

The State Agricultural College
OF COLORADO.

The Twelfth Annual Report

—OF—

The Agricultural Experiment Station

For 1899.

Published by the Station,
Fort Collins, Colo.,
1900.

FORT COLLINS EXPRESS PRINT,
FORT COLLINS, COLO.



J. D. STANNARD, PHOTO.

Fig. 1. FORESTS AND SNOW. Snow Drifts in Green Timber June 21, 1899.
Elevation 9500 ft. above sea level. Looking N. E.

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Colorado Experiment Station

J. D. STANNARD, PHOTO.

Fig. 2. Looking Southwest into Dead Timber from same point as Fig. 1 and same date.

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THE STATE AGRICULTURAL COLLEGE.

THE AGRICULTURAL EXPERIMENT STATION,

FORT COLLINS, COLORADO.

BOARD OF CONTROL:

THE STATE BOARD OF AGRICULTURE.

EXECUTIVE COMMITTEE IN CHARGE.

TO APRIL, 1899.

A. L. Kellogg, Rocky Ford, *Chairman*, P. F. Sharp, Denver.
Alston Ellis, Fort Collins, John J. Ryan, Fort Collins.
B. F. Rockafellow, Canon City.

SINCE APRIL, 1899.

P. F. Sharp, Denver, *Chairman*, B. F. Rockafellow, Canon City.
J. L. Chatfield, Gypsum, Jesse Harris, Fort Collins,
P. A. Amise, Pruden.

STATION STAFF.

Alston Ellis, A. M., Ph. D., LL. D. Pres. and Director (to Aug. 1899)
E. O. Aylesworth, A. M., LL. D. President
L. G. Carpenter, M. S. Director and Irrigation Engineer
C. S. Crandall, M. S. Horticulturist and Botanist
C. P. Gillette, M. S. Entomologist
W. W. Cooke, B. S., A. M. Agriculturist
W. P. Headen, A. M., Ph. D. Chemist
A. M. Hawley Secretary
L. M. Taylor Stenographer
R. E. Trimble, B. S. Assistant Meteorologist and Irrigation Engineer
Frank L. Watrous Assistant Agriculturist
L. A. Test, B. M. E., A. C. Assistant Chemist
E. D. Ball, B. S. Assistant Entomologist
C. H. Potter, M. S. Assistant Horticulturist
F. C. Alford, B. S. Assistant Chemist
Joseph Lownes, B. S. Assistant Chemist
H. H. Griffin, B. S. Superintendent
of the Arkansas Valley Sub-station, Rocky Ford.
J. E. Payne, M. S. Superintendent
of the Plains Sub-station, Cheyenne Wells.

LETTER OF TRANSMITTAL.

To His Excellency, Charles S. Thomas, Governor of Colorado:

I have the honor to transmit, in accordance with the act of Congress establishing Agricultural Experiment Stations, the twelfth annual report of the Agricultural Experiment Station of Colorado. The financial statement is for the fiscal year ending June 30, the other operations being reported substantially for the calendar year.

Respectfully,

L. G. CARPENTER,
Director.

Jan. 15, 1900.

**Secretary's Financial Statement of the Experiment
Station Fund, for the Fiscal Year Ending June
30, 1899.**

<i>Receipts—</i>	Hatch Fund.	Special Fund.	Total.
United States Treasurer.....	\$ 15,000 00	.....
Balance on hand July 1, 1899....	.....	\$ 763 66	
Rent, farm, miscellaneous sales.....	.....	1,212 01	
Sheep feeding sales.....	.....	837 76	
Total	\$ 15,000 00	\$ 2,813 43	\$ 17,813 43
<i>Disbursements—</i>			
Salaries.....	\$ 9,082 69	\$ 1,041 63	\$ 10,124 32
Labor.....	2,246 45	497 28	2,743 73
Publications.....	1,369 95	205 55	1,575 50
Postage and stationery.....	48 30	9 70	58 00
Freight and express.....	48 61	16 40	65 01
Heat, light and water.....	.....	41 05	41 05
Seeds, plants, sundry supplies..	251 52	.....	251 52
Fertilizers.....	12 00	144 78	156 78
Feeding stuffs.....	21 00	2 05	23 05
Tools, implements, machinery..	30 25	21 53	51 78
Scientific apparatus.....	196 97	27 27	224 24
Live stock.....	668 43	270 00	938 43
Traveling expenses.....	861 86	122 70	984 56
Contingent expenses.....	10 00	.....	10 00
Buildings and repairs.....	151 97	21 80	173 77
Total expenditures.....	\$ 15,000 00	\$ 2,421 74	\$ 17,421 74
Balance on hand July 1, 1899.....	.....	391 69	391 69
Totals.....	\$ 2,813 43	\$ 17,813 43	

A. M. HAWLEY,

Secretary of the State Board of Agriculture.

REPORT OF THE DIRECTOR.

To the Executive Committee of The State Board of Agriculture:

GENTLEMEN—Having assumed the responsibilities of Director on September first, the fiscal year (ending June 30th) covered by this report had already closed. While the reports of the sections are brought to November—a more convenient date for reporting the operations of field work—a large part of the work reported is prior to the term of the present Director.

Since the last published report no change has taken place in the scientific staff of the Station. Mr. J. E. DuBois, who, for four years, had been Secretary of the State Board of Agriculture, and as such came in close contact with the Experiment Station, gave up on account of poor health, and was succeeded by Mr. A. M. Hawley, of Canon City. The pleasant personality of Mr. DuBois made his death, shortly afterwards, seem a personal loss. The termination of the services of Alston Ellis, A. M., Ph. D., LL. D., as President of the Agricultural College, thereby took from the directorship one who was energetic in his management of station interests.

The available time has been largely occupied in the organization of the details of the office, in getting hold of the various threads of the past history of the Station and its branches, and in a study of the financial details as a means of obtaining an insight into the present condition and as a guide for the future. The routine business and correspondence has increased, but it is evident that it may and should become greater as we come in closer contact with the agricultural population of the state. The office of the Director has been

changed from its recent location in the President's office, some new equipment obtained and other ordered.

The change in the organization of the Station and its formation with its own executive head, marks a change in the plan followed for some years back and gives occasion for a more careful consideration of the relation of the Station to the College and its form of organization, in order that the conditions should be most favorable for efficient work.

At the time of the official inspection by the Department of Agriculture, Dr. A. C. True, who has the oversight of the Experiment Stations of the United States, met some members of the Board, and in the course of the conference expressed the result of his experience. He was requested to write the principles which experience had shown to be desirable in the organization and management of Experiment Stations to obtain the best results. This he did in the following letter, which it is desirable to permanently record. The recommendations involve added duties and responsibility on the Director. While it has its undesirable side for the occupant, it also represents the recommendations obtained from the most successful stations represented at the July meeting of the American Association of Agricultural Colleges and Experiment Stations:

U. S. DEPARTMENT OF AGRICULTURE, }
 OFFICE OF EXPERIMENT STATIONS, }
 Washington, D. C., Aug. 19, 1899. }

Hon. P. F. Sharp, Denver, Colorado:

DEAR SIR—Referring to our recent conversation regarding the organization and work of the Colorado Experiment Station, it seems to me that the following points should especially engage the attention of the governing Board in considering the reorganization of the Station:

1. The Station is, under the law, a department of the College, and as such, should have an organization which will consolidate it to work as a unit. Experience shows that this can best be done by

giving the Station its own executive head (a director), and organizing a staff to work under his immediate direction.

2. The Director should be made fully responsible for the planning and carrying out of the work of the Station, for its expenditures and publications, and for the management of all business details, and he should be given ample authority for these purposes. The Board should look to him for the initiative in all matters relating to the Station, including the nomination of members of the staff, and should ordinarily confine itself to the appointment of the officers of the Station and passing upon the plans for work and expenditures submitted by the Director, through the president of the College, and auditing accounts. The Director and other chief officers of the Station should be chosen to serve during good behavior and efficiency, and the plans of work and expenditures should be submitted to the Board annually.

3. The members of the staff should be individually responsible to the Director as regards Station work and should be held to the performance of work ordered by the Director, which would often involve the co-operation of several members of the staff. As members of the Station Staff, the professors should be distinctly subordinate to the Director. In this respect they should hold a different position as regards Station work from that which they hold as instructors in the College. Thus the professor of chemistry is the head of the department of chemistry of the College, as far as instruction goes, and, as such, is subordinate only to the president of the College, but as chemist of the Station he should act under the orders of the Director.

4. The Station Council should be simply an advisory body, holding meetings for consultation on Station interests, but voting, if at all, merely to express opinions.

5. The general plan of expenditures should be drawn up annually by the Director, after consultation with members of the staff, and approved by the Board. This should include estimates for salaries, expenses of the several departments, publications, etc. There should always be a certain reserve fund, to be spent at the discretion of the Director, to meet emergencies arising during the year.

Expenditures should be made on requisition drawn by the different members of the staff and approved by the Director, and all bills should be approved before payment by the Director. The accounts and vouchers for each year should be finally audited and endorsed by a committee of the governing Board.

6. The main work of the Station should be along one or two lines, and all members of the staff should co-operate in this work, as far as practicable. This need not exclude smaller pieces of work in

a few other lines, and it is well for each department to have some work in which it is alone concerned. In Colorado it seems natural and desirable that the Station should concentrate its work on irrigation problems, and it should be a leading authority on these problems.

Plans for the work should be carefully drawn up annually by the Director, after consultation with members of the staff and when approved by the Board should be carried out carefully and vigorously. Careful attention should be given to the proper recording of work, and the Station records should be preserved in fire proof safes or vaults.

7. *All* the work of the Station, wherever conducted (whether at Fort Collins or in other localities in the state), should be under the immediate charge of the Director, or such member of the staff as he may assign to have charge, and the Director should be made responsible for the management of all work without regard to locality. Sub-stations are not contemplated by the Hatch Act and have generally proved very expensive and of little value, those in Colorado not being exceptions to the rule.

The Station should work for the general interests of the agriculture of Colorado and should carry on its investigations wherever they can best be prosecuted, but should be free to move its field work from point to point as the requirements of the work may demand. It is not fair to the farmers of the state to maintain expensive sub-stations in two or three favored localities. The amount of field work to be done at Fort Collins should be determined by the nature of the investigations pursued by the Station at any particular time and may be relatively small. If the Station is organized to pursue a series of *special investigations* for the benefit of Colorado agriculture, there will be little difficulty in deciding where the work can best be done. The location of the work in any given instance should, of course, be left to the Director and other expert officers of the Station.

I am not sure I have covered all the points you desired me to touch upon. I shall, of course, be glad to write you further at any time

Very respectfully yours,

A. C. TRUE.

The December meeting of the State Board of Agriculture adopted regulations governing the Experiment Station in accordance with the recommendations of Dr. True.

The work of the Station is by no means confined to the region near the home Station, but has

extended throughout the state, as needs have required. The principal railroads of the state have cordially aided by furnishing transportation over their lines to a greater or less extent. The Santa Fe, the Burlington, the Union Pacific, the Colorado & Southern and the Denver and Rio Grande are all entitled to our grateful acknowledgments for such courtesies to various members of the Station force.

The demands from Colorado, a state with an area as great as New England and New Jersey combined, with climate ranging from Kansas to Spitzbergen, make varied calls on a single Station. The range of questions is greater because the state does not have the experience that becomes common knowledge in old farming localities. Distances are great, trips extending 300 to 500 miles from the College are of almost weekly occurrence. The Entomologist or his assistants has made several trips to Grand Junction, on the Western Slope, to examine the reported ravages of an insect on sugar beets; a collecting trip to the San Luis valley and Gunnison; another through the Arkansas valley, and to Trinidad; one down the South Platte, returning via Cheyenne; one on the plains, and one through the mountains, these latter having as principal objects the study of the grasshopper and an examination into the reported appearance of the destructive Rocky Mountain locust.

The Botanical Section made several trips by rail and by wagon, lasting, in one case, for several weeks, and extending into the high mountains and the Western Slope, in connection with the study of grasses, and for collecting purposes; also into the Arkansas valley, to examine the reported cantaloupe diseases.

The Section of Meteorology and Irrigation Engineering has carried on considerable work in the Arkansas valley, requiring the presence of one or more from the force for a greater part of the

season. Numerous trips have extended as far as the eastern part of the state. The whole 200 miles from the foothills to Kansas have been traversed more than once on wheel and by horse. Numerous series of measurements to determine the amount of water used have been carried on by the co-operation of various public spirited and generous individuals; about 500 miles of measurement to determine the seepage gain of streams taken, etc. Trips have been taken to timber line to observe the effect of forests on the preservation of snow, etc.

The Agriculturist has continued work relating to the sugar beet, and the various co-operative experiments in many parts of the state have caused him to frequently visit widely separated localities.

While the work of the Chemist is principally done in the laboratory, the subjects under investigation, and demands, have caused the services of the Section to be of use to many parts of the state.

Our bulletin mailing lists show a total of 5,800 names, of which about 3,500 are in Colorado; 300 are sent to newspapers and periodicals in Colorado, and 800 to periodicals, exchanges, institutions and individuals in other states, and 1,200 to Experiment Stations. This list should be increased in this state. It is intended to rearrange and classify the mailing list so that people desiring only a special line of bulletins need not be sent the whole list. We should encourage the preservation of bulletins for permanent use, and when the available number is small, give preference to those who preserve them. A file of bulletins becomes of considerable value, greater as the file is complete, and this is not less true of our own than of other states. Our earlier bulletins are already rare and difficult to obtain. That they are appreciated by some is seen from the fact that as high as \$5 has been offered for copies of single bulletins. The

question of how best to reach the individual who uses the results, will be more seriously considered in the management of the Station. Our list should be greater. We need a more intimate connection with the agricultural communities.

Press bulletins are under consideration, and within limits, are looked on with favor. The large bulletins too often do not reach the individual who may be benefited. How best to do this will always be a problem. It is evident that many do not take time to read the bulletin, which can not be issued promptly to meet any sudden need. Some medium of promptly communicating to the public any important information, the result of investigations which, from their character or incompleteness, are not adapted for a bulletin proper, or other information, is needed. Under our conditions, with agricultural papers few in number, and with diversified interests in the state, such a series must be sent to a larger list of individuals than where local and agricultural papers form a more complete medium of distribution.

Besides the bulletins as a means of communicating the results of researches to those interested, the members of the staff have freely attended such farmers' institutes as have requested their services. While these take time and extra work, the personal contact with the farmer under conditions favorable to an understanding of the problems in the various parts of the state, is an advantage to the worker on the Station.

During the fiscal year the following bulletins were issued and distributed:

No. 47. Colorado's Worst Insect Pests and Their Remedies. 54 pp., 36 ill., by C. P. Gillette.

No. 48. Loesses from Canals from Filtration or Seepage. 36 pp., 2 figs., by L. G. Carpenter.

No. 49. Meteorology of 1897, with Illustrations. 72 pp., 18 figs., by L. G. Carpenter and R. E. Tripple.

No. 50. Notes on Plum Culture. 48 pp., 18 plates, by C. S. Crandall.

No. 51. Sugar Beets in Colorado in 1898. 44 pp., by W. W. Cooke.

No. 52. I. Pasturing Sheep on Alfalfa. II. Raising Early Lambs, by W. W. Cooke.

The Station consists of five sections and two sub-stations. The plans for work for the year are shown in the outlines submitted with this report. A description of the principal features of the work is contained in the reports of the sections and by the sub-stations, to which your attention is called. There are other details, lists of fruit, records of weather, etc., which are desirable to make a matter of record, but have not been asked for this report.

The work of the Station on sugar beets has had much to do with calling attention to the adaptability of Colorado for the production of sugar. Bulletins 7, 11, 14, 21, 36, 42, 46, and 51 have been given to this subject, besides the data given in the various reports. One factory is already built, and two others are expected to be in operation for the crop of another season.

The Entomologist has rendered valuable aid with the insect pests which have shown themselves. A special press bulletin was issued in August to place a knowledge of the means to combat the insect in the hands of every one needing it. A copy was sent to every person in the state who was known to be growing sugar beets for factory purposes.

Some work done by the Botanical Section and the superintendent of the Arkansas Valley Station, in attempting to combat the ravages of blight affecting the cantaloupe industry, gives promise of success.

Work in continuation of the study of the water resources of the state was continued by the Irrigation Engineer. Several hundred miles of streams were measured in detail, and measurements and study continued on a number of farms and orchards, many of them in the Arkansas valley.

The sub-stations also present their work. Both superintendents have worked earnestly and conscientiously, but under difficult circumstances. The prevailing idea of a Station farm is, that it should be a model farm, and should do better in each crop than the specialist. These are impossible expectations. More than that, as defined by the Department of Agriculture, it is not the function of an Experiment Station. The idea, however, hampers the work. The cost of farm operations is great and does not produce an adequate return for the outlay. The lines in which the Station has accomplished the most, with small outlay, is where the work has been carried on largely with the co-operation of individuals. The farming features at both the main Station and the sub-stations have met with sharp criticism from the United States Department of Agriculture, who say that it is not only an illegal use of the Hatch fund, but it is unfair to the other farming communities to confine the work to a favored locality. The fact that the results from co-operative work, where individuals throughout the state have furnished the fields and equipment, has given more results at a far less expense, shows, as a business proposition, the advisability of changing the character of the work at the sub-stations.

The sub-stations have cost the Hatch fund in round numbers:

Plains Station.....	\$ 7,200
Divide	8,000
San Luis Valley.....	15,400
Arkansas Valley.....	28,000

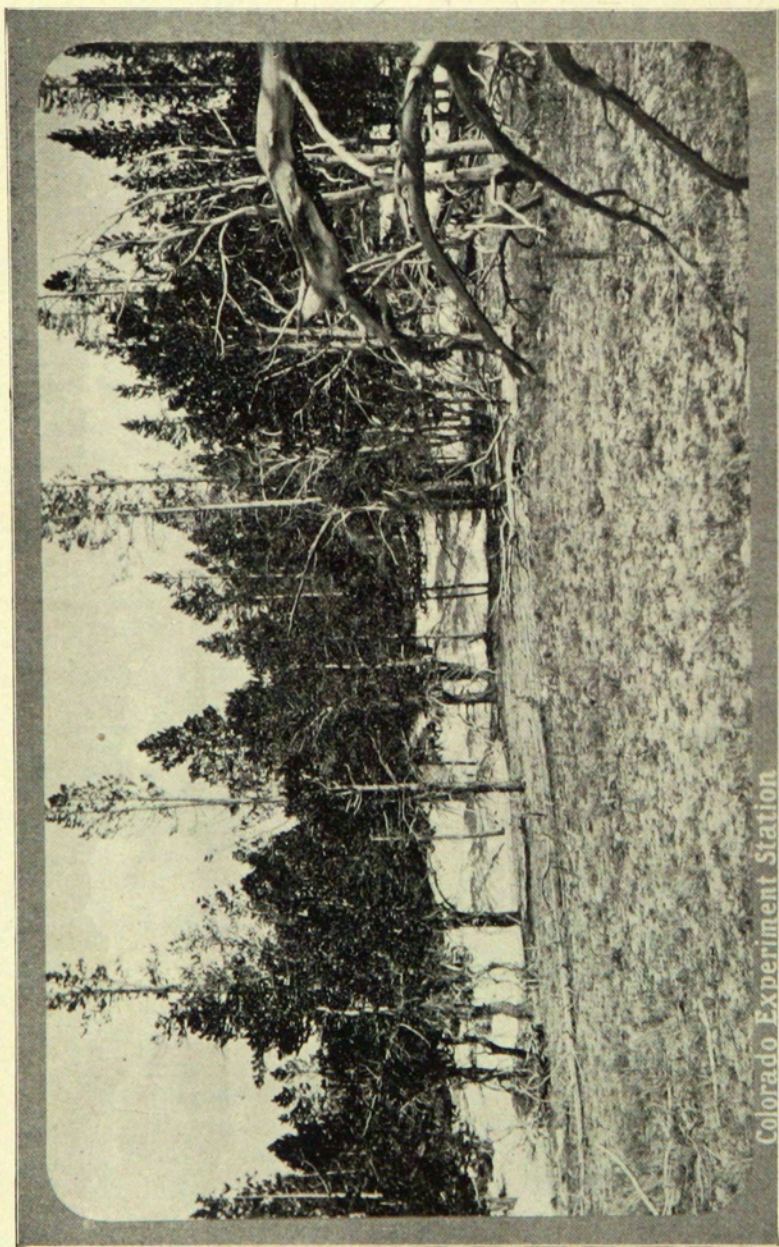
There have been receipts of \$9,200 from the Arkansas Valley, and \$2,000 from the others. This reduces the net outlay, but can not be returned to the Hatch fund.

The Arkansas Valley Sub-station is located about two miles east of Rocky Ford. At first it was called Bent County Station, but on the division of that county, its name was changed to the present

one. The land had been under lease to Hon. G. W. Swink, but was relinquished by him and the land deeded by the state to the State Board of Agriculture "so long as it should be used for an Experiment Station." For the past two years 120 acres have been leased, leaving 80 acres under the supervision of the superintendent, of which perhaps the larger part may be termed farm crops, raised experimentally. The lines of investigation have been many. The superintendent has been faithful and devoted, but has been under difficult conditions. During the past year some time has been given to the work on problems off the Station farm, and, as in these cases the superintendent does not have to attend to other than the questions under investigation, the results reached are of greater value and the expenditure little beside the time required. More of such work is needed, in other lines than cantaloupe blight and the codling moth. The sugar beet questions of that valley will bring a host of questions, where the time of such a man can do far more than can possibly be done on the Station farm, and the conditions there need such aid from us. The cost of the Station, from the Hatch fund, has been \$27,999.14. It has given receipts of \$9,164.26 (which could not enter the Hatch fund), or a net cost of about \$19,000.

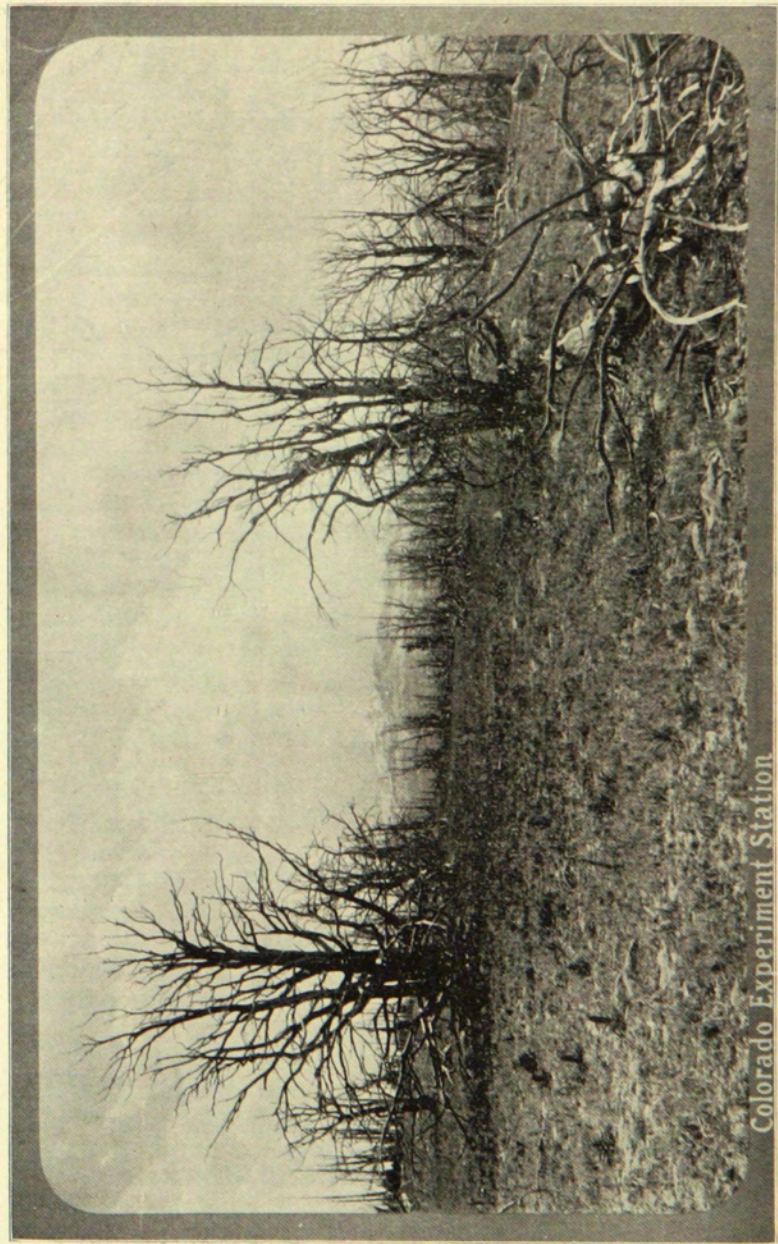
The name of the Rainbelt Sub-station has been changed to the Plains Sub-station.

The Rainbelt Station was established in Tp. 14 S Range 44 W, by the legislature of 1893. A sum of \$2,500 was appropriated by the legislature, and \$1,200 furnished by the community. The Station was opened in 1892, on land conditionally deeded by the Union Pacific railway. The present superintendent, a graduate of the Kansas Agricultural College, took charge in 1896. The grounds of the Station show almost the only spot of green along the line of the railroad for a couple hundred of miles. The plains are well worthy of careful



J. D. STANNARD, PHOTO.

Fig. 3. FORESTS AND SNOW. Snow Drifts in Green Timber June 21, 1899.
Elevation 9000 ft. Looking East. 341



J. D. STANNARD, PHOTO.

Fig. 4. From same point as Fig. 3. Same date. Looking Southwest into unprotected area.

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and prolonged investigation. The nature of the questions negatives the idea of immediate results along the most important lines, yet the work already done makes it seem more than hopeful. With a limited sum of money the time of the superintendent is the principal available means. It is certain that the present arrangement, whereby the superintendent is tied down by the exacting demands of the area under cultivation, is not calculated to give the best returns. An arrangement by which the superintendent may be enabled to study the Plains in a broader way, and to study the methods already tried by others in eastern Colorado, will furnish a fund of information which may save some costly experience, and will result in more positive gains. Even if means should be found to continue the Station on the present lines, such a method would be the best in results.

The total cost of the Station, to date, has been approximately \$7,200.

Calling this Station the Rainbelt substation has given apparent support to a notion at one time prevalent of a belt in eastern Colorado with more rainfall than the plains either east or west, and with enough for ordinary agriculture. This discredits the station at the outset, for while its purpose is to find the truth, it appears under the shadow of a false claim. As this station comes immediately in contact with questions of the plains, and these are the ones which justify its continuance, it would be well to call it in future the Plains substation.

The San Luis Valley Substation was organized in 1888, on land deeded conditionally to the State Board of Agriculture.

The location was poor, and several exchanges were made before the present location was obtained. It consists of 160 acres deeded to the State Board of Agriculture, so long as used for the purpose

of maintaining an Experiment Station. In 1896 the area was leased to the former superintendent on condition that he do some stipulated experimental work, and for three following years to J. H. Stone. A team of horses and some farm implements are still owned by the Station. As there is no immediate prospect of opening the Station, it would seem advisable to sell or otherwise dispose of these.

The total expenditure on this Station since its organization has been approximately \$15,408.97, with receipts of \$1,968.77, a net cost of \$13,440.20.

The Divide Substation is located on the summit of the high ridge between the Arkansas and the Platte rivers, east of Palmer Lake.

In July, 1888, the State Board of Agriculture leased 640 acres of school lands in section 16, Tp. 11, R 64 W, for \$32 annually. Two payments were made on the lease, but no other expenditures. In 1890 a tract of 40 acres was provided by subscription of various citizens of Monument, and a deed given to the State Board of Agriculture conditional on its use as an Experiment Station. If abandoned for this purpose, before the expiration of ten years, it is to be conveyed to Perry M. Kean, as trustee. Such trustee shall cause the land and improvements to be appraised separately by three disinterested persons, after which the lands and improvements are to be sold, the proceeds from improvements paid to the State Board of Agriculture, and the balance divided among the contributors. Early in 1896, with the lack of expected appropriations from the state, the movable property was sold, and the premises leased to W. A. Diebold, who still leases them at the same rate of \$40 per annum. The buildings have been inventoried for several years at \$700.

During the time of its existence, the expenditures on the Divide Station have amounted to \$8,085.06.

Mr. Diebold reported for 1899:

"The crops, this year, are almost a failure. The crops consist of 12 acres of wheat, drilled in on fall plowing, yielding 46 bushels, all told. Fifteen acres of oats, plowed in, yielded $87\frac{1}{2}$ bushels. The ground is in good condition for another year. The buildings need repairing and painting badly."

In closing, it may be added, that the field for the Experiment Station in Colorado is extensive as well as varied. In addition to nearly all the questions which meet the stations of the east, there are the special and extensive problems arising from agriculture by irrigation. While the results of investigations in other lines can be applied in Colorado to a great extent, in this line the western stations must depend on themselves. With limited funds and limited time, it becomes a question to what extent it is wise for us to attempt to cover all the interesting questions which arise. The station has acquired a strong hold on the people of the state, and it is hoped that it will none the less deserve their respect and confidence in the future.

Respectfully submitted,
L. G. CARPENTER,
Director.

Fort Collins, Colorado,
December 11, 1899.

INVENTORY.

Office fixtures and equipment.....	\$	317 75	
Stationery supplies.....		52 25	
Bulletin library.....		500 00	
		\$	900 00
Agricultural Section—			
Dairy supplies.....	\$	380 00	
Implements and tools.....		75 00	
Office equipment and miscellaneous.....		435 00	
		\$	890 00
Entomological Section—			
Laboratory supplies.....	\$	73 95	
Entomological supplies.....		75 65	
Insecticides and insecticide apparatus.....		90 95	
Apiary.....		138 45	
Station microscope, etc.....		335 00	
		\$	715 00
Horticultural Section—			
Glassware.....	\$	6 74	
Photographic apparatus and supplies.....		94 35	
Instruments.....		43 00	
Trees and nursery stock.....		322 40	
Miscellaneous.....		1 25	
		\$	467 74
Meteorological and Irrigation Engineering Section—			
Meteorological instruments.....	\$	540 19	
Hydraulic apparatus.....		181 75	
Stationery, books, maps, etc.....		163 42	
Irrigation apparatus.....		134 03	
Instruments.....		72 25	
Miscellaneous.....		12 50	
		\$	1,104 14
Library—			
.....		\$	1,100 00
Total Main Station.....		\$	5,176 88

Arkansas Valley Substation—

Water rights and apparatus.....	§ 1,846 00
Fencing, gates and bridges.....	357 80
<i>Buildings and improvements—</i>	
Dwelling.....	§900 00
Barn.....	750 00
Sheds and out buildings.....	160 00
Set farm scales.....	60 00
Weather instruments and shelter.....	15 00
	<hr/>
	§ 1,885 60

Live stock—4 horses, 8 hogs.....	216 00
Implements and tools.....	459 60
Miscellaneous.....	41 15

Farm produce on hand—

95 tons alfalfa hay.....	§285 00
55 bushels barley.....	33 00
550 " corn.....	165 00
320 " oats.....	112 00
175 " wheat.....	105 00
150 " rye.....	90 00
9 " peas.....	6 95
15 tons sugar beets.....	45 00
1000 pounds coffee beans.....	10 00
2000 " cow peas.....	20 00
2500 " potatoes.....	18 75
60 " cantaloupe seed.....	30 00
Miscellaneous.....	10 00
	<hr/>
	§ 930 70

§ 5,736 25

Substation at Cheyenne Wells—

Dwelling and barn.....	§800 00
940 rods fencing.....	100 00
3000 feet supply pipe (iron).....	60 00
	<hr/>
	§ 960 00
Two horses.....	50 00
Farm implements.....	136 15
Apparatus.....	104 05
Supplies on hand.....	97 60
	<hr/>

§ 1,347 80

Substation at Monte Vista--	
Buildings, fencing, etc.....	\$ 1,497 00
One team of horses.....	150 00
Farm implements.....	82 15
	<hr/>
	\$ 1,729 15
Substation at the Divide--	
Buildings	\$ 729 00
	<hr/>
Total Substation Property.....	\$ 9,513 20
Total Main Station Property.....	5,176 88
	<hr/>
Total Experiment Station Property.....	\$ 14,690 08
In addition, the Station has the use and control of other property, as long as used for experiment station purposes, as follows:	
160 acres at Cheyenne Wells.....	\$ 200 00
40 acres at Monument.....	200 00
160 acres at Monte Vista.....	2,110 00
Water right in Rio Grande Canal.....	300 00
<i>Arkansas Valley Substation--</i>	
40 acres garden and fruit land at \$85....	\$ 3,400 00
160 acres farm land at \$40.....	6,400 00
	<hr/>
	\$ 9,800 00
	<hr/>
	\$ 12,610 00

This has previously been counted as part of Experiment Station property. As the title is conditional only, it is thought proper to list it separately.

OUTLINES OF STATION WORK FOR 1899.

The schedules of station work for the year were presented, revised, and adopted. These schedules were adopted at a regular monthly meeting of the Executive Committee. The outlines of experimental work for the different sections of the Home Station and the substations, located at Rocky Ford and Cheyenne Wells, are herewith given:

AGRICULTURAL SECTION.

Wheat—

Tests of the effect of changing from a higher to a lower altitude and from a lower to a higher; the same for latitude and for both combined.

These tests are to be made in co-operation with the experiment stations of North Dakota, Minnesota, and Iowa, and with local observers in Colorado in the San Luis Valley and on both sides of the range. Duplicates of all tests to be made at Fort Collins.

These tests are designed to show the effects on the milling qualities, the bread making qualities, and the value of grain for human food.

Tests for improving wheat by selection so as to increase the amount of gluten and decrease the proportion of bran.

Tests to develop a variety of wheat that will ripen with a smaller amount of water than is now required.

Oats—

Tests of the effect of changes of altitude to be made at Fort Collins and in connection with volunteer observers in the mountains and on the Western Slope.

Tests for the development of a variety of oats better suited for human food.

Tests for the development of a variety of oats with a thinner husk.

Barley—

An endeavor to produce a variety that will ripen seed with fourteen inches annual rainfall.

Peas and Oats—

An endeavor to learn why peas or peas and oats do not grow well in this vicinity.

Corn—

Third and last year of the three years' test of seed from different altitudes and latitudes.

Alfalfa—

Co-operative experiments with Turkestan alfalfa to find out its adaptability as a crop for the Divide without irrigation.

Brome Grass—

Test of its feeding value per acre as a pasture for sheep.

Dwarf Essex Rape as a pasture for sheep.

Sugar Beets for the production of seed.

Co-operative experiments with twenty-three persons in the irrigated parts of Colorado.

Feeding Tests—

Continuation of the present tests in feeding cows, sheep, and hogs.

Creameries—

Collections of statistics from all the creameries and cheese factories as the basis for a bulletin on the dairy industry of Colorado.

Land Plaster—

Second year of the experiments on alfalfa and grain crops, extending the experiments to include pasture land.

SECTION OF BOTANY AND HORTICULTURE.

I. The study of the Flora of the state, special attention being given to:

1. The weeds of the farm and garden.
2. Grasses, native and introduced.

II. The further introduction to the garden of such wild fruits as can be obtained.

III. Nursery test of orchard fruits with a view to the study of the adaptability of varieties to this climate.

- (a) A study of the blooming periods of varieties of plums.
- (b) A study of the degree of self-sterility in plums.

IV. Tests of varieties of small fruits.

V. Co-operative work with the Division of Forestry of the U. S. Department of Agriculture.

It is also proposed to continue the work of last season with different methods of grafting, and with crossing.

CHEMICAL SECTION.

I. Continuation of work on part II of Bulletin No. 46, "A Soil Study.

II. A study of methods used in extracting beeswax from old combs.

III. Study of Colorado grasses in cooperation with the Department of Botany.

IV. A digestion experiment with sheep. This is intended to be supplemental to Bulletin No. 39.

This work, already begun, will require more than a year for completion.

ENTOMOLOGICAL SECTION.

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

II. Continuation of experiments for the destruction of insect eggs.

III. A continuation of the Orthopterological survey of the state.

The object of the work taken up under this head is, not alone to collect and determine the Orthoptera (mainly grasshoppers and locusts) that occur in different localities of the state, but also to determine, as far as possible, their food habits, life histories, diseases, enemies and artificial remedies.

IV. Experiments with the Codling Moth.

(a) To determine the value of kerosene emulsion for the destruction of this insect.

(b) To determine the number of broods and the times of their appearing in the different apple-growing regions of the state.

(c) To determine the value of arsenical sprays for the destruction of the different broods, and the real saving due to spraying.

V. A study of the habits of the "ash borer" which in the past two or three years has become so destructive to ash shade trees in and about Denver.

The main object of the study will be to determine the most effectual methods of suppressing the borer.

VI. Experiments in the apiary.

(a) A continuation of the work of collecting and making a list of the native forage plants of the state.

(b) Experiments with comb foundation.

(c) Testing new apiary appliances.

SECTION OF METEOROLOGY AND IRRIGATION ENGINEERING.

- I. Meteorology as before.
- II. Evaporation from water surface, extending to soils and vegetation to some extent.
- III. Soil moisture determinations.
- IV. Soil temperatures.
- V. The irrigation questions of the state.
 - (a) San Luis Valley.
 - (b) Arkansas Valley.
- VI. Seepage measurements.
- VII. Sediment determination of the Arkansas Valley.
- VIII. The effect of forests on retention of snow and water supply.

ARKANSAS VALLEY SUBSTATION.

Rocky Ford, Colorado.

CEREALS.

1. *Wheat*—A comparative test of varieties shown last fall.
2. *Rye*—Four acres of Mammoth Spring rye.
3. *Barley*—Three acres of Hulless Barley.
4. *Corn*—Two acres to be divided for a test of cultivation *versus* irrigation; a few varieties tested for productiveness and time of maturity.

GRASSES AND CLOVERS.

1. *Bromus inermis*—One and one-half acres sown last fall to be used for pasture.
2. *Orchard Grass*—One and one-half acres for pasture.
3. *Australian rye and Tall Meadow oats*—A test plot of one-eighth acre each.
4. *Alfalfa*—The sowing of last fall to be compared with spring sowing; small area sown in furrows to note the effect of sub-irrigation and cultivation. Test Turkestan alfalfa for growth and adaptability.
5. *Cow Pea*—A test of a few varieties for date of ripening and yield; sown in a portion of the orchard to test it as a cover crop and fertilizer for orchards.
6. *Hairy Vetch*—Additional plantings to those we have to test it for pasture, cover crop, and fertilizer.
7. *Soja Bean*—One-eighth acre to secure seed for future use.
8. *Field Peas*—One acre under general farm conditions to show their value as a forage and grain crop.
9. *Coffee Pea*—Same as above.

VEGETABLES.

1. *Cantaloupes*—
 - (a) Tests of different amounts of irrigation as affecting quality and production.
 - (b) Alfalfa sod *versus* natural soil.
 - (c) Three distances of planting to note yield and condition.
 - (d) What effect injudicious seed selection has upon the future crop.
 - (e) Seed to be selected from perfect specimens and held for distribution to help maintain a high quality of product.
 - (f) Notes upon, and work with, insects and fungi affecting this crop.
 2. *Celery*—Small area devoted to this crop to note the general requirements.
 3. *Potatoes*—About one-half acre to be planted to one variety to note the following:
 - (a) Comparison of different dates of planting.
 - (b) Irrigation experiments.
 - (c) Sod land *versus* cultivated soil.
 - (d) Small area planted with Mammoth Pearl variety for seed.
 4. *Sugar Beets*—One acre to be grown by field culture and a record kept of the cost; such information for the benefit of those wishing to grow them for feeding or factory purpose.
- Beans*—Planting and spraying trials to control the blight.

ORCHARDS AND FRUITS.

1. *Old Orchard*—
 - (a) Notes on blooming, fruiting, etc.
 - (b) Spraying and band experiments with the codling moth in connection with the Entomological Section
 - (c) Observations with the blight and experiments connected with the pruning of trees affected by it.
2. *New Orchard*—
 - (a) Vacancies to be filled with new and untried varieties of fruit and nut trees.
 - (b) Establishment of a test plat of nut trees to be grown from seed.
3. *Small Fruits*—Securing strawberry plants to fill vacant places caused by the hail.
4. Variety tests of blackberries and raspberries.
5. *Grapes*—Establishing a test of of foreign kinds.

ENTOMOLOGY.

Observations upon injurious insects; spraying and other remedies for their control.

METEOROLOGY.

Continuation of present records.

FERTILIZERS.

1. Gypsum to be used upon about one acre of "black alkali" soil to note its value in reclaiming the same. Note its effect upon crops grown where it was spread the previous year.

2. Ground bone and wood ashes to be used upon a few apple trees of bearing age to note the effect upon health, and productiveness.

The remainder of the station land to be devoted to such crops as will be of most feeding and commercial value.

RAINBELT SUBSTATION.

Cheyenne Wells, Colo.

I.

- I. Fall grain already sown—
1. Wheat, 2 acres,
 2. Winter oats, 2 acres,
 3. Winter rye, 1 acres. 5 acres.
- II. Campbell Test—
1. Corn, 5 acres,
 2. Barley, 2 acres,
 3. Sorghum, 3 acres,
 4. Truck patch, $\frac{1}{2}$ acre,
 5. Sweet corn, $\frac{1}{2}$ acre,
 6. Potatoes, 1 acre. 12 acres.
- III. Alfalfa—
1. Already growing, $\frac{1}{2}$ acre,
 2. To be sown, 5 acres. 5 $\frac{1}{2}$ acres.
- IV. Grasses and Clovers—
1. *Bromus inermis*, growing, 2 acres,
 2. *Bromus inermis*, to be sown, 1 $\frac{1}{2}$ acres,
 3. Other grasses and clovers, $\frac{1}{2}$ acre. 4 acres.
- V. Seeds of several forest trees.
- VI. Extend test of fruits to include currants, blackberries, dewberries, strawberries, Russian cherries, peaches, apricots, etc.
- VII. Plant 3,000 seedling trees—apple and forest—in nursery

for use later in making shelter belts and orchard in plat through which the ravine runs.

VIII. All cultivated land not used otherwise to be planted to millet, barley and sorghum for forage. Accounts to be kept to determine cost of producing fodder or hay.

IX. Test improving pasture.

1. By furrows drawn across slopes.
2. By running disc harrow across slopes.

(To hold water where it falls.

X. Improve ponds in ravine by dams.

XI. Investigate, by correspondence and travel, the results of the efforts of settlers to raise crops and grow trees.

XII. Further use of gypsum on different crops; test of Russian forage plants in co-operation with the U. S. Department of Agriculture.

II.

I. Continue soil investigations of former years:

1. Evaporation from soil surface.
2. Evaporation from soil surface, using soil mulch of different depths to retain moisture.

II. Evaporation from water surface, a continuation of the work of 1898.

III. Test amount of water used by growing crop of wheat already planted.

IV. Test amount of water used by growing crops of corn.

V. Continue meteorological observations.

VI. Autumn work—

1. Wheat, 2 acres,
2. Oats, 2 acres,
3. Barley, 2 acres,
4. Rye, 1 acre. 7 acres.

(To be sown late in summer for a soil cover.)

VII. Co-operation with U. S. Department of Forestry in planting a few acres of forest trees on the station land.

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 for the past year.

The experimental work of this section has been conducted along three general lines, *i. e.*, the raising of crops experimentally on the college farm; the feeding of stock and the conducting of co-operative experiments with farmers throughout the State. During the past season the third and final year's work was completed on the subject of the effect of altitude and latitude on the growth of corn to be used for seed, in Colorado, and the results are now ready to be written up for publication.

We have also completed three years work on making ensilage from corn and feeding it to cattle and sheep. This finishes the work that had been contemplated in that line, and we plan to begin, in 1900, a series of tests on alfalfa ensilage. In general it may be said that our work shows that corn ensilage cannot profitably be used under present Colorado conditions, as a food for either cattle or sheep that are being fattened out doors during cold weather. Our tests with dairy cows gave no conclusive results either way, but are not favorable to ensilage.

The number of calls that have come for the bulletin issued last spring on the raising of early lambs, shows that many farmers are contemplating this method for disposing of their alfalfa. To continue these tests along slightly different lines, forty ewes have recently been purchased, and they and their lambs will be fed for next summer's market.

During the past season two series of co-opera-

tive experiments were carried on in Colorado. The first was to determine the best time and the proper distance apart to plant sugar beets. The results of these tests are not yet all on hand. This Section has devoted a great deal of time the past three years to the sugar beet question, and the interest in the matter throughout the state is greater now than ever before. At the present time there is no work that can be done by the Section that will be of greater good, or will bring more immediate results, than investigations along this line. The field is unlimited, and the more it is investigated the plainer becomes the fact that the problem in Colorado is radically different from that in any other portion of the world where sugar beets are grown. The problems will have to be worked out independently for the Colorado farmers. At the same time, what has been accomplished so far is very gratifying, and the outlook for the industry in Colorado was never brighter.

The first of a five-years' test of a new variety of alfalfa has been conducted, and all that can be said at the present time is, that the test was gotten fairly under way.

The larger part of the energies of this Section has been devoted the past season to the beginning of a series of tests of the influence of latitude, and especially latitude and altitude combined, on the growth of cereals, especially wheat and oats, and on their value as stock food and as human food. The results of the first year's work are quite gratifying, but though an enormous amount of work was put on the question, and much yet remains to be done in working up the results of the 1899 crop, yet the most we can claim is, that a fair start has been made. These tests were made at the college farm, and five other farms in Colorado, and with the co-operation of four other experiment stations and the Department of Agriculture, at Washington.

Three more cows have just been purchased, to be used in connection with those on hand in tests

of the feeding value of sugar beets and mangels, and it is expected that we will be able to conduct some tests on the feeding of beet pulp, which is destined in the very near future to play an important part in the stock feeding of Colorado.

Respectfully submitted,

W. W. COOKE,
Agriculturist.

Fort Collins, Colorado,
December 1, 1899.

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 the work of the Section of Botany and Horticulture.

The horticultural work of the Section has been mainly the continuation of the systematic test of varieties of fruits which was commenced in 1894.

The plum orchard, which, in 1898, contained 152 varieties, was reported on in Bulletin No. 50, "Notes on Plum Culture," which was issued early last spring. The lines of study there recorded have been followed this season, and records are on file giving blooming periods of varieties, the results of studies in self-sterility, and further observations upon the characteristics of varieties.

The continuous and unprecedented low temperatures of the winter of 1898-99 did much damage to the plum orchard and was a severe test for even the hardiest varieties. Thirty varieties were entirely killed. These were distributed in the following groups: Chicasaw, 5; Beach Plum, 1; Wild Goose, 6; Domestica, 6; Japanese, 7; Americana, 4; and hybrids, 1. Eighty varieties are recorded as having been very seriously injured, these are dis-

tributed through all groups, and the individual injury varies between killing to the ground and the loss of the greater portion of the top. The ten Japanese varieties not killed outright were dead to the ground. The balance of the varieties represented are recorded as uninjured or killed back only at the tips of the branches. These with the exception of a few of the Miner group, belong to the native Americana group.

It cannot be said that any variety escaped injury; even the hardiest that were uninjured in branch or twig were very tardy in opening the leaf bud, and the flower buds were nearly all killed. Individual trees of 44 varieties produced some bloom. Of these 37 were Americana varieties, five belong to the Miner group, two were unclassified hybrids, and one was *Prunus Besseyi*. On all the flowers were thinly scattered, sometimes not more than a dozen on a tree. They were small in size, very tardy in expanding, and but few formed fruit. This evident lack of vitality in the flowers, and their small numbers, rendered the work on flower periods and sterility unsatisfactory. The conditions being abnormal, the results obtained cannot be used as a basis for conclusions, but will be preserved for comparison with other years.

To, in part, replace the trees killed, 74 trees, representing 40 varieties, were planted last spring. Seven of these varieties had not been previously represented in the collection. As the orchard now stands, it contains 507 trees, representing 137 varieties. Most of the living trees made a fair growth during the season and have formed buds that promise a handsome abundant bloom next spring.

The young apple orchard suffered even greater loss than did the plum orchard. As reported a year ago, the trees were not in thrifty condition, having suffered from lack of water, and it was not surprising that so many were killed. The number

killed outright was 150, and many others were severely injured. From a count just made it appears that there are left about 300 trees that are of sufficient promise to warrant transplanting and further care, as directed by your committee when the orchard was inspected in June. It is hoped that arrangements can be made to locate the orchard on land where water for irrigation is available.

The co-operative experiment with the Division of the United States Department of Agriculture, to test the relative hardiness of forest-tree seedlings as grown from seeds produced in different sections of the country, has apparently been abandoned, as no word regarding it has been received this season. The seedlings grown in 1897, and those of 1898, which together represent seven species from 23 states and Canada, have been transplanted and cultivated through this season. Records have been kept of vigor of growth and hardiness, and the tabulations show some interesting results, pointing to the correctness of the belief that northern grown seeds produce the hardiest seedlings. While not regarded as conclusive, the test is sufficiently instructive to warrant preparation of the data for publication.

The abandonment by the Forestry Division of the Department of Agriculture, of the forest plantation commenced in 1896, renders it necessary that some action should be taken regarding the disposition of the land set apart for this purpose. No work has been done upon the plats since July, 1898, and upon a portion of the area weeds have become abundant. There are four plats of one acre each, on which are growing several thousand trees. The pines and spruces have nearly all died, but deciduous species have, in general, lived and made some growth. Of living trees, the aspen is most numerous, but there are many locust, soft maple, black cherry and boxelder, with a few of elm, mulberry, birch and ash. On one plat are nearly 4,000

plants of Southernwood (*Artemisia abrotanum*), of spreading, shrubby growth, about four feet high, and among these are a few aspen, elm and silver maple. This species was planted as a nurse plant for conifers; it covers the ground completely and serves well the purpose of protecting other plants, but it is of no other use as it kills to the ground each winter. If the land is not needed for other purposes, I believe the plantation should be maintained. Possibly some additions could be made until we have a compact growth of trees, which will serve as a source of supply for planting on other portions of the farm, and as an illustration of the behavior of different species when grown under forest conditions. To bring the plants into good condition will require some expenditure of labor, but I believe the plantation would soon take care of itself, and in time give valuable returns for the investment.

The work on the flora of the state has advanced but little during the season. Neither time nor means were available for prosecuting the work of collecting. One brief trip to the Western Slope, which allowed but one day for collecting, was made in May. In late July and extending into August, a trip of three weeks, during vacation, was made into the North Park region for the special purpose of studying grasses and the methods of irrigating meadows. Large collections of grasses and many additions to the general flora were secured, although the work was seriously hampered by the frequent rains. It would be very desirable that similar expeditions be made in South Park and the San Luis valley, so that the forage problems of these high park regions could be compared and treated in one publication. The grass problem of the plains region is so different in character that it could best be treated separately. It is no less important and should receive attention.

Late in October a short trip into the mountains west of Fort Collins, was made for the pur-

pose of collecting seeds, particularly of the pines and spruces.

About 1,800 specimens of plants for the herbarium have been received in exchange during the year. They are as yet unmounted, but it is hoped that they may be mounted and arranged for use during the winter. The number of exchanges could be greatly increased if we had the assistance necessary in preparing the plants for sending out. Several offers of exchange have been declined because no time was available for the work involved.

Last year I reported upon several fungus diseases sent in from various parts of the state. This year the number received has been greater, and it is becoming more and more evident that this matter of the diseases of plants must become an important feature of the work of the section. The cantaloupe disease, at Rocky Ford, did great damage to the crop this season, and is worthy of persistent attention by the Station. In September I visited this section and, in company with Mr. Griffin, went over many diseased fields. That the crop was shortened, and in many cases entirely ruined by the disease was apparent. Early in the season Mr. Griffin made applications of Bordeaux mixture in several places to small areas. The results have been encouraging, and next season a thorough demonstration of the beneficial effects of the treatment should be made. This work is important to the cantaloupe industry, and I believe would reflect credit upon the Station.

Respectfully submitted,

C. S. CRANDALL,

Botanist and Horticulturist.

Fort Collins, Colorado,

December 1, 1899.

REPORT OF THE ENTOMOLOGICAL SECTION.

To the Executive Committee of the State Board of Agriculture:

GENTLEMEN—I have the honor to submit the following report upon the work of the Entomological Section of the Experiment Station for the year just closing:

CODLING MOTH.

Experiments with the codling moth have been continued, particularly for the purpose of determining the number of broods of this insect in Colorado. A series of experiments were carried out at the Home Station, and similar ones at Rocky Ford, by Mr. Griffin, and by others at Canon City and Grand Junction. Reports have not yet been received from the last named place, but data gathered by Mr. Griffin, at Rocky Ford, Doctor Peare, of Canon City, and from our experiments here prove very conclusively that this insect is wholly two-brooded, with no indication of a third brood in these localities. The experiments give further proof, also, of the importance of the bandage system of fighting this insect.

Kerosene emulsion has also been tried as a remedy this year, but the results do not warrant recommending its use. Prompt and thorough use of arsenical sprays still remains our most reliable remedy.

ORTHOPTEROLOGICAL SURVEY.

Good progress has been made in the study of the grasshoppers of the state. Several species, not known to occur here before, have been taken, and among these are a few species that are as yet unknown to science.

It was thought by many that the unusually

cold winter of 1898-99 would greatly lessen the number of grasshoppers for a few years, but such does not seem to have been the case.

A reported visitation of the Rocky Mountain locust, on the eastern border of the state early in July, was the occasion of a trip, by Mr. E. D. Ball, over the line of the Burlington railroad as far as Stratton, Nebraska, where it was reported that the locusts were in greatest numbers. Mr. Ball found the injuries to be due almost entirely to two common species that are present every year, namely, the two-lined locust (*Melanoplus bivittatus*) and the differential locust (*Melanoplus differentialis*). No specimens of the Rocky Mountain locust were found, and, in fact, for a considerable number of years, this destructive insect has not been recorded with certainty, from the state; and we believe it is fairly safe to predict that the terrible periods of devastation of this insect within our borders is a thing of the past. In all our collecting of insects over the state for the past nine years, not a specimen of the Rocky Mountain locust has been seen.

A trip through the San Luis valley was made by myself in the month of August for the purpose of studying grasshopper conditions, and I am glad to state that in no place were grasshoppers found to be doing perceptible injury to cultivated crops, though native species were abundant over much of the wild pasture land.

During a trip to the western portion of the state, with stops at Salida, Gunnison, Delta and Grand Junction, grasshoppers were found relatively scarce at the two former places, while in many places about Delta and Grand Junction they were doing serious harm to cultivated crops, and especially alfalfa and orchard trees. In these localities, also, the two-lined locust and the differential locust were the chief depredators.

Mr. E. S. G. Titus made a trip into the southern portion of the state, and Mr. E. D. Ball a

somewhat extended one into the foothills and plains of the northern portion, gathering information which we hope to incorporate into a bulletin at some later date.

THE BEET ARMY-WORM (*Laphygma flavimaculata*). *

This insect, which is a close relative of the "Army-worm," and particularly of the "Fall Army-worm," has been known for many years to occur in small numbers in various parts of the country, but has never been known as a destructive insect until the past summer, when it appeared in many localities in injurious numbers. The most remarkable outbreak that has come to our notice was about Grand Junction, Delta and Montrose, during the month of August. The sugar beet was chiefly attacked, though the caterpillars showed themselves to be capable of living upon almost any green thing that could furnish them succulent vegetation for food. It was estimated that two or three hundred acres of the beets were completely ruined. When the leaves did not furnish sufficient food, the caterpillars did not hesitate to eat off the crown of the plant and devour the root also. Experiments tried in the field demonstrated that the ordinary arsenical mixtures will destroy the worms if properly distributed upon the leaves.

Two trips were made to Grand Junction to study this insect, where I was shown every courtesy and greatly assisted in the work by the officers and managers of The Colorado Sugar Manufacturing company.

Advice was given to many individual growers, and to the Sugar company, as to remedies, and a press bulletin was written and mailed to all who were growing sugar beets in the localities above mentioned. The insect matured in enormous numbers, and is passing the winter as a moth. There is every reason to expect a recurrence of

* Determined by Dr. J. B. Smith, New Brunswick, N. J.

of the caterpillars next summer, at about the time for the thinning the beets, when growers will do well to keep a very close watch and be prompt in the application of arsenical poisons for the destruction of the first brood of caterpillars.

Mr. Griffin, of the Rocky Ford Station, also sent me a few caterpillars of this insect from beets grown on the Station grounds at that place.

THE ASH BORER (*Podosesia syringæ*).

This lepidopterous borer seems to be rapidly increasing in and about the city of Denver. It has killed many trees outright, and others are weakened and disfigured. A stump eighteen inches in length, from the grounds of Mr. E. Milleson, Horticultural Inspector for Arapahoe county, is in my office, from which over twenty moths hatched last summer.

INSECTICIDES.

Several arsenical mixtures have been tested the past summer to determine their effects upon foliage and upon insects. I will say, in brief, that of three proprietary compounds, viz: "green arsenoid," "pink arsenoid," and "white arsenoid," that we found the two former very promising and of easy application, while the last was too injurious to foliage to allow of its use. Arsenate of lead was also used and found to do no harm to the most tender foliage, in ordinary strengths, while it remained long upon the leaves and was destructive to the insects that ate it.

APIARY EXPERIMENTS.

The apiary experiments have been chiefly for the purpose of determining the best form of foundation to use for comb honey, and the best methods of using the foundation in the section. The experiments this year have proven, beyond a doubt, that bees do thin thick foundation and use the material thus obtained in building out comb cells.

It is expected to incorporate the results of these experiments in a bulletin at no distant date.

This Section is much in need of better accommodations for experimental and breeding-cage work. Such rooms as are needed could be built on to the present apiary building, at small cost, and would be of much service to the Entomological section. Respectfully submitted,

C. P. GILLETTE,
Entomologist.

REPORT OF THE CHEMICAL SECTION.

To the Executive Committee of the State Board of Agriculture.

GENTLEMEN—I have the honor to report that no changes have been made in the lines of investigation of the Department. The study which we have been making on the plot of ground west of the Town ditch south of the land running west from the College barn, has been continued during the past season. We have made no change in the plan pursued in former seasons. We have even continued the same crop. Part I. of this study has already been published, and the material for Part II. is nearing completion. This work has already passed far beyond the limits originally set for it.

The work in conjunction with the Botanical Department, on the grasses of the state, has scarcely passed beyond the preparatory stage, and cannot be taken up immediately.

The work on the methods of extracting bees-wax, which is co-operative work in conjunction with the Department of Entomology, is well under way, but, like all work of this kind, will probably take a much longer time to complete than we even now expect.

We hope to finish the series of experiments on digestion of corn fodder, timothy hay, native

hay and alfalfa, with sheep, begun over a year ago, within the next few months.

This is the present state of the work in hand.

It is due to my assistants in particular, that I should state that the volume of work accomplished has been very considerable, and its quality excellent. I do not know of any misunderstanding, spirit of caviling, or any unpleasantness whatever existing among my assistants, either in their relations toward one another or toward myself.

I have no recommendations to offer at this time and no request to make.

Respectfully submitted,

W. P. HEADDEN.

Fort Collins, Colorado,

December 11, 1899.

REPORT OF THE METEOROLOGIST AND IRRIGATION ENGINEER.

During the past year the character of the investigations in progress is indicated by the outline of work, which has been essentially the same for a number of years.

SEEPAGE GAINS AND LOSSES.

The measurements to determine the gains or losses from seepage have been continued this year on streams previously measured. These include the Cache a la Poudre, from the canon to its mouth, a distance of 50 miles; the Big Thompson, about the same distance; the Little Thompson, a tributary of the Big Thompson; the St. Vrain from Lyons to the Platte, and its tributary, Left Hand Creek; the Rio Grande, from above Del Norte to the state line, a distance of about 100 miles; the Arkansas, from Canon City to the Kansas state line, a distance of 200 miles; nearly 500 miles of river measurement in all for this particular pur-

pose. Each of these streams requires driving the full length, visiting every headgate, and the measurement of every ditch and every tributary. Altogether it has required several thousand miles of driving for this particular purpose. The general results of previous measurements are confirmed. A tendency to increase in the amount of water returning to the river is noticeable, especially on those streams where the return waters have some distance to pass to reach the stream. The Rio Grande is an exception, in that a marked loss is noticeable at the rim of the valley. There is then a gain, but not enough to balance the loss.

CACHE A LA POWDRE.

The fourteenth measurement of the Poudre, from the canon to the mouth, was made September 26th to 29th. The distance is about forty miles by the axis of the river, and much more by the sinuosities. The measurements prior to 1896 are given in detail in Bulletin No. 33. The following is a summary of the last four:

	1896	1897	1898	1899
	Nov.	Oct.	Aug.	Sept.
Weir to water works.....	- 2.92	+ 1.39	- 7.76	- 0.85
Water works to L. & W.....	?	+16.61	+ 9.16	+16.14
L. & W. to No. 2 Supply.....	- 5.68	- 3.96	+ 3.37	+10.13
Supply to Strauss bridge.....	-22.87	- 2.90	+14.84	- 1.12
Strauss to No. 2 canal.....	+16.41	+10.42	+ 1.28	+ 8.62
No. 2 to Eaton ditch.....	+10.42	+13.36	+ 8.34	+ 3.05
Eaton to No. 3 canal.....	+ 5.77	+35.72	+15.44	+13.74
No. 3 to mill power canal.....	+16.64	?	+21.16	+21.86
Mill power canal to Camp ditch.	+25.52	+26.57	+25.98	+30.93
Camp ditch to mouth.....	+21.98	+23.58	+33.37	+31.62
			135.18	133.59

TOTAL GAINS ON THE CACHE A LA POUUDRE—CANON TO MOUTH.

<i>Year.</i>	<i>Date.</i>	<i>Total in sec. feet.</i>
1885....	Oct. 12-15....	86.9
1889....	Oct. 14-17....	98.96
1890....	Oct. 16-18....	100.8
1891....	Oct. 29-30....	84.6
1892....	Mar. 10-12....	96.1 plus from Ogilvy to mouth, about 30 ft.
	Oct. 5-8	101.65
1893....	Nov. 9-11....	98.7
1894....	Mar. 13-15....	82.3
	Aug. 20-23....	118.2
1895....	Oct. 9-14....	164.4
1896....	Nov. 11-14....	88.3 plus from New Mercer to L. & W. dam.
1897....	Oct. 7-14....	142.69 plus from No. 3 to Greeley pump
1898....	Aug. 9-12....	135.18 house, probably 30 feet.
1899....	Sept. 27-30....	133.59

When brought to a uniform method of treatment these will be subject to slight changes. No allowance is made in the above for temperature.

Measurements in October, 1892, and in 1896 are affected by a periodical exchange of water between the Larimer & Weld canal and a mill at Fort Collins. The effect of this would extend to the Cache a la Poudre canal No. 2. In recent years there have been numerous seepage ditches constructed, and an increasing amount is intercepted by these ditches and by storage reservoirs.

The quantities given are those reaching the river; hence an allowance is to be made for the amount thus intercepted before an estimate strictly comparable with the earlier years can be made.

ON THE ST. VRAIN.

The St. Vrain creek rises in the high mass of mountains from Long's peak southward to the head waters of Boulder creek, and waters one of the most fertile of the tributary valleys of the Platte.

The following gains were found in the measurement made October 26-28, 1898, and in November, 1899, by Mr. Trimble, with the aid of Mr. L.

H. Dickson, of Longmont, Water Commissioner of District No. 5.

	<i>Distance.</i>		<i>Gain—sec. feet.</i>	
	<i>Miles.</i>	1898	1899	
From Lyons to the Oligarchy ditch.....	3.7	2.62	4.69	
From the Oligarchy to the Niwot ditch.....	2.7	3.24	6.14	
From the Niwot to Boulder-Weld county line.	6.7	7.39	12.21	
County line to Boulder creek.....	2.2	5.34	21.60	
Boulder creek to Fleming place.....	5.8	4.21	— .44	
Fleming place to Platte river.....	7.0	2.98	— 2.44	
Total.....	28.0	25.79	41.76	

LEFT HAND CREEK.

	<i>Gain.</i>
Star ditch to Holland ditch.....	1.01
Holland ditch to Williamson & Way.....	0.28
Williamson & Way to Burch school.....	0.44
Burch school to St. Vrain creek.....	4.01
Total.....	5.74
From both St. Vrain and Left Hand.....	47.50

The amount of land irrigated in Water District No. 5, which includes the St. Vrain and Left Hand creeks, is 89,000 acres, according to the report of Water Commissioner Dickson. This does not include the amount entering Boulder creek which is also a tributary of the St. Vrain.

THE BIG AND LITTLE THOMPSON.

The Big Thompson heads in the high mountains surrounding Estes Park. The highest is Long's peak, rising to 14,260 above sea level. An unusual proportion of the watershed has a northern aspect, so that the stream maintains its flow well. The head waters of the Little Thompson are but five miles east of Long's peak, from which they are separated by a transverse valley.

	<i>Distance.</i> Miles.	<i>Gains.</i>		
		1897 Nov. 5-8	1898 Nov. 2-3	1899 Nov. 16-17
Handy to Home Supply canal.....	1.0	0.0	.....	.....
Home Supply to Barnes ditch.....	5.7	15.78	8.13	8.88
Earnes ditch to Loveland & Greeley	3.1	4.62	3.52	0.86
Loveland & Greeley to Big Thomp- son ditch.....	10.05	12.38	13.31	1.38
Big Thompson ditch to Hill and Brush.....	5.3	4.52	6.62	10.85
Hill & Brush to the Big Thompson and Platte.....	10.6	12.42	9.59	5.74
Big Thompson and Platte to the Evans town ditch.....	11.0	14.36	11.59	9.67
Total.....	64.08	52.74	47.00	38.70

ON THE LITTLE THOMPSON.

	<i>Distance</i> Miles.	<i>Gains.</i>		
		Nov. 13	Nov. 4	Nov. 17
From Eagle ditch to Dry creek.....	3	1.35	3.16	2.46
Dry creek to Rockwell ditch.....	2	2.77	1.52	2.16
Rockwell to Miner ditch.....	3	2.43	1.32	7.62
Miner ditch to mouth.....	6	4.08	2.89	6.89
Total.....	14	10.63	8.89	13.15
Total Big and Little Thompson	74.71	61.63	51.85	

The amount of land irrigated from this stream is approximately 65,000 acres. An increasing amount of seepage is being intercepted by ditches and reservoirs.

THE RIO GRANDE.

The fourth measurement has been made on the Rio Grande, from the canon above Del Norte to a point near the New Mexico line. The elevation ranges from about 8,000 to about 7,000 feet above sea level. For this portion of its course the river passes through the San Luis Valley, an ancient lake bed surrounded on all sides by high mountains. Many streams enter the valley from the surrounding rim; but with few exceptions all

sink. It is found that the Rio Grande itself shows a large loss as it crosses the rim, and while it gains during the rest of its course in the valley, it is not enough to make up for the loss in the first three miles.

	1896.	1897.	1898.	1899.
From canon to Del Norte.....			-51.69	-61.96
Prairie canal.....	-107.03	-72.09	+ 1.84	+ 4.53
to Montevista.....	+ 54.32	+ 6.61	+ 6.26	+ 2.46
San Luis canal.....	- 5.68	+27.25	+ 8.82	+16.93
Hickory Jackson.....	+ 27.14	+42.10	+18.10	+36.10
Alamosa.....	+ 4.85	+ 7.45	+ 2.78	-13.78
Above Conejos.....	+ 16.70	....	+ 1.57	- 2.64
Below ".....	- .41	+ 4.20	....	- 0.06
La Saucos.....	+ 5.27	+ 6.93	+ 0.92	+ 0.38
Iron bridge.....	....	+ 9.23	....	- 1.78
Near State line.....	- 3.58	....	....	....
Total.....	- 8.42		-13.24	-15.59

In 1897 the section between Alamosa and Conejos river is vitiated by the omission of Trinchera Creek, a small stream ordinarily dry. This was reported on reliable evidence and not visited, but our comparisons afterwards make it probable that it was subject to a flood at the time. This stream was not measured in 1896, but was measured in 1898 and 1899.

THE ARKANSAS RIVER.

The third measurement was made on the Arkansas river from the canon above Canon City to the Kansas state line. The measurement was made from October 20th to November 3d. As the season was late, the measurement was begun at the Bessemer ditch, above Pueblo, and carried to the state line.

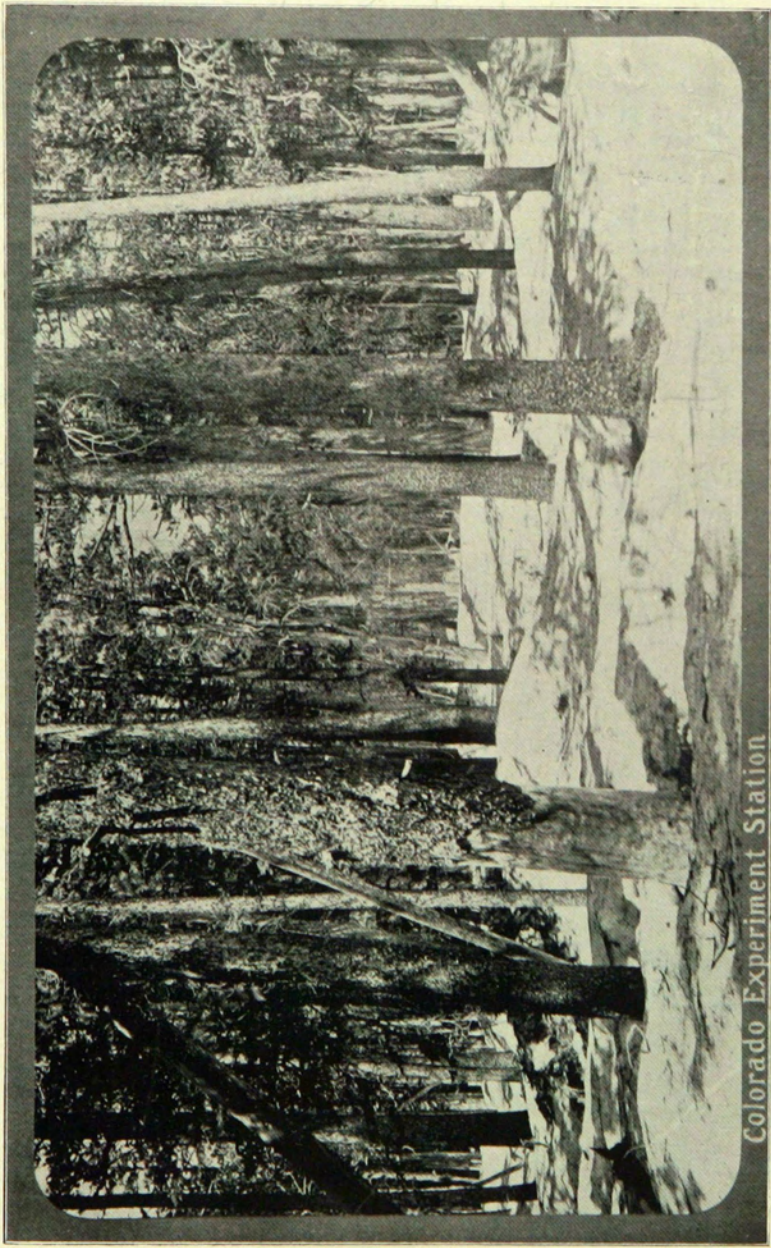
The following summary shows the seepage gains and losses that were found in 1897, 1898 and 1899, the measurements being given in cubic feet per second. The drainage area above Canon City is about 4,600 square miles:

Place.	Dist. Miles.	Area of Tribut'y Water- shed— square Miles.	1897		1898		1899	
			Gain.	Loss.	Gain.	Loss.	Gain.	Loss.
Canon Cy to Bes- semer ditch..33		1481	53.40	.....	55.17	.....	.....	.....
Bessemer to Pueblo.....10		255	.....	42.18	.....	15.96	.....	30.25
Pueblo to Or- chard Grove.. 8		1101	.....	9.40	19.41	.....	.....	30.31
Orchard Grove to Boone.....16		1335	163.47*	.....	20.30	.....	.....	7.55
Boone to Ne- pesta.....10		2235	40.44	.....	.....	17.65	33.45	.....
Nepesta to Otero canal..... 8		182	.....	5.78	.....	11.00	15.24	.....
Otero canal Ap- ishapa creek.. 7		57	16.90	.....	18.15	.....	.....	6.43
Apishapa creek to Rocky Ford.16½		1637	30.55	.....	31.21	.....	32.73	.....
Rocky Ford to Ft Lyon canal... 9		749	35.59	.....	22.39	.....	52.20	.....
Ft. Lyon canal to La Junta..... 3		88	13.04	.....	8.20	.....	6.77	.....
La Junta to Jones ditch...11		115	10.85	.....	14.76	.....	.....	4.96
Jones ditch to Las Animas.. 9		193	23.51	.....	20.08	.....	39.33	.....
Las Animas to Old Ft. Lyon. 6		3509	33.14	.....	13.26	.....	16.46	.....
Old Ft. Lyon to Caddoa.....11		650	3.63	.....	.....	0.16	11.37	.....
Caddoa to Amity canal.....10		445	.....	.....	.....	6.64	.....	24.09
Amity to Lamar.11		256	.....	.....	6.68	.....	13.71	.....
Lamar to Holly.39		461	13.21	.....	14.29	.....	45.19	.....
Holly to Cool- idge, Kan.... 7		1171	.....	.....	.....	.....	3.21	.....
	215	15960	303.26†	57.36	243.81	51.41	269.63	103.59
			57.36		51.41		103.59	
			245.90†		192.40		166.07	
							55.‡	
							221.	

* Evident error.

† This omits the section from Caddoa to Lamar, lost by the breaking of the meter in slush ice and considers the gain from Orchard Grove to Boone to be that found in 1898.

‡ Estimated gain from Canon City to Bessemer ditch.

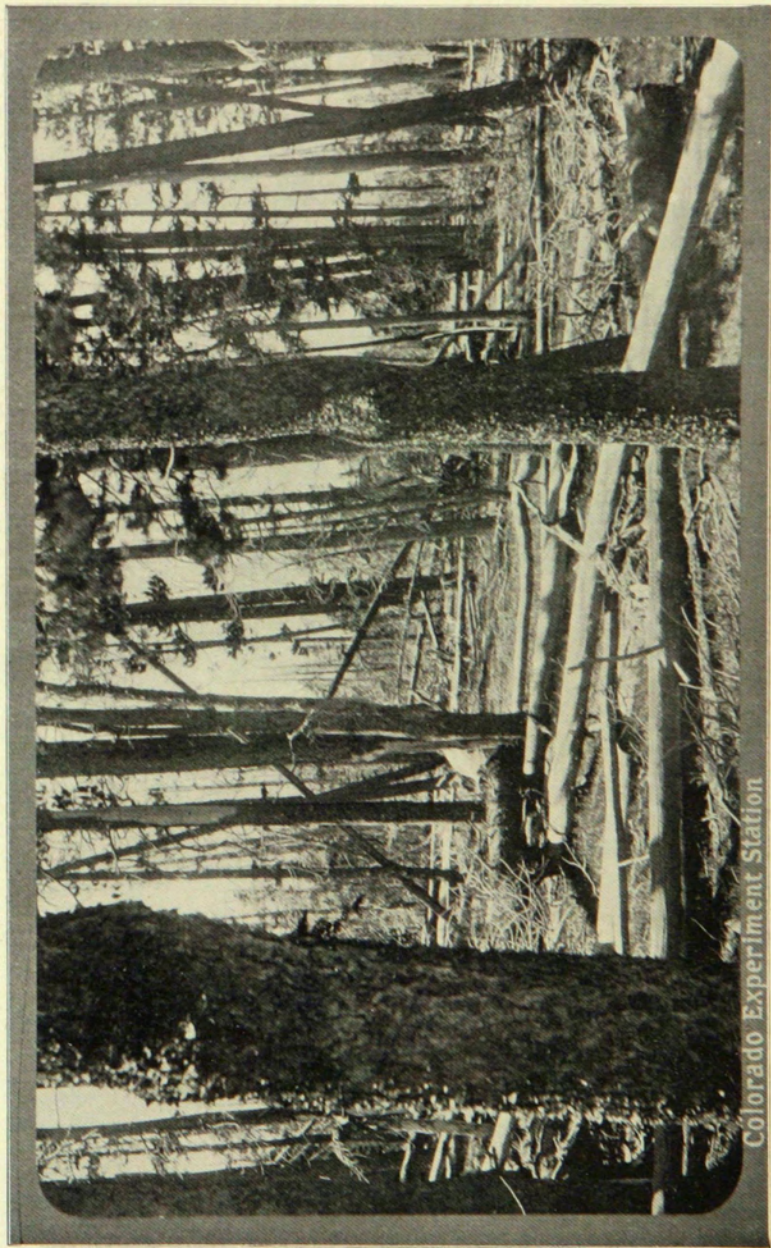


Colorado Experiment Station

Fig. 5. FORESTS AND SNOW. Snow Drifts in Green Timber June 21, 1899.
Elevation 9600 ft. Looking Northwest.

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J. D. STANNARD, PHOTO.



J. D. STANNARD, PHOTO.

Fig. 6. From same point as Fig. 5. Same date. Looking Southwest into area exposed to sun. (B 42)

River Flow.

The Poudre river, watering the valley adjacent to Fort Collins and Greeley, is a typical irrigation stream. For fifteen years records have been kept of the discharge at a point about twelve miles from the College with automatic instruments. The watershed above this point exceeds 1,000 square miles. Weekly bulletins have been prepared for the local use of papers in northern Colorado. The quantity given is the amount measured at the canon, and includes an amount not exceeding 150 cubic feet per second diverted from other watersheds. This is not separately considered here. The amount is in cubic feet per second.

Week Ending	1899	1898	Normal.	Week Ending	1899	1898	Normal.
April 18	311	167	149	Aug. 15	640	153	350
" 25	340	181	280	" 22	463	134	329
May 2	356	285	471	" 29	302	121	268
" 9	546	248	636	Sept. 5	355	127	225
" 16	1085	533	938	" 12	254	82	197
" 23	1526	764	1355	" 19	203	58	163
" 30	1791	1123	1750	" 26	130	46	146
June 6	1739	1317	2046	Oct. 3	123	35	142
" 13	2441	1286	2149	" 10	103	50	141
" 20	3114	1567	1932	" 17	133	66	124
" 27	3107	1266	1680	" 24	126	77	115
July 4	2594	790	1378	" 31	240	68	100
" 11	1789	575	1069	Nov. 7	164		
" 18	1407	617	842	" 14	130		
" 25	971	332	642	" 21	95		
Aug. 1	874	231	495	" 28	75		
" 8	845	202	421	Average	360	431	708

Duty of Water.

Measurements were continued on a number of farms, several by automatic recording instruments.

The hay ranch of W. M. Post, and the general farm of J. H. McClelland, have now had the amount of water used by them measured for nine consecutive years. The results show very decided differences from year to year, so much so that it is evident that any conclusion based on the records of anything less than several years is on a very uncertain basis. Canal companies are often suspicious of inquiries of this nature; nevertheless several have cordially furnished their records for use. J. H. Crowley, of Rocky Ford, P. H. Sheridan, Hon. B. F. Rockafellow, and Henry Earle, of Canon City, and W. F. Crowley, of Holly, are among those whose aid has been especially useful. This material will soon be brought into form for publication. A number of diagrams are already prepared.

The investigations on irrigation in the Arkansas Valley have not reached the degree of success hoped for. Mr. R. W. Hawley, who became acquainted with the valley in 1898, was continued in the summer, and made a promising start. An attack of typhoid fever, probably contracted in the exposure in connection with the work, took him from the field in August. As no one else was available with the detailed knowledge of the localities and the investigations, the records for the latter part of the season have lacked the supervision which it was intended to give. The records themselves have not been worked up, and until that is done, full judgment can not be given. Several canal companies have furnished valuable records. Among these records are records on the amount of water used on fields of varying crops, and on orchards, with several places where automatic instruments were used. In some places the records hoped for were interfered with by sediment, which, in the case of the Arkansas river, is sometimes present in large quantities.

The work in meteorology has been continued along the same lines as hitherto. Such observations need to be maintained to give full informa-

tion concerning the conditions surrounding plant growth, and should be rendered accessible to those wanting them. While such material is not desirable for a bulletin for general distribution, it could well be printed as a part of the annual report, and the demands would be met by having some printed separately. There is now considerable data of value obtained from following the same plan for eleven years, and is now worth reducing. When that is done, it will doubtless be desirable to reduce the time given to some of this work.

The snow in the mountains last winter was so exceptional in amount that it gave an unusual opportunity to study the effect of the forest on the preservation of snow. The time chosen was when ground began to show in the forests, in order that photographs would more clearly show the influence to the eye. When our mountain correspondents indicated this period, Mr. Stannard was sent with camera and field developing outfit, and through the guidance of Mr. John Zimmerman, of Home P. O., whose long and intimate acquaintance with the mountains took him to the proper spots without loss of time, some unique photographs were secured. Others were taken in the vicinity of Chamber's lake, through the aid of similar courtesies shown by Mr. John McNabb, superintendent of the "Sky Line" ditch. The photographs show distinctly the important influence the forests exercise in protecting the snow from wind and sun.

Acknowledgements are due to many for favors and courtesies shown. This includes a list too long to give here, and over all parts of Colorado east of the Range.

Respectfully submitted,

L. G. CARPENTER.

Fort Collins, Colorado,

December 6, 1899.

REPORT OF THE RAINBELT SUBSTATION.

(The Name is now changed to Plains Substation.)

To the Executive Committee of the State Board of Agriculture.

GENTLEMEN—I present a report of the work done at the Rainbelt Experiment Station during the year 1899.

The schedule adopted has been carried out, so far as crops were concerned, but we have been unable to carry on investigations concerning the work done by others in the Plains region on account of work at the Station.

We have kept a meteorological record, under the direction of the Meteorologist of the Central Station and have also acted as Volunteer Weather Observer and Crop Reporter for the United States Weather Bureau.

A history of the Station, giving the results of the work from the time of its organization to the present time, has been written and placed in the hands of the Director.

HORTICULTURE.

The trees all grew well. One tree matured a few small apples. Cherry trees bore a small crop. Plums matured no fruit. Gooseberry crop was light.

The seeds of twenty-five varieties of trees were planted. Only a few grew. More may germinate next year.

The following table shows the result of planting trees and plants in the year 1899:

	<i>Number Planted.</i>	<i>Number Living.</i>
Peach trees.....	19	12
Cherry trees.....	6	4
Crab apples.....	10	9
German prunes.....	5	1
Dwarf pears.....	6	6
Russian apricots.....	12	12
Honey locust.....	1000	438
Ash.....	1000	484
Wild black cherry.....	100	17
Elm.....	100	43
Catalpa.....	100	90
Russian wild olive.....	10	10
Raspberries.....	36	0
Dewberries.....	100	25
Gooseberries.....	30	3
Blackberries.....	150	12
Strawberries.....	350	20
Currants.....	10	7
Dwarf Juneberries.....	12	10

A garden was planted, but nothing did well except beans, peas, radishes and lettuce.

FIELD CROPS.

Five acres were sown to alfalfa. A good stand was obtained upon four acres.

Small grain was a complete failure.

Several varieties of foreign millet were sown. None gave better yields than the ordinary varieties. All foreign varieties ripened seed, but none grew tall, and some of the plants merely stuck their heads out of the ground and went to seed.

Corn made a small crop of fodder, but only two or three bushels of grain per acre.

Potatoes were damaged badly by dry weather and beetles. Only the early varieties produced tubers.

Several varieties of sorghums were tested. Some of them promised well enough to warrant a test on a larger scale. But few of the sorghums

mature seed here. Brown Durra is an early variety of non-saccharine sorghum which has matured a good yield of seed every year it has been tested here.

One variety of cow pea has been grown on the plains until it has become naturalized. It yields a fair crop every year, and has yielded 600 pounds per acre here.

One variety of Navy bean, known as the Tree bean, gives promise of becoming valuable here.

THE "CAMPBELL PROCESS."

Ten acres were devoted to a test of this method of soil culture. Corn, barley and potatoes were planted. A part of each plat, or field, was prepared and cultivated according to instructions given by Mr. Campbell, while the remainder was given good culture merely. No difference can be seen in the results obtained by different methods of culture.

IMPROVEMENTS.

The dwelling has been repainted and storm windows have been put on the north side. An office has been fitted up in the barn and a chimney built in the room.

RECOMMENDATIONS.

1. The crops which have given the best results in small plats should be given field tests.
2. The testing of untried grasses and forage plants should be continued on a small scale.
3. More attention should be given to tree planting.
4. The results obtained by settlers on the plains should be investigated. This information should be published so as to help others who want to live here, or warn those who may not like to live on the plains under the conditions which exist.
5. To enable the superintendent to travel and gather information, the acreage in experi-

mental work proper should be materially reduced. The remainder of the cultivated land might be planted to forage crops which would yield sufficient income to pay for cultivation.

6. Endeavor to induce settlers to co-operate with us in testing forage plants on a large scale.

7. Put more work upon studying the conditions under which crops are produced, and recording observations along that line.

8. Give special attention to ornamental trees, shrubs and flowers best adapted to this region, in order to help people to beautify their homes.

Respectfully submitted,

J. E. PAYNE,
Superintendent.

Cheyenne Wells, Colorado,

December 12, 1899.

REPORT OF THE ARKANSAS VALLEY SUBSTATION.

To the Executive Committee.

GENTLEMEN—Herewith is presented a report, in detail, of the operations of the Arkansas Valley Substation for the year 1899.

The station is located at Rocky Ford, on land belonging to the state, a title being furnished conditional on its use as an experimental farm. The area is 200 acres, 120 of which is leased to F. M. Harsin on shares. The leased portion has consisted, approximately, of 13 acres in corn, 50 acres in cereals, and 50 acres in alfalfa, the balance being taken by roads, railroads, etc. The remaining 80 acres have been under my personal supervision, and the acreage (approximately) may be summarized as, in vegetable and fruit crops, 5 acres; orchards and fruits, 10 acres; grasses, forage and leguminous crops, 15 acres; alfalfa, 15 acres; field crops, 25 acres; waste land and roads, 10 acres.

FEEDING.

The line of feeding inaugurated in the fall of 1898 (the production of "Baby Beef"), was carried through to a successful conclusion. For this purpose 15 head of calves, from 7 to 10 months old, were purchased about the middle of November. Four head had been raised by hand, the others were still running with the cows when purchased. Four head were grade Herefords; one was mostly Texas blood, and the remainder were grade Short-horns; they were considered a fair average lot of range calves. They were brought to the yards November 14th, and weighed on the 18th, before watering, averaging 342.6 lbs. They were fed on alfalfa hay until December 1st, when they were started on grain by feeding one pound of corn chop per head per day. The grain was gradually increased until, in two weeks, they were receiving three pounds per head daily. About this time we commenced to feed a few sugar beets. They were divided into three pens of five each for a comparison of rations, January 1st. Pen No. 1 was given a ration of three pounds of corn chop and four pounds of sugar beets; pen No. 2, composed of the smaller animals, was given three pounds of corn chop, to which was soon added one pound of whole oats; pen No. 3 was given a ration of three pounds of corn chop and one pound of oats per head daily. In one month this pen was put exclusively on corn. The whole were given the run of a large yard and as much alfalfa hay as they could consume.

The rations were gradually increased until April 1st, when each pen was put on what we considered "full feed." Pen No. 1 received five pounds of chop and eight pounds of sugar beets; pen No. 2, four pounds of corn chop and two pounds of oats; and pen No. 3, seven pounds of corn chop per head daily. These calves were fed an average of 178 days. They were sold to local butchers for \$4.60 per cwt., deducting 3 per cent. for shrinkage.

The results for the whole period may be summarized as follows:

Average Prices.

Hay consumed,.....	25,705 lbs.....	£3.00 per ton.
Chop consumed,.....	9,370 lbs.....	.80 per cwt.
Corn consumed,.....	979 lbs.....	.70 per cwt.
Oats consumed,.....	1,271 lbs.....	1.00 per cwt.
Sugar beets consumed..	4,047 lbs.....	3.00 per ton.
Average weight when purchased,.....	342.6 lbs.	
" " sold,.....	602.7 lbs.	
Total gain, (less 3 per cent).....	3,974 lbs.	
Number of days fed.....	178	
Average daily gain, (less shrinkage).....	1.49 lbs.	
Total cost, (15 head at \$18.00).....	\$270.00	
Total cost of feed at these prices.....	\$139.14	
Total amount sold for.....	\$415.88	
Cost of gain per pound at above prices.....	3½ cts.	

GRAINS.

Twenty varieties of fall wheat were tested for growth, production and period of maturity. The principal object was to secure some hardy, productive variety of good quality that would mature before the hot summer weather. Some of the varieties did not prove desirable and were not threshed separately, hence their yields do not appear in the following table.

<i>Name.</i>	<i>Yield in lbs.</i>	<i>Amount sown lbs.</i>	<i>Date of ripening.</i>
Red Mediterranean.....		1	July 18
Big May.....		1	July 18
Fultz.....		1	June 30
Ruby.....	65	1	July 19
Hunter's Winter.....	67	1	June 30
Scotch Fife.....	67	1	June 25
Hodgerow.....		1	July 5
Defiance.....	69	1	July 10
Advance.....		1	" 15
University No. 169.....	64	1	" 18
Preston.....		1	" 18
University No. 163.....	69	1	" 10
Willman's Fife.....		1	" 20
Bolton's Bluestem.....	67	1	" 15
Russiau No. 10.....	653	10	" 10
Russian No. 4.....	326	3	" 15
Russian No. 2.....		2	" 20
Russian No. 4.....	357	3	" 15
Red Russian No. 19.....	1,920	25	" 5

Samples were selected in the field of the most desirable seed for sowing in the fall of 1899. The following were sown under field conditions, in the amounts given, on the 6th and 7th of October 1899, and were looking well when winter came: Red Russian, 190 pounds; Hunter's Winter, 67 pounds; Scotch Fife, 52 pounds; Bolton's Bluestem, 67 pounds; No. 169, 52 pounds; Russian No. 4, 63 pounds; Ruby, 25 pounds; and Russian No. 10, 63 pounds. Seed was furnished us from the Agricultural Section, at Fort Collins, as a part of the test of latitude and altitude upon the gluten content of the wheat.

Four acres of Polish wheat or Mammoth rye were grown, under field conditions, for seed distribution and feeding purposes. It was our aim to introduce this for growing under ditches of scant water supply to supplement corn as a sheep food. It yielded at the rate of 25 pushels per acre.

Hulless barley was grown on slightly less than three acres of land to note its growth and productiveness and for seed distribution. The straw was short and the growth not satisfactory; 55 bushels were threshed and we considered the yield at the rate of 20 bushels per acre.

CORN.

The Iowa Silver Mine, Leaming, White Kansas King and Golden Beauty varieties of corn were grown under field conditions to note their growth, yield, period of maturity and adaptability. By seed selection we are attempting to reduce the ripening period of the Golden Beauty. This is a splendid variety of corn and the results this year show that its ripening period has been so reduced that it will fully mature here. From 4.7 acres we secured 245 bushels of ear corn. The Iowa Silver-Mine and Leaming have not been husked at this writing. From one pound of seed 390 pounds of ear corn were obtained from the Kansas King.

PASTURES.

The testing of grasses and clovers for pasture purposes has been continued. Those showing the best results were placed under field conditions, to demonstrate in a larger way their utility.

About $1\frac{1}{2}$ acres were sown to *Bromus inermis* in the fall of 1898, and a good stand was secured. This was pastured lightly this fall. This grass has not proven, so far, all that was expected of it. This sowing was made to give further trial before passing judgment.

The Station has demonstrated that Orchard grass thrives well, and in order to place it under practical conditions, considerable sowings of it, both alone and with mixtures, were made. About one acre was sown for pasture; also a plat containing Tall Meadow Oat grass and another containing alfalfa. Perennial Rye grass, Tall Meadow Oat grass and Hairy Vetch were also sown with the view of using them for pasture.

ALFALFA.

Turkestan alfalfa is being tested to note its growth and adaptability and for comparison with the kind commonly grown.

Fall and Spring sowings of alfalfa are being compared and notes are being taken on the effect sub-irrigation and cultivation may have upon seed production.

GREEN FERTILIZERS.

Hairy or Russian Vetch, field pea and cow pea were grown to note their value as green fertilizers. The work this year has consisted of noting their growth and yield and the production of seed for future use. April 1st, 54 pounds of Mummy field pea were put on about $\frac{3}{4}$ of an acre. They made splendid growth, about 4 feet, and were harvested July 12 for seed. The yield was 9 bushels after considerable loss from storm. The Hairy Vetch, sown in 1898, did not take much growth until the

spring of 1899. On April 27th it was about six inches high. It was allowed to go to seed this year, yielding 65 pounds on 10,270 square feet of land. It ripened the first week in July. This is a valuable bee plant, blooming profusely as it does in early spring.

Four varieties of the Cow pea were grown, namely, Whipporwill, Black, Clay and Blackeye; the last two in small quantities only. Fifty-five pounds of the former were put on about 6-7 of an acre. The yield of straw and grain was 2,800 pounds. Fifty-seven pounds of the Black were put on about $\frac{7}{8}$ of an acre. The yield was 2,125 pounds. The Whipporwill is the most desirable because of its upright growth. This plant is valuable for this section, especially for planting late and turning under as a fertilizer.

FORAGE.

The Idaho pea, field pea, Cowpea and Soya bean are being tested as forage and grain crops. Foreseeing the need of a nitrogenous grain for feeding purposes, we hoped to demonstrate the value of their production and the advisability of their more general use. The first mentioned is not quite meeting expectations in the matter of growth. It bears seed profusely, but it is so short of stem that it is difficult to harvest. It yielded 4,000 pounds per acre, straw and grain. Most of it was fed to hogs without threshing, and was relished by them. An epidemic of sickness among the hogs of this vicinity prevented reliable notes on the growth it would produce.

The medium Soya bean was grown. The seed was drilled in May 25, irrigated for germination on the 31st, and again irrigated June 28 and August 23. 155 pounds of grain were taken from 16,600 square feet of land, or at the rate of 400 pounds per acre. It was ripe by September 10; cut with mower and raked with horse.

This plant yields heavily, resists drouth extremely well, and is very highly nitrogenous.

CANTALOUPE.

Different amounts of irrigation were given to three plats of cantaloupe to test the effect on quality and production. The soil was of the same character, the seed was planted at the same time and treated in the same manner for the first month.

One plat received seven irrigations, on June 19, 30, July 10, August 1, 17, 26, and September 4; another three irrigations on June 30, August 1, September 4; and the third one irrigation on July 10, just before a very heavy rain. Each irrigation lasted about six hours.

It is common in this vicinity to irrigate about every eight days, paying but little attention to the needs of the plant. Very heavy rains occurred in July, furnishing all the moisture necessary. There was no appreciable difference in the yield or the quality of the first two plats mentioned. Both the fruit and the vine of the third were smaller and consequently the production less. The quality seemed to be better than the others.

The idea prevails with some that much rainy weather has a tendency to produce a poor quality of melon. Our tests indicate that a too plentiful supply of moisture may deteriorate the melon, but as it is not marked, the loss in quality so much complained of, must be traced to some other cause.

The next experiment we wish to note was a comparison of cantaloupes on alfalfa sod with those grown on a soil cropped in different ways for a few years past. We also wish to note the difference in quality and production of the crop grown on this soil as compared with barnyard manure used in the hill, and bone dust (finely ground bone) also in the hill. The alfalfa was plowed under in the fall and replowed in the spring. On the alfalfa sod the vines were large and rank, the fruit of good size and quality, and production larger. Some hills had as high as eighteen good, merchantable

melons. They also resisted disease much better, hence produced fruit later. The quality, as a general thing, was better. There was no appreciable benefit from the use of the bone. That manured with barnyard manure produced more and better vines and fruit than when no fertilizer was used. Evidently a nitrogenous fertilizer is all that is needed upon these soils for the cantaloupes.

A test was made to note to what extent hot-bed propagation may hasten maturity and how successfully it may be performed.

The seed was put in hot beds April 3d. Some seed was put in cans so arranged that the plants could be taken from them without disturbing the roots. Other seed was put in the hot bed without any support. It was found quite difficult to transplant them when the roots were at all disturbed. Fully 95 per cent of those set out from the cans grew, and about 50 per cent. of those taken from the bed without support.

The first planting in the field was on April 29th, and the next on May 10th. The first ripe melon was taken from the transplanted vines August 17th, only one day ahead of the plants grown on alfalfa and manure, and only four days ahead of those grown with no fertilizer. They ripened in quantity, however, faster, and for the next ten days gave more ripe melons than any other planting.

Anticipating that the leaf blight that had been affecting the cantaloupe for two or three seasons previous to 1899 would gradually increase until it endangered this crop, we secured some seed from melons affected in 1898, to plant in 1899, to note whether the disease was communicated to the plant from the seed. The seed was planted separately and on land that had not produced melons for some years at least. The trial did not show that the disease is communicated to the plant by the seed. A striking similarity is shown between the product and the parent crop. To further note this and to improve the quality and shape by selec-

tion, for the purpose of securing high-class seed for distribution to maintain a high quality of this product three grades of seed were made this year for use of another season.

The only insect troubling the cantaloupe was a few small, black flea beetles. These appeared when the plant had but two leaves. A spraying with Paris green and lime (1 oz. of the green to 10 gallons of water) was sufficient to reduce their injury.

During the season much valuable work was done combatting the leaf blight (*Macrosporium cucumeris* of the cantaloupe. This disease was prevalent and seriously affected the crop, especially in the vicinity of Rocky Ford. This disease appeared seriously in 1898 in some fields but this year it spread rapidly and reduced the product on many fields to a very small amount. The quality of the cantaloupe was greatly impaired wherever this trouble was of a serious nature.

We began early to spray the plants grown from seed taken from blighted melons in 1898. The first spraying was done June 22d, at which time there was no appearance of blight, but one-half of the vines were left unsprayed as checks. They were again sprayed June 30th when we noted "something on the leaves which appears like blight." At this time the vines were just beginning to run well. Previous to the 19th of June the weather had been very dry. July 7th we had .44 in. of rain, and during the month 7 inches fell, most of it in the week commencing the 13th.

We did not spray again until July 22d, at which time the blight was strongly in evidence. July 31 we sprayed the new growth. August 11 we sprayed what new growth had been made. The sprayings made after the 22d of July were a great benefit. The vines held up fairly well and the fruit was of good quality, while that of the unsprayed vines ripened prematurely. The sprayed vines were in good condition from two to three

weeks after the others had succumbed to the disease. This disease spread so rapidly, and the question was of so much importance that we inaugurated other experiments, in the latter part of July, on a much more extensive scale. Spraying was done with Bordeaux mixture and with ammoniacal copper carbonate, both upon the Station and upon Mr. I. D. Hale's place. We also used the Bordeaux mixture upon about an eighth of an acre of cantaloupes belonging to G. W. Swink, and on about one acre belonging to I. D. Hale. These were given but one spraying. To further test the Bordeaux mixture, $1\frac{3}{4}$ acres were sprayed once on Mr. Fenlason's place. This was done August 22 and 23. The vines were large and completely covered the ground. The blight was showing quite extensively. The principal object was to obtain the cost of spraying. These tests confirmed the conclusions formerly drawn, and the many people who saw the effect of the spraying were convinced of its benefits.

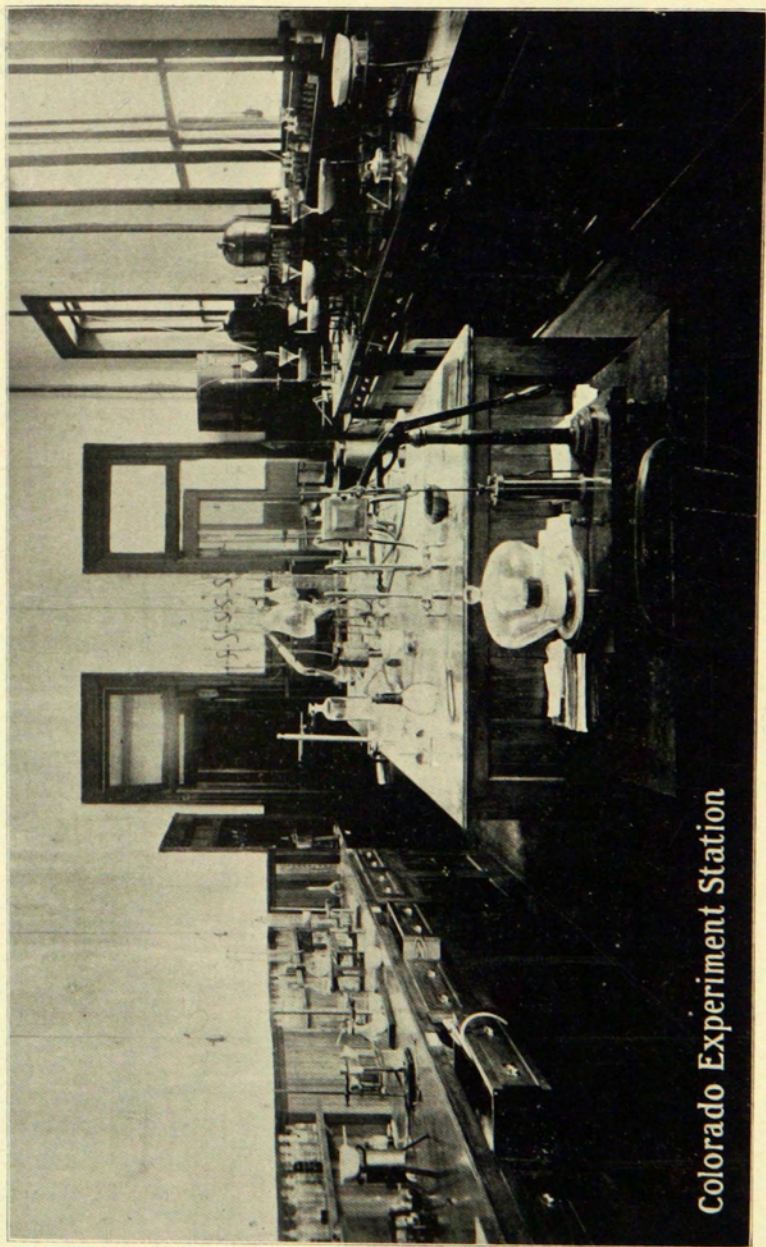
POTATO.

This section of the state is not the habitat of the potato. Much experimental and field work has been done by the Station with this vegetable.

Our work embraced some investigations bearing upon soil treatment and general cultural requirements, hoping at least to establish some general principles that would enable the farmer to produce potatoes in sufficient quantity for domestic use.

Three plantings were made on different dates on alfalfa sod, namely, May 11, 26, June 13. The yields were 570 pounds from the first planting; 420 pounds from the second; and 138 pounds from the third from the same area for each. The first planting was much the best: the last was small and of little value.

A test was made to find the effects of different amounts of irrigation. Eighteen rows of Mammoth



Colorado Experiment Station

Fig. 7. Chemical Laboratory.

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Pearl and 14 rows of Rose Prolific each 217 feet long were employed. The former was divided into two plats of nine rows each, and the latter into two of seven rows each. It was intended to irrigate one plat of each kind a sufficient number of times to keep the plants growing thriftily. The other plats were to remain without water until such time as they were actually in need of it.

The idea prevails that irrigation causes the rank growth of vines at the expense of the tuber growth. The following table gives the amounts of irrigation and the results:

<i>Name.</i>	<i>No. of rows.</i>	<i>Dates of Irrigation.</i>	<i>Yield in Pounds.</i>
Mammoth Pearl	9	July 1, 31, Aug. 20, Sept. 5	405
Mammoth Pearl	9	Aug. 4, 20, Sept. 5	145
Rose Prolific	7	July 2, Aug. 18, Sept. 4	545
Rose Prolific	7	Aug. 3, 18, Sept. 4	305

Planting was done May 30 and irrigation employed to germinate the seed. The cultivation of each plat was the same.

CELERY.

Owing to the demand for information upon the growth of celery, some work has been done to note the character of soil and the methods of culture needed for its production.

To do this we have compared the work of the Station with that of outside parties. Two things have been demonstrated; namely, that the seed must be sown in open field and only the large and thrifty plants used for transplanting; and second, that blanching by earth must be employed to secure a quality at all desirable.

SUGAR BEET.

Three lines of work have been employed with the sugar beet; viz: in a small way to test what effect the different dates of planting may have upon the germination, yield and sugar content of the beet; the production of seed (from beets tested

by the specific gravity method for high saccharine quality) for the improvement of the sugar content; and one acre, under field conditions, to note the general requirements and the cost of production.

Four rows, each twenty feet long, were planted April 4 and 17, and May 2, 16 and 21. On May 2, two plats of four rows each were planted so two rows were eleven inches apart, then a space of 27 inches and then 11 inches between rows again. The weather was such that germination was very poor, and not before May 16 were we able to secure a fairly good stand.

The beets were dug October 21 and sent to Grand Junction for analysis the 23d. The table gives results:

No.	Time of planting.	Yields in lbs.	Per cent. total solids.	Per cent. sugar in juice.	Per cent. purity.
1	April 4	123	19.42	16.10	83
2	April 17	112	18.09	14.95	83.2
3	May 2 (close)	110½	20.20	16.90	83.7
4	May 2 (wide)	112	17.21	13.80	80.2
5	May 2 (close)	97½	17.71	14.65	80
6	May 2 (wide)	125½	18.18	14.65	80.6
7	May 16	191½	18.42	15.55	84.5
8	May 31	131½	18.32	14.80	86.8

The sugar content of about 110 beets tested from 17 to 23 per cent. by the specific gravity test. A considerable quantity of seed was secured which will be planted to test to what extent the sugar content may be improved. Some of these beets were planted between rows of corn and in the protection of orchard trees. The results showed no benefit. There was no destruction (from wind) of the seeds where grown in the open. The above work was done in connection with Professor W. W. Cooke.

To test the cost of production 8½ pounds of seed were put in with grain drill May 4. The land was in splendid condition when the planting was done, but the cold, dry weather following pre-

vented germination. Accordingly, on June 1, the ground was well harrowed with an Acme harrow and 6½ pounds of seed again drilled in. About 50 per cent. of a full stand was secured from the planting. An account was kept of the number of hours employed in the production of the crop. The results are as follows:

Plowing, harrowing, etc., 11½ hours, at 30c.....	\$3.45
Furrowing and cultivating, 23 hours, at 25c....	5.75
Seeding, 3 hours, at 30c.....	90
Hoing and thinning, 63 hours, at 15c.....	9.45
Irrigation, 26 hours, at 15c.....	3.90
Plowing out at harvest, 11½ hours, at 30c....	3.45
Topping and pulling, 42½ hours, at 15c.....	6.37

Total cost.....	\$33.27
Yield, 10 8 tons at \$3.00.....	\$32.40

To the above must be added the cost of seed; but on the other hand we must consider that the land is well plowed and an allowance for this should be deducted.

These beets analyzed on the 23d of October: Total solids, 17.55 per cent; sugar in juice, 14.75 per cent; purity, 84.1 per cent. These results were obtained under the most adverse circumstances. The last seeding was too light, but no more seed was available.

BEANS.

Spraying and cultural work has been carried on with the bean, looking to the control of a blight which affects it. Spraying the vines with Bordeaux mixture has given no beneficial results.

Plantings were made May 17 and June 20 to note whether time of planting and maturity has any effect on the occurrence of the disease. The first planting matured August 12, the second by September 13. Both plantings were badly blighted, but the difference, if any, was in favor of the late planting. We anticipated doing some work for the control of the bean anthracnose which was prevalent in 1898, but it did not appear in 1899.

ORCHARD.

The hail storm of June 6, 1899, together with the severe winter following, destroyed nearly the whole of the orchard trees set in 1896, and those reset in the spring of 1898. This is what has been termed the young orchard. The most of the land was reset last spring; with 28 varieties of apples, 15 of cherry, 21 of plum, 25 of peach and 16 of pear, besides the following kinds of nuts: butternut, French walnut, Japanese walnut, shellbark hickory, filbert, pecan, sweet chestnut, English filbert and almond.

The number of trees set is as follows: Apples, 75; nuts, 40; cherries, 31; plums and prunes, 45; peach, 50; nectarines, 4; pear, 42; of which 10 apples, 23 nuts, 18 cherries, 11 plums, 11 peaches, 1 pear and 1 nectarine failed to grow.

The large loss of cherries was mostly due to stock injured by the severe winter.

Some varieties in the old orchard have been cut out and many more are in such condition that we will cut them down. The first variety to blight was the Wagner; this was followed by the Mann, Peters, Smith's Cider, Baldwin and Delaware Red, The Clapp's Favorite, Flemish Beauty and Keiffer pears have died. The Longworth still survives, but is not healthy.

Ground bone and wood ashes were applied to the roots of some bearing apple trees to note any effect upon their health, growth and productiveness. Owing to a late frost destroying the bloom, there were but a few scattering apples.

From 12 to 25 plants each of seven new varieties of strawberries were set out this spring, making 24 varieties upon the Station. Seventeen of these varieties were reset from an old bed in the spring of 1898. The hailstorm of June 6 destroyed many plants and so weakened the others that it has taken most of this season for the plants to establish themselves in a healthy condition.

The Strawberry leaf-roller has become quite

troublesome. Burning the vines, over which a light coating of straw had been placed, has been done both fall and spring with beneficial results. If this method is pursued, no doubt this insect can be exterminated.

There is considerable demand for information in regard to varieties of small fruits which will succeed in this section. About one dozen plants of each of the following varieties of berries and one-half dozen of the grapes, besides three plants of the Campbell Early grape were set to supply information along this line:

<i>Blackberries.</i>	<i>Red Raspberries.</i>	<i>Black Raspberries.</i>	<i>Foreign Grapes.</i>
Western Triumph, Taylor Prolific,	Miller Red, London, Cuthbert, Columbian,	Eureka, Gregg, Palmer, Kansas,	Muscat, Ladyfinger, Black Hamburg, Emperor, Cornichon, Flame Tokay, Thompson Seedless.

The weather was very dry and cold after the above were set, and many plants failed to grow. It will take another season to tell to what extent they did succeed. The winter of 1898-1899 killed to the ground all varieties of grapes upon the Station except covered. The list of grapes includes Moore's Early, Lady Washington, Empire State, Worden, Duchess, Concord, Pocklington, Lady, Niagara, Brighton, Delaware, Martha, Woodcraft Red, Catawba and Iona.

The plums fruited but very little this year, the severe winter killing the buds. One tree of Forest Garden, one of De Soto, and two unknown trees were well loaded with fruit. There were a few plums on the west and south sides of the Chickasaw.

Observations have been taken upon some troubles affecting the tomato crop, with the intention of formulating some experiments for their control. Chief among these troubles is a blight of the vines, a rot of the fruit, and a failure of the vine to produce fruit.

ENTOMOLOGY.

In connection with Professor Gillette, some work was done in the orchard of J. H. Crowley, bearing upon the codling moth. It consisted of covering eight trees with netting, to study the efficacy of spraying and to what extent each brood affects the apples. The results seem to show that we have but two broods of the moth, and that the moth ceases transforming about the 20th of August.

METEOROLOGY.

The meteorological records include the following: temperature, maximum and minimum; psychrometer; wet and dry bulb at 7 a. m. and 7 p. m.; precipitation; sunshine; wind; frosts; dews; and other phenomena. Reports have been sent monthly to the section at Fort Collins and duplicate reports to the Weather Bureau. The weather of the past season has been characterized by a very cold, windy, dry, spring, followed by heavy rains in July and August, with late and pleasant fall.

We fail to see any beneficial results from the application of gypsum in 1898. All that such a soil needed was proper cultivation and irrigation.

In addition to the experimental work proper, enumerated above, 7 acres of oats, yielding 297 bushels, were grown. Three crops of alfalfa were harvested from 11 acres of land, the yield being estimated at 40 tons. About 60 pounds of cantaloupe seed were saved besides that selected for experimental purposes. Thirty-five crates and five baskets of cantaloupes were sold.

The returns from the leased land have been 85 bushels of corn, (estimated), 60 tons of hay (measured), and 335 bushels of grain.

Respectfully submitted,

H. H. GRIFFIN,

Superintendent.

Rocky Ford, Colorado,

November, 30, 1899.

RECORD OF SIX YEARS WORK AT THE PLAINS SUBSTATION.

J. E. Payne, Superintendent.

Note by the Director:

The Rainbelt Station was established in accordance with the act of the legislature. It is located near Cheyenne Wells, certain so-called wells having existed near the old Overland trail. Subsequently artesian water was sought by the government, and several wells have been put down to considerable depth, the only water found being within a few hundred feet of the surface.

This station has the characteristic climate of the Great Plains --hot summer days, with heavy drying winds, and occasional heavy downpours of rain. The region is entirely given to range stock. The early trials of the settlers at farming have been failures. Now a few, who are principally interested in the range industry, are again making trial and with some degree of success. The investigations of the Station have followed the plans of the superintendent, and have been carried on under discouraging conditions. The work has been largely negative in results. The unsuccessful as well as the successful trials are here recorded so as to be accessible to those who may be interested in the Plains.

In general the available supply of moisture has not been sufficient to tide the shallow-rooted crops over the dry periods. A plan of investigation somewhat different will be followed in 1900.

Until 1870 but very little country west of the one hundredth meridian was settled. But the pressure of population in the eastern states induced people to look for homes in the "Great Plains" region. Gradually, the tide of immigration, led on by land agents who advertised the country, flowed

westward until all the "blue-stem" region was settled, and much of the "short-grass country" was occupied by enthusiastic home-seekers.

By the year 1888 a considerable part of eastern Colorado was in possession of people who were determined to make the desert "blossom as the rose." One or two years of well distributed rainfall encouraged settlers. These were followed by several years unfavorable to farm crops. These, coupled with an imperfect knowledge of crops adapted to the country, soon caused an exodus of the enthusiasts. Only those who depended upon stock-raising for their living stayed in the country.

Land agents and railroad companies held the theory that eastern Colorado and western Kansas could be a farming country without irrigation if the conditions prevailing could be thoroughly understood.

Acting upon this theory, an agitation was begun for the establishment of an Agricultural Experiment Station in what was called "the Rainbelt." This resulted in the passage of a bill appropriating twenty-five hundred dollars (\$2,500) from the Internal Improvement fund for the equipment of such a station to be located in Cheyenne county. This law went into effect too late in 1893 for any farming to be done that year.

A committee from The State Board of Agriculture, consisting of Messrs. Emigh, McClelland, and Kellogg, selected the northeast quarter of section 29, township 14 south, range 44 west (the same being railroad land), as the site of the Station. This land was deeded to The State Board of Agriculture on condition that it be used forever as an agricultural experiment station.

After the land was acquired, the northeast forty acres was broken during the winter of 1893-94. Contracts for a dwelling house and a barn were also let. The house was ready for use in April, 1894, and the barn a little later.

The question of water supply came up early

in the history of the Station. The school district in which the Station was located offered to supply water for the domestic use of the Station. To make the water furnished by the school district available, 3,000 feet of pipe was laid. Two T's were put in. One is twelve and a half rods north of the north fence of the Station, and the other opposite the mixing pits of the brickyard, which are about fifty rods north of the north fence of the Station. The latter was afterwards fitted with a valve, and a pipe was attached for supplying water to the brickyard. The one nearest the fence was plugged.

Water was supplied according to contract by the school district until January 1, 1899, when the Union Pacific railroad company leased the well and assumed the obligations of the school district in this particular.

April 1, 1894, Mr. J. B. Robertson, a practical farmer of considerable experience, took charge of the Station as Superintendent.

The season of 1894 was unfavorable for crops all over the plains region. The crop on the Station farm, being on sod, fared badly. Only a few hundred pounds of fodder per acre was cut from the plats planted to corn, Kaffir corn, and saccharine sorghums. No grain of any kind was produced. A few trees were set out near the house, and ground was broken in October for an orchard.

In 1895 all fodder crops produced good yields. Small grain was a failure on account of a severe hailstorm June 20th. The same storm cut corn down so badly that but little mature seed was produced. Two acres were planted to fruit and forest trees.

April 1, 1896, Mr. Robertson was succeeded by Mr. J. E. Payne. The schedule of work for the year had been already adopted, and was carried out as planned. No trees were planted. Small grain was a failure. No grain was produced except by three varieties of Kaffir corn. The study of soils was pursued as circumstances would per-

mit. An implement shed was built this year; also a sod wall wind break. A moderate yield of fodder was produced.

The year 1897 was quite favorable to the production of fodder crops. This year, the main work of the Station was put upon a test of varieties. Several hundred varieties of grains and grasses were planted, but none proved to be better than the standard varieties grown in western Kansas. Three thousand seedling Russian mulberries were set out. Nine hundred cuttings of Russian *Artemisia* were planted. The Russian mulberries are now stout shrubs which winterkill badly. Only three *Artemisia* shrubs are now alive. The vacancies in the orchard were filled with trees from Fort Collins.

In 1898 some small grains made moderate yields. Corn yielded about fifteen bushels per acre. Only a few varieties were tested. No trees were set. Fodder crops which were cultivated made good yields, but sorghum sown made practically nothing.

The year 1899 proved to be one of the most unfavorable in the history of the Station. Twenty-three hundred forest trees were set. Seven hundred plants of various small fruits were set out. A few standard fruit trees were planted. A large number of varieties of seeds of foreign plants were sent here by the U. S. Department of Agriculture. None tested have proved superior to varieties already in cultivation on the plains.

The following maps give some idea of the location of the trees and buildings, and also of the cropping of the cultivated land since it was first broken:

Plate I	shows	the	location	of	crops	in	1895,	so	far	as	known.
Plate II	"	"	"	"	"	"	1896,				
Plate III	"	"	"	"	"	"	1897.				
Plate IV	"	"	"	"	"	"	1898.				
Plate V	"	"	"	"	"	"	1899.				

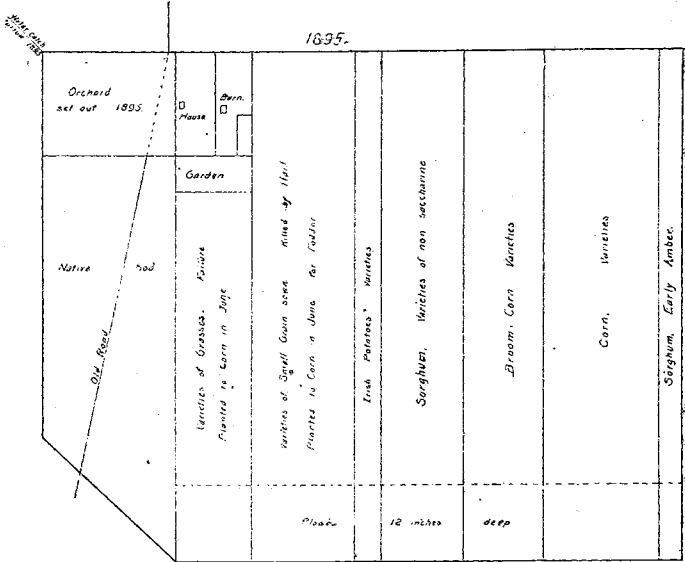


PLATE I.

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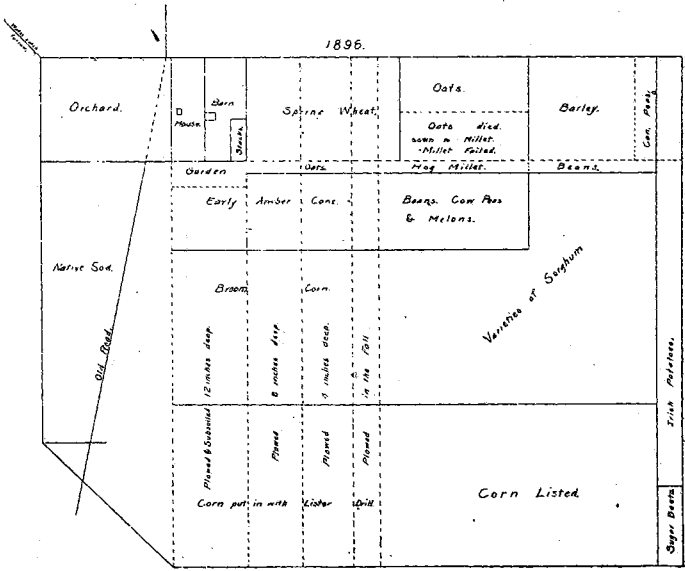


PLATE II.

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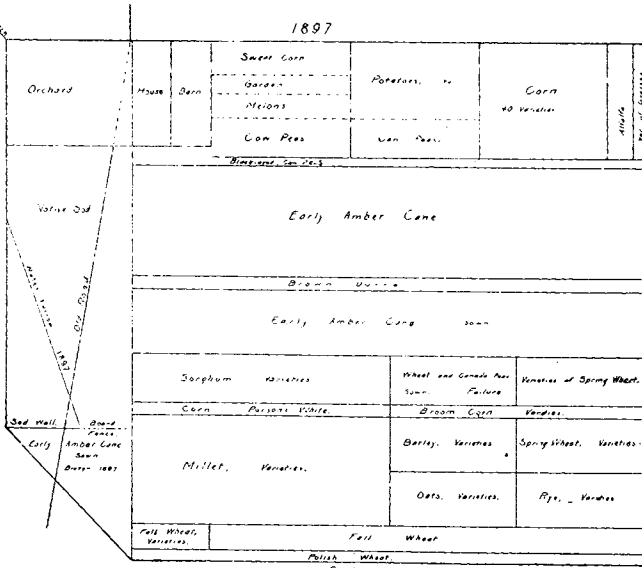


PLATE III.

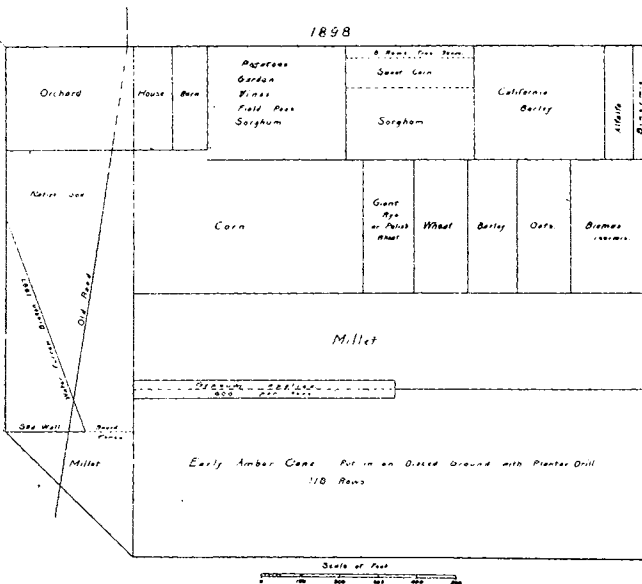


PLATE IV.

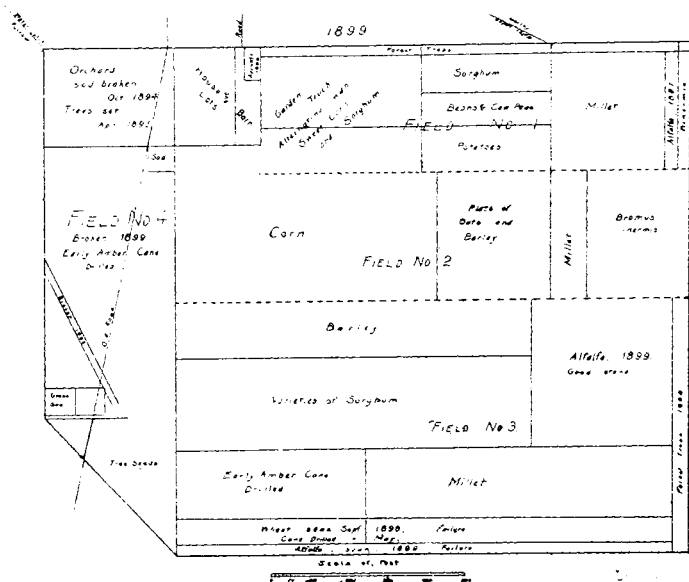


PLATE V.

The following table shows the precipitation at this Station from June 1st, 1894, until Nov. 24th, 1899. The table given in the report for 1898 is incorrect in several cases.

MONTHS	1894	1895	1896	1897	1898	1899	Means
	Inches	Inches	Inches	Inches	Inches	Inches	
January67	.45	.26	.08	.47	.38
February27	Tr	.10	.00	.36	.15
March16	.71	1.58	.61	.39	.69
April	1.67	3.41	1.20	1.10	.08	1.48
May	1.49	2.28	1.44	5.56	2.88	2.72
June48	3.00	3.03	2.22	3.95	1.89
July	1.99	6.38	2.27	4.19	2.09	3.67
August	1.03	1.22	3.07	3.24	1.33	.55
September14	Tr	.84	.92	2.00	.78
October14	.21	.78	2.73	.48	Tr
November	T	.30	T	.10	.50	2.49
December55	.42	.80	.20	.48	0.55
Total	—	15.79	17.44	18.18	18.18	14.06

The following tables summarize the tests of the different crops and the results. Practically the same methods of culture have been practiced in variety tests from the time the work began until the present time.

BARLEY.

1894—Only one variety, the California, was sown on May 2. Failure.

1895—Three varieties were sown, the California and Mansury, on April 8, and the Black Hulless, on May 6. All failed.

1896—Black Hulless, Mansury and Highland Chief were sown April 20. All failed.

1898—Nineteen varieties were sown. Most produced only seed. Some gave a small yield which is indicated in the figures after the names of the varieties. All were sown April 10.

	<i>Bu.</i>		<i>Bu.</i>		<i>Bu.</i>
Black Hulless....		Mansury	2.2	Highland Chief...	
White Hulless...		New Beardless...		Surprise.....	
Odessa.....	2.8	Trooper		Vanguard.....	1.7
Nugent.....	1.6	Royal		Emerson.....	
Sudney.....		French Chevalier		Manhattan.....	
Nepaul.....		Silver King.....	1.8	Success.....	3.3
		Ideal.....			

1898—Two varieties were sown, the California, April 30, which yielded 18 bushels per acre; and the Black Hulless, sown on April 28, yielded 21.6 bushels on packed ground, and 20.2 on unpacked ground.

1899—Only one variety, the White Hulless was sown April 6. Failure.

RYE.

1894—None sown.

1895—Spring rye, sown April 8. Failure.

1896—Colorado Giant Spring rye, sown April 24, and Large Pennsylvania White, sown September 28. Both yielded seed.

1897—Four varieties were sown in April, and none in October. Prolific Spring and

St. John's, sown April 5, yielded seed only. Colorado Giant Spring, sown April 25, yielded 3.4 bushels per acre. Winter rye, sown October 13, was a failure.

1898—Colorado Giant Spring rye, sown April 27, yielded 5.3 bushels on packed and 4.1 bushels on unpacked ground per acre.

1899—None sown.

OATS.

1894—Three varieties were tried. Excelsior was sown April 7; White Russian and White oats May 2 and 3. Failure on account of winds and grasshoppers.

1895—Excelsior, sown April 7, was cut for hay. Yellow French, sown April 18, was destroyed by hail June 20.

1896—Twelve varieties were sown. Two, the Excelsior and Black Russian, were sown April 9; the remainder April 23. The Excelsior was an entire failure, having been blown out. The others produced seed only.

Black Russian,	White Russian,	Belgian,
Golden Sheaf,	Superior Scotch,	Burt's Extra Early Rust Proof.
Red Georgia,	Clydesdale,	Red Rust Proof,
New Welcome,	Nebraska White,	American White.

1897—The following thirty-one varieties were sown April 9. In most cases seed only was produced. The figures following the names indicate the number of bushels per acre where the yield was greater:

Excelsior,	Black Russian,.....	5.6
Golden Sheaf,.....	Superior Scotch,.....	
Burt's Extra Early Rust Proof, 2.0	Red Georgia,.....	3.7
Clydesdale,.....	Red Rust Proof,.....	
New Welcome,.....	American White,.....	
Race Horse,.....	Badger Queen,.....	
Scotch,.....	Hazlett's Seizure,.....	
Scottish Chief,.....	Imported Irish,.....	
Rosedale,.....	Victoria Price,.....	
White Wonder,.....	Welcome,.....	
Poland,.....	Banner,.....	
Prize Cluster,.....	Mennonite,.....	
Great Northern,.....	Gold Mine,.....	
White Maine,.....	White Bonanza,.....	
Mexican Gray,.....	Mortgage Lifter,.....	3.3
Silver Mine,.....	New Zealand,.....	
Negro Wonder,.....	Lincoln,.....	
White Schoenen,.....	Winter Oats,.....	

1898—Two varieties: the Russian, sown April 28 on packed ground, yielded 20.5 bushels; on unpacked ground, 28.5, Winter Oats, sown October 1, proved a failure.

1899—Seven varieties were sown on April 8. All proved a failure.

Black Russian,
American White,
Negro Wonder,
White Schoenen.

Red Rust Proof,
New Zealand,
Lincoln,

WINTER WHEAT.

No Winter wheat was tried in 1894 or 1895, 1897 or 1899.

1896—Thirty-five varieties were sown. The first ten named were sown September 23; the next nine, September 28; the remainder September 30, except the last two, which were sown October 1. Where figures are given after the names the yield per acre is indicated.

Buckeye	Seneca Chief.....
Turkey.....2.1	Red May.....
Tasmanian Red.....4.0	Zimmerman.....3.9
Theiss.....1.8	Deitz.....1.1
Currell	Fulcaster.....1.6
Golden Cross.....1.7	Gold Coin.....
Poole.....1.7	Jones' Winter Fife.....2.2
Early Red Clawson.....1.1	Improved Fultz.....1.4
Forty-fold	Rochester Red.....2.3
Prize Taker.....	YX (Russian).....
Red Winter.....	Genealogique Red.....
Bearded Winter.....	Amautka.....
Red Girka.....	De Thiess.....
Compound	Belokoloska.....
Genealogique White.....	Winter Girka.....
Buda Pesth (Austria).....1.2	Turkey (in row—Kansas)....4.2
Mediterranean (in row—Kansas)1.6	Turkey (Kansas) broad cast...4.6
	Mediterranean " ".....4.2

1898—One variety, the Golden Cross, was sown October 10. Failure.

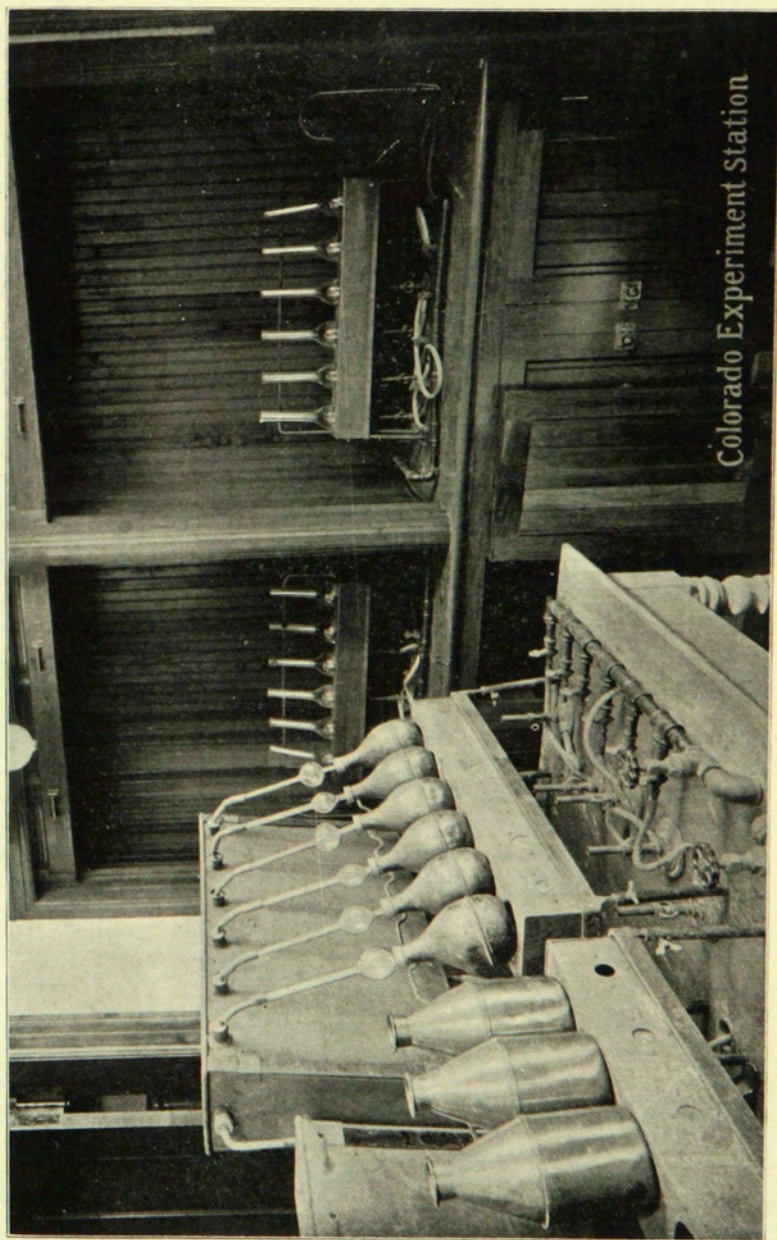


Fig. 8 Room for Nitrogen Determination. 351

SPRING WHEAT.

1894—Three varieties, Blount's No. 10, No. 16, and Defiance, were sown May 3. Failure.

1895—Four varieties, Velvet Chaff, Saskatchewan Fife, Marvel and Polish, were sown March 18, and Defiance, April 17. All proved a failure.

1896—Blount's No. 16 and Defiance were sown April 21, Polish, April 24. Seed was produced.

1897—Twenty-nine varieties were sown; the first three on April 5, the remainder April 10. The figures after the names give the number of bushels per acre:

Blount's No. 16.....	2.8	Defiance	
Polish.....	3.4	Velvet Chaff.....	
Saskatchewan Fife.....	2.0	Spiltz.....	
Club	2.3	Colorado.....	
Sutherland.....	2.8	Ladoga	2.2
Alpha	1.8	Red Fife	1.8
Advance	1.7	White Fife.....	1.3
Rideau	1.8	Old Red River.....	1.8
Admiral.....	2.0	Crown	1.7
Stanley	1.8	White Connel.....	1.6
Preston .....	.9	Pringle's Champlain.....	1.8
Blue Stem.....	1.6	Pillsbury	1.8
Hayne's Pedigree Blue Stem..		Pedigree Blue Stem.....	
Assiniboia		Okanagan Velvet Chaff.....	
		Spring Girka.....	

1898—Only two varieties were sown, April 26 and 27. Blount's No. 16 yielded 3.8 bushels on packed ground; 4.6 on unpacked. Defiance yielded 5.1 bushels on packed ground, and 4.6 on unpacked ground.

1899—No varieties tried.

BROOM CORN.

1894—Four varieties, California Golden, New Japanese, Dwarf and Imperial Evergreen, were sown May 10. Each produced from 400 to 450 pounds of fodder.

1895—Three varieties, The Missouri Evergreen, Tennessee, California Golden, were sown

May 23. About 800 pounds of good brush were obtained from the low ground.

1896—The same three varieties were sown May 28. A little good brush was obtained. All cut for fodder.

1897—Eight varieties were sown May 18. The Missouri Evergreen and Tennessee produced good brush. The Dwarf was a failure. The Wisconsin, Early Japanese, Australian, Wilson's Improved Evergreen and Dwarf Emerald produced medium brush of poor quality.

1898—No broom corn was planted. A good yield of brush was obtained by those who did plant.

1899—No broom corn planted in Cheyenne county.

MISCELLANEOUS FORAGE PLANTS.

1894—None tried.

1895—*Avena flavescens*, *Holcus lanatus*, and *Bromus inermis*, sown March 22. All blown out. *Bromus uniloides*, *Panicum virgatum*, and *Sergula maxima*, sown May 6. Failure. Timothy and meadow fescue, sown May 13, did not grow. *Bromus inermis*, sown June 6, was taken by grasshoppers. Redtop (*Agrostis vulgaris*), sown June 28. Failure.

1896—*Bromus inermis*, sown May 2, did not grow.

1897—Thirty-four varieties were sown May 2. Johnson grass was the only one that made a good stand. The others did not grow. The seed of all the other varieties, except the first five, came from Queensland, Australia.

Bromus inermis,

Lolium tenue,

Lolium italicum,

Arrhenatherum avernaceum, (Tall
Meadow Oat),

Esparsette,

Panicum simialatum,

Panicum parviflorum,

Panicum Indicum,

Panicum Crus-galli,

Bromus arenarius,

Atriplex vesicaria,

Atriplex mummularia,

Sporobolus Virginicus,

Tragus racemosa,

Perotis rara,

Pappophorum Nigricans,

Dyuxia Forsteri,

Paspalum Galmarra,

Eragrostis Brownii,

<i>Panicum Prenticeanum.</i>	<i>Anthistiri ciliata,</i>
<i>Andropogon erianthoides,</i>	<i>Anthistiri arenaceae,</i>
<i>Andropogon schænanthus,</i>	<i>Leersia hexandra,</i>
<i>Andropogon pertusus.</i>	<i>Astrelba pectinata,</i>
<i>Chrysopogon gryllus,</i>	<i>Setaria macrostachya,</i>
<i>Chrysopogon parviflorus,</i>	<i>Setaria glauca,</i>
<i>Leptochloa Chinensis,</i>	<i>Sorghum halpense</i> (Johnson
<i>Pollinaria fulva.</i>	grass).

1898—Johnson grass was winter killed. *Bromus inermis* was sown April 30, and made a good stand.

1899—Nearly all the *Bromus inermis* sown in 1898 was killed by the dry weather; also that sown April 20 did not live through the dry weather. *Agropyron cristatum*, from Russia, sown April 20, proved a failure.

POTATOES.

1894—Four varieties, the Chicago Market, Negro, Mountain Sprout and Early Rose, were planted May 5. All proved a failure on account of drouth.

1895—A better result was secured. Vick's Perfection, planted April 20, yielded 16.5 bushels; Mammoth Pearl, 32.5 bushels; Mammoth Prolific, 36 bushels; and Late Ohio, 27.5 bushels. These were planted May 20.

1896—The Early Ohio, Early Six Weeks, Early Kansas, King of the Earliest, were planted April 30. Vick's Perfection, Mammoth Pearl, Mammoth Prolific and Late Ohio were planted May 22. Potato beetles took all except a small plat of Mammoth Pearl, which yielded 80 bushels.

1897—Forty varieties were planted May 12 and 13. The figures after the names give the number of bushels per acre obtained:

1. Early Rose.....28.0	2. Early Ohio.....45.6
3. Early 6 weeks.....46.5	4. Early Kansas..... 8.0
5. Early Thoroughbred....48.0	6. Irish Daisy.....33.0
7. Carman No. 1.....48.9	8. Early Vaughan.....40.5
9. Victor Rose.....41.0	10. Beauty of Beauties.....57.0
11. Carman No. 3.....59.0	12. Snowflake.....56.8
13. Crown Jewel.....41.5	14. Early Fortune.....62.3

15. Early Minnesota.....	46.2	16. Early Montana.....	36.4
17. King of the Earliest....	20.6	18. Ajax.....	30.4
19. Maggie Murphy.....	32.5	20. Early Freeman.....	21.7
21. Boston Red.....	38.3	22. Bliss Triumph, or Stray	
23. American Wonder.....	26.9	Beauty.....	39.0
24. Harvest King.....	45.0	25. World's Fair.....	22.3
26. Champion of the World....	24.7	27. Ironclad.....	32.3
28. Good Times.....	41.3	29. 100-Fold.....	34.7
30. Early Beauty of Hebron		31. New York Early Rose....	38.2
.....	19.8	32. Peerless.....	16.1
33. Lightning Express.....	28.0	34. Extra Early Ohio.....	36.5
35. Quick Crop.....	23.5	36. Acme.....	28.5
37. White Star.....	20.7	38. Ohio Junior.....	35.0
39. Burbank's Seedling.....	22.0	40. Burbank.....	42.0

The first sixteen varieties mentioned in the list for 1897 were sown in 1898

1898—The potatoes were all damaged by beetles. Only a few of the early varieties produced any tubers.

1899—Four varieties were sown April 29. The Early Beauty of Hebron and Carman Nos. 1 and 3 were failures. The Early Ohio yielded 17 bushels per acre. All were damaged by beetles. The Rural, Planted July 13, was taken by beetles.

SWEET CORN.

1894—Stowell's Evergreen and Early Crosby were planted May 15. No record. Said to be an entire failure.

1895—Stowell's Evergreen planted May 24. No record. Said to be a failure on account of hail storm of June 20.

1896—Stowell's Evergreen, White Cob Cory, Black Mexican and Country Gentleman planted May 2. All produced a few ears.

1897—Eighteen varieties were planted May 11. All gave good yields. Those marked * did especially well. The date after the name of the variety gives the time when edible ears were obtained.

White Cob Cory.....	July 26	Black Mexican.....	Aug. 5
* Country Gentleman....	Aug. 21	* Egyptian.....	Aug. 19
Early Minnesota.....	Aug. 11	Perry's Hybrid.....	Aug. 5
* First of All.....	July 26	* None Such.....	Aug. 19
Shaker's Early Concord..	Aug. 5	* Early Bonanza.....	Aug. 14
Improved Ruby.....	Aug. 21	Northern Pedigree....	Aug. 5
First of All.....	Aug. 4	Early Crosby.....	July 26
Early Adams.....	July 26	Early Marblehead.....	July 26
Moore's Early Concord...	Aug. 9		

1898—The Mammoth and the first thirteen varieties of those given in 1897 were planted May 18. Drouth affected all varieties badly. None produced large yields. The dates when edible corn was found were about the same as for the same varieties in 1896. The Mammoth gave edible ears August 20.

1899—Egyptian, First of All, None Such, Mammoth, Everbearing and Metropolitan were planted May 17. The season was very unfavorable. But few edible ears were produced by any variety. The location of the plats with regard to the amount of water they obtained, seemed to influence the yield more than the variety planted.

GARDEN.

1894—Early garden was a failure. Late garden did well, but was badly damaged by insects, especially grasshoppers.

1895—The planting of March 22 was a failure on account of dry weather. That planted May 15 produced a good stand, but was destroyed by grasshoppers and hail. That planted June 10 was destroyed by hail. Beans planted June 20 made a small crop.

1896—Planted May 2. Onions and beets proved a failure. Peas, beans, lettuce, sweet corn and popcorn did fairly well. No early garden planted. Summer squashes did well. All pumpkins were taken by bugs.

POPCORN.

1894-'95—None planted.

1896—Queen's Golden, White Pearl, White Rice and Red Jacket were tested, only a few hills of each variety being planted. Planted May 2. Each kind produced a few ears.

1897—The same varieties planted. Each produced a good yield.

1898—Queen's Golden and White Pearl planted May 18, producing a small yield.

1899—Queen's Golden planted May 17. But

few ears were produced; some plats dried up entirely.

RASPBERRIES.

1894—Twelve each of the Gregg and Cuthbert were set. Tops entirely winter killed.

1895—Tops all winter killed.

1896—Tops covered with stable manure—all winter killed.

1897—Canes covered with straw and manure—all winter killed.

1898—Bore a few berries on the new canes.

1899—Canes which were covered with dirt lived and bore a few berries. Twelve each of Progress, Egyptian and Queen were set. None lived.

DEWBERRY.

The first trial was made in 1899. Fifty each of Lucretia and Mammoth were set. Of the first variety twenty lived; of the second five lived.

GOOSEBERRIES.

1894—Six Downings were set: all lived.

1895—Twelve each of the Champion, Downing and Industry were set. No record of the location. Twelve lived.

1896—A few berries were produced.

1897—A small crop.

1897—A heavy crop.

1899—A small crop. In addition, ten each of the Houghton, Downing and Industry were set. Only three of the Houghton lived.

BLACKBERRIES.

1895—Three each of the Snyder and Wilson were set. None lived.

STRAWBERRIES.

1899—350 were set; 20 lived.

CURRANTS.

1894—Twelve of Fay's Prolific were set; all lived through 1895.

1895—Of the Red Dutch variety twelve were set; six lived.

1896—Eleven lived.

1897—All dead.

1899—Five plants of each of the varieties named were set. Three of the first and four of the second lived.

DWARF JUNE BERRIES.

1899—Twelve were set, of which ten lived.

GRAPES.

1894—Of the Concord, six were set; none lived. Clinton, six set; four lived.

1895—Concord, six set; none lived. Clinton, three lived. Delaware, six set; four lived. Moore's Early and Worden, three of each were set; none lived.

1896—Two of the Clinton and three of the Delaware are alive.

1897—Two Clinton and three Delaware alive.

1898—One Clinton and three Delaware alive.

1899—Three Delaware alive—one blossomed.

FOREST TREES.

White ash—

1894—Fifteen set; all lived.

1895—Fifty set; one died.

1896—None set; two died.

1897—Planted May 13; a few grew.

1899—Planted May 25; none grew.

Russian mulberry—

1895—Twenty-five set; one died.

1897—3,000 set; 2,000 lived. Some planted May 13; none grew.

1899—Planted May 26; none grew.

Black locust—

1895—Fifty set; one died.

1897—Planted May 13; one-half grew. Some to height of five feet.

1899—Planted May 26; only a few grew.

Miscellaneous—

Hawthorn, Wild Black Cherry and European Ash, Planted May 13, 1897, and May 26, 1899; none grew.

Of the Boxelder, planted the same dates, a few grew in 1897; none in 1899.

In 1899, 1,000 Honey Locust trees were set; 438 lived.
100 Wild Black Chery " " 17 lived.
100 Catalpa " " 90 lived.
10 Russian WildOlive " " all lived.

Of the Boxwood planted in 1899, none grew. A few of the Coffee bean grew. Apricots were taken by squirrels, in 1899. A few Honey and Yellow locust grew in 1899.

The following tree seeds were planted May 26, but none grew:

Mahaleb Cherry,
Sycamore Maple,
Sassafras,
Catalpa,
American Apple,
Catalpa (*speciosa*).

Mazzard Cherry,
Norway Maple,
Ailanthus,
Buckthorn,
Black Walnut,

CHERRY TREES.

Rocky Mountain Cherry—

1894-'95—Twelve set in each year. All lived.

1896—A small yield.

1897-'98—A heavy crop.

1899—A small crop.

Early Richmond—

1894—Six set.

1895—Twelve set; one died.

1897—A few cherries.

1898-'99—A small crop.

Common Morello--

- 1894--Six set; all lived.
 1898-'99--A few cherries.

English Morello--

- 1895--Twelve set; seven lived and bore a few fine cherries in 1899.
 1899--Two each of three varieties were set. Dye House, one lived; Large Montmorency, one lived; Ostheim. two lived.

Russian Apricot--

- 1895--Six set; none lived.
 1899--Twelve set; all lived.

Dwarf pears--

- 1899--Two each of the Seckel, Anjou and Duchess were set; all lived.

Crab apple--

- Five each of the Whitney and Martha were set in 1899. None of the first died.

German prunes--

- Five set in 1899; none lived.

Peach trees, budded--

- In 1899 five varieties were set: four Alexander, one lived; four Bailey's Seedling, two lived; three Champion, all lived; four Bokhara, four lived; four Elberta, two lived.

Plum trees--

- 1894--Six each of the Weaver and the Minor set, of which three died.
 1895--Vacancies filled and three seedling Pond set; two died. Three Saratoga set; one died. Twelve Wild Goose; six died.
 1896--No crop. No record of the location of previous year's planting to be found.
 1897--Blossoms on the older trees. In addi-

tion three Wolf were set; two lived. Three American Eagle and three Cheney were set; all lived. Three Rollingstone were set; two lived. These grew well in 1898 and 1899.

1898—A few plums.

1899—A few plums on the 1899 trees. A few were on the 1895 planting, but none matured.

Apple trees—

1894—Four each of the Wealthy, Duchess of Oldenburg and Ben Davis were set; all lived. Damaged by hail in 1895. Made a small growth in 1896 and 1897. Made a moderate growth in 1898. Seemed thrifty in 1899.

1895—Four varieties set. Twenty-five Ben Davis, of which 24 lived; 12 Utter's Red, 9 lived; 3 Missouri Pippin, 1 lived; 12 Geniton, 11 lived; 2 Romanite, 3 Belleflower, 5 Grime's Golden, 5 Red Astrachan; all lived. These made a small growth in 1896, and a moderate growth in 1897. In the latter year the trees in the northeast corner, where extra water runs in from the prairie, began to show a larger growth than those in the south west corner. Blossomed in 1898. The difference in the size of the trees in the northeast corner as compared with those in the southwest corner is still more marked. In 1899 one apple was matured. The trees in the northeast corner fully double the size of those of the same age in the southwest part of the orchard.

1897—Four each of the Sweet Bough, Plumb's Cider, Willow Twig and Mann were set. All lived. These were set very deep. In 1898 all made a good growth, but started slowly. In 1899 some of the trees set in

1896 were as large as the trees near them which were set in 1895.

MILLET.

1896—Four varieties, Common, German, Hungarian and Hog millet, were sown June 12. The first three were killed by dry weather. The last produced some seed and 16 pounds of hay.

1897—Four varieties were sown May 26. The figures after the names give the number of pounds of hay per acre obtained from them:

1. Common	.....3090	2. German	.....2290
3. Hungarian	.....3190	4. Hog Millet	.....2010
5. Hirse	.....2240	6. Common (Dakota grown	
7. California	.....3130	seed)	.....2310
8. Golden Wonder	.....1790	9. Manitoba	.....1810
10. Early Harvest	.....2050	11. Japanese	.....2210

1898—The first four varieties were sown June 14 and 16, producing a small amount of hay—500, 300, 600 and 400 pounds, respectively, per acre.

1899—The same four varieties were planted May 31 and June 3, yielding 1,364, 0, 1,221 pounds, respectively, per acre. Seven other varieties were sown June 13, producing a small amount of hay and some seed. Golden Wonder produced 406 pounds of hay; ripened seed. Manitoba, 232 pounds of hay; Early Harvest, 406 pounds of hay; Japanese, 348 pounds hay; Russian (Salzer), 957 pounds hay; Russian (U. S. Department of Agriculture No. 2794), 406 pounds hay; Russian (U. S. Department of Agriculture No. 2960), no hay; ripened seed very early, but grew only one to three inches high.

LEGUMES.

Alfalfa--

1894—Sown May 14, taken by grasshoppers.

1895—Sown July 22, good stand.

1896—Partly killed.

1897—Small crop of hay.

1898—Small crop of hay.

1899—Plowed up to kill the grasshoppers. No crop. More was sown May 4, 1897; good stand. Yield one ton per acre in 1898. Some was sown May 20 1899—good stand.

Turkestan alfalfa--

Sown May 20, 1899; poor stand.

Clovers--

The seed of White clover, Medium Red, Mammoth, Crimson, and Alsike clovers was sown May 13, 1895. None germinated.

In 1897 seed of the same varieties, and also of Sand clover, Japan clover, *Medicago media*, *Medicago lupulina*, and *Vicia sativa*, was sown May 2. None grew.

Canada peas--

Sown April 8, 1895, taken by grasshoppers. Sown April 24, 1896, produced a small crop. Twelve varieties sown May 14, 1897, produced a small crop. Sown May 20, 1898, produced a small crop.

Sand vetch--

Sown May 26, 1896; a poor stand, but good growth. This produced seed in 1897 and was destroyed in 1898. Another sowing was made May 14, 1897, producing about half a stand, but made good growth. Destroyed in 1898. Same sown May 20, 1899--poor stand and small growth.

Lupines--

Three varieties were sown May 14, 1896. All were taken by grasshoppers.

Cowpeas--

Blackeyed (home-grown seed), was planted June 14, 1896; yield, two bushels. 1897, planted May 14; yield, 9.9 bushels. 1898,

planted April 20; yield, six bushels. Same variety, from Plant of St. Louis, planted April 20, 1898; yield, a few ripe pods. The Whip-poor-will cowpeas, planted same date, gave a few ripe pods; and the Black cowpeas gave one and one-half bushels.

Idaho peas—

First planting May 14, 1897. Mostly taken by grasshoppers. Planted April 20, 1898, produced eleven bushels. Planted May 23, 1899, taken by beetles.

Beans—

Navy beans, planted May 14, 1897; failure. Planted April 20, 1898; small yield. Planted May 23, 1899, taken by insects.

Tree beans—

Planted same dates as above (1897), yield large crop; taken by beetles in 1898; produced four bushels in 1899.

SORGHUMS.

1894—Five varieties were sown May 8 and 9. White Kaffir corn produced 400 pounds of fodder per acre; Jerusalem corn, 455 pounds; White Milo maize, 390 pounds; large African millet, 375 pounds. Red Kaffir corn, no report.

1895—White Kaffir corn, sown June 14, gave 3,000 pounds; Jerusalem corn, White Milo maize, Russian maize, and Egyptian Rice corn, sown May 22, taken by grasshoppers. Early Amber cane, sown May 25, gave a large yield, but no estimate is found.

1896—White African, sown June 3, gave 2,000 pounds; White Milo maize and Red Kaffir corn, sown same date, gave 2,200 pounds. Egyptian Rice corn, sown same date, gave 1,800 pounds of fodder. The rest were sown May 26. Jerusalem corn, which was damaged by hail, gave 600 pounds of seed. Large African millet, no seed, fodder de-

stroyed by hail. Early Amber cane produced a little seed, and 2,500 pounds of fodder. Fodder cane, no seed. Brown Durra, 1,250 pounds of seed. Yellow Milo maize and Black Rice corn gave a little seed. Kaffir corn No. 39, some seed, but little fodder. The hailstorm of August 21 cut most of the fodder off from the last five varieties, leaving only the stalks.

1897—Seed was sown May 19, except one variety. The White and Red Kaffir corn, Large African millet, Early Orange cane, gave no seed. Yellow Milo maize, Black Rice corn, Kaffir corn No. 39 and Early Minnesota cane gave some seed. Jerusalem corn gave 750, and Brown Durra, 850 pounds of seed. The Early Amber cane, sown June 5, gave 5,600 pounds where sown on sod, 4,560 pounds on old ground, and 6,000 pounds where drilled and cultivated.

1898—Ten varieties were sown May 27. White Kaffir corn gave 6,720 pounds of fodder per acre. Red Kaffir corn, 5,320 pounds; Large African millet, 6,565 pounds of fodder; Jerusalem corn 750 pounds of seed; Early Amber cane, 6,192 pounds of fodder; Brown Durra, 1,000 pounds of seed; Yellow Milo maize, 5,110 pounds of fodder; Black Rice corn, 4,970 pounds of fodder; Early Orange cane, 8,400 pounds fodder; Kaffir corn No. 39, 600 pounds seed.

1899—Sixteen varieties were sown from May 18 to May 22, yielding as follow: Red Kaffir corn, 486 pounds fodder; Early Amber cane, 1,032 pounds, some seed; Fodder cane, 924 pounds, no seed; Brown Durra, 300 pounds seed; Kaffir corn No. 39, some seed; Early Minnesota cane, some seed, 1,500 pounds fodder; Early Orange cane, no seed, 1,512 pounds fodder; Folger's Early cane, 1,308 pounds fodder; White African cane, 780 pounds fodder; Collier cane, no seed, 756 pounds fodder; Coleman cane, no seed, 744 pounds fodder.

Five varieties from the U. S. Department of Agriculture: Edgar cane (No. 2373), a little seed,

500 pounds of fodder. Variety No. 161 (No. 2,363), some seed, 1,000 pounds of fodder. Honey Dew (No. 2,367), some seed, 1,500 pounds of fodder. Folger's Early (No. 2,291), no seed, 400 fodder. Chinese (No. 2,372), no seed, 200 pounds of fodder.

MISCELLANEOUS WORK.

1894-1895—No record of any work except the culture of crops.

1896—Tested capillary rise of water in four types of soil.

Examined soil of cultivated land by boring holes and making notes concerning character of soil found. Bored holes and noted strata in 280 places on the northeastern 40 acres of the farm.

Twelve rods of sod wall wind break was built.

1897—Built solid board fence, continuing wall made of sod in 1896 until the two are twenty-two rods long.

The work connected with variety tests of crops was so great that no scientific work was done.

1898—Filled buckets with soil and placed them at different distances from the wall. These were weighed at intervals. Results were reported in the annual report for 1898.

Eight galvanized-iron cans 52 inches deep and 18 inches in diameter, were filled with soil for the purpose of testing the amount of water used by crops. Also, testing evaporation from different soils. It was found that too much work was already on hand to do this work properly. Two tanks 18 inches in diameter and 52 inches deep, were filled with water. One shaded, the other left in the sun. Evaporation from the two has been reported.

1899—About 16 acres of cultivated land was surveyed to determine the levels. Also the levels of the ravine were determined for the purpose of estimating probable cost and utility of dams.

APPENDIX TO REPORT OF METEOROLOGIST.

R. E. Trimble, Observer,

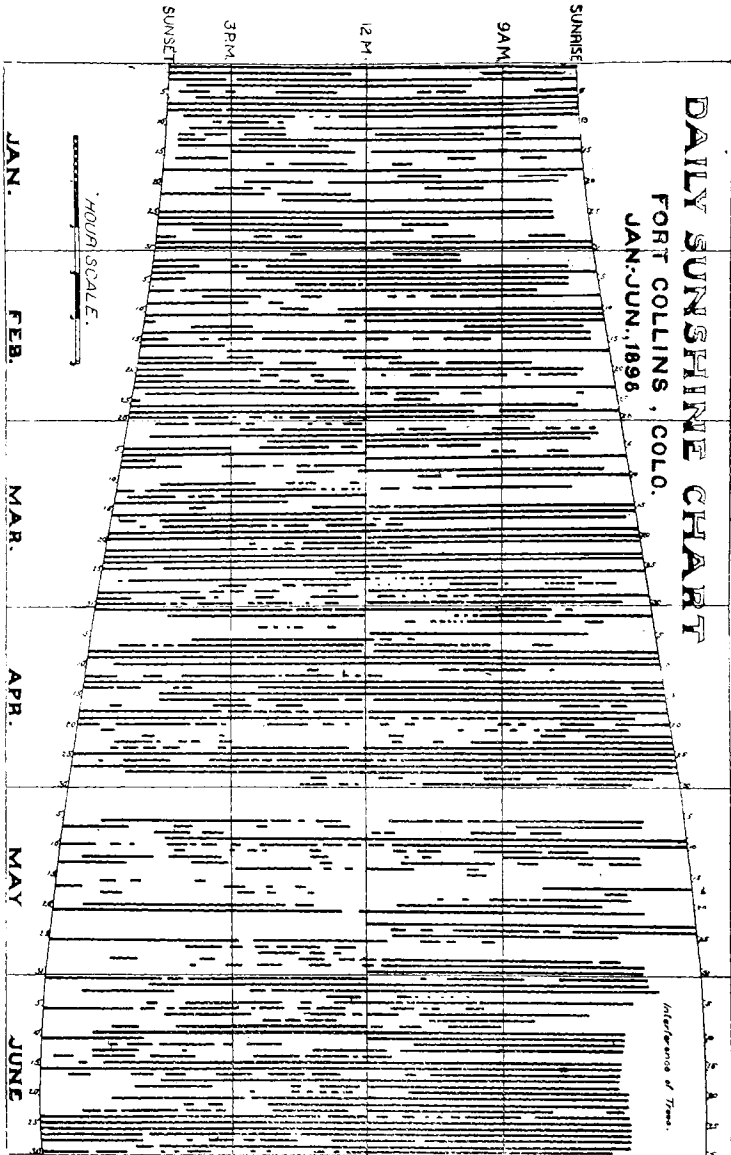
METEOROLOGICAL OBSERVATIONS.

The meteorological observations include ordinary weather observations, and a series bearing directly on agricultural meteorology. These include eye readings, twice daily, of standard instruments, and records from a number of self-recording instruments, principally of the Richard pattern. These include a self-recording rain-gage, barograph, thermograph, psychrograph, statoscope, evaprometer, anemograph, sunshine, recorder, etc.

The year 1899 was one with temperature below the normal. The winter of 1898-'99 was one of unusually low temperatures. The month of February averaged 15° below the normal. For sixteen consecutive days the thermometer fell below zero. During the existence of our record the temperature has been below -20° but seven times, never below -30° . But in February, for four consecutive days—February 4-7—the temperature dropped below -30° , and again on the 11th and 12th. On two days—February 6 and 12—it reached -38° . On February 2 and 11, the highest temperature of the day remained below zero. The extreme cold was trying on plant life especially, and the losses were unusual in amount.

The year also furnished the greatest change in temperature observed in one day. Up to this year, the greatest range observed had been 56° , in February, 1895. On the morning of February 12, the minimum temperature was -38.4° . During the afternoon it rose to $+16^{\circ}$, and fell again to -1° by midnight; but rose to $+37^{\circ}$ by 6 A. M., on the 13th, or a change of 75° in twenty-four hours.

The precipitation was not so unusual in amount, but a larger proportion than usual fell early in the winter, and the extreme cold permitted it to remain on the ground unmelted or unevaporated. The supply of water for irrigation was, therefore, unusual in amount with the streams of northern Colorado. On the headwaters of the Rio Grande it was deficient.



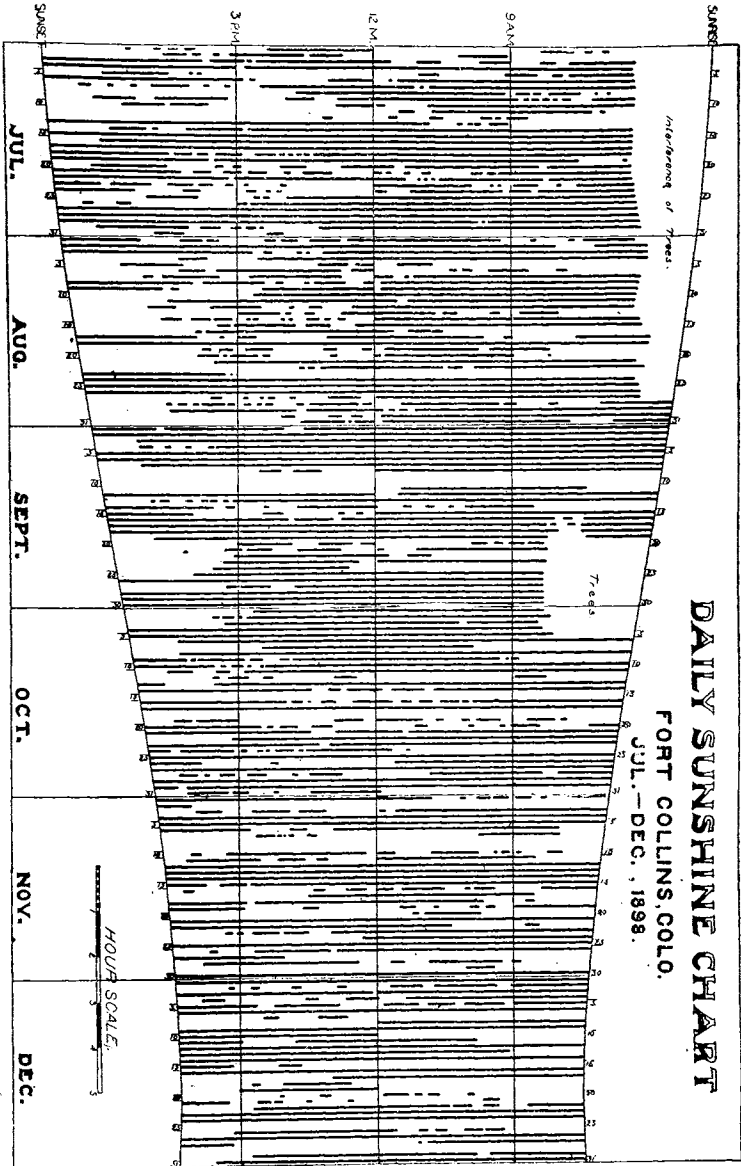


TABLE 1.

SUMMARY FOR 1898 and 1899, AT AGRICULTURAL COLLEGE, FORT COLLINS, COLO.
 Latitude, 40° 34'; Longitude, 105° W from Greenwich; Elevation of Barometer, 4,994 ft; ground, 4,980 ft.
FOR 1898.

Month	TEMPERATURE (IN DEGREES FAHRENHEIT).										Precipitation, (Rain or Melted Snow).		Snowfall	No. of Stormy Days	Relative Humidity	Dew Point	Frost No. days, Frost Dew or Dew Obs'd		
	Mean $\frac{1}{2}$ max + min	Average Maximum	Average Minimum	7 A. M.	7 P. M.	Absolute Maximum	Absolute Minimum	Mean Range	Greatest Range	Wet Bulb 7 A. M.	Wet Bulb 7 P. M.	Average Temperature below 32°						Minimum below 32°	Irs.	Ins.	Per Ct.	F°
Jan....	25.6	40.7	10.6	13.8	23.5	61.5	-11.8	30.1	47.4	12.4	30.2	24	31	0.14	1.38	3	75.2	11.0	15
Feb....	34.1	50.6	17.6	21.8	32.0	63.7	-6.7	33.0	43.0	19.6	26.7	12	23	0.08	.83	0	67.5	16.2	17
March..	32.7	47.9	17.5	24.5	32.8	66.3	-6.2	30.4	48.9	21.9	26.4	13	30	0.50	5.33	0	62.6	15.2	12
April..	47.7	64.5	30.9	43.3	50.7	86.2	14.5	33.6	55.2	36.8	39.7	1	16	1.08	1	0	52.2	27.3	7
May....	51.6	62.7	40.4	48.8	53.0	81.8	29.6	32.3	48.5	44.7	45.9	0	7	3.65	13	0	71.4	49.4	1
June...	64.0	79.9	48.2	60.4	66.7	97.2	36.0	31.7	50.5	53.9	55.9	0	0	1.37	0	0	62.9	49.1	0
July...	69.0	85.1	53.0	64.2	71.8	97.0	44.3	32.1	46.8	57.2	59.7	0	0	0.50	0	0	60.4	52.2	0
August	69.9	87.6	52.2	62.5	71.2	95.6	43.1	35.7	46.8	57.2	57.9	0	0	0.98	0	0	59.0	50.6	0
Sept...	58.6	73.3	38.2	47.5	57.1	90.2	29.7	39.4	55.5	42.2	46.8	0	2	0.50	0	0	60.1	37.0	2
Oct....	46.3	61.0	31.5	37.7	44.5	85.7	16.2	29.6	50.5	31.9	36.1	0	16	0.32	1	0	55.6	24.0	15
Nov...	30.3	44.5	16.1	23.6	27.8	71.3	-11.3	28.4	49.5	29.5	24.2	17	23	1.24	11.5	0	72.4	16.5	11
Dec...	23.6	37.9	9.3	13.2	19.6	55.0	-22.3	28.7	46.8	11.4	16.6	24	31	0.17	3.5	0	73.6	8.4	17
Year...	46.1	61.7	30.5	38.4	45.9	97.2	-22.3	31.2	55.5	34.0	38.0	91	189	11.03	37.46	80	64.5	29.0	97
Norm'l	46.5	61.9	31.8	39.5	46.8	99.2	-28.4	30.2	56.2	35.1	39.0	.....	.....	13.68	.....	70.6	64.5	30.2	.....

FOR 1899.

Jan....	24.7	39.0	10.4	16.6	24.3	55.0	-16.8	28.6	57.8	14.1	20.8	24	31	0.66	11.4	6	70.2	10.6	8
Feb....	9.9	25.3	-5.5	1.0	10.6	50.8	-38.4	30.7	75.4	0.8	9.1	26	24	1.04	14.0	11	57.2	2.4	14
March..	29.7	41.6	17.9	24.2	29.9	65.7	-24.5	23.7	51.4	21.9	26.4	17	29	1.50	19.8	11	73.7	18.8	13
April..	44.7	60.5	28.9	40.3	47.8	78.0	8.0	31.6	51.0	34.2	37.4	4	20	1.10	4.75	6	53.7	24.6	11
May....	53.8	69.5	38.0	49.7	56.8	82.5	23.4	31.6	45.6	43.4	45.1	0	4	1.01	0	0	53.2	34.6	5
June...	63.6	79.8	47.4	60.0	66.8	96.1	36.4	32.5	50.9	54.8	53.7	0	0	1.03	0	0	54.5	44.6	1
July...	67.0	81.3	52.7	63.0	67.2	94.0	44.6	28.6	49.0	57.5	59.6	0	0	4.98	0	13	70.8	54.8	19
August	67.6	84.2	51.9	62.3	67.0	95.2	39.7	33.1	50.7	55.4	57.0	0	0	0	0	0	63.1	50.3	16
Sept...	61.4	80.3	42.4	52.8	59.3	94.6	29.0	37.9	52.6	46.5	49.8	0	0	0.21	0	0	60.8	41.6	12
Oct....	46.1	60.2	31.9	37.3	45.4	86.7	23.7	33.3	54.0	37.3	38.0	0	13	3.23	13	10	52.8	23.7	8
Nov...	40.8	56.6	24.9	29.1	37.4	69.5	15.0	31.8	48.1	26.5	31.9	1	27	T	T	0	69.2	23.1	6
Dec...	27.7	42.6	12.7	19.8	24.8	63.7	-9.3	29.9	51.2	17.3	20.9	23	31	0.47	6.0	3	74.1	13.1	16
Year...	44.7	60.1	29.5	38.1	44.6	96.1	-38.4	30.7	75.4	33.9	37.5	95	186	16.19	57.5	87	66.9	29.1	86
Norm'l	46.4	62.1	31.7	39.4	46.0	99.2	-38.4	30.2	75.4	34.9	38.8	.....	.....	13.84	.....	71.6	64.7	30.1	.....

* Extreme values.

TABLE 2.

SUMMARY FOR 1898 and 1899, AT ARKANSAS VALLEY SUBSTATION, ROCKY FORD.

W. F. CROWLEY, OBSERVER, JANUARY TO MARCH; H. H. GRIFFIN, FROM MARCH 1.

Latitude 39° 3'; Longitude 103° 45'; Elevation 4,160 feet.

FOR 1898.

Month.	TEMPERATURE (IN DEGREES FAHRENHEIT)														Precipitation. (Rain or Melted Snow.)	Total Snow fall	No. of Stormy Days	Relative Humidity Mean	Dew Point, Mean	Frost No. d.ys. Frost or Dew Obs'd	Prevailing Direction of Wind	
	Mean	Average Maximum	Average Minimum	7 A. M.		7 P. M.		Absolute Maximum	Absolute Minimum	Mean Range	Greatest Rang.	Wet Bulb		Av. Temp. Below 32°								Minimum Below 32°
				7 A. M.	7 P. M.	7 A. M.	7 P. M.															
Jan....	27.6	42.6	12.7	17.2	27.7	61	-10	29.8	47	15.8	24.7	20	31	0.40	3.4	1	77.9	16.1	20	n		
Feb....	38.5	55.9	21.1	29.0	39.8	74	12	34.8	52	24.7	33.0	4	27	0.	0.	0	65.0	21.1	13	n		
March..	40.1	57.5	23.7	30.6	44.2	74	2	34.8	58	26.5	34.8	4	27	.16	1.	2	51.6	18.1	15	n		
April...	53.5	69.4	37.6	46.0	55.5	86	23	31.8	48	41.1	45.6	0	6	1.06	1.	6	38.5	35.2	13	n		
May....	57.6	70.7	43.5	53.7	60.9	90	30	26.1	42	49.2	51.7	0	1	2.71	4.	10	38.7	15.5	10	n		
June...	69.5	83.7	55.3	64.0	71.1	99	41	28.4	40	57.1	60.1	0	0	3.16	4.	3	32.6	53.3	6	e		
July...	74.2	88.5	58.4	67.4	74.4	99	53	29.6	44	61.3	63.2	0	0	3.52	—	3	35.2	37.6	6	e		
Aug....	74.4	91.3	57.4	64.6	74.2	100	52	33.9	43	59.0	63.3	0	0	.92	—	3	35.2	36.6	11	e		
Sept...	61.1	79.3	42.9	51.7	62.9	96	32	36.4	50	46.8	53.1	0	0	1.55	—	4	34.4	44.2	1	e		
Oct....	49.3	65.7	32.9	40.8	51.1	90	20	32.8	48	36.0	42.3	0	16	1.36	—	4	30.3	31.6	6	n		
Nov....	37.4	54.0	20.8	26.4	36.3	80	3	33.1	58	23.2	30.2	10	26	.37	.25	4	33.1	18.8	1	n		
Dec....	24.1	38.8	9.4	15.7	22.7	64	-17	20.4	50	14.6	20.4	21	31	.96	8.	4	71.7	12.4	1	n		
Av.....	50.6	66.5	34.6	42.3	51.7	100	-17	31.7	58	37.9	43.5	59	16.5	16.17	17.65	47	61.6	34.3	...	n		

FOR 1899.

Jan....	27.4	42.6	12.1	16.9	26.5	61	-20	30.5	48	15.1	23.1	18	30	0.98	8.	3	73.7	13.8	—	n
Feb....	16.9	33.1	0.6	-4.1	9.3	60	-32	32.5	52	-4.5	7.7	22	28	0.55	6.5	4	83.3	-1.8	...	n
March..	40.2	57.6	22.7	28.9	41.7	82	2	34.9	52	25.4	34.1	6	28	0.32	4.	3	60.0	20.7	...	n
April...	52.7	71.3	34.1	43.9	55.7	87	18	37.2	56	37.1	41.9	0	13	0.28	0.5	2	44.7	26.4	...	n
May....	62.0	79.0	45.0	55.3	65.8	94	32	34.0	46	46.7	50.1	0	0	0.99	—	4	46.7	35.8	2	w
June...	70.9	88.2	53.6	63.8	73.1	105	43	34.6	49	56.1	57.6	0	0	0.78	—	6	53.1	48.2	4	e
July...	72.5	87.0	58.0	66.3	72.5	102	53	29.0	45	61.6	63.1	0	0	7.00	—	9	71.1	58.5	9	n
August	73.7	90.8	56.6	65.5	75.9	99	45	34.2	51	58.7	63.8	0	0	2.22	—	5	61.4	55.8	9	n
Sept...	65.8	83.8	47.8	55.4	66.5	99	35	36.0	54	60.4	56.3	0	0	1.43	—	5	65.1	47.9	10	n
Oct....	53.9	71.8	36.0	44.4	54.9	92	22	35.9	54	38.6	44.3	0	10	0.63	—	2	54.6	32.2	2	n
Nov....	43.0	59.3	28.5	32.5	43.2	74	19	30.8	49	30.6	38.4	0	24	2.40	—	4	75.8	30.1	1	n
Dec....	27.1	41.7	12.6	18.3	25.2	66	-20	29.1	49	17.0	22.8	22	31	0.98	13.	3	81.0	16.3	...	n
Av...	50.6	67.2	34.0	40.6	50.9	105	-32	33.2	56	36.0	41.9	68	164	18.56	20.0	50	61.2	32.0	...	n
Norm'l	51.4	68.3	35.0	42.7	52.6	...	...	33.1	...	38.9	45.3	...	...	13.76	...	38.8	67.3	36.8	...	...

* Extreme values.

TABLE 3.

SUMMARY FOR PLAINS SUBSTATION, (CHEYENNE WELLS, J. E. PAYNE, OBSERVER.

Latitude 38° 50'; Longitude 102° 20'; Elevation 4273 Feet.

FOR 1898.

Month	TEMPERATURE (DEGREES FAHRENHEIT)											NO. DAYS		Precipitation. (Rain or Melted Snow)	Total Snowfall	No. Stormy Days	Relative Humidity Mean.	Dew Point. Mean	Frost No. Ds. Frost Dew or Dew Obs'd	Average Cloudiness	Prevailing Direction of Wind		
	Mean 1/2 max + min	Average Maximum	Average Minimum	7 A. M.		7 P. M.		Absolute Maximum	Absolute Minimum	Mean Range	Greatest Range	Wet Bulb											
				7 A. M.	7 P. M.	7 A. M.	7 P. M.					Av. Temp. Below 32°	Minimum Below 32°										
Jan...	28.9	43.3	14.5	21.8	25.6	69.2	0.0	28.8	50.5	19.0	21.4	20	31	.03	0.25	1	64.1	12.6	14	7	1	3.2	nnnw
Feb...	35.9	52.2	17.5	26.2	31.3	70.4	4.2	34.4	53.6	22.5	24.5	9	28	.00	0.00	0	52.5	10.8	7	1	1	2.6	nnnw
March	35.7	52.2	17.5	26.2	31.3	72.0	-12.0	34.4	53.2	21.4	23.3	9	28	.61	2.00	0	59.4	15.3	4	1	1	4.7	w n w
April	49.1	64.3	33.4	40.6	45.0	83.6	18.6	30.3	45.2	39.8	40.4	1	12	1.10	1.10	1	55.7	30.3	4	1	1	4.0	see
May...	49.1	64.3	33.4	40.6	45.0	83.6	18.6	30.3	45.2	39.8	40.4	0	3	5.56	5.56	5	58.1	51.9	1	1	1	5.5	see
June...	67.8	80.2	50.0	57.0	63.3	97.0	39.4	26.3	39.2	55.0	60.6	0	0	3.95	3.95	5	67.0	54.2	1	1	1	4.1	see
July...	72.8	85.2	59.4	64.6	69.7	97.0	51.8	27.7	43.2	61.2	58.1	0	0	2.39	2.39	5	58.1	51.9	1	1	1	4.0	see
August	72.8	85.2	59.4	64.6	69.7	97.0	51.8	27.7	43.2	61.2	58.1	0	0	1.33	1.33	5	57.6	53.8	2	2	2	3.6	w s w
Sept...	62.2	78.4	45.9	55.0	61.2	95.2	31.6	31.1	46.0	47.8	50.3	0	2	2.00	5.10	3	60.0	40.9	3	3	3	3.3	w s w
Oct...	47.0	62.6	31.4	40.9	44.4	89.6	19.0	31.2	45.8	35.7	37.5	0	21	0.48	1.85	3	61.6	28.8	14	14	14	3.6	w n w
Nov...	33.4	49.2	11.8	25.4	29.5	75.6	-12.0	31.6	47.4	22.4	25.1	14	28	0.50	2.16	3	69.6	17.1	14	14	14	3.3	w n w
Dec...	26.1	40.4	11.8	18.3	20.3	67.6	-17.4	28.6	47.6	16.3	17.7	22	31	.48	2.70	3	74.9	11.7	20	20	20	3.3	n w w
Av.	48.9	64.0	33.9	43.3	47.3	97.5	-17.4	30.1	53.8	37.9	39.4	74	186	18.13	18.06	50	63.0	31.6	74	29	29	3.6	w n w

FOR 1899.

Jan...	26.4	42.0	10.7	18.2	23.8	60.6	-16.8	31.3	45.6	16.6	20.9	20	31	0.47	4.2	4	76.9	14.1	13	13	13	4.2	w s w	
Feb...	14.9	28.5	1.3	9.1	13.1	58.6	-26.4	27.2	53.6	8.2	11.7	23	28	0.36	2.95	4	84.7	7.0	3	3	3	4.6	w n w	
March	34.9	50.1	19.9	27.2	32.4	76.4	7.6	30.0	51.0	24.7	28.1	12	29	0.39	3.0	3	71.8	20.4	9	9	9	4.9	n w	
April	49.7	67.4	32.2	45.7	50.9	83.4	15.2	35.2	50.8	37.7	39.1	0	16	0.03	T	1	46.4	24.4	1	1	1	4.1	see	
May...	59.5	75.8	43.8	56.6	60.6	90.8	26.4	32.5	53.6	48.0	48.2	0	3	2.83	2.83	3	51.2	37.1	1	1	1	3.2	see	
June...	68.8	85.0	52.6	65.5	69.1	102.4	39.0	32.4	49.4	56.2	55.4	0	0	1.89	1.89	6	54.0	46.8	5	5	5	4.1	see	
July...	71.6	85.1	58.6	68.3	71.4	98.6	51.8	26.6	39.6	62.6	62.7	0	0	3.67	3.67	11	70.5	58.9	9	9	9	4.8	see	
August	75.6	91.5	59.8	71.4	78.8	101.9	50.5	31.8	45.6	59.6	59.9	0	0	0.55	0.55	3	47.8	50.4	3	3	3	3.3	n w	
Sept...	66.3	83.0	49.6	61.5	65.7	101.6	32.0	33.3	47.8	52.7	53.9	0	0	6.73	6.73	3	56.0	45.3	1	1	1	2.7	s	
Oct...	53.4	69.1	37.2	46.7	52.2	83.2	25.6	32.4	45.2	41.2	44.8	0	7	T	T	0	63.3	35.9	2	2	2	3.2	n w	
Nov...	43.4	57.9	28.9	34.6	44.7	71.0	4.0	29.0	54.0	31.8	38.8	1	20	2.49	2.49	3	72.2	30.4	2	2	2	3.6	n w	
Dec...	28.1	38.3	17.9	23.1	26.5	62.6	0.8	20.4	41.0	21.7	25.3	21	29	0.55	4.0	3	86.5	21.1	6	6	6	4.3	w n w	
Av.	49.4	64.5	34.3	44.0	48.8	102.4	-26.4	30.2	54.0	38.4	40.7	77	163	14.06	14.06	46	65.2	32.6	49	22	22	3.5	s w	
Norm'l	50.0	65.0	35.1	44.5	49.0	100.0	0.0	29.8	50.0	39.4	41.7	15.55	15.55	43.9	67.4	34.4

TABLE 4.

SUMMARY AT MR. CARLYLE LAMB'S AT THE BASE OF LONG'S PEAK,
ESTES PARK P. O., COLO. ELEVATION 9,000 FEET, APPROX.

FOR 1898.

MONTH	Mean Temperature	Average Maximum	Average Minimum	Absolute Maximum	Absolute Minimum	Mean Range	Greatest Range	No. of Days		Precipitation Inches	Snowfall Inches	No. Stormy Days
								Average Below 32.	Minimum Below 32.			
January.....	20.0	32.3	7.7	56	-21	24.6	47	27	29	0.40	5.	4
February.....	23.8	38.4	15.3	52	0	23.0	39	20	28	0.45	9.	3
March.....	23.6	35.1	12.0	52	-14	23.1	41	25	31	0.59	13.25	5
April.....	36.3	49.3	23.3	67	0	26.0	52	5	25	1.73	17.	5
May.....	38.4	49.7	27.2	64	8	22.5	36	7	21	1.82	17.75	10
June.....	50.5	61.2	36.7	79	23	27.5	46	0	6	2.06	4.	5
July.....	53.4	65.4	41.3	73	31	24.1	36	0	0	2.94	—	7
August.....	56.6	71.8	41.5	81	33	30.3	43	0	0	1.53	0.	8
September.....	50.4	66.0	35.2	78	21	30.5	46	1	10	0.81	1.	2
October.....	38.5	50.3	26.6	65	13	23.0	43	6	20	0.60	7.5	3
November.....	27.2	36.8	16.9	57	-12	20.0	54	15	21	1.60	23.	4
December.....	20.0	31.7	8.4	51	-24	23.4	51	28	31	0.60	9.	3
Year.....	36.8	49.2	24.3	81	-21	24.8	54	131	222	15.13	106.5	59

16th to 31st July Temperature missing.

FOR 1899.

January.....	21.7	30.9	12.6	46	-7	18.3	44	28	31	0.52	7 $\frac{1}{4}$	5
February.....	15.4	23.9	7.0	43	-31	17.0	44	26	23	1.05	16 $\frac{3}{4}$	10
March.....	23.8	33.6	14.0	54	-22	19.6	43	21	28	2.97	39 $\frac{3}{4}$	11
April.....	35.4	46.6	24.3	60	-1	22.3	36	8	21	1.10	13 $\frac{1}{2}$	6
May.....	41.9	54.6	29.2	65	17	25.5	36	2	21	0.38	5	4
June.....	50.2	61.3	36.0	79	22	28.3	44	0	9	1.09	3 $\frac{1}{2}$	6
July.....	54.6	68.7	40.6	78	37	28.1	40	0	0	3.32		16
August.....	56.0	69.9	42.0	79	32	27.9	38	0	0	1.73		8
September.....	51.5	67.6	35.4	82	20	32.2	40	0	7	0.11		1
October.....	37.3	49.1	25.5	69	8	23.6	42	6	26	2.31	29	8
November.....	35.1	47.2	23.0	59	6	24.2	44	10	25	.03	1 $\frac{1}{2}$	1
December.....	25.5	37.2	13.8	55	-9	23.3	52	23	28	0.62	11 $\frac{1}{2}$	4
Year.....	37.4	49.5	25.3	82	-31	24.2	52	127	227	15.23	123	80
Normal.....	37.5	49.6	25.4	85	-31	24.2	54	126	221	17.86		63

TABLE 5.

SUMMARY AT MR. GEO. A. BARNES', PINKHAMPTON, NORTH PARK,
 COLO. ELEVATION 8,400 FEET.

FOR 1898.

MONTH	Mean Temp. 5 (a. m.)	Av. Temp. 7 a. m.	Av. Temp. 12 m.	Av. Temp. 7 p. m.	Highest	Lowest	Mean Range	Greatest Range	No. Days Aver- aging Below 32	No. Days Mini- mum Below 32	Precipitation	Snowfall	No. Stormy Days
January	10.5	3.9	29.8	16.7	48	-25	26.0	47	31	31	.45	4.5	5
February	21.8	16.2	38.8	17.4	54	-4	12.3	46	26	28	.52	5.25	4
March	20.6	15.3	37.1	23.0	55	-10	22.9	45	31	31	1.30	13.	9
April	42.5	38.8	41.1	36.2	75	8	27.4	50	2	19	.33		5
May	47.5	36.3	41.1	38.6	78	16	22.3	42	0	8	2.10	—	12
June	60.4	44.0	41.1	46.8	90	32	32.8	44	0	0	0.66	5.	6
July	65.8	49.9	41.1	51.6	94	40	31.8	48	0	0	0.50	—	6
August	64.0	46.4	41.1	51.5	90	37	33.2	52	0	0	0.82	—	10
September	53.4	33.3	41.1	43.6	92	20	10.4	62	0	11	0.15	0.5	2
October	38.2	26.8	41.1	49.6	72	8	22.8	50	5	21	1.51	13.	6
November	26.4	15.6	41.1	37.2	70	-12	23.1	48	20	24	2.10	21.	6
December	13.2	1.7	41.1	24.7	54	-27	23.6	38	29	31	1.50	15.	3
Year	38.7				91	-27	26.7	62	144	204	11.94	77.25	74

FOR 1899.

MONTH	Mean Temperature	Average Maximum	Average Minimum	Absolute Maximum	Absolute Minimum	Mean Range	Greatest Range	No. Days Av. Below 32	No. Days Min. Below 32	Precipitation	Snowfall	No. Stormy Days
January	21.8	30.0	13.6	46	-12	16.4	36	22	31	3.33	50	12
February	19.1	23.7	8.6	53	-12	21.1	50	23	28	2.60	24	14
March	30.8	41.6	20.2	62	-15	21.4	54	17	23	1.60	13	10
April	40.1	50.1	24.2	76	4	31.9	56	5	23	1.60	12	10
May	46.7	58.0	35.4	82	16	22.6	38	2	19	0.27	12	13
June	56.6	71.1	42.0	80	30	29.1	46	0	1	0.60	11	13
July	64.3	79.7	48.2	91	40	30.8	48	0	0	1.15	11	13
August	60.4	77.2	43.5	86	35	33.7	48	0	1	0.91	11	13
September	54.6	74.2	34.9	82	26	34.3	52	0	9	0.30	11	13
October	41.3	53.2	29.4	76	16	24.2	56	1	18	3.09	11	13
November	36.4	48.5	24.3	64	7	24.2	44	6	20	1	11	13
December	19.1	28.7	9.4	41	-27	19.4	40	29	30	1.17	17	13
Average	40.9	54.0	27.9	91	-12	26.1	56	111	197	18.65	186	91

Precipitation in winter months deduced from snowfall.

TABLE 6.

SUMMARY AT GLENEYRE P. O., MRS. F. W. SHERWOOD, OBSERVER.
NEAR HEAD OF THE LARAMIE RIVER, ELEVATION 8,000 FEET.

FOR 1898.

MONTH	Av. Temp. 7 a. m.	Av. Temp. 2 p. m.	Av. Temp. 9 p. m.	Mean Temp. ½ (Max.+Min)	Av. Maximum	Av. Minimum	Absolute Maximum	Absolute Minimum	Mean Range	greatest Range	No. Days Av. Below 32°	Days Minimum Below 32°	Precipitation Inches	Snowfall	No. Stormy Days
January	10.9	25.9	16.4	15.5	26.7	4.3	44	-22	22.5	47	29	31	.....	4	2
February	21.2	33.6	23.1	25.4	35.6	15.1	49	-2	20.5	35	20	18	.....	1	1
March	17.3	32.2	20.6	23.0	34.7	11.3	50	-13	23.4	42	27	31	.....	20	8
April	30.6	49.1	34.0	39.2	53.8	24.6	73	3	29.2	48	4	26	.....	16	7
May.....	38.0	54.7	38.2	44.4	57.9	31.0	80	10	26.9	43	2	14	.....	10	6
June.....	50.9	71.8	50.0	56.9	74.3	39.5	90	28	34.8	52	0	7	.70	T	7
July.....	55.9	76.0	53.1	61.5	80.3	42.7	90	34	37.6	52	0	0	.70	—	5
August	52.4	75.9	52.5	60.4	78.2	42.5	88	34	35.7	49	0	0	.....	—	.....
September	44.9	67.0	39.6	50.6	70.3	30.8	81	18	39.5	54	0	15	.....	5	3
October	31.8	48.3	28.8	36.8	50.5	23.2	69	5	27.3	43	8	26	.....	19	7
November.....	18.1	35.8	19.4	23.9	37.3	10.5	59	-11	26.8	42	22	28	.....	12	4
December .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Year .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

FOR 1899.

January .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
February .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
March .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
April .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
May.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June.....	48.6	65.9	46.6	54.9	73.7	36.1	97	22	37.6	60	0	6	1.00	.....	15
July	54.0	71.7	50.8	59.5	77.1	42.0	94	35	35.2	49	0	0	1.00	.....	15
August	51.5	72.4	50.5	59.1	78.4	39.7	87	28	38.7	55	0	4	.50	.....	5
September.....	42.8	70.5	44.9	53.3	84.6	31.9	90	20	42.7	57	0	15	T	.....	0
October	31.4	47.0	31.0	36.9	49.7	24.1	71	4	25.6	53	11	26	2.53	38	8
November.....	26.6	45.7	29.3	33.8	47.6	20.1	63	7	27.5	48	10	29	0.40	4	2
December	12.9	25.5	15.1	16.6	26.9	6.3	44	-19	20.6	36	30	31	2.90	29	10
Average .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

The precipitation and stormy days are partly estimated.

TABLE 7.

WEEKLY MEANS OF SOIL TEMPERATURES SET A. IN AN IRRIGATED PLAT NEAR THE COLLEGE BUILDING. IN DEGREES FAHRENHEIT.

FOR 1898.

Week Ending	DEPTH						Week Ending	DEPTH					
	3 in.	6 in.	1 ft.	2 ft.	3 ft.	6 ft.		3 in.	6 in.	1 ft.	2 ft.	3 ft.	6 ft.
Jan. 8.	29.69	30.04	31.40	34.96	38.93	48.23	July 9.	73.69	73.06	72.42	68.80	66.21	58.67
" 15.	28.22	29.08	30.94	34.66	38.50	47.44	" 16.	75.83	75.39	74.19	70.26	67.44	59.80
" 22.	27.21	28.12	29.91	33.88	37.82	46.70	" 23.	76.97	76.89	76.11	72.23	69.16	61.01
" 29.	26.44	27.28	29.13	33.29	37.19	45.91	" 30.	76.84	76.78	76.14	72.69	70.03	62.11
Feb. 5.	28.47	29.02	30.11	33.05	36.65	45.41	Aug. 6.	72.51	72.97	73.25	71.66	69.96	62.95
" 12.	30.87	31.11	31.30	33.05	36.51	44.64	" 13.	70.52	70.89	70.76	69.74	68.82	63.33
" 19.	31.56	31.49	31.66	33.36	36.50	44.14	" 20.	74.23	74.15	73.32	70.74	69.08	63.52
" 26.	30.86	31.07	31.66	33.73	36.70	43.80	" 27.	74.88	75.04	74.39	71.79	69.97	63.93
March 5.	32.42	32.23	32.59	34.48	37.22	43.59	Sept. 3.	73.41	74.15	73.95	71.92	70.34	64.49
" 12.	33.82	34.40	35.10	36.31	38.53	43.67	" 10.	64.10	65.31	67.96	69.11	69.05	64.64
" 19.	35.00	35.41	35.74	36.85	38.96	43.86	" 17.	58.58	60.24	61.04	63.78	65.06	Broken
" 26.	35.23	35.91	36.19	37.27	39.31	43.90	" 24.	63.16	64.03	64.14	63.91	64.03	.....
April 2.	37.51	37.93	37.76	38.27	39.86	43.99	Oct. 1.	62.26	63.49	63.96	63.84	63.95	.....
" 9.	41.39	41.50	41.28	40.49	41.19	44.06	" 8.	56.38	58.54	60.04	61.60	62.72	.....
" 16.	50.60	49.88	48.18	44.99	44.10	43.82	" 15.	54.54	56.46	57.77	59.29	60.71	.....
" 23.	52.89	52.79	52.07	49.35	47.74	45.18	" 22.	43.66	46.85	49.66	54.46	57.56	.....
" 30.	55.70	55.81	54.64	51.46	49.81	46.81	" 29.	44.59	46.39	48.09	51.08	54.02	.....
May 7.	42.86	44.28	45.81	47.90	49.20	47.99	Nov. 5.	44.03	45.74	47.34	49.70	52.39	.....
" 14.	51.30	51.25	50.69	48.70	48.40	43.11	" 12.	37.62	40.18	42.86	47.24	50.55	.....
" 21.	51.75	51.84	51.67	50.47	49.94	48.56	" 19.	34.44	36.26	38.24	42.77	47.14	.....
" 28.	59.97	58.79	57.54	53.81	52.01	49.45	" 26.	32.69	34.96	37.26	41.42	45.12	.....
June 4.	63.49	63.16	61.99	57.90	55.42	50.86	Dec. 3.	31.67	33.36	35.23	39.18	43.07	.....
" 11.	60.97	60.93	60.47	58.18	56.79	52.38	" 10.	26.01	28.82	31.60	36.86	41.21	.....
" 18.	66.62	66.05	64.92	60.92	58.40	53.61	" 17.	25.52	27.26	29.15	34.29	38.94	.....
" 25.	73.00	72.46	71.16	66.06	62.54	55.14	" 24.	27.22	28.53	29.79	33.56	37.68	.....
July 2.	74.68	74.21	73.54	68.99	65.32	57.04	" 31.	27.90	28.97	30.16	33.41	37.06	.....
							Av.	49.15	49.84	50.31	50.73	51.63	51.47

* Average 6 days.

This set was in grass plat east of railroad until April 9, when removed to point a few rods west of railroad and south of driveway. The latter place has a slight inclination to the south and at first the surface was bare.

TABLE 8.

WEEKLY MEANS OF SOIL TEMPERATURES, SET A. IN DEGREES
FAHRENHEIT.

FOR 1899.

Week Ending	DEPTH					Week Ending	DEPTH				
	3 in.	6 in.	1 ft.	2 ft.	3 ft.		3 in.	6 in.	1 ft.	2 ft.	3 ft.
Jan. 7...	23.98	26.41	28.41	32.87	36.54	July 8...	66.83	68.26	68.46	67.01	65.43
" 14...	24.20	26.25	27.80	31.78	35.64	" 15...	67.75	69.10	69.16	67.03	65.58
" 21...	28.97	29.53	30.01	31.77	35.19	" 22...	69.41	70.36	69.85	67.26	65.81
" 28...	29.54	30.36	30.74	32.10	35.09	" 29...	70.64	71.67	71.35	68.72	66.85
Feb. 4...	26.01	27.64	29.19	32.23	35.22	Aug. 5...	68.21	69.27	69.13	67.64	66.68
" 11...	22.38	24.10	25.56	31.58	34.84	" 12...	67.13	68.65	68.71	67.29	66.44
" 18...	25.37	26.51	27.85	31.02	34.25	" 19...	67.32	68.54	68.46	66.99	66.25
" 25...	27.63	28.83	29.76	31.34	34.01	" 26...	66.46	67.28	67.15	66.51	66.06
March 4...	28.85	29.60	29.98	31.34	34.00	Sept. 2...	67.24	68.25	68.19	66.67	66.01
" 11...	31.71	31.47	31.45	31.67	34.11	" 9...	66.11	67.61	67.81	66.71	66.16
" 18...	31.15	31.88	31.74	31.86	34.24	" 16...	61.96	64.20	65.18	65.29	65.52
" 25...	34.59	34.35	33.49	32.94	34.84	" 23...	58.21	60.82	61.89	62.91	63.89
April 1...	31.94	33.08	33.98	35.24	36.78	" 30...	57.34	60.14	61.24	62.01	62.82
" 8...	34.97	35.41	35.27	35.34	36.86	Oct. 7...	53.34	56.06	58.31	60.04	61.49
" 15...	46.06	45.45	43.64	39.99	39.57	" 14...	48.61	51.46	53.92	57.06	59.19
" 22...	48.91	49.82	47.93	44.82	43.71	" 21...	44.25	46.77	48.53	52.49	55.79
" 29...	54.18	57.19	53.34	49.44	47.15	" 28...	44.91	47.24	48.74	51.42	53.81
May 6...	48.16	49.06	49.04	48.17	48.08	Nov. 4...	40.75	43.06	45.09	48.94	51.98
" 13...	55.06	54.94	53.56	50.25	48.95	" 11...	40.26	42.35	43.85	46.93	49.99
" 20...	58.84	59.01	58.03	54.39	52.15	" 18...	39.54	41.56	43.16	45.99	48.89
" 27...	58.31	58.67	58.08	55.44	53.85	" 25...	35.85	38.41	40.91	44.41	47.59
June 3...	60.41	60.84	59.97	57.06	55.11	Dec. 2...	36.69	38.48	39.75	42.64	45.93
" 10...	60.39	61.09	60.36	57.69	56.27	" 9...	31.02	33.81	36.08	40.89	44.69
" 17...	64.14	63.86	62.40	59.22	58.29	" 16...	30.21	32.24	34.14	38.69	42.71
" 24...	67.40	68.20	67.05	62.98	60.86	" 23...	29.09	30.96	32.56	36.99	41.08
July 1...	71.08	71.59	70.51	66.57	63.91	" 30...	30.68	31.51	32.62	36.11	39.95
						Average	47.18	48.53	48.94	49.30	50.32

TABLE 9.
WEEKLY READINGS (not averages) OF SOIL THERMOMETERS, SET C.
(On unirrigated ground).
FOR 1898.

Date	DEPTH				Date	DEPTH			
	6 in	1 ft	2 ft	3 ft		6 in	1 ft	2 ft	3 ft
January 6	29.1	29.6	33.8	36.3	July 7	71.7	67.9	64.5	69.9
" 13	25.6	27.1	32.8	35.3	" 14	73.4	70.2	66.4	62.8
" 20	24.5	25.6	31.0	33.8	" 21	72.7	70.4	67.6	63.9
" 27	23.0	24.5	30.3	33.3	" 28	75.2	71.9	69.1	64.9
February 3	25.7	26.3	30.4	32.8	August 4	71.9	69.4	67.8	65.1
" 10	31.4	30.6	31.3	33.1	" 11	70.2	68.1	68.3	64.4
" 17	32.1	31.9	33.3	34.0	" 18	71.1	68.9	67.4	64.8
" 24	30.1	30.6	33.4	34.3	" 25	72.0	69.6	68.1	65.4
March 3	32.6	32.6	34.2	34.8	September 1	72.4	70.6	68.7	65.7
" 10	34.2	34.0	35.3	35.8	" 17	60.1	59.2	60.8	60.8
" 17	33.1	33.7	35.6	36.2	" 22	62.1	60.5	60.9	60.2
" 24	32.6	33.2	35.3	36.3	" 29	61.6	60.6	60.9	60.0
" 31	35.8	34.6	35.8	36.2	October 8	55.0	55.0	57.8	58.3
April 7	49.2	38.6	38.4	38.9	" 13	54.2	54.5	56.8	56.8
" 14	48.7	45.6	42.6	40.6	" 20	43.6	46.5	52.6	54.4
" 21	51.7	49.5	46.8	44.0	" 29	45.2	45.6	49.1	50.9
" 28	54.2	51.9	49.8	46.5	November 3	42.2	43.2	48.0	49.8
May 5	39.7	41.1	45.2	46.0	" 10	39.1	41.2	46.3	48.3
" 12	52.1	50.1	48.2	46.0	" 17	35.2	36.9	42.7	45.6
" 19	52.2	50.8	49.8	47.9	" 25	32.7	35.3	40.9	43.8
" 26	58.4	56.6	53.7	50.8	December 1	31.7	34.8	39.6	42.2
June 2	63.2	60.0	56.7	53.1	" 8	26.7	29.5	36.3	39.9
" 9	62.1	59.6	57.1	54.1	" 15	23.2	25.2	32.4	36.6
" 16	65.7	62.2	59.1	55.8	" 22	25.3	27.0	32.1	35.1
" 23	68.7	65.5	61.8	58.0	" 29	28.5	28.3	31.7	34.3
" 30	72.0	68.2	64.0	60.0					
					Average	47.8	47.1	48.3	48.0

This set of thermometers is placed on a knoll near the farm barn, unirrigated.

TABLE 10.

WEEKLY READINGS (not averages) OF SOIL THERMOMETERS, SET C.
(On unirrigated ground).

FOR 1899.

Date	DEPTH				Date	DEPTH			
	6 in.	1 ft.	2 ft.	3 ft.		6 in.	1 ft.	2 ft.	3 ft.
January 5.....	23.7	26.2	31.4	34.1	July 6.....	66.8	64.8	62.6	59.9
" 12.....	23.9	24.0	29.4	33.7	" 14.....	37.5	65.6	63.7	60.8
" 19.....	28.2	27.6	30.3	32.5	" 20.....	68.8	66.2	64.0	61.2
" 23.....	28.2	28.3	31.2	33.1	" 27.....	69.4	67.4	65.0	62.1
February 2.....	26.2	27.7	31.4	33.0	August 3.....	63.5	66.8	64.6	62.0
" 9.....	21.6	21.6	23.0	32.6	" 10.....	67.2	65.7	64.5	62.3
" 16.....	24.7	24.6	27.9	.....	" 18.....	67.7	65.9	64.7	62.5
" 23.....	23.5	23.8	27.7	.....	" 24.....	66.3	65.0	64.3	62.2
March 2.....	32.2	30.1	32.8	.....	" 31.....	67.8	66.2	64.9	62.8
" 9.....	32.9	32.0	32.8	33.1	September 7.....	59.7	66.4	64.9	62.8
" 16.....	32.5	32.2	32.8	33.8	" 14.....	65.6	63.9	63.5	62.0
" 23.....	32.7	32.6	33.7	34.1	" 21.....	60.1	59.5	61.0	60.7
" 30.....	33.2	33.1	34.3	34.5	" 29.....	57.7	58.1	59.8	59.3
April 6.....	33.2	33.0	34.1	34.6	October 5.....	55.0	55.3	58.3	58.4
" 13.....	45.5	42.0	38.4	34.7	" 12.....	52.2	52.0	55.5	56.1
" 20.....	44.2	42.6	41.9	40.2	November 2.....	40.2	42.0	47.0	49.3
" 27.....	52.0	49.8	45.8	43.1	" 8.....	41.2	41.1	45.0	47.3
May 4.....	46.5	44.7	45.5	44.4	" 9.....	46.7	41.1	44.5	47.1
" 11.....	51.2	50.6	47.8	45.8	" 16.....	41.4	41.0	43.8	45.7
" 18.....	55.7	52.7	50.8	48.5	" 23.....	38.9	39.1	42.5	44.6
" 25.....	59.2	55.5	52.3	49.8	December 1.....	38.0	37.7	40.8	42.8
June 1.....	53.4	56.2	54.1	51.6	" 7.....	33.2	34.5	38.9	41.5
" 8.....	59.1	57.1	55.0	52.7	" 14.....	32.2	33.3	37.3	39.8
" 15.....	62.8	59.7	57.3	54.4	" 21.....	29.7	31.7	35.9	38.6
" 22.....	65.2	62.7	59.8	56.5	" 28.....	31.1	31.6	35.1	37.5
" 29.....	70.2	65.9	61.0	58.4					
					Average.....	46.99	46.22	47.07	47.93

TABLE 11.

DATES OF EXTREME TEMPERATURES AT DIFFERENT DEPTHS FROM READINGS AT 7 A. M. AND 7 P. M. SET A.

Year	DEPTH											
	3 INCHES				6 INCHES				12 INCHES			
	Date	Max	Date	Min	Date	Max	Date	Min	Date	Max	Date	Min
1889	June 30..	87.7	Jan. 9...	16.0	July 1...	81.2	Jan. 9...	21.0	June 30..	76.8	Jan. 21-22	26.0
1890	July 1...	86.2	" 2...	14.5	" 1...	81.2	" 2...	20.0	July 16...	72.5	" 24...	25.5
1891	" 24...	84.0	Feb. 9...	17.8	" 11...	80.6	Feb. 2...	21.9	.....	.....	.....	.....
1892	Aug. 24...	84.2	Jan. 13...	16.3	Aug. 14...	80.8	Jan. 11...	20.7	Aug. 15...	72.5	.....	.....
1893	June 28 to July 4	87.5	" 18...	21.3	July 5...	83.9	" 18...	26.0	July 5...	76.1	Jan. 21...	30.3
1894	June 12...	78.6	Dec. 23...	14.7	" 27...	76.1	Dec. 23...	21.4	" 27...	71.5	Dec. 28...	24.3
1895	July 6...	83.2	Jan. 15...	8.5	" 6...	78.8	Jan. 15...	13.0	" 29...	71.6	Jan. 15...	19.2
1896	" 13...	90.8	" 4...	18.8	" 13...	86.1	" 4...	22.7	" 13...	77.1	" 4...	27.9
1897	" 7...	78.2	" 5...	18.9	Aug. 12...	77.3	" 5...	23.9	Aug. 12...	77.0	" 5...	29.5
1898	" 15...	85.4	Dec. 14...	20.0	July 17...	82.2	Jan. 27 to Dec. 14	24.7	July 19...	77.7	" 27...	28.0
1899	June 28...	84.3	Jan. 10...	18.8	June 28...	79.2	Feb. 8...	21.6	" 24...	73.9	Feb. 7...	25.3

Year	DEPTH											
	2 FEET				3 FEET				6 FEET			
	Date	Max	Date	Min	Date	Max	Date	Min	Date	Max	Date	Min
1889	July 18...	67.3	Jan. 28...	30.9	Aug. 19...	64.6	Jan. 29-31	33.3	Sept. 5-10	60.0	Mar. 3...	39.2
1890	" 17 27 28	66.9	Feb. 11...	30.6	" 21...	64.6	" 29...	33.3	" 1-12...	60.0	Feb. 18...	39.4
1891	Aug. 7...	70.0	" 14 16 17	32.1	" 16 17	65.6	Feb. 19 22	34.0	" 17...	63.8	Mar. 12-23	39.0
1892	July 26...	68.7	" 14 16 17	32.1	19 20.....	65.6	23 26.....	34.0	" 17...	63.8	Mar. 12-23	39.0
1892	Aug. 17...	68.7	Jan. 24-25	31.4	Aug. 18...	65.5	Feb. 28...	33.6	" 1...	60.2	Feb. 24-26	39.6
1893	July 6...	75.3	" 22...	32.6	Jan. 23 27	67.6	Jan. 23 27	34.8	July 6...	67.4	" 21 22-25	40.2
1894	June 28...	69.8	Feb. 25...	31.5	June 28...	69.7	" 27-28	33.5	June 28...	64.4	Mar. 15...	38.5
1895	Aug. 2...	68.0	Jan. 16...	27.5	Aug. 7-8...	65.9	Jan. 18...	32.8	Aug. 30-	61.0	" 1...	39.3
1896	" 15-17	71.9	" 6...	31.6	" 16-17	69.5	" 8 17 18	35.5	Sept. 19...	61.0	" 1...	39.3
1897	" 12...	76.1	Feb. 2...	32.4	" 17...	73.6	Feb. 2-10	35.5	Aug. 24-25	62.8	Feb. 17-22	41.0
1898	July 30...	73.0	Feb. 12...	33.0	Sept. 1...	70.6	" 7-20	36.5	Aug. 16...	75.5	Mar. 24-	41.0
1899	" 26-28	69.1	" 15...	30.9	July 28...	67.2	Mar. 4...	34.0	Sept. 5-6	67.5	Apr. 10...	43.4

* Water applied to lawn 69.2 July 31 was probably highest otherwise.
 † " " " 62.6, Sept. 11-13.
 ‡ July 31, 68.5, unaffected by water.
 § Aug. 22, 66.7.
 ¶ Sept. 2, 62.5.
 ** Affected by irrigation.
 †† 74 June 29 after watering grass.
 ††† Observations made at 2 and 9 p. m., before July 1, 1889. 6 feet thermometer broken Sept. 10, 1898.

TABLE 12.

EVAPORATION FROM WATER SURFACE, TANK 3x3x3 FEET, FLUSH WITH GROUND, AT FORT COLLINS, COLO.

(In inches.)

Latitude 40° 34'; Longitude 105° +; Elevation 4,980 feet.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1887	2.46	3.23	4.60	5.55	5.19	5.75	5.23	4.24	4.12	3.26	1.48	1.60	46.71
1888	.....	.....	.....	.....	4.45	7.70	7.00	4.06	3.94	2.17	1.35	0.99	.....
1889	1.08	1.03	2.75	4.06	3.72	4.34	5.26	5.15	5.19	3.28	0.62	1.42	37.84
1890	0.86	2.36	3.58	3.50	4.32	5.71	5.44	5.76	3.69	2.71	1.32	1.10	40.25
1891	1.89	1.90	2.23	2.24	5.03	4.97	5.72	4.91	4.12	3.62	1.74	0.75	39.12
1892	2.51	3.15	2.78	3.58	3.49	4.20	4.69	5.64	5.11	3.33	1.93	1.13	40.54
1893	P	1.52	3.79	5.40	5.12	6.12	6.41	4.73	5.04	3.79	1.05	1.88	.....
1894	1.14	1.15	1.95	4.61	4.66	5.01	5.74	4.88	3.77	3.75	1.64	1.22	39.52
1895	1.19	1.19	P	4.91	4.27	4.13	4.57	4.52	4.06	2.24	1.53	1.68	.....
1896	2.64	2.25	2.39	4.71	5.91	5.09	5.23	5.80	3.34	2.94	1.62	1.25	43.17
1897	1.80	2.20	P	3.33	4.13	4.26	4.64	4.76	3.97	2.88	1.47	0.94	.....
1898	1.12	1.31	2.53	4.65	3.90	5.67	7.33	6.57	5.57	4.64	1.36	0.67	45.32
1899	1.51	1.59	1.54	3.19	5.35	6.37	5.38	5.86	5.04	2.87	1.86	1.15	42.11
Average	1.65	1.81	2.81	4.19	4.58	5.33	5.58	5.14	4.38	3.79	1.46	1.18	41.30

* Based on record for part of month.

† From Record of two months.

‡ From record from February 17.

P Tank punctured, record lacking.

§ From record of three months.

TABLE 13.

RAINFALL AT THE AGRICULTURAL COLLEGE, FORT COLLINS, COLO.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
1872	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.02	0.20	.....
1873	0.25	0.16	0.00	1.20	2.30	1.50	1.30	0.85	0.75	0.42	0.20	0.17	9.10
1874	0.06	0.43	1.29	0.77	2.95	0.65	3.15	0.25	0.00	1.00	0.62	0.00	10.40
1870	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.75	0.15	0.60	.....
1880	0.72	1.09	0.38	0.94	0.60	0.86	1.80	0.37	1.47	2.07	.....	0.10	.....
1881	1.10	0.55	1.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1882	.....	.....	0.17	.....	4.67	3.07	1.76	0.89	2.51	0.82	0.29	.....	.....
1883	1.60	1.50	0.68	.....	2.51	3.18	.....	1.78	1.00	1.29	T	1.33	.....
1884	1.10	0.70	1.15	3.94	4.84	.....	.....	.....	.....	0.10	1.80	0.35	.....
1885	1.77	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1886	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.69	1.18	0.33	.....
1887	0.86	0.23	0.25	1.10	1.23	1.96	3.05	2.12	0.54	0.43	0.15	0.00	12.12
1888	0.29	0.36	0.73	1.23	3.39	0.47	0.60	1.01	0.29	0.88	0.38	0.16	9.79
1889	0.21	0.34	0.65	2.07	3.39	2.06	0.79	0.95	0.42	3.16	0.43	0.01	14.48
1890	0.13	0.21	0.22	3.92	1.19	0.12	1.27	3.14	0.07	0.70	0.32	0.12	13.58
1891	2.32	0.16	1.21	2.14	4.07	1.30	0.17	2.05	1.01	0.20	0.60	0.46	15.69
1892	0.60	1.29	1.52	1.60	4.83	2.42	1.32	0.22	0.14	0.93	0.23	0.01	15.45
1893	0.02	0.54	0.14	1.66	1.2	0.26	0.64	0.92	0.18	0.16	0.55	0.12	7.11
1894	0.25	0.60	0.67	0.89	3.09	0.42	1.72	1.53	2.29	T	0.14	0.76	12.36
1895	0.24	1.52	0.54	1.36	3.62	3.65	3.75	1.45	0.47	1.06	0.40	0.01	18.07
1896	0.43	0.03	1.73	1.26	1.68	3.05	3.05	2.20	1.55	0.49	0.05	0.24	15.76
1897	0.18	0.54	2.15	1.39	2.06	1.69	2.65	1.74	0.75	0.75	0.67	0.67	15.24
1898	0.14	0.08	0.50	1.08	3.65	1.37	0.50	0.98	0.50	0.82	1.24	0.17	11.03
1899	0.66	1.04	1.50	1.10	1.01	1.03	4.95	0.99	0.21	3.23	T	0.47	16.19
Normal	0.62	0.60	0.85	1.63	2.79	1.61	1.91	1.30	0.79	1.00	0.42	0.32	13.84

TABLE 14.
PRECIPITATION 1898.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Pinkhampton.....	0.45	0.52	1.30	0.33	2.10	0.66	0.50	0.82	0.15	1.51	2.10	1.50	11.94
Larbs	0.40	0.45	0.59	1.73	1.82	2.06	2.94	1.53	0.81	0.60	1.60	0.60	15.13
Gleneyre	0.40	0.10	0.60	1.20	1.60	0.70	0.70	0.30	0.50	0.95	1.20	—	—
Shetland Ranch	—	—	—	—	—	—	—	1.02	0.44	1.55	2.60	1.40	—
Waterdale	0.24	0.25	0.87	1.42	3.43	1.86	1.20	1.61	0.50	0.75	1.62	0.50	14.25
Fort Collins.....	0.14	0.08	0.50	1.08	3.65	1.37	0.50	0.98	0.50	0.82	1.24	0.17	11.03
Rocky Ford.....	0.40	0.0	0.16	1.06	2.71	3.16	3.52	0.92	1.55	1.36	0.37	0.96	16.17
Cheyenne Wells.....	0.03	0.0	0.61	1.10	5.56	3.95	2.09	1.33	2.00	0.48	0.50	0.48	18.13

PRECIPITATION 1899.

Pinkhampton.....	3.33	3.60	2.60	1.60	0.27	0.60	1.18	0.91	0.30	3.09	T	1.17	18.65
Larbs	0.52	1.05	2.97	1.10	0.38	1.09	3.32	1.73	0.11	2.31	0.03	0.62	15.23
Shetland Ranch.....	3.13	3.87	1.20	0.13	—	—	—	—	—	—	—	—	—
Waterdale	0.53	1.10	1.25	0.84	0.67	0.92	2.12	0.94	0.16	3.30	0	0.49	12.35
Fort Collins.....	0.66	1.04	1.50	1.10	1.01	1.03	4.95	0.90	0.21	3.23	T	0.47	16.19
Rocky Ford	0.98	0.55	0.32	0.28	0.90	0.78	7.00	2.22	1.43	0.63	2.40	0.98	18.56
Cheyenne Wells.....	0.47	0.36	0.39	0.03	2.88	1.88	3.67	0.55	0.79	T	2.49	0.55	14.07

Pinkhampton for Jan., Feb., March, Dec., 15 in. snow taken for 1 in. rainfall, 15 in. of snow taken for 1 in. rainfall at Shetland Ranch for Jan., Feb., March and April.

Shetland Ranch is near Home Postoffice on the Poudre River; elevation 7800 feet. John Deaver, observer.

Waterdale is on the Big Thompson, in the foothills west of Loveland. P. H. Boothroyd, observer.

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