ground and matured August 26th.

POLISH WHEAT.

This made a very vigorous growth after it had germinated, producing a heavy yield of straw. It would have made a large amount of hay had it been cut at the proper time. It would have proved a valuable forage crop under the conditions of last season, providing the beards did not affect the stock to which it is fed. The yield was only 18 bushels per acre as it was killed by frost on the 22d of September, before it had matured.

FIELD PEAS.

Only one variety of field peas could be obtained in the local market, so no variety tests were made.

The common Mexican field pea was used in the tests of different quantities of seed. Half-acre plats were sown on the 15th of May with the following amounts of seed per acre: eighty, sixty, and forty pounds. The yield per acre on the first two plats was estimated to be two tons, there being very little, if any, difference be-

tween the eighty and sixty-pound seeding: while that, where forty pounds of seed were used, yielded only 1 1-2 tons per acre.

Peas with oats. This plat was sown on the 30th of March with the seed so mixed that forty pounds of peas were taken to one bushel of oats. The yield was estimated at 2 1-2 tons per acre. The product is superior to peas alone for a forage crop.

Different seasons of sowing were tried. Half-acre plats were sown on the following dates: April 1st, May 1st, and May 15th. All the plats were cut August 16th. The first two plats yielded two tons per acre. The yield on the plat sown on the 15th of May was a little lighter than the other two plats and the yield was probably 1 3-4 tons per acre. It is generally best to sow peas early in the season so that the crop can be cut in July for hay and the plowing done in August if the ground is to be sown to wheat or oats the next season.

FORAGE CROPS AND GRASSES.

Small plats of *Bromus inermis*, orchard grass, English rye grass, tall meadow oat grass, timothy, meadow fescue, alsyke, red clover, and mammoth red clover were sown in small plats May 26th.

Orchard grass made a very vigorous growth and was large enough by September 15th to produce a crop of hay.

Tall meadow oat grass also made a good growth and would have produced a crop the first season.

Timothy, *Bromus inermis*, and meadow fescue also made a fair growth and go into the winter in good condition.

The clovers all did fairly well. The mammoth red clover grew large enough to have produced a light crop of hay.

German, common, and Hungarian millet were sown on the 29th of May. None of these made a very good growth but were delicate and unhealthy throughout the season on account of the cool weather which prevailed through the summer. Under the conditions of last season, it would not pay to grow millet for a forage crop.

Alfalfa. The plats sown last year were all more or less damaged by winter-killing. The plats sown after May 1st and with nurse crop, were almost totally destroyed and only about half the plants revived in the plats sown on April 1st and May 1st. Young alfalfa winter-killed badly in all parts of the valley last season. The probable cause was the extreme dry fall and winter of the past season. A small portion of one of the plats sown was irrigated late in October, so the ground went into winter in a moist condition. The percentage of plants killed on the irrigated ground is very small compared with that of plants on the ground not irrigated. About ten per cent. of the plants were killed where the ground was irrigated and fifty per cent. where it was not irrigated.

Different seasons of sowing alfalfa were tested. The dates of sowing were April 1st, May 1st, May 15th, and June 1st. All the plats have made as good growth as could be expected and go into the winter in good condition. Some plats which had been seeded last year were sown again this year. Another season's growth will be necessary before the advantage of the different dates of sowing can be determined.

POTATO CULTURE.

Variety tests were made. The ground selected for these tests was summer fallowed the previous season. It was plowed to an average depth of eight inches and thoroughly harrowed a few days before planting. The seed were carefully selected from medium-sized potatoes of each variety and cut with a single eye in each piece. The potatoes were planted on the 13th of May, with an Aspinwell potato-planter, in rows three feet apart and the hills fifteen inches apart in the rows. During the heavy rain the last of May, the plat was greatly damaged by water standing over a large portion of it. In order to get anything like a fair test it was necessary to select parts of the rows which were the least damaged and measure them.

The tests of the varieties taken from those grown on the Station last season resulted as follows:

Name of variety.	Date of Maturity.	Yield of		Total.
		marketable potatoes in bushels per acre.	Small potatoes in bushels per acre.	
Yankee Notion.....	Sept. 1st	96	24	120
Freeman	Sept. 1st	105	36	141
North Spy.....	Sept. 5th	107	27	134
Vick's Perfection.....	Sept. 5th	106	76	182
Early Beauty of Hebron.....	Sept. 15th	146	37	183
Snow Flake.....	Sept. 15th	120	40	160
Sterling	Sept. 15th	123	40	163
Arizona	Sept. 15th	163	27	180
Minister	Sept. 15th	156	52	208
Seedling 36.....	Sept. 25th	86	17	103
Rochester Rose.....	Sept. 25th	103	34	137
Dictator	Sept. 25th	138	9	147
Ohio's Fancy.....	Oct. 1st	125	13	138
Negro	Oct. 1st	150	58	208
Plymouth Rock.....	Oct. 10th	152	43	195

The varieties which were brought from the Divide Station were planted by hand on the 13th of May. These were also damaged by water standing over the plar so that some varieties were entirely destroyed. The ground was so wet and cold that many of the plants did not appear until the last of June, making it impossible to obtain the date of maturity with any degree of certainty. The result of the yield is given in bushels in the following table:

Name of variety.	Marketable yield.	Small.	Total.
Early Minnesota.....	105	35	140
Rose Beauty of Beauties.....	117	17	134
Early Standard.....	96	24	120
Pearl of Savoy.....	127	17	144
Winner	75	15	90
World's Fair.....	70	23	93

Name of variety.	Marketable yield.	Small.	Total.
Salt Lake Rose.....	77	20	97
Carman No. 1.....	117	39	156
Lee's Favorite.....	84	18	102
Maggie Murphy.....	100	16	116
Manitoba Rose.....	93	23	116
Blue Victor.....	140	12	152

Trials were made of early and late planting. The results of this experiment were very unsatisfactory on account of the cold, late spring and the poor, uneven stand obtained in the early planting. The seed used in the early planting were the Rose Seedling variety, and only one-fourth of a stand was obtained. The plants were uneven in coming up, some of them being as late as the 15th of June. The crop was planted April 15th on ground which had been irrigated and then plowed to an average depth of eight inches. The plat was not in condition to dig until October 1st and yielded 50 bushels of marketable potatoes per acre. The product was worth eighteen cents per bushel at the time of digging. This was at the rate of \$9 per acre. The cost of producing and marketing the above crop was \$13 per acre. The variety used in the late planting was the Mammoth Pearl. These were planted on May 15th, and a fair stand was obtained. The yield per acre, of marketable potatoes, was 104 bushels. The price at the time of digging was fifteen cents per bushel or at the rate of \$15.60 per acre. The cost of producing the late crop was \$14.80 per acre. The items of expense are as follows: plowing and preparing the ground, \$1.25; seed, \$1.50; planting, \$1; cultivating and hoeing, \$3.50; water rent, \$1.20; sacks, \$1.80; harvesting, \$3; hauling to market, \$1.60—making a total of \$14.80. The difference in the cost of the two plats is due to the extra sacks and the hauling in the latter case.

Unfertilized land was compared with fertilized, barnyard manure being used. Three varieties were used in this experiment. A plat containing 11.2 acres was

manured at the rate of ten loads per acre. The ground was irrigated and then plowed to an average depth of nine inches. On the 9th of April a half acre each of the Rose Seedling, Mammoth Pearl, and Barclay's Prolific was planted. Only one-fourth of a stand was obtained of the Rose Seedling and about one-half of the Mammoth Pearl; while Barclay's Prolific made a fair stand. The plat was cultivated five times and irrigated once by running water between the rows. This was all the irrigation necessary as the ground had sub-irrigated. The yield per acre in marketable potatoes was as follows:

Rose Seedling, 50 bushels.

Mammoth Pearl, 100 bushels.

Barclay's Prolific, 155 1-2 bushels.

The yield per acre on ground which had not been fertilized was as follows:

Rose Seedling, 50 bushels.

Mammoth Pearl, 104 bushels.

Barclay's Prolific, 79 bushels.

In the latter case both Barclay's Prolific and Mammoth Pearl were good stands while the Rose Seedling was but little better than on the manured ground.

To cultivate or not to cultivate after irrigation was tested. As the ground was sub-irrigated, no benefit was derived from the irrigation. The part of the plat irrigated and cultivated after the irrigation showed no increase of yield over that not cultivated.

THE GARDEN.

Garden peas were planted on the 19th of April on ground which had been irrigated and fertilized with barnyard manure before it was plowed. Of the fourteen varieties planted the Alaska and First and Best proved the most desirable for early use, while none of the others equals the Stratagem in production and quality. The Alaska and First and Best were ready for use July 14th. They were delayed on account of a hailstorm on the 28th of June which destroyed the bloom and pods which had already set.

Two varieties of radishes were planted April 19th and were ready for use June 10th. The Half Long Deep Scarlet possesses qualities which make it the most desirable for table use.

Turnips were also planted April 19th and were ready for use July 8th. The Yellow Ruta Baga turnip though later than other varieties is the most desirable for table use.

Parsnips and carrots also gave excellent results.

Two varieties of cabbages were transplanted from the hot-bed May 18th, for early use. The Early Summer was ready for use August 7th, and proved the most desirable for early cabbage. The Early Winningstadt was not ready for use until two weeks later, but produced the greater number of heads.

The cauliflower was transplanted from the hot-bed May 20th. Of the two varieties planted the Early Snowball was ready for use August 1st. Large Early Dwarf Erfurt was ready for use a week later and proved the most desirable variety.

Celery gave excellent results this year as soil which is sub-irrigated can be kept in the very best condition for its growth.

No results were obtained in the experiments with beans and tomatoes as these plants were so badly damaged by hail on the 28th of June that none of them matured.

During the past year the small plat grounds have been laid out in 24 plats of one-half acre each. The barn has been painted and a potato seeder and shovel plow for hilling potatoes have been purchased.

Respectfully submitted,

CHAS. A. DUNCAN,

Superintendent.

Monte Vista, Colorado, November 30, 1895.

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