

THE STATE AGRICULTURAL COLLEGE
OF COLORADO

THE EIGHTEENTH ANNUAL REPORT

OF

The Agricultural Experiment
Station

For 1904-5

LETTER OF TRANSMITTAL.

To His Excellency,

JESSE F. McDONALD,

Governor of Colorado :

In accordance with the requirements of an Act of Congress providing for the establishment of agricultural experiment stations, I have the honor to present herewith the report of the Colorado Experiment Station, it being the eighteenth annual report. The report of the activities of the Station is for the whole year, while the fiscal report ends with June 30, in conformity with the fiscal year of the United States.

The report and the accompanying documents give an indication of the activity of the Station. The publication of the experiments is made in separate form as bulletins which are widely distributed among the agricultural population of the State.

Respectfully submitted,

L. G. CARPENTER,

Director.

The Agricultural Experiment Station,
State Agricultural College,
Fort Collins, Colo.
December, 1905.

The Agricultural Experiment Station,

FORT COLLINS, COLORADO.

THE STATE BOARD OF AGRICULTURE.

	Term Expires
HON. P. F. SHARP, <i>President</i> , - - - - -	Denver. 1905
HON. JESSE HARRIS,† - - - - -	Fort Collins. 1905
HON. HARLAN THOMAS, - - - - -	Denver. 1907
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HON. R. W. CORWIN,††† - - - - -	Pueblo. 1913
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STATION STAFF.

L. G. CARPENTER, M. S., <i>Director</i> , - - - - -	IRRIGATION ENGINEER
C. P. GILLETTE, M. S., - - - - -	ENTOMOLOGIST
W. P. HEADDEN, A. M., PH. D., - - - - -	CHEMIST
WENDELL PADDOCK, M. S., - - - - -	HORTICULTURIST
W. L. CARLYLE, B. S. A., - - - - -	AGRICULTURIST
G. H. GLOVER, B. S., D. V. M., - - - - -	VETERINARIAN
W. H. OLIN, M. S., - - - - -	AGRONOMIST
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J. A. McLEAN, A. B., B. S. A., - - - - -	ANIMAL HUSBANDMAN
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B. O. LONGYEAR, B. S., - - - - -	ASSISTANT HORTICULTURIST
P. K. BLINN, B. S., - - - - -	FIELD AGENT, ARKANSAS VALLEY, ROCKYFORD

OFFICERS.

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 A. M. HAWLEY, - - - - - SECRETARY
 MARGARET MURRAY, - - - - - STENOGRAPHER AND CLERK

† Term expired April 25, 1905.

†† Resigned April 25, 1905.

††† From April 25, 1905.

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†† To April 25, 1905.

††† From April 25, 1905.

§ Resigned August 1, 1905.

|| Appointed August 1, 1905.

FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1904.

RECEIPTS.

Dr.	U. S. Fund.	Special Fund.	Total.
From the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1905, as per act of Congress approved March 2, 1887.....	\$15,000.00	\$.....	\$.....
Balance on hand July 1, 1904.....		479.40	.....
Miscellaneous		488.35	.....
	<hr/>	<hr/>	<hr/>
Total receipts			\$15,967.75

DISBURSEMENTS.

Classification.	U. S. Fund.	Special Fund.	Total.
Salaries	\$10,863.30	\$ 10.00	\$10,873.30
Labor	211.61	31.00	242.61
Publications	1,780.93	150.00	1,930.93
Postage and stationery	356.02	2.70	358.72
Freight and express	7.30	.....	7.30
Heat, light, water and power .....			.....
Chemical supplies .....			.....
Seeds, plants and sundry supplies	344.11	.10	344.21
Fertilizers	30.20	.....	30.20
Feeding stuffs .....			.....
Library	42.69	.....	42.69
Tools, implements and machinery.....	16.60	.....	16.60
Furniture and fixtures	46.40	.....	46.40
Scientific apparatus	265.27	35.00	300.27
Live stock	428.06	.....	428.06
Traveling expenses	586.51	32.90	619.41
Contingent expenses	21.00	20.00	41.00
Buildings and repairs .....			.....
	<hr/>	<hr/>	<hr/>
Total expended	\$15,000.00	\$281.70	\$15,281.70
Balance		686.05	686.05
	<hr/>	<hr/>	<hr/>
Grand total			\$15,967.75

REPORT OF THE DIRECTOR.

The Experiment Station was organized in 1888, under the provisions of an act of Congress commonly known as the Hatch Act. The conditions of the act were accepted by the legislature in 1889. By this Act \$15,000 is furnished annually by the General Government for research work or experiments bearing directly on the agricultural industry, having due regard to the varying conditions and needs of the respective states. This appropriation is available solely for the necessary expenses of conducting investigations and experiments and printing and distributing the results. In no case is a sum to exceed five per cent. to be used for buildings. The Station is given the privilege of sending its bulletins without postage under the signature of the Director.

The Station was organized in 1888, and as the agriculture of the State is necessarily dependent upon irrigation, that branch was given a prominent place in the establishment and has since continued. Other lines of investigation provided for were in agriculture, horticulture, chemistry, and veterinary science. Afterwards entomology was added and veterinary was abolished and again made a part of the Station in later years. At the time of organization it was thought, mistakenly, that an important feature of the work would be in the maintenance of permanent substations in different parts of the State. It was soon seen, however, that the cost of these substations was entirely disproportionate to the results; more than that, the conditions were not such as could be met. Many expected these substations to be model farms. People wanted experimentation in their own lines of agriculture in which they were interested, and practically expected a specialist in each of the different lines, a condition which no one man could meet. The General Government finally ruled that the appropriation under the Hatch Act was not available for permanent substations; that the appropriation was for *an* experiment station, not several, and that while it might be available for investigations which might, if necessary, be conducted in different parts of the State, yet none of it could be used for the purpose of farming or for permanent substations. Accordingly, when the present Director took charge of the Station one of the first problems was to withdraw from the various substations, with as little friction or conflict as possible. The men who had been superintendents of the

substations were freed from any responsibility for farming and given special investigations, and their work immediately became fruitful. The substations had been a very great draft upon the revenues of the Station. A total expenditure of practically one-half of the revenues of the Station had been made in this way, and the results had been almost nothing. It had developed that the substations took a large part of the available resources, and the investigational departments of the Station were seriously crippled and were left with practically no means for taking up or continuing the investigations in which they could be useful.

In the last ten years this condition has gradually been changed. The substations have entirely ceased to be a draft upon the revenues of the Station. A part of the land has been sold and others leased, and arrangements so made that the Station is not responsible for the conduct of farming operations. The area which originally formed a part of the substation at Rockyford has mostly been sold; the tract remaining is simply used as a residence for the Field Agent and a small plot of ground used for experiments in connection with certain specific lines, principally cantaloupes and sugar beets. The intention, however, is that this shall not confine the Field Agent to that point, but that a large part of his work shall be in the Arkansas Valley. The only cost now is the salary of the Field Agent, who as an investigator is assigned certain problems in that region, and the former station is furnished him as rent. The land constituting the former substation at Cheyenne Wells is still retained, but for a number of years it has caused no expense. The work of the last Field Agent was devoted to the Plains, and as such developed many of the conditions of the Plains, which resulted in a series of bulletins and in the starting of the Macaroni or Durum wheat industry.

The publications of the Station have correspondingly increased in number. During the first eleven years only fifty-two bulletins were issued, and in the six years since fifty-five bulletins have been printed, besides a large number of smaller bulletins, which, for convenience, have been termed press bulletins. The sums formerly taken by the substations have been available as a working fund, increasing the effectiveness of the Station, while before the tendency towards economy frequently made it necessary to economize even in publication. It has also made it possible for the investigators to visit different parts of the State when conditions made it desirable. The size of the editions has gradually increased until now most of the bulletins are published in editions of from nine to ten thousand. The number of names in the mailing list is nearly eight thousand. The bulletins are sent without cost to all who apply. The distribution of bulletins has been the subject of much

thought to the Station authorities, and no completely satisfactory method has been found. A large proportion of the bulletins necessarily falls into hands that do not use them. Such loss, however, seems to be incident to all methods of distribution. Nature scatters a thousand seeds in order that one may take root and grow.

We have taken pains to make our bulletins more frequent, shorter, and more direct. So far as important lessons are conveyed by bulletins, it is expected that they will be applied only by the more progressive men in a country, and that gradually the others will acquire the results by observation. Ordinarily it requires from five to ten years at least for important scientific results to be appreciated and applied. It is noticeable that bulletins that may be most popular when issued, have an ephemeral demand, and after a short time are never called for. On the other hand many of those which are not at all popular, yet include the results of honest, scientific work, have a permanent value, and the demand for them may be greater after ten years have elapsed than it was after one year. Apparently the value is more and more appreciated, and certainly the honest work involved is respected and is of value. The popular compilations are not without their value, but this demand ought not to blind us to the fact that they are temporary in character, are of little permanent value, and have little or no effect upon the agricultural practice of the country. The life of the Station has now been long enough to emphasize this lesson. The experiment stations in the States which have done the most earnest and thoroughly scientific work are those which are now the most thoroughly established in the good opinion of the agricultural community.

The number of pages that have been issued and distributed by the Experiment Station during the year is nearly 2,500,000. The bulletins issued during the year ending December 1, are twelve in number. The following is a list:

No.	Title.	Author.
93—44 pages.	Colorado Hays and Fodders—Digestive Experiment	Dr. Wm. P. Headden
94—86 pages.	(Technical Series No. 6.) Report of the Entomologist; Some of the More Important Insects of 1903 and an Annotated List of Colorado Orthoptera, by	Prof. C. P. Gillette
	II.—Some New Colorado Orthoptera, by	Lawrence Bruner, of Nebraska.
	III.—Bees of the Genus <i>Nomada</i> Found in Colorado, by	T. D. A. Cockerell
95— 8 pages.	Early Cantaloupes, by	P. K. Blinn
96—28 pages.	Shade Trees of Denver, by W. Paddock and B. O. Longyear	
97—14 pages.	Feeding Steers on Sugar Beet Pulp, Alfalfa Hay and Farm Grains, by	W. L. Carlyle, C. J. Griffith, A. J. Meyer

98—22 pages. Beet Worms and Their Remedies, by
C. P. Gillette and S. A. Johnson

99—16 pages. How Can We Maintain the Fertility
 of Our Colorado Soils? by.....Dr. Wm. P. Headden

101—16 pages. The Western Cricket, by...C. P. Gillette and S. A. Johnson

102—12 pages. Feeding Steers on Beet Pulp, Alfalfa
 Hay, and Ground Corn, by...W. L. Carlyle and C. J. Griffith

103—32 pages. The Thorough Tillage System for the
 Plains of Colorado, by.....W. H. Olin

104—16 pages. A Rust Resisting Cantaloupe, by.....P. K. Blinn

105—12 pages. A new Apple Rot, byB. O. Longyear

Annual report, 1903-4.

The number 100 was assigned to a bulletin on the Flora of Colorado, the manuscript of which was sent to the printer early in the year. This bulletin is one of several hundred pages, involves the results of the work done by the Station and College men on the plants of Colorado during a series of a great many years, and has taken much longer to get through the press than was expected. The preparation of the copy has been in the hands of the New York Botanical Garden, connected with Columbia College, New York City, the work being done by Dr. P. A. Rydberg, the foremost authority on Rocky Mountain botany.

When the number was assigned it was anticipated that it would issue from the press in its due order. The delay, and the number of other bulletins ready for printing in the mean time, will make it out of order when finally distributed.

The great area of Colorado, the variety of conditions, and the new problems brought by irrigated agriculture bring a great variety of questions for the Station to consider. These are far beyond the power of the Station to take up at any one time. Most investigations of value require from one to five or more years to carry through. Hence, only a limited number of specific investigations can be taken up at once. Of necessity the Station has to refrain from taking up many investigations which are of importance because they would interfere with other existing lines of investigation. This condition of things is likely to increase rather than decrease even with added revenue, for as the people appreciate the points where help may be obtained from the Station, their requests for aid will likewise increase.

The variety of conditions may be realized when the character of the State in comparison with other states is considered, as has been mentioned in a previous report. The area of Colorado is practically equivalent to the areas of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York combined. Its variation in elevation from 3,500 to over 14,000 feet induces extremes of climate as great as those between South Carolina and Spitzbergen. It has the new problems that come with a new country where there is no experience as to crops or

varieties which will be suitable; it has the variety that comes with both the plains and the mountains; it has the problems that come with irrigation, while agriculture in older countries becomes largely a search for fertilizers, under our conditions it becomes largely a search for water. Under the former conditions agricultural research is largely a chemical question, under our conditions from analagous reasons it may become largely an engineering question.

It is manifest that the fund for experimentation for such an area is small, and that only a limited variety of questions can be taken up. In the equivalent area above mentioned the United States supports seven experiment stations, with an appropriation of \$105,000. In addition the states themselves support two more. That the stations are recognized to be of value is shown by the fact that the state appropriations usually amount to more than those from the Government. Belgium, with an area of a little over one-tenth of that of Colorado, has sixteen experiment stations. As the Experiment Station becomes better known, as the men become trained for this work, there is bound to be an increase in demand. An obstacle in obtaining additional support from the General Government has been the claim that the states themselves ought to help support these stations. An encouraging step was taken by the last legislature in a bill signed April 6, 1905, which, besides furnishing some support for work in the Agricultural College, appropriated an aggregate of \$14,000 for the Experiment Station for the two years 1905-1906. This appropriation provides \$10,000 "to conduct investigations calculated to develop the beef, pork, mutton, wool, and horse producing interests of the State, and especially to devise and conduct feeding experiments intended to determine the most successful combination of stock foods, particularly in Colorado grasses, grains, and forage crops, and to discover the most economical and successful methods of maintaining animals and feeding them for the market; to investigate the various contagious and other diseases of live stock, especially of poisonous plants infecting the ranges of Colorado; to investigate live stock conditions, both at home and in other states of the Union, and to publish the results of such experiments and investigations."

Section 3 provides an appropriation of \$3,000 for the two years "to conduct co-operative experiments in the several sections of the State in order to discover the best methods of producing grain, forage, and grasses on the different soils and under the various climatic conditions of the State, for the purpose of improving the different varieties grown for the several purposes, and to publish the results of such experiments."

Section 4 makes an appropriation of \$1,000 "to investigate

and demonstrate the best method of fertilizing, seeding, and cultivating sugar beets, potatoes, and other root crops on the various soils of the different sections of the State; to experiment upon the production of sugar beet seed, especially adapted to Colorado conditions, and to perform such other experiments and conduct such other investigations as are calculated to increase the yield of potatoes and sugar beets and percentage of sugar in the beet crop, and to publish reports on such experiments."

None of this fund was available until late in the fall of 1905 after the growing season was past and as there was uncertainty whether it would be available at all, it was not safe to anticipate its payment.

Plans have been made by the various sections of the Station along these lines for the present winter and coming summer. Among these is one by Professor Carlyle, the Agriculturist, which involves a three years' test for comparison of different systems of wintering steers in Colorado. Sixty steers are to be selected this fall from different parts of the State, thirty of which are to be brought at once to the Station and placed on feed; the remaining thirty to be left with the ranchmen under range conditions. In a year fifteen more will be removed from range conditions and put on feed, and the next fall the remaining fifteen will be brought from the range and placed on feed. The object is to compare the different systems of wintering cattle as it affects the cost of beef production, the quality of the meat, etc. Other feeding tests include the value of sugar beets in fattening pigs; an experiment to determine the cost of wintering brood sows; comparison of foods for wintering steer calves.

The provisions of this section also enabled the Station to revive and continue an experiment on loco, which had been dropped for some years because of the conclusion which we reached that unless the investigation could be taken up on a much more thorough plan than we could afford it was better to leave loco alone. Considerable field work was done by Mr. Payne, and this work made clear the necessary conditions. The Department of Agriculture was interested in the same subject and a co-operative investigation was arranged whereby the Department furnished an expert from the Department of Agriculture, and this Station furnished horses and cattle for the test. Dr. C. Dwight Marsh, of the Department of Agriculture, has spent his summer at Hugo in this investigation, which is expected to continue for one or more years further. It was manifest from the previous work on loco that the first step necessary was absolutely to establish the connection between the plant and the so-called disease. A further reference will be found in the report of Dr. Glover, Veterinarian.

A further reference to the investigations of the different sections is found in their reports, which are appended. In most cases the reference to the work done is short. The financial report gives the statement of the expenditure of funds under the classification adopted by the United States. The expenditure for the sections for the fiscal period ending June 30, has been as follows. This does not include the expenditure for salaries or general purposes of the Station, like printing, stationery, postage, etc.:

Agricultural section	\$898.28
Horticultural section	328.74
Irrigation and Meteorology	359.13
Chemical section	64.18
Entomological section	253.55
Veterinary section	190.60

There is a bill now before Congress known as the Adams Bill, to increase the appropriation for experiment stations. The effect of this bill will be to increase the amount by \$5,000 the first year, by \$7,000 the second, and so on until the appropriation is \$15,000 more than at present after a period of five years. It is the hope that this bill will pass, for it will be of very great value to the Station.

INVENTORY AGRICULTURAL EXPERIMENT STATION,
1905.

DIRECTOR'S OFFICE

Office Fixtures & Equipment.....	\$1,278.06	
Stationery & Supplies.....	344.00	
Half Tones & Zinc Etchings.....	250.00	
Library	2,365.00	
		<u>\$4,237.06</u>

METEOROLOGICAL & IRRIGATION ENGINEERING SECTION.

Meteorological Instruments	650.90	
Office Fixtures	195.05	
Stationery, Books, Maps, Etc.....	49.05	
Irrigation & Hydraulic Apparatus.....	437.40	
Photo Supplies & Negatives.....	233.99	
Tools & Supplies for Soil Work.....	180.95	
Miscellaneous	358.18	
		<u>2,105.52</u>

ENTOMOLOGICAL SECTION.

Laboratory & Office Supplies	302.65	
Entomological Supplies	127.95	
Insecticides & Insecticide Apparatus	293.45	
Apiary	114.20	
		<u>838.25</u>

CHEMICAL SECTION.

Two Analytical Balances.....	150.00	
One Polariscopes, one Beet Pulp Machine, one Beet Juice Press	250.00	
		<u>400.00</u>

HORTICULTURAL SECTION.

Glassware	7.40	
Photographic Apparatus	64.35	
Instruments	122.00	
Herbarium	1,640.00	
Tools	30.80	
		<u>1,864.55</u>

AGRICULTURAL SECTION.

Implements & Tools	193.05	
Miscellaneous	547.00	
Plant Industry Fund (marking set)	39.30	
Seeds & Grains.....		
		<u>679.35</u>

VETERINARY SECTION.

Kodak	18.90	
Stationery	2.00	
Stock at Hugo (Loco experiment).....	190.00	
		<u>210.90</u>

ROCKYFORD SUB-STATION.

Buildings & Improvements	1,484.00	
Farm Machinery & Tools.....	201.00	
Office Furniture & Fixtures.....	19.50	
Camera & Photo Supplies.....	30.00	
40 Acres Land With Water Rights (title conditional).....	7,000.00	
		<u>8,734.50</u>

EIGHTEENTH ANNUAL REPORT.

CHEYENNE WELLS SUB-STATION.

160 Acres of land (title conditional).....	800.00	
Fencing	110.80	
3,000 ft. gal. Iron Pipe in ground.....	30.00	
Dwelling House & Barn.....	750.00	
		1,690.80
(U. P. Ry. Property at Station \$18.)		
Total		\$20,760.93

EXCHANGES.

BOOKS, PAMPHLETS, SCIENTIFIC PROCEEDINGS, ETC., 1905.

Argentine Republic:

- Anales del Museo Nacional de Buenos Aires.
 Anales del Ministerio de Agricultura.
 Boletín de Agricultura y Ganadería.
 Boletín del Ministerio de Agricultura.
 Camera Mercantil.
 Coal, Petroleum and Water in Argentine.
 Cotton Cultivation.
 Cronica Agricola.
 El Cultivo del Trigo.
 Immigration Statistics from 1857 to 1903.
 Index Explicatif des Objects Exposes par le Ministere des Travaux
 Publics.
 Los Hongos Parasitos de la Langosta. J. Kunckel D'Herculeis.
 Le Surra Americain ou Mal de Caderas. Fdederic Sivori et Emmanuel
 Lecler.
 Memoria Presentada al Honorable Congreso. Dr. Wenceslao Escalante.
 Monthly Bulletin Municipal Statistics of the City of Buenos Ayres.
 Official Report of Mines, Mining, Metallurgy and Mining Laws of
 Argentine Republic.
 Section of Statistic and Rural Economy.
 Project for improving the Navigability of the River Uruguay, Between
 the River Plate and Concordia.
 Sketch of the Argentine Republic as a Country for Immigration.

Australia:

- Annual Report Bureau Sugar Experiment Station, Queensland.
 Department of Agriculture of Victoria, bulletins.
 Journal of Agriculture of Victoria.
 Annual Report Live Stock Association.

Canada:

- Annual Report Bee Keepers' Association.
 Annual Report Dairymen's Association.
 Annual Report Entomological Society.
 Annual Report Farmers' Institutes.
 Annual Report Fruit Growers' Association.

Canada:

- Department of Agriculture, Ontario, Bulletins & Reports.
 Department of Agriculture, Ottawa, Bulletins & Reports.
 First Annual Meeting Canadian Seed Growers' Association.
 First Annual Meeting Canadian Stock Breeders.
 Northwest Territory College & Experiment Station Bulletins & Reports.
 Ontario Bureau of Industries. Crop Bulletins.
 Ontario Fairs and Exhibitions.
 Report School of Horticulture of Nova Scotia.

England:

- Journal Royal Horticultural Society, London.
 Report Fifth International Conference of Sheep Breeders.
 Report Injurious Insects and Other Animals. Walter E. Collinge,
 Birmingham.

Finland:

- Skadeinsekters Upotradande I Finland.

Germany:

- J. Bolle. Bericht uber de Tatigkeit der K. K. Lindeochemischen
 Versuchsstation in Gorz, 1902.
 J. Bolle. Der Seidenbau in Japan.

- Dr. C. Brick. Bericht über die Tätigkeit der Abteilung für Pflanzenschutz.
- O. V. Czadek und Dr. K. Kornauth. Ueberfadenziehendes Brot. Eisenaufnahme von Spinat.
- Dr. Ludwig Hecke. Beizversuche gegen Hirsebrand Ueber das Auftreten von *Plasmopara cubensis* in Oesterreich.
- Die Rostkrankheiten unfeyer Sonder-Abdruck aus den Berichten der Deutschen Botanischen Gesellschaft.
- Dr. C. Parrot. Verhandlungen der Ornithologischen Gesellschaft in Bayern, 1903.
- Prof. Dr. Baessler. Bericht über die Tätigkeit der Agrikultur-chemischen Versuchs und Samenkontrollstation in Koslin.
- Prof. Dr. Baessler. Kartoffel-Anbau und Dungungs-Versuche.
- Dr. A. Voigt. Bericht über die Tätigkeit der Abteilung für Samenkontrolle. Hamburg.
- India:
Irrigation Administration Report of the United Provinces, 1903.
- Jamaica:
Bulletins of the Department of Agriculture.
- Japan:
Prof. Chujiro Sasaki—A New Field Mouse in Japan. On Wax Producing Coccid, *Ericerus pe-la* Westwood. Some Observations on *Antheroea* (*Bombyx*) *Yamamai* G. M. and the Methods of Its Rearing in Japan.
Imperial Agricultural Experiment Station; San Jose' Scale, Abstract of Bulletin 30, About Some Injurious Insects.
- Mexico:
Boletin Meteorologico. Toluca.
- Netherlands:
Prof. Dr. J. R. Bos. Tijdschrift over Plantenziekten.
- New South Wales:
Agricultural Gazette, Sydney.
Botanical Gardens and Domains.
- New Zealand:
Annual Report Department of Agriculture.
Chemical Report—B. C. Aston, Wellington, N. Z.
- Peru:
Boletin del Ministerio de Fomento, Lima.
Sociedad Geografica de Lima.
- Russia:
Journal für Experimentelle Landwirtschaft.
- South Africa:
Fourth Annual Report of Government Entomologist, Natal.
The Transvaal Agricultural Journal.
The Transvaal Annual Report Department of Agriculture.
The Statistical Year Book, Colony of Natal, 1902.
- Scotland:
West of Scotland Agricultural College Report.
- Wales:
Lledwigan Farm Publications.
University College Publications, Bangor.
- United States:
American Philosophical Society, Philadelphia, Pa.
Annals Observatory of Harvard College.
Bulletin of Agriculture, Raleigh, N. C.
Clarkson Bulletin, School of Technology.
Chemical Factor in Human Progress—Dr. Peter Austen.
California Fruit Growers' Convention.

- Dunn County School of Agriculture, Menomine, Wis.
 Elisha Mitchell Scientific Society Journal.
 Food for Plants—Wm. S. Meyers, N. Y.
 Forest Fires in the Adirondacks in 1903.—H. M. Suter.
 Florida Monthly Bulletin.
 Geological Survey of N. J. Report for 1903.
 Geological Survey of Louisiana, 1899.
 Iowa State Horticultural Society.
 Journal Franklin Institute, Philadelphia.
 Lloyd Library, Cincinnati, Ohio.
 Minnesota Plant Diseases.
 Missouri Botanical Gardens.
 Marathon County School of Agriculture, Wis.
 Maryland Agricultural College Quarterly.
 Nebraska Irrigation, 1901-02.
 New Jersey State Board of Health Report, 1904.
 New York Museum Bulletins.
 New York Botanical Garden Bulletins.
 Nut Grower, Poulan, Ga.
 Pennsylvania Forestry, 1903-04.
 Proceedings Iowa Park and Forestry Association.
 Public Library, Providence, R. I.
 Report Oregon Board of Horticulture, 1905.
 Report Oregon Railroad and Navigation Company.
 Rochester Academy of Science.
 Report State Board of Health of Maine.
 Report State Chemist of Florida.
 State Board of Agriculture, Topeka, Kan.
 State Board of Agriculture, Newark, Del.
 State Board of Agriculture, Raleigh, N. C.
 State Board of Agriculture, Richmond, Va.
 State Food Commissioner's Report, Ill.
 State Board of Health, Augusta, Maine.
 State Horticultural Society, Kansas.
 State Horticultural Society, Massachusetts.
 South California Academy of Science.
 St. Louis Academy of Science.
 Tuskegee Normal and Industrial Institute.
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 Republic, St. Louis, Mo.
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 Sun, The, Baltimore, Md.
 Prowers County News, Lamar, Colo.

REPORT OF THE AGRICULTURIST.

The work accomplished has not been as great in extent or value as hoped. The work in the Agronomy Section has been in the direct charge of Professor W. H. Olin, who with his assistant, Mr. Danielson, have accomplished wonders with the funds available. As you are aware, Professor Griffith severed his connection with this Department in June of the present year to engage in ranch work. Prof. J. A. McLean has been selected to fill this position and take charge of work in the animal husbandry department. Mr. Danielson has notified me that he will sever his connection with the College and Experiment Station some time during December of this year. He has spent five years in this Department developing hardy grains in the San Luis Valley and in some sugar beet investigations in this district, and will prepare a report covering his work for the time he has been engaged in it. Professor McLean, in view of the fact that he has only been with us about three months, will have no report this year.

Work Accomplished. In the past year, the experiment to determine the feeding value of sugar beet pulp and alfalfa hay in fattening range steers has been completed and the results tabulated and discussed in Bulletin No. 102. The results of this experiment were decidedly satisfactory and I believe will be of great benefit to the feeders in general, particularly in the vicinity of the sugar factories in this State. The conclusions drawn from the results of the work may be briefly summarized as follows:

1. A two-year-old steer will make a gain of one and one-half pounds per day on alfalfa hay alone and will require approximately twenty-eight pounds of hay to make one pound of gain. The addition of ground corn to the ration of alfalfa hay will increase the market price of the steer and will add to the profit of the feeding venture if corn can be procured anywhere below 90 cents per hundred pounds. A pound of corn is equal in feeding value to 2.8 pounds of alfalfa hay and nine pounds of beet pulp for fattening two-year-old steers.

2. 3.22 pounds of beet pulp is equivalent to one pound of alfalfa hay when fed in conjunction with hay to two-year-old steers.

3. With alfalfa hay at \$5 per ton, it will pay to feed ground corn with hay to fatten the steers, provided the corn can be purchased below 90 cents per hundred pounds.

4. With alfalfa hay at \$5 per ton, sugar beet pulp is worth \$1.50 per ton to combine with corn for fattening steers.

The Horse Breeding Experiment. The co-operative experiment with the U. S. Department of Agriculture in the production of American Carriage horses has been successfully inaugurated. Nineteen brood mares and one stallion have been secured and are now on the College farm. Five of these mares were in foal when purchased and the foals have been successfully reared and have recently been weaned from their dams. All of the mares have been bred to Carmon and as far as present indications can determine, all of them with one exception are safe in foal. These mares have been kept in the mountain pasture since last May. Last spring, the barbed wire fence surrounding this pasture was removed and a woven wire fence of the most approved pattern was erected surrounding the entire pasture. In all, 1,600 rods of this woven wire fence was erected by the College the wire being furnished by the Department of Agriculture.

Plans and specifications have been prepared for a suitable horse barn, stables and sheds for the proper conduct of this experiment. The bids will probably be opened and the contract let within the next ten days and the building erected in time to care for the stock during the inclement weather of the coming winter. Fifty tons of choice upland hay have been purchased by the Department of Agriculture for the feeding of these horses during the winter months, and bids have been asked for the supplying of 1,000 bushels of oats, which we hope will be sufficient to carry the horses through the coming year. Corrals have been planned in connection with the barn and stable to be erected on the new farm purchased from Mr. Andrews for the experiment work.

Plans for Future Work in Animal Husbandry. Owing to the liberality of the last legislator, sufficient funds are available for the carrying on during the coming year of some valuable work in the live stock department of the Station. A large portion of the funds, however, will have to be used in erecting suitable buildings and sheds for the horse breeding experiment and the steer feeding work contemplated. We have planned to carry on some feeding experiments with hogs to determine the feeding value of sugar beets for fattening young hogs and also for wintering brood sows. We feel that this is an important work to be undertaken in this State at the present time.

A line of work has also been planned which will be used as a demonstration as much as an experiment. This is to determine the advisability of giving liberal feed, care and shelter to range calves and yearling steers during the winter months. Our plan as outlined, is to secure sixty steer calves as soon as they are weaned

from their dams, this month. We plan to secure these from different parts of the State so as to have the work as fully representative of the various sections as possible. Fifteen of these calves will be from the western slope, thirty from the foothills of the eastern slope and fifteen from the ranges of the Eastern Plains. These calves will be branded when selected and twenty of them will be brought to the College farm at once, five from the western slope, five from the lot on the eastern plains, and ten from the foothills of the eastern slope and the remainder will be wintered under the conditions followed in the sections where they are now being ranged. One year later, twenty more head will be selected and brought to the College farm and one year after that, the remaining twenty head will be brought to the farm here. The calves brought to the farm this fall will be used in experimental feeding when good care will be given them and they will receive sufficient feed to keep them growing and in a thrifty condition. During the summer months they will be given the run of a good pasture and will be compared with the second lot of twenty, which will come to the College farm next fall. Both of these lots will have good feed while on experiment and will be kept in a growing and thrifty condition and both lots will have good pasturage on the range the succeeding summer. The remaining twenty head will be brought to the farm two years from this fall. All will be marketed together in the following spring and a comparison made of the carcasses of representative steers from each lot to determine the difference in quality of meat, etc. Careful records will be kept of the prices paid for the steers in the different lots together with the expense of bringing them through the experiment so that an accurate estimate may be made as to the profits which may be derived from the different systems of maintaining steer calves from birth until marketed.

We have outlined a small experiment with twenty head of calves to be brought to the farm this fall. One-half of these will be given a ration composed of grain, alfalfa, hay and roots. The other half will be given grain and hay.

For the next summer we have planned nothing very definite, but will do some work in the growing of soiling crops for dairy cows.

In the Agronomy section extensive plans have been outlined and as Professor Olin expects to take the matter up very fully in his report, it will not be necessary for a discussion of these plans at this time.

The College and Station farm is, I believe, improved in condition and with the addition of the 67 acres recently purchased by the Board, we are very hopeful that some excellent work will be

accomplished that will be of great benefit to the agricultural interests of the State.

There is a great field of investigation in sugar beet growing and also with alfalfa. I am sure that a much improved type of alfalfa may be secured by a proper system of selection and we are planning to engage somewhat extensively in investigations with this end in view during the coming year. We are also very hopeful of the success of Macaroni or Durum wheat for the farmers of eastern Colorado. The results of the present season have been very encouraging and the fact that this crop can be grown under very adverse conditions means much to the farmers on the Plains. Our work in the Agronomy section for the past year has been very largely in investigating the conditions in the various sections of the State. In the future, however, we hope to confine our work as much as possible to the Station farm and not spread too much over the whole State. While there are very urgent demands coming from all sections, yet I believe that we can accomplish a much greater permanent good to all concerned by undertaking more definite lines of investigation and carrying them through for a term of years under the most rigid inspection so that when we secure results there may be no question as to their accuracy. While a certain amount of good is to be accomplished by co-operative work, yet it is not of a character which can always be depended upon for absolute reliability.

Very respectfully submitted,

W. L. CARLYLE,
Agriculturist.

SUB-SECTION OF AGRONOMY.

OUTLINE OF WORK PLANNED.

The following outline shows the scope of the work planned:

1. Field Nursery Work.
2. Test of Variety Types of Grains and Forage Plants.
3. Co-operative Field Work in Different Sections of the State.
4. Sugar Beet Investigation Work.
5. Compiling Data Obtained for Station Use.

Field Nursery Work. Early in the year I arranged the work so Mr. A. H. Danielson, my assistant in this section, could complete his investigations and breeding work with various grains. I therefore placed the field nursery work under his charge, with the exception of work with corn and alfalfa.

In the field nursery Mr. Danielson has sought by cross breeding and seed selection to develop a beardless drouth resistant type of wheat for the plains, a rust resistant type of spring wheat for our irrigated lands, a hardy and early maturing spring wheat for our higher altitudes, a hardy early maturing type of oats for the higher altitudes of the State, a desirable and hardy winter wheat, a more desirable type of emmer than is now obtainable, a superior stock beet, native beet seed, and a hardy soy bean. He has given this work his close attention and I have asked him to make a concluding report to you showing results obtained.

I have had charge of the other lines of investigation work.

The value of the field nursery work is apparent when we consider that here we study the heredity and prepotent power of individual plants. Here the initial work is done which gives us vital seed stock, especially important in a State like Colorado with such varying climatic conditions. Each seed stock which comes from the field nursery must show adaptability, producing capacity and superior quality. When these elements are maintained under field conditions we shall hear no further complaint of "seed running out," failure to mature, and low yields. I believe the work in our field nursery should bring out better seed stock, adapted to our particular conditions of plant growth.

CORN.

When I came to the Station in July, 1904, Prof. Paddock turned over to me the work with a particular strain of corn he

was studying. This was an eight rowed dent corn brought into this State by Mr. Swadley from West Virginia some thirty years ago. It has shown itself adapted to our seasons and has been known to mature a crop of corn as high as 6,000 feet elevation. The seed selected for crop of 1904 had a majority of eight rowed ears and a few ten rowed ears. My work with this corn shall be to improve its physical characteristics and increase the number of rows of kernels to the ear—thereby increasing its producing capacity. While corn is a minor crop in Colorado, still there are certain localities raising corn that will continue to grow this crop for some years to come. If they can grow a better type of corn yielding fifteen to twenty-five per cent. more than they now can obtain, it will be of considerable importance to them. Corn can not be grown with profit on high priced land. Unless one can make a ten per cent. profit on his capital invested, his crop is not a profitable one. Mr. R. V. Pickett of Edgewater, Colorado, is carrying on co-operative work with me on this corn breeding work.

ALFALFA.

Alfalfa is the greatest forage crop grown in the State. I find such a variation in character of plants in field, cultural methods and quality of hay that I have decided to carry on some plant selection work in alfalfa with different cultural treatment. Mr. Philo K. Blinn at Rockyford has taken up an experiment with me in the study of individual plants of alfalfa. The plants for study were seeded this spring in rows two feet apart each way. The alfalfa made a good growth this season and nearly every one blossomed and set seed. Remarkable differences were observed as to character and amount of foliage and number of seed pods borne by different plants. These points of difference were tabulated and these mother plants made units of seed selection. Those having the most desirable foliage, bearing the largest amount of vital seed, will be propagated, with the idea of developing and fixing that particular strain. It is my plan to continue this alfalfa nursery just started at Rockyford and to start one on the College grounds this coming season with the view of studying plant differences, cultural methods and seed production.

Test of Variety Types of Grain and Forage Plants. To determine the varieties of grain best adapted for our conditions, we decided to grow, in tenth acre plots, the very best types of wheat, oats and barley which we could procure. These were seeded under as nearly uniform conditions as possible on the field south of Agricultural Hall. The barleys selected were:

1. Hanna—The best two-rowed barley of Germany.
2. Hanchion—A desirable two-rowed barley of Sweden.

3. Princess—A superior two-rowed barley carefully bred in Sweden and imported by Prof. D. G. Fairchild, Agricultural Explorer of the U. S. Department of Agriculture.
4. U. S. No. 7584—This is a barley imported from Africa and claimed to have been grown on alkali lands near the Sahara Desert.
5. Ideal Hullless—A beardless six-rowed barley developed by Mr. Danielson.
6. Minnesota No. 105—A vigorous high yielding barley developed at the Minnesota Experiment Station.
7. Oderbrucher—A barley (six-rowed) obtained from Wisconsin. This barley has been developed for its high protein content, often running as high as 15 per cent. protein where average barley runs 9 to 11 per cent.
8. U. S. No. 12023—A barley obtained from the Department of Agriculture as a vigorous two-rowed barley.
9. U. S. No. 12709—A barley obtained from the Department of Agriculture as a very sturdy type of bald barley.

These plats were all seeded the same day—March 28th. The ground upon which these varieties of barley were seeded had been in alfalfa for several years and gave a remarkably good growth of straw. A heavy wind and rain storm July 8th caused all the varieties but Minn. No. 105 and Oderbrucher to lodge badly, only about ten per cent. of these two plats went down. U. S. No. 12023 barley lodged very badly, nearly 90 per cent. of it being blown down. The harvest yields were as follows:

Name.	Bushels.	Lbs. Per Bu.
1. Hanna	35.4	52.2
2. Hanchion	59.6	51.0
3. Princess	41.6	48.0
4. U. S. 7584	42.4	48.6
5. Ideal Hullless	36.0	63.0
6. Minn. 105	45.2	49.7
7. Oderbrucher	28.6	51.0
8. U. S. 12023	53.4	51.0
9. U. S. 12709	42.7	62.5

(Hullless).

It will be observed that the Hanchion and U. S. No. 12023—two rowed barleys—gave an increased yield over the other seven types in the test. The two bald barleys—Ideal Hullness and U. S. No. 12709—show a lessened yield, but we must remember that these thresh out like wheat without the hull and, like wheat, are measured on the basis of 60 pounds to the bushel while the other types of barley, with the hull, are measured on the basis of 48 pounds to the bushel.

This experiment was conducted on alfalfa sod encouraging a rank growth of straw and a tendency to lodge.

The quality of the U. S. 12023 was exceptionally fine and its sturdy growth shows it to be a desirable type of barley. Just before the plots began to ripen the field gave the finest showing of barley that I ever saw. I shall test these types side by side another year in our experimental fields, under uniform conditions.

The varieties of wheat seeded were as follows:

1. Colorado No. 45.—A type of wheat developed by Mr. Danielson for Colorado conditions.
2. Colorado No. 50—A type of wheat developed by Mr. Danielson for the higher altitudes.
3. Arcada Wheat—A soft white wheat being grown in San Miguel County for milling purposes.
4. Kansas No. 201 Wheat—A Durum wheat being grown at Hays, Kansas.
5. Kansas No. 203 Wheat—A Durum wheat being grown at Hays, Kansas.
6. Kansas No. 206 Wheat—A Durum wheat being grown at Hays, Kansas.
7. Egyptian or Seven Headed Wheat—A wheat believed in many parts of the State to be a superior wheat of high yielding power.
8. Minnesota No. 169—A hard spring wheat which has proven to be a superior wheat in the Northwest; this was developed at the Minnesota Experiment Station.
9. Minnesota No. 292—A hard spring wheat developed at the Minnesota Experiment Station which has shown good qualities previous seasons in Colorado.
10. Minnesota No. 181—A hard spring wheat developed at the Minnesota Experiment Station which has shown good qualities previous seasons at this Station.
11. Blue Stem Wheat—A wheat which has proven of worth in eastern Oregon.
12. Polish Wheat—One that at other stations has shown great vigor but low yielding power; not a milling type and grown this season for a comparative study with other wheats.
13. Sonora—One of the wheats which has been grown for many years in Colorado.
14. Kubanka Durum Wheat—A type which other stations have found superior in point of yield and milling quality to all other types of Durum.
15. Black Don Durum Wheat—A type now being grown in some non-irrigated sections of our State.
16. Defiance—One of the very best types of Colorado spring wheat.

In connection with these plats we arranged a series of plats testing effect of different periods for seeding spring wheat, a tenth acre plot of Kubanka Durum and a tenth acre plot of Defiance were seeded on the last Saturday of January, February, March, April, May and June. All the varieties of wheat made a good growth, the season being a very favorable one and the ground alfalfa sod, fall plowed.

Storms caused much of the grain to lodge, the Sonora wheat lodging quite badly. It was also seriously attacked by rust. Rains were so seasonable that none of the wheat was irrigated until June 26th. Only one irrigation was given the wheat. The wheat varieties were seeded March 29-31. The first varieties to ripen were Colorado No. 45 and Colorado No. 50. The latter was in medium dough July 26th and fully ripe August 4th. Colorado No. 45 was a few days later. Minnesota No. 169 was the last to ripen, the grain being only in the milk when above named varieties were in the dough state. It was not ripe for full ten days after Colorado No. 50 was harvested. The plats testing different periods of seeding showed very little difference in growing period for the January and February seedings. The Kubanka seeding for March

ripened ten days before Defiance seeded at same time. The latter seeding of Defiance was attacked by rust and did not stool as well as the earlier seeding. The June seeding was to show the effect on stooling of grain and how it is subjected to rust and insect attacks when seeded quite late. It was a total failure as a grain crop and was cut for hay.

The Kubanka wheat seeded in April and May was not seriously injured by rust but the Defiance seeded in April and May suffered injury from rust.

The harvest report for wheat varieties is here given:

Name.	Bushels Per Acre.	Weight Per Bu.
1. Colo. No. 45	34.9	60.6
2. Colo. No. 50	29.9	61.0
3. Arcada	21.5	54.5
4. Kans. No. 201	43.0	64.2
5. Kans. No. 203	38.0	64.0
6. Kans. No. 206	31.9	64.2
7. Egyptian	27.2	60.0
8. Minn. No. 169	33.1	58.7
9. Minn. No. 292	41.9	60.0
10. Minn. No. 181	35.2	58.3
11. Blue Stem	40.1	58.2
12. Polish Wheat	41.6	60.1
13. Sonora	40.0	63.1
14. Kubanka 5639	42.8	65.9
15. Black Don	38.5	65.5
16. Defiance	28.3	54.1

The Defiance lodged very badly before it was fully ripe, which lessened its yield and reduced the quality of its grain. This was also true with Arcada and Minn. No. 169. While Sonora lodged badly, yet it did not seem to reduce the quality or quantity of its grain seriously. Rust attacked Sonora more severely than any other grain.

SEEDINGS AT DIFFERENT PERIODS.

Date.	Kubanka Durum, Yield,		Defiance, Yield.	
	bu. per acre.	lbs. per bu.	bu. per acre.	lbs. per bu.
Jan. 28.....	36.1	62.9	53.7	60.9
Feb. 25.....	28.9	62.3	48.0	60.5
Mar. 25.....	41.7	62.7	40.1	57.5
Apr. 29.....	41.6	62.6	30.9	55.2
May 27.....	21.3	59.0	9.5	47.0
June 24.....	4.95	49.0	Cut for hay	

The quality of the June seeded Defiance was so inferior that it was cut for hay. The experiment indicates that wheat seeded in May and June will ripen but give yields which are below profitable production and grain of inferior quality. The earlier seedings would seem to show the better results but further experiments are necessary to determine the best month for spring seeding of wheat. The quality of the grain from the January and February seedings

was superior to the quality of the threshed grain from the other seedings.

VARIETIES OF OATS.

1. Colorado No. 13.—This is a selection of New Market Oats grown at a high altitude last year; these oats were imported from the Dalmeny Estate, Scotland, by Mr. Eugene Grubb, three years ago.
2. Kansas No. 2—These oats were grown at Hays, Kansas, last season. This was one of the two best yielding varieties grown, commonly called the Kherson Oats.
3. Kansas No. 4.—Grown at Hays, Kansas, last season; one of two best yielding varieties, commonly called the Texas Red Rust Proof.
4. U. S. No. 12303—This is an early maturing type of oats imported from Russia by Prof. M. A. Carleton; it is commonly known as Sixty Day Oat.
5. Colorado No. 5—A type of oats developed from the Field Nursery by Mr. Danielson.
6. Colorado No. 9.—A type of oats developed from the Field Nursery by Mr. Danielson.
7. Wisconsin No. 4—The best variety out of a test of forty different types of oats tested at the Wisconsin Experiment Station. This is a special seed selection from the Swedish Select Oat imported by Prof. M. A. Carleton.
8. Early Champion—The best early oat in a four year test at the Iowa Experiment Station. Developed by Mr. Frank Fowler of Ames, Iowa.
9. North Finnish Black—A superior yielding and good quality black oat imported by Prof. Carleton.
10. White Russian—The standard white oat of Colorado.

These oats were seeded March 31st on ground adjacent to the wheat and barley plats. The growing period showed marked differences. Early Champion and U. S. No. 12303 ripened earliest and showed a finer straw than other varieties. Colorado No. 5 and Colorado No. 9 were matured within a very few days of Early Champion. All four varieties were cut July 31st. In growing habit Colorado No. 13 and Wisconsin No. 4 closely resembled each other. They showed the same sturdy straw, wide, deep green leaf and large well filled panicles. Both ripened the same time, August 7th.

The last variety to ripen was the White Russian. It was the last variety to head out and was just in the milk when the first oats were cut. The harvest yields follow:

	Name.	Bushels.	Lbs. Per Bu.
1.	Colo. No. 13.....	92.4	41.2
2.	Kans. No. 2.....	92.8	39.0
3.	Kans. No. 4.....	78.2	40.0
4.	U. S. No. 12303.....	81.8	38.0
5.	Colo. No. 5.....	81.6	47.0
6.	Colo. No. 9.....	77.0	45.8
7.	Wis. No. 4.....	84.4	40.6
8.	Early Champion.....	80.9	39.5
9.	North Finnish (Black)..	80.7	40.0
10.	White Russian.....	93.1	38.7

MILLING WHEAT INVESTIGATIONS.

While testing varieties of wheat for yield and general quality we must not lose sight of the fact that good milling wheat is desired by our millers.

To determine what types our millers prefer a circular letter was addressed to the millers of the State asking them to name the best spring wheat and best winter wheat for milling purposes, grown in Colorado. The almost universal reply was, for spring wheat, *Defiance*, and for winter wheat, *Turkey Red*. When I sought to aid farmers to obtain good seed stock of each I found it impossible to get pure *Defiance* or *Turkey Red* seed wheat. Mr. Danielson found this last spring that he had a small amount of *Defiance* wheat which he had increased from a single wheat plant in his Field Nursery. This seeded an increase plot equal to one-quarter acre in area. The wheat obtained this year will be used for a larger seed plot next year and in this way develop a sufficient quantity for distribution in the irrigated sections of the State growing a spring wheat.

By correspondence I found that Mr. S. C. Bassett, Secretary of the State Board of Agriculture of Nebraska, had a very fine strain of *Turkey Red* winter wheat. I secured 100 bushels of this wheat, sending 50 bushels to the Arkansas Valley for distribution and holding 50 bushels for distribution in northern Colorado.

I obtained 15 bushels of the best strain of *Kharkov* wheat from the Kansas substation at Hays and seeded it on sod on Mr. H. P. Miller's ranch southwest of Fort Collins. Mr. Miller purchased 25 bushels of the Bassett *Turkey Red* so we can compare the value of these desirable types of hard winter milling wheats. Since *Durum* wheat was tested on the plains of the State a few years ago, with a fair degree of success, I deemed it advisable to continue this experiment to definitely determine in what section of the non-irrigated regions it can be successfully grown one season with another. Further investigation seemed necessary to ascertain the milling quality of Colorado grown *Durum*. Millers of the State were loth to test it, believing this wheat has no merit, and farmers should be discouraged from growing it. Mr. B. F. Hottel of Fort Collins last fall decided to purchase for milling purposes 1,500 bushels of *Durum* wheat. He ground this and permitted Mr. Danielson and myself to direct experiments with this flour. It was tested in pastry, biscuits and raised bread by many of the College people and citizens of the town. More than forty experienced bread makers of Fort Collins testified that bread made of this *Durum* flour had an excellent flavor, good texture and volume. In fact they agreed that *Durum* flour has good baking

qualities. This preliminary test was quite satisfactory and warranted making a State test of Durum wheat. Kubanka having been proven the best Durum wheat for milling purposes at the North and South Dakota Stations, I determined if possible to get seed Kubanka of known government importation which had been kept pure and true to type. I found 4,000 pounds out near the east line of the State, crop of 1903, which U. S. Cerealist M. A. Carleton pronounced genuine, a sample sent to him being the best he had received at Washington.

I found 10,000 pounds which could be traced back to this College and from there to Prof. Carleton's importation. This gave us 14,000 pounds of genuine Kubanka which was sent in amounts varying from 10 to 100 pounds per farmer in 30 of the 59 counties of the State.

On the 1st day of May each farmer receiving this wheat was asked to report on the nature of soil where wheat was sown, date of seeding, amount of seed per acre and character of stand.

On July 1st I asked these co-operators to report climatic and crop conditions.

On September 1st a circular was sent out calling for a report on data of maturing wheat, prevalence of rust, presence of foreign grain (oats, barley or other kind of wheat) in the plat sown to Kubanka, more or less than the usual amount of rain this past crop season, yield and sample of grain when threshed. Not all these reports have come in but when received I desire to issue a progress bulletin on the season's results.

To thoroughly answer all objections to Kubanka Durum as a milling wheat I am now conducting tests on a commercial scale. Two millers are now purchasing this wheat for milling, and I am in hopes that all millers located near the regions where this wheat is being grown will soon be willing to convert it into flour so these farmers can make this positive gain by growing their own bread, and thereby add many hundred acres to the wheat area of the State.

Another question to be settled while millers of the State decline to purchase this wheat, is a market for that not needed for seed purposes. I have corresponded with the leading grain merchants and commission men of Salt Lake City, Omaha, Kansas City, Cincinnati, Chicago and Minneapolis. I find there is a strong market for good No. 1 Durum for export. The market question is settled for this year and I am satisfied we can find a market for all the Durum we can grow even if millers of Colorado do not use it. I desire to continue the field test two more seasons, keeping in close touch with farmers growing this wheat, so I may discover the regions best adapted to Durum wheat culture. I trust in this

way we can encourage seeding those types of milling wheat which give best returns to both the farmer and the miller.

I am discouraging all attempts to grow Durum wheat on the irrigated lands, since I am convinced from personal study and observation that irrigating this wheat causes it to deteriorate.

On account of the live stock interests of Colorado, forage crops are of special importance. In the San Luis valley where field peas furnish the principal forage we continued an experiment testing various types of field peas for both forage and grain. Canada White, Canada Green, White Marrowfat, Black eyed Marrowfat, Garbanzo Peas and Golden Vine were this year tested. The experiment has been on Mr. L. B. Sylvester's farm for two years. Last year the Canada Green and Marrowfat gave the best results in yield of grain. This season's crop is not yet threshed. When results are tabulated I desire to publish same in crop report bulletin.

Proso, a drouth resistant millet, has given very good results in many localities where it has been tested west of the Missouri river. I am this year testing this millet for Colorado conditions. I find the red proso much earlier and yields more grain than the white, although the latter has a sturdier growth and yields more forage. I shall make a field test of these drouth resistant millets next year.

CO-OPERATIVE FIELD WORK IN DIFFERENT SECTIONS OF THE STATE

(a.) *North Park.* Cattle raising has been the chief occupation of the North Park citizens for many years. Prices for the last few years have cut down the profits in the business, causing many of these people to investigate the possibility of doing some crop farming in the Park. Last year oats, wheat and barley were grown in some sections of the Park with a fair degree of success.

At the request of these North Park people we carried on some preliminary experiments with ranchmen, testing oats, barley, various grain, root and forage crops which seemed adapted to high altitudes. At Walden, and on Mr. Barney Mallom's ranch, these various experiments were placed in plot form. The work with the experimental plots was done by Mr. Glynn Stannard, a post graduate student in Agriculture. The people of the Park furnished Mr. Stannard ground for the two experimental series of crops, and team and buggy to visit the various co-operators in the Park. You will remember you allowed me to use \$200 of the experiment fund to pay Mr. Stannard for time employed, with the understanding that incidental expenses would be kept to the minimum. The money apportioned was not sufficient for Mr. Stannard to carry the experiments through to completion. Mr. Will Mosman of Walden told Mr. Mallom he would report results to me, but I have

not been able as yet to get harvest data from the experiments. The last report from Mr. Stannard showed:

1st. That many experiments were seriously interfered with by rabbits and gophers. One crop farmer had 20 acres of his crop destroyed by rabbits and gophers;

2nd. That proso, a drouth resistant and early maturing millet, was too easily affected by frost. It is a failure at high altitudes;

3d. Both red and alsike clover do fairly well, but the first season are liable to be choked out by weeds;

4th. Turnips, rutabagas and sugar beets, and mangels, made a satisfactory growth;

5th. Early maturing oats and bald barley made a satisfactory growth and were headed out July 20th to 26th, being seeded from May 15th to May 31st;

6th. Field peas did well when irrigated. Seeded May 15th to 30th, were 15 inches high July 25th and just in bloom. I am satisfied when the crop can be irrigated it will be a paying one in North Park.

7th. Mr. E. C. Lee of Hebron has had good success this season with winter wheat, winter rye and emmer. He seeded winter wheat and winter oats July 18th this season.

8th. The success of Mr. Lee and the good showing made by others with winter grains led me to send enough hardy winter barley and winter wheat to seed five acres each, to Mr. Stannard. These he gave to five of his most careful co-operators and they seeded the grain early in August.

9th. These preliminary experiments should be made the basis for definite experimental work with grain, root and forage crops in North Park. The people want to grow supplemental feeds for their stock so they can send their cattle to market as long twos or short threes, instead of long threes or short fours, as they have heretofore done. With better market facilities they have encouragement to engage in mixed farming to at least a limited extent.

The State is so large, climatic and soil conditions vary so much, that we need to carry on experimental work in many sections of Colorado to determine the crops and the particular variety of these crops most profitable for each section.

I think our policy should be to do that work which will be productive of the greatest good to the greatest number of citizens. This I believe can best be accomplished by (a.) taking one section at a time and making a thorough crop inspection of that particular region.

(b.) Co-operative work with farmers testing Durum wheat in various portions of the State, which has been mentioned previously.

(c.) *Field Peas in San Luis Valley.* This has been an ex-

periment to determine the best varieties for grain and forage for the valley conditions. It has been carried on with Mr. L. B. Sylvester, as mentioned above.

(d.) Experiments with alfalfa and early maturing types of dent corn. These experiments were taken up with Mr. P. K. Blinn, Station Field Agent at Rockyford. The corn was selected by Prof. C. P. Hartley in charge of the corn breeding work of the U. S. Department of Agriculture. He selected early maturing types of corn for this experiment. The worms attacked the corn at earing time and made it practically impossible to get any yield tests from the experiment. We were not even able to obtain a satisfactory quality of seed for the succeeding year. We have several corn counties in the state and I hope we can take up some work with them as soon as our crop regional investigations shall have been completed.

The alfalfa work at Rockyford has been to study seed production and forage producing strains of alfalfa, as referred to on a previous page. Alfalfa is our most important forage plant. It has been grown for forage in various countries for centuries. I find that great differences are to be observed in different alfalfa plants. With the County High School students of Montrose, I counted fourteen different kinds of alfalfa plants in one hour's study of an alfalfa field. By the study of individual plants, I believe it possible for us to select a type of plant which shall improve the quality and increase the quantity of alfalfa forage obtained from a given area.

My primary aim is to breed up a type of alfalfa adapted to our conditions, find out and encourage successful methods of seed production and study cultural methods which shall prove beneficial to crop production. I have long desired to carry out this work. At the Iowa Station I did just enough of this work to show me great possibilities in it. I now wish to make alfalfa study an important part of our Station work.

(e.) *Crop Investigation Work.* This past year I have tried to acquaint myself with crop conditions in the various sections of the State. I have visited and studied the crops in nearly all counties of the State where crop farming is being carried on. I think this will be of considerable value as it has made me familiar with the prevailing conditions in these sections so I can intelligently cooperate with farmers and ranchmen, in crop investigation work, later on. My purpose is to encourage the improvement of quality of crops grown through careful selection and interest the boys and girls in this work through the "Colorado Seed Competition," spoken of in another portion of this report. When we get well adapted and acclimated types of crops of superior quality, we want to hold

them for the farmers of tomorrow to derive the profits on same. I trust that interesting the boys and girls of today in seed selection will enable us to do so. Our conditions are favorable for seed production for other states. It will add another source of revenue and show the possibilities in our grains, forage and roots.

SUGAR BEET INVESTIGATION WORK.

(a.) In co-operation with the U. S. Department of Agriculture, Mr. Danielson has carried on some very interesting and important investigations relative to seed production. He has just completed a three year investigation of commercial fertilizers for beets. I have asked him to report upon both of these. He has carefully compiled the data for Station use.

(b.) To determine the best types of beets for our conditions, we have begun a test of those varieties which have proven most desirable in different sections of the beet region of this country, as well as Austria, France and Germany. Since this work has but just been started, we have no data for publication.

(c.) We have planned for an experiment testing the effect of constant cropping of beets upon the soil.

(d.) We have an experiment testing different cultural methods with sugar beets. From the same seed in similar soil, seeded at the same time, one Arkansas valley farmer obtained eight tons while his neighbor just across the road obtained thirty tons per acre of beets this past season. It is our purpose to try to find the cause for these differences that we may aid the beet farmer to make this new industry still more profitable.

(e.) Testing the feasibility of using Colorado-grown seed. It is believed that our soil and sun puts sugar into the beet. The Station has used home-grown seed for two years and the indications are that a higher sugar content is made possible by using home grown seed. We wish to make a thorough demonstration of this, before publishing any data.

(f.) To learn through correspondence the methods of culture practiced by our best sugar beet growers and, through press bulletins, to give all sugar beet growers the benefit of their experience, and successful methods.

COMPILING DATA FOR STATION USE.

(a.) *Bulletin on the Thorough Tillage System.* To meet a growing demand for some facts bearing upon the principles of semi-arid farming, bulletin 103 was compiled. It was written to show that the character of the soil, amount of rainfall, careful seed selection of such crops as show drouth resistant power, of known market value, thorough and careful tillage of the ground

must be considered in farming ventures on lands where irrigation cannot be practiced. Not all unoccupied land is good farming land and this bulletin seeks to show that the total area of land which can be successfully farmed within our state "above the ditch" is yet to be determined.

It is believed that a conservative statement of the facts already found out by the experiment stations in the semi-arid regions of our Nation, together with an explanation of the principles of thorough tillage, may prevent later disaster to men of small capital who might otherwise attempt farming operations where crop production could not be made profitable.

It is to be hoped that our next legislature will be able to furnish money for the operating of State Demonstration Farms in these lands, similar to the plan now being successfully operated in Utah.

(b.) *Crop Statistics.* We need to have some system for obtaining reliable crop data in Colorado. The daily newspapers of Denver have, in compiling their crop statistics, sought assistance from me and after diligent search was forced to confess I was unable to furnish anything but an estimate. I believe that we can compile this data and, if the expense account can be met, I am willing to undertake the task of gathering this statistical crop data for State and Station use.

While the year just closing has been a busy one, I have most thoroughly enjoyed the work and trust that, through your guidance, the counsel of Dean W. L. Carlyle, and the efficient help of my assistant, we can make the work of the Agronomy Section of growing interest and value to the Agriculture of Colorado.

W. H. OLIN,
Agronomist.

Dec. 1, 1905.

REPORT OF THE CHEMIST.

To The Director:

The work of the Chemical Section has been continued on the lines given in previous reports. The results of our digestion experiments with sheep to determine the coefficients of digestion of timothy hay, upland hay, alfalfa hay, corn fodder, sorghum fodder and hay made of the salt bush (*Atriplex Argentea*) have been presented, in part, in bulletin No. 93.

There is another section of this study which I hope to present in the near future. The work on this has been completed, or will be within a short time, debarring subsidiary questions which may still arise, and may be deemed of sufficient importance to solve by further chemical study. I do not now know of any reason why I should not report the work forming the basis of this bulletin as practically completed.

This bulletin will be on the lines of study presented in bulletin 39, and will consider the coefficients of digestibility of the various extracts, alcoholic, aqueous, including both the cold and hot water, etc. I have in this study endeavored to determine the amounts of the various sugars, starches, gums, pentosans, the hemicellulosee, the portion attacked and brought into solution by the action of chlorin and sodic hydrate, and the true celluloses, together with their respective coefficients of digestibility.

The character of this work is very far from that of a popular bulletin, but is a work which I hope will contribute something material to our knowledge of the composition of fodders in general, which despite the large amount of work that has been done on this subject, and the still larger amount that has been written, is very unsatisfactory.

The work which we have done can only be presented as a further attempt to contribute a little to the subject. This little may be very small but we have done the best that we have been able to do, and while I know that there are certain weaknesses in our work which it would be easy to point out, both in regard to things which we have not done, and also in regard to the manner in which we have done others, we shall be content to present it as it is, wholly our own errors, weaknesses and merits, if there be any.

In bulletin 99 we presented our views on the means at the disposal of the Colorado ranchman with which to maintain the fertility of our soil. There may be questions to present to him con-

cerning which longer proclamations may be made, but there is none of more vital importance within the province of my department, or as I believe, of any other. I have of late noticed some very misleading statements relative to this subject, which tend to do great injury by leading ranchmen into the belief that the crops now coming to be generally grown, particularly sugar beets, do not make the heavy drain upon the soil's fertility, that they have been led to believe to be the case. Bulletin 99 is in this respect timely and fortunate. All of the data on which this bulletin is based are facts, ascertained by our study of Colorado conditions, and apply to the lands of our ranchmen.

I would again urge upon you for consideration, the question of the waters of the San Luis valley, of which we began to make a study some years ago. We did quite an amount of work on this subject, studying its broader features. The results of that work have never been presented for the reason that it is incomplete and much of the analytical work was done on samples which were entirely too small and should be done over again. We should certainly make a new study of some of the artesian wells, but more particularly of the waters of the Rio Grande. I am aware that a representative of the U. S. Geological Survey spent at least one summer in the valley making a study of its waters. I have not as yet seen the publication of his results, but I would scarcely expect our study to cover the same phases of the question that he would consider. I know that a study has been made, but I do not know its scope, though I was in correspondence with Dr. Siebertahl, the representative of the Survey.

This study would mean quite an expense to the Station, perhaps, but it is surely worth completing. I would not predict that it would lead to the recognition of new facts, but many of those already obtained relating to the changes in the waters used for irrigation would be greatly strengthened by duplication, for as yet there is no great mass of observed facts pertaining to this subject.

During the past year I have done but little or nothing, pertaining to the subject of alkali in Colorado. This has been partly due to my failure to obtain certain material, the study of which I hoped might throw important light upon the subject as it is presented in this State, partly too, because we have already made our views upon the practical points of this subject to our farmers known both by lectures and by publications on the subject; partly also, because there is a large portion of our people who have already accepted the views that we hold on this subject.

The subject is still an interesting one and really of no less importance than it has been heretofore, though the people have

come to pay less worthy attention to it and have begun to alleviate the conditions producing it by draining their lands.

The work on the methods of extracting bees wax has been for the most part repeated this summer, and is nearly completed. We found it necessary to do this in order to bring it up to date, and to establish our results. Unfortunately we have not yet found time to complete it and write up the notes. This work has been wholly in the hands of Mr. Alford, whose other duties take up the whole of his time, leaving none which he can devote to this work, which fact I regret exceedingly.

The study of the changes which barn yard manure undergoes under our conditions, the loss in nitrogen and organic matter, in short its rate of deterioration, has been continued. Very much analytical work awaits us in connection with this subject, in fact we have only made a fair beginning on this study.

There is some material on hand pertaining to the composition of our native grasses. A beginning was made on this study several years ago, and a number of them—34—were collected and analyzed, but owing to changes in our working force, this work has never been completed. This material might perhaps be collected and presented either by itself or with other material as a bulletin. This subject, it is true, has been presented in a bulletin by this Station, but when this work was begun we had it in mind to make a much more extended study than the one already published, but as it is, it might be well to do something with this material as it includes our most important pasture and hay making grasses.

In addition to the lines of work already presented, we have done a small amount of unclassified work among which is some for the Section of Agronomy on the composition of wheats and flours. I mention this because I think it may prove to be a line of investigation worthy of considerable study. Still I am aware that such studies have been made by other stations, and it is possible that we would only repeat their experiments to arrive at their conclusions, which are already supported by a sufficient mass of concordant results. I believe, however, that it would be well to pursue this line of investigation far enough, to prove that our wheats and flours are fairly represented by results already obtained, when it would be quite proper to drop the chemical side of the investigation.

The amount of miscellaneous work required by the Section during the last year has been very large. I am aware, and greatly appreciate the fact that both the Director of the Station and the President of the College, have been very considerate in this matter, still the number of requests that have come to the department

has been sufficient to have kept the whole force of the department busy for the greater part of the year had we undertaken to comply with them. While I am willing to give such information as I can on the variety of subjects presented, and while I think that there are some instances in which we can properly grant the requests for work, I believe that by far the greater number of requests are made without any appreciation of the nature of the request. In some instances persons making requests are very reasonable, in others they are not. The requests have ranged from the most trivial subjects to important topical investigations which were strictly personal matters and likely to involve us in local factional strife and lawsuits, with which it would, in my opinion, be very impolitic for us to have anything to do.

Respectfully submitted,

WM. P. HEADDEN,

Chemist.

Fort Collins, Colorado, November 15, 1905.

REPORT OF THE ENTOMOLOGIST.

To *The Director*:

Sir: I have the honor to make the following report from the Entomological Section of the Agricultural Experiment Station, for the year 1905.

Referring to the schedule adopted for the year's work I might say that I have not deviated much from the schedule there given.

The usual amount of work has been done collecting and rearing insects to determine their habits and Colorado fauna. Many notes have been recorded upon economic species and numerous illustrations have been made by Miss Palmer in ink that will be of service in later publications.

The caterpillars that did so much injury to sugar beets in Colorado last year appeared in some of the beet-growing sections early in the summer but they have not attracted attention since. It seems to be a fair inference that their parasites, which were noticed in considerable numbers in the fields early in the season, succeeded in keeping their numbers down.

Mr. Johnson has continued his studies upon the Potato Flea-beetles but they too have been much less numerous this year so that he was unable to make satisfactory tests of field spraying as a remedy. He wishes to continue the investigation another year.

Mr. Johnson has also given some attention to the Woolly Aphis during the year but wishes to continue the work another year before publishing his results. The Black Peach-aphis was very destructive again this year to the fruit of peach trees that were laid down about Canon City but I have had no opportunity to test any methods for their destruction or control.

As I was unable to secure the co-operation of the ranchmen in Routt in carrying out experiments for the control of the Western or "Mormon" Cricket, no work was taken up with this insect. Its ravages have been reported less severe than in 1904, although their area of infestation has extended.

The experiments to determine the value of spray mixtures for the destruction of the Cottony Maple Scale have been closed and resulted successfully.

That part of the work which was being carried on in the Apiary conjointly with the Department of Horticulture and Botany have been concluded, the results being negative and indicating that

the germs of pear and apple blight do not live over winter in honey in the bee-hive.

The work of collecting bees and other insects at the flowers of apple and pear trees for the purpose of learning their possible relation to the spread of blight received considerable attention during the time fruit trees were in bloom, and I wish to continue the work in 1906.

A more exhaustive and detailed report upon the injurious insects of the year can be put in shape for publication if it is thought best.

Early in the year it seemed that an unusual number of insect depredations were reported but few of the species were as numerous in later broods so that, as a whole, 1905 has not been much above the average for insect losses in Colorado. Grasshoppers have been more injurious and the Codling Moth has infested a larger percentage of apples than for two or three years previous.

The office of this section has been removed to new and better quarters and an additional room has been provided for use as an insectary.

Respectfully submitted,

C. P. GILLETTE,
Entomologist.

REPORT OF THE HORTICULTURIST AND BOTANIST

To The Director:

The experiments with commercial fertilizers with potatoes, mentioned in my last report, have been continued through the present season in co-operation with Mr. E. R. Bliss, Greeley, Colorado. These tests were in acre plots on the second crop of potatoes. The first crop followed alfalfa sod. Last year our results showed a slight increase in yield in favor of bone meal. This season nitrate of soda gave slightly the best returns. While the second crop is not so good as the first we must conclude as the result of these experiments that the lessened yield is not due to a lack of plant food. We shall consider these experiments concluded so far as they relate to this particular kind of soil and crop rotation.

VARIETY TESTS WITH POTATOES.

Our tests this year include nearly fifty foreign varieties sent to us by the Department of Agriculture. The purpose of all of our variety tests with potatoes is to find if possible some kind which will be better adapted to our conditions than any we now have. Should any of these kinds show any decided tendency to resist disease and the effects of our peculiar conditions they will form the basis for breeding a potato suited to our needs.

FORESTRY EXPERIMENTS.

Last season we purchased six thousand seedling catalpa speciosa and six thousand seedling black locust trees and planted them in nursery rows on the college grounds. These trees are to be distributed next season among twenty farmers in as many representative localities in the State. The purpose of this experiment is to demonstrate the feasibility of growing forest trees for utility purposes and to encourage such plantings. In some parts of the State posts are already very scarce and ten years from now, when these plantations are to be turned over to the farmers for their use they should be very valuable. And in the meantime we expect that these experiments will do a great deal of good by bringing the subject before the people. The whole subject of forestry is one with which this State is peculiarly and vitally interested.

APPLE ROT.

In my last report mention was made of a new apple rot

caused by an undescribed species of *Altenaria*. Our studies with this disease have now progressed far enough to warrant the publication of a bulletin on the subject, the manuscript for which is now nearly completed. The same fungus was found this season rotting pears and also attacking pear leaves.

PRUNING.

The manuscript for a bulletin on pruning is about ready for publication.

PLANT DISEASES OF THE YEAR.

Root-rot of apple and pear. This disease occurs in all of the orchard sections and appears to be slowly on the increase. Beyond the fact that the trees die but little is known of the disease.

GRAPE MILDEW.

This disease was found quite abundant on varieties of the vinifera grape in two different localities the past season. It is due to the attacks of a parasitic fungus commonly known as the Powdery mildew of the grape *Uncinula Spiralis*. The fungus attacks all young growing parts of the plant and when severe causes the affected parts to shrivel and die. Its presence is first indicated by a whitish moldy growth on the surface of the affected parts soon followed by a powdery appearance due to the immense number of spores which are formed. Brownish discolorations of the tissues affected then appear while more or less stunting and distortion of parts follow. While the disease is often quite abundant in some vineyards it does not appear to be doing serious damage as yet.

MILDEW OF THE PEACH.

A great deal of this disease was found in one peach orchard early in September of this year. It is due to a fungus parasite, *Sphaerthecca pannosa*, which forms a white felt-like growth on the surface of young leaves. In many cases too it had spread on to the twigs of recent growth and was also found to some extent on the fruit. In the latter case it is capable of doing some damage as the flesh of the affected spots becomes hardened and accompanied by an abnormal outgrowth of fuzz.

YELLOWS OF RED RASPBERRY.

Attention was called to the yellows of the Marlboro red raspberry in one locality where it was stated to be quite general. The same trouble was also observed in another region, where the plantation was situated on low ground in which the water level was not far from the surface. This is evidently the same disease that

is killing out the Marlboro variety in New York and briefly described by Stewart in Geneva Experiment Station Bulletin. The underground portions of affected plants are found to be discolored as well as a portion of the canes above the surface of the soil, and at the point where the brown and green portions join a slight constriction occurs. The tissues of the inner bark were found to be invaded by the hyphae of a fungus, which it is now believed will prove to be the cause of this trouble.

ASPARAGUS RUST.

This disease is surely gaining a foothold in this State and threatens serious reduction to an otherwise paying truck crop. It was reported this year from two localities at two different plantations. In one of these Resin Bordeaux mixture was tried but under conditions which did not favor very definite results. Sulphur was also used on a small portion of the same plantation but without any effect in checking the disease. The disease is a true rust like those of the cereals and possesses the three forms of the fungus. Further efforts in checking the ravages of this parasite will be made next season.

TOMATO BLIGHT, BACTERIAL.

A blight of the tomato of bacterial origin was noted in a number of localities during the past season. The plants first show signs of attack by wilting. This is due to the fact that the roots are so affected by the parasitic organism as to fail in supplying water to the rest of the plant. Fields when once infected are liable to give rise to the same trouble year after year, which fact indicates the necessity for crop rotation. The disease is often held over, too, in the soil of the seed bed unless care is taken in renewing it after the trouble appears.

BLIGHT OF EGG PLANT.

A blight of egg plant also of bacterial origin was reported during the season from one locality where a large area blighted last year. It is capable of doing much damage and attempts to prevent its occurrence should be the same as those of the bacterial blight of the tomato.

STRAWBERRY LEAF BLIGHT.

This is a fungous disease which produces a spotting of the foliage of the plants after which they die prematurely. It was reported from two localities and seems to be most serious on low poorly drained soils.

RHIZOCTONIA OF SUGAR BEET.

During the past season the rotting of sugar beets due to this fungus has been noted in a number of localities. In some cases it affects the lower end of the root, in others the crown is found so badly diseased that the leaves are nearly all eaten off at the base. The root itself is usually blackened wherever affected and eventually decays. The disease manifests its presence first by the wilting and dying of the leaves, although this may take place quite slowly. In fields where the disease occurred the year before it is found to be worse the next, although cases were noted in which the trouble appeared in fields planted for the first time to beets. The parasite is a soil fungus and is apt to be most destructive under conditions unfavorable to the best growth of the plants.

Respectfully submitted,
W. PADDOCK.

REPORT OF THE IRRIGATION ENGINEER.

To The Director :

During the year 1905, the work of the section of Irrigation Engineering and Meteorology has been along the lines hitherto taken up. During the spring and much of the summer, the head of the section was absent for most of the time in connection with the work in protecting the agricultural interests of the State against an attack made on it by our neighboring state and this call was largely based upon previous investigations of the Experiment Station.

During this time, the work, as outlined, was carried on by Mr. Trimble. The line consisted principally of observations and records, in extension of previous work and which now practically completes some of the work that has been in progress for a series of years, and has required the accumulation of records of a number of years in order to be valuable. A great part of the work of reduction and of digestion of records is still to be done. This series of records have largely been a development of the plan of work outlined in 1890-91, and published in the report in the outlines of those years.

In brief, there were two general lines of work outlined; one, the investigation of the amount and application of water, including the determination of the amount applied, the amount absorbed in the soil and the amount of run-off. The second general line was an irrigation survey of the State. The latter was planned to be extensive in character; to take up the valleys of the State one by one with a study of the special problems and special investigation as might be called forth by conditions as they developed. The seepage investigations, which have proved to be much more extensive than anticipated, the studies in evaporation, the studies in duty of water, were all parts of this general line.

For a number of years we had available but a small sum of money, usually less than two hundred dollars, so that the hopelessness of the completion of the general line was evident, and when that appeared, the general plan was not published from year to year, although it still formed the basis of our work. With the money available it was necessary to take up such special problems as did not require the expenditure of money. While these subjects were not such as would have been chosen with free choice, they were of such type as it was necessary to choose and the re-

sults showed that they were of great importance. The problems that could be chosen, if free choice were available, might include such as were of immediate value to the individual farmer, or those, which while not of immediate value, yet ordinary foresight would indicate were of great importance to the State. The former, as a class, required apparatus, an expenditure beyond our reach. The latter, by the co-operation of various canal companies, and utilization of means furnished by other people, required the least expenditure of money, and with those which were selected those studies have led to the publication of a number of bulletins which have received considerable attention and have resulted in additional studies wherein the field work is essentially complete. These include seepage, additional seepage measurement now available, records of a number of thousands of miles of measurement, additional investigation of forestry and its relation to snow, given in extension in Bulletin 55. Studies for the irrigation survey of the San Luis Valley, Poudre Valley and Arkansas Valley are of such a degree of advancement that their completion is evident in the near future. Some of these investigations developed of such importance in their application to the broader questions of the State and protection of the whole irrigated agriculture of the State that it seemed best, when the interests of the State were considered, that there should not be premature publication and hence these have been held back so far as they relate to the Arkansas and San Luis Valleys, in both of which there have been, or are, serious attacks upon irrigation and consequently, upon the agriculture of the region. It seemed far better to withhold the results until they could be supported by a mass of data than to make premature publication. These investigations, made with the help and cordial co-operation of the Board have been the basis of the defense by the State in the attack by Kansas, and were also the means of preventing a serious direct decision against Colorado in the Elephant-Butte case. The reasons, which actuated the retention in the former valley are no longer operative, and these results will probably be issued in the near future.

During the past two years the work as State Engineer came very largely as a development of the work of the Station and while causing interference with many phases of the work has not been without its advantages, in the fact that some lines could be developed and made helpful to the investigations of the Station. This was especially so in the studies of forestry in relation to snow-fall and as important factors in the preservation of the water supply for the agriculture of the State, besides many important irrigation inquiries. Previous investigations which resulted in bulletin 55 had shown the desirability of much further winter in-

vestigation at high altitudes. The expense was, however, beyond the reach of the Station, or seemed to be. Through some available funds of the State Engineer's office, and the necessity for similar investigation in connection with the Kansas case, it was made possible, with a small expenditure from the Station, to develop a large amount of unique data along this line.

Mr. Mills made a circuit throughout the mountains of the State at high altitudes, at great personal risk, and for a sum exceedingly small, when the risks are considered, and obtained a mass of data and a set of photographs that is remarkable in its character and excellence. This is supplemented by similar photographs taken through the aid of Mr. Decker at the head waters of the Laramie, of the Poudre, and of the Grand. This requires working up, and a portion is issued by the State Engineer in so far as valuable for the work at that office. When the trip was made, by the addition of the expense of photographs, etc., a large part of the work is available for a more complete investigation and will supplement bulletin 55, and has formed the basis of a conviction regarding the usefulness of forests to the agricultures of the State.

With a further development of conditions and additional aid that was provided this fall, I hope that we may take up the further investigations along the line as planned in 1891, and develop the series of studies and bulletins along the line of the irrigation survey of the State and the further study of the relation of plant life to water. This latter requires instruments in order that the investigations will be of real advancement. It is very easy to imagine tests of importance which, while they may be interesting and curious, are of really no advance in addition to the knowledge that we have. It is largely the waste of money to do what has hitherto been done. But there is, however, an opportunity to real advancement along these lines and it is hoped that we shall be able to take this up.

The studies in Meteorology have followed the same lines that have been carried on for a series of years. The general purpose of these records, in addition to giving ordinary meteorological records, has been to put upon record and give data to make a study of that date important to plant life, and which might be termed agricultural meteorology. This includes, especially, those elements relating to moisture, further study of rainfall, of evaporation, of the amount of moisture in the air. We now have one of the longest series of records, so that the United States Weather Bureau has made special request that I prepare a report and summary of the records of evaporation, of which there are none to compare with ours in length and uniformity of character. We also have a unique series of records of solar radiation for the

intensity of energy and heat which comes from the sun, and which is the final cause of the growth of plants. These elements, which we have especially studied are not taken to any extent by the Weather Bureau, whose function is principally to forecast the weather, and not to study the climate or agricultural meteorology. The series of records now includes some eighteen years continuous record. There is much labor and a constant surveillance of the records, but the greater part of the work comes in the collation and study of the records after they are taken. Clearness in presentation is only the result of the labor of many unsuccessful trials.

Respectfully submitted,

L. G. CARPENTER.

REPORT OF THE VETERINARIAN.

To The Director:

My work in connection with the Experiment Station dates from June 1, 1904, and has been directed largely along the line of investigation of poisonous plants, on the range, and their effect upon live stock, with special reference to loco and larkspur.

Early in the spring an agreement was entered into between the Director and the U. S. Department of Agriculture, whereby we were to share the expense, as well as any credit that might result in a co-operative investigation of these weeds, and their effect upon live stock. This work, on the loco investigation, has been under the more immediate direction of Dr. C. D. Marsh of the Department of Agriculture. I have in accordance with our agreement aided him in every way possible, by counsel and by directing the post mortems.

Together we have visited various sections of the State studying loco weeds and the conditions relative to their supposed injurious effects upon live stock.

The work with larkspur has been under our charge, and directed by me. The Department at Washington has assisted in identification of plants, determining their toxicity, and etc.

LOCO.

Satisfactory arrangements were made in April for two pastures, one-half mile south of Hugo, in which to carry on the work during the season. We were especially fortunate in securing these pastures in such close proximity to the railroad and a good town, and further in this respect, the one being by a few hours work, made entirely free from loco weeds and furnishing most excellent pasture on the creek bottom. The other, adjoining is was as badly infested with white loco as any we had seen, and purple loco was in abundance. On the ranch was a cottage which conveniently furnished Dr. Marsh with living rooms and laboratory. On May 5th, the last of the live stock was shipped to Hugo. Six yearling and six 2-year-old steers were purchased at the Stock Yards in Denver, they having come from the vicinity of Greeley and raised on farms free from loco weeds.

Seven horses were also purchased at the Stock Yards and came from a non-locoed section in Utah. Eight horses were secured at Fort Collins, seven coming from a pasture four miles

west of town and one from a pasture south of town. These animals were all with the exception of the one from south of Fort Collins, in very poor condition. This was deemed no objection as we wished to conform as nearly as possible to actual range conditions in every particular.

The horses and cattle, upon arrival at Hugo, were divided as nearly equally as possible into two lots. Six steers, (three yearlings, and three 2-year-olds) with seven horses (one having died) were placed in the locoed pasture, and the remainder in the non-locoed pasture to serve as a check.

The animals that were placed in the pasture free from loco weeds have continued to thrive throughout the season, and are in good condition now. Disease and misfortune have been the lot of the others until now they are all gone.

This, it seems is the experience of ranchers who try raising cattle, horses, or sheep and use ranges infested with the loco weed. They do not all become locoed, but succumb to different maladies, which animals in a thriving condition would otherwise easily escape.

METHODS ADOPTED WITH ANIMALS ON LOCOED PASTURES.

The season of 1905 has been disadvantageous because of the unusual precipitation early in the spring, and the frequent showers throughout the summer months.

The stock were placed on the pastures late in April and the last of them on May 5th. The grass was already well started and for three weeks they were watched carefully, and were seen to persistently avoid the loco weeds.

At this time, one horse and one steer were placed in the corral and fed exclusively on white loco, (rattle weed, *Astragalus mollissimus*). They partook of it reluctantly at first, but within two days were eating it freely. At the end of one week, it was noticed that they were becoming very weak and for fear that they would get down in their enfeebled condition, they were turned back on the pasture. They returned to grass, and were seldom seen to touch either the white or purple loco.

This experiment was repeated several times, with the same animals and then with others but always with the same results—they would not acquire the habit of eating loco weeds, but at all times preferred the grass which by this time was luxuriant.

This one thing became very noticeable, however, that on an enforced loco weed diet they immediately began to show unmistakable symptoms of starvation and became very weak. All the animals in this pasture, because of being taken up at intervals and placed on exclusive diet of the weeds and possibly from a partial ration of the plants in the pasture, were not thriving as were the stock in the non-infested pasture.

By the 23d day of July, the grass became very short, while the loco weeds from not having been molested, were green and very tempting. At this time, one 2-year-old steer was seen to be eating largely of white loco. One week from this time he had developed typical loco symptoms, according to experienced stockmen.

A careful post mortem was held. From this time on, one steer after another was seen to be eating largely of the white loco, and the symptoms would as surely develop a little later.

WHITE LOCO PREFERRED.

At this point it may be well to note the fact that when both purple and white loco were placed before either horses or cattle, they would invariably eat of the latter.

The white variety largely predominated but certain places in the pasture the other was in abundance, but our observation so far point to the probability that the white is much preferred by them.

The claim is made by many of the most reliable stockmen, that while the white variety is more generally eaten, the purple is much more to be feared.

CATTLE FURNISHED BEST SUBJECTS.

While the horses remained poor and weak, they did not develop typical cases of locoism and invariably the most satisfactory results were secured in cattle.

Two horses died in August of acute glanders. Two became so weak from eating the weed that they got down and died without developing characteristic symptoms.

The two dying of glanders, did not interfere greatly with our plans as there was but one left in this pasture, the others not having been exposed.

The steers having succumbed one by one, in the infested pasture and it not being deemed advisable to purchase more so late in the season, two steers were taken from the control pasture, and placed on the loco diet early in September, and in three weeks were seen to be eating of the weed and losing in condition. At this date they are showing unmistakable symptoms of locoism and, while they may not now succumb from the disease, they will never survive the winter under range conditions.

POST MORTEMS.

Not only were the experiment animals carefully dissected, but we visited various places in the eastern portion of the State wherever diseased animals could be found and held careful autopsies.

The brain, nerve roots, and spinal cord were carefully preserved for future histological study, extracts were made and forwarded to Washington. Also large quantities of the plants and different media cultures from the body cavities.

The results of the autopsies will be given only in a general way for the reason that the uniformity of results do not warrant a detailed account of each particular case. They are interesting only because of the uniform negative results obtained.

The macroscopic examination of both the living animal and the internal organs in our numerous autopsies have aided us only in eliminating quite a number of foolish theories loudly proclaimed by over confident theorists.

As the investigation is not completed, I do not feel warranted in drawing any conclusions, or expressing my opinion regarding the probable outcome of any phase of the loco problem.

The work has progressed much more satisfactorily than we had hoped for. It has unfolded new facts and conditions at every step which have been wrought with great interest and we feel encouraged that in the end at least, some of the hidden mysteries surrounding this perplexing problem may be unraveled.

The results of the investigations so far have attracted our attention to the following:

1. Locoism is a specific condition and is associated with at least one species of plant, *Astragalus mollissimus*.
2. Horses and cattle prefer grass and eat but sparingly of the weed as long as grass can be had in quantity to satisfy hunger.
3. The white loco plant has an extremely low nutritive value.
4. There are no uniform pathogenic lesions, post mortem or anti mortem.
5. Parasites are found in no greater quantity than in other emaciated animals. No unusual parasite has been found and no one parasite is uniformly present.
6. The theories as to clot of blood or serum in the fourth ventricle of the brain; sand in the stomach; an excess of arachnoid fluid, have no foundation, in fact, according to the results of autopsies held up to date.
7. I believe a qualitative chemical analysis of the plant and of the contents of the stomach containing loco weeds is of the greatest importance.
8. There is no evidence as yet that stock will eat of loco weeds when grass is plentiful.
9. Several parasites live upon the loco weeds and in some places have devastated large areas of the plant.
10. Considering the immense loss to the live stock industry from the ravages of these plants the economic possibility of ex-

terminating them by the grubbing hoe is worthy of serious consideration.

LARKSPUR.

There can be no question but that several species of larkspur growing native in the mountainous districts of Colorado are a greater source of loss to the stockmen than all other weeds combined, loco weeds alone excepted.

It has been estimated by Dr. E. V. Wilcox of Montana that the loss from poisonous plants in that State is greater than from all other causes and diseases taken together and not far from \$100,000 annually.

In Colorado we have at present no statistics whereby we can estimate with any degree of accuracy the aggregate mortality. Judging, however, from the loss reported in other states and reports received at this office from most every section of this State, I feel confident that \$40,000 from larkspur alone is a conservative estimate.

There are four species of larkspur found growing abundantly in the middle and western part of the State and one found growing sparingly in the eastern section.

Other species have been found in isolated places but have not been especially accused of doing any harm and their toxicity has not been proven. Named in the order of their abundance and the damage which they are reported to have occasioned, they are:

Delphinium bicolor.

Delphinium glaucum.

Delphinium scopulrium.

Delphinium azureum.

Delphinium penardi.

In June a circular letter was addressed to several thousand stockmen in this State and a fairly liberal response was received. Of those who replied, 93 per cent. had experienced loss from various poison weeds, ranging from one to sixty per cent. in different years. A very small proportion of those who had been losing heavily for years were satisfied with regard to the identity of the plants responsible. All kinds of harmless plants were sent to me, presuming them to be larkspur, or other deadly weeds.

Larkspur is confused with aconite; camas with wild onion; hemlock with wild parsnip, and perfectly harmless plants with those which are known to be toxic or at least suspicious. All agreed that larkspur was more dangerous in the early spring, and especially during or after a storm.

Twenty-five per cent. were sure that they died from bloat the same as from alfalfa. The remedies tried were as varied as they

were amusing. Tapping through the side and allowing the gas to escape from the rumen, was generally practised and bleeding in the tail or in the ear was recommended by seventy per cent. of the replies.

As soon as larkspur was four inches high, I began gathering it at intervals of two weeks and after drying for ten days, forwarded it to the Bureau of Plant Industry, Washington, for chemical analysis. The first was gathered on April 26th, and the last in full bloom on June 12th. The report sent me by Albert C. Crawford, pharmacologist, was as follows:

The method used in testing the physiological activity of plants was to weigh accurately 5 grams of the powdered plant, then extract this over night with 20 c. c. of water and 10 c. c. alcohol added mainly as a preservative. The following day the extraction with water and squeezing was continued until the fluid came colorless. The fluid was then evaporated to dryness in vacuo at about 40° C., and the residue made up to 30 c. c. with water. Any number of c. c. would do as well. The alcohol was given off in vacuo.

The First Batch Collected April 26, 1905.

1 c. c. injected into a guinea pig (subcutaneously), weight 730 grams. Caused no disturbance.

3 c. c. in guinea. No symptoms.

6 c. c. in same guinea. Killed.

6 c. c. injected into guinea pig, 285 grams. Killed in 33 minutes.

4 c. c. injected into guinea pig, 352 grams. No symptoms.

5 c. c. killed guinea pig weighing 196 grams. Died in 55 minutes.

4 c. c. injected into guinea pig, 299 grams. No symptoms.

Evidently lethal dose for this solution lay between four to five c. c.

Second Stage, Gathered May 16, 1905.

Solution corresponding to 4 c. c. of No. 1 caused no symptoms in guinea pig weighing 445 grams, while 5.3 c. c. killed one of 350 grams, but death was delayed longer than with extract of 1st stage.

Third Stage Gathered in June, 1905.

Solution corresponding to 4 c. c. caused no symptoms in guinea pig weighing 376 grams.

5.3 c. c. caused no symptoms in guinea pig weighing 500 grams.

6.6 c. c. caused no symptoms in guinea pig weighing 480 grams.

Evidently lethal dose is much higher and the plant loses much of its activity in development."

This report is very conclusive as showing that the plant contains an active poison and consequently, that animals do not die merely from bloat. It is also interesting in that the results substantiate the claims of experienced observers that the plant loses its toxic properties as it approaches the flowering period. In my laboratory at the College, I fed rabbits and sheep on both dried and green larkspur. The detailed report will appear in a bulletin now being prepared. It will show that the fresh larkspur is much more toxic than the dried.

Rabbits lived for days on a spare dish of dried purple larkspur, but succumbed readily to the fresh. The tall larkspur *Del-*

phinium glaucum, gathered on the College campus and fed green, killed a rabbit weighing two pounds and one ounce, it having eaten seven and one-half grams. The symptoms were those occasioned by an overdose of a powerful sedative.

At first there was a brief period of excitement, in which the breathing was accelerated and the eyes had a glassy appearance. This was thirty minutes after eating the last of the weed. Fifteen minutes later, it was seen to be bloated and rolled over on its side. The breathing became very slow; the heart beats scarcely perceptible, and it became unconscious. A hypodermic injection of 1-100 gr. of glonoin was given and repeated in thirty minutes. No decided improvement resulted. One hour later, the bloat had disappeared, but otherwise symptoms had not improved. No other physiological antidote was tried. It remained in a comatose condition for twenty hours and died. This and similar experiments proved conclusively that the cause of death is in the main from the presence of an active poison which depresses the function of the involuntary nervous system.

There is reason to believe, however, that in many cases, especially with cattle and sheep that the bloat becomes so severe that death results directly from this cause.

OTHER ANTIDOTES TRIED.

Without going into detail at this time, I will state that experiments with potassium iodide and aluminum sulphate as recommended by Chestnut and Wilcox in their report on poison weeds of Montana have proven all that is claimed for them, as a chemical antidote. I have recommended it to our stockmen and have received some favorable reports from them. True it is that many cases occur on the range when the rider is not in attendance but at the same time, it is also true that poisoning more generally happens when they are being driven at time of round-up, or to and from the range. Poisoning more generally happens during the early spring time and especially during a storm and by guarding them more closely during the dangerous times and being ready with this antidote carried at all times in the saddle bags, I believe the loss can be greatly reduced.

Experiments with Atropia Sulphate, as a physiological antidote, have given very surprising results. After the poison has been absorbed into the system, and it is too late for a chemical antidote, the alkaloid of belladonna, is theoretically antagonistic, and practically promises us a satisfactory remedy. The fact that most stockmen keep a hypodermic syringe for vaccinating their cattle against blackleg and anthrax and are therefore, familiar with its use, make the administering of this antidote easily understood.

Atropine tablets ready for use can be secured at most any drug store and considering the size of dose are extremely cheap. From one-half to one grain according to size of animal is dissolved in teaspoonful of water and injected subcutaneously. It is physiologically antidotal to the toxic substance in the weed and in five minutes shows its beneficial results in the improved heart action. The improvement has been so marked in two or three instances tried experimentally on sheep and rabbits that the animal has gotten onto its feet within ten minutes and tried to run away.

While the report by Dr. Crawford on the plants sent to Washington, were extremely interesting in determining the physiological activity of the plants at different stages of growth, he failed to report the nature of the poison. This he promises to undertake later upon the receipt of larger quantities of the dried plants.

The several conclusions arrived at with reference to larkspur are as follows:

1. The larkspur, at least five species, contains a specific poison and does not kill by bloat like alfalfa as many have supposed.
2. The toxic principle of larkspur has not yet been determined.
3. The plant loses its poisonous qualities as it approaches the flowering season and finally becomes harmless.
4. Two species because of their abundance, are doing most of the damage, viz.: *Delphinium glaucum* and *Delphinium bicolor*.
5. The stockmen generally have little knowledge of the identity, poisonous nature, or satisfactory remedy for larkspur.
6. Considering the enormous loss and the fact that larkspur is usually found in circumscribed areas, it would seem feasible in many localities at least, to undertake its eradication by the grubbing hoe.
7. By avoiding the areas where larkspur abound during the months of April, May and June, the loss can be reduced to the minimum.
8. In potassium permanganate and atropia sulphate, respectively, we have a chemical and physiological antidote of real practical value. These drugs can be carried by the range riders and easily and quickly given.

The results in restoring badly poisoned sheep, rabbits, and cattle, by their use experimentally has been remarkably satisfactory.

OTHER POISONOUS WEEDS.

Besides the several species of loco and larkspur other poisonous weeds have received some attention.

From our present knowledge of the subject it appears that fully ninety-five per cent. of the total annual loss can be attributed

to several species of five different genera of plants, namely, loco, larkspur, camas, lupine and hemlock. It is estimated in the state of Montana that the annual loss from all poison weeds is not far from \$100,000 and more than the loss from all other causes of death by disease and accident combined. In this State, it must be nearly, or quite as great.

The study of poison weeds presents a complex and exceedingly difficult problem.

Some plants are poisonous at certain periods of their growth and not others. Certain parts may be deadly while others are comparatively inert, and the quantity of poison may vary in the same parts of the same species under different conditions.

The majority of these plants are not of sufficient importance commercially to have ever been studied chemically and the nature of this poison remains a mystery.

Some plants are not only perfectly harmless ordinarily but furnish a most desirable food, may under climatic and other influences suddenly become deadly. For example, the common potato when exposed to the sunlight develops an active principle called solonine and Kaffir corn under conditions of drouth and a backward season develops when eaten by cattle, the deadly poison, prussic acid.

Indeed, it has been shown conclusively, that the quantity of alkaloids in the foliage of cinchona leaves varies greatly between day and night and on cloudy and sunny days.

Whether it be true or not, that animals eat certain plants instinctively when sick, certain it is that instinct teaches them to avoid many dangerous plants when left entirely to themselves and not suffering from the ravages of hunger. It is a matter of common report that animals left to themselves for months on a badly infested range escape harm but as soon as they are driven in the round-up or to market they reach for weeds right and left that they otherwise would not touch and become poisoned.

Most plants as they approach the flowering period become coarse and unpalatable, or the foliage dries up and even though they may be equally as deadly are not so freely eaten.

The aconite or monk's hood is very deadly at all periods of its growth but seldom eaten because of its peculiar bitter taste, and the tingling sensation in the tongue.

There is one species of the rubber plant, *Ocotelea richardsonii*, which has caused extensive loss among sheep in Middle Park in the month of July. This plant according to report from Washington contains no poison but forms an indigestible rubbery mass in the stomach which proves fatal by obstructing the bowels.

The lupines grow abundantly in all of the mountainous re-

gions of this State. If eaten, when wet from dew in the morning or from rain or snow, will cause bloat the same as alfalfa or clover. Lupines are cut for hay in Montana and the danger comes from cutting it for hay after it has gone to seed. The poison appears to be confined to the seed, and produces a jaundiced condition, called lupinosis.

We have several species of the carrot family, which go without distinction as, wild parsnip. Here is a good example of the need of education among farmers and stockmen. The several species have a close resemblance in their characteristic umbrella shaped tops but differ greatly in their toxic properties. The poison, hemlock, (*Conium maculatum*) supposed to have been the death potion of Socrates, contains the alkaloid conine and while not as abundant as some of the others is far more deadly. It is found growing at high altitudes and in damp places.

The water hemlock, (*Cicuta maculata*) is the one, because of its abundance and deadly nature in doing the greatest harm. It grows along ditch banks and on the borders of alkali places. The tops are poisonous early in the season and the roots are extremely poisonous at all times.

The water parsnip (*Sium cicutaefolium*) somewhat resembling the others is not poisonous. It grows abundantly on the Gunnison River, and its tributaries.

Wild parsnip (*Pastinaca sativa*) the common garden parsnip run wild, is seen growing along the river in Boulder and in many places in the State. It is generally supposed to have become poisonous in its wild state, but this is not true.

The death camas (*Zygadenus venenosus*) is a dangerous plant. It is not confined in its growth to "shallow depressions where there is slow seepage" but in this State is found growing quite luxuriantly on dry elevations. It has a bulb with a frail root stalk and hence, is not easily pulled from the ground. Because of its bulb it is often mistaken for wild onion and prairie lily (Indian sego) both harmless plants.

The camas is very deadly but dries up early in June. Some disastrous cases of poisoning have been reported from this weed in the month of May. One man sent some of the plants to me for identification, claiming that it had killed ten milch cows for him inside of one hour.

The most important of something like seventy-five different poisonous plants reported, and not yet spoken of in this report, I will merely mention a few worthy of more especial consideration, and which should be made subjects for investigation in the future.

Swamp Camas. Ergot-and-smut.

Several species of the spurge family, especially showy milkweeds.

Swamp helleboe, (skunk cabbage).

Night-shade.

Potatoes, under certain condition.

Kaffir corn and sorghum.

Prairie fennels.

Wild cherry—especially a scrubby species growing in the draws in the eastern part of State.

Henbane.

Oregon yew.

Arnica.

Anemone.

False mallow.

Sage brush.

Wild geranium.

Wild sunflower.

False esparcet.

Respectfully submitted,

GEO. H. GLOVER,

Veterinarian.

REPORT OF THE ARKANSAS VALLEY FIELD AGENT

To The Director:

I desire to submit the following report as an outline of the work of the Field Agent for the season of 1905.

The work of the Field Agent has been largely co-operative in nature with field observations and some small plat work on the Experiment Station property.

Investigations have been made on the following topics:

CANTALoupES.

1. Development by seed selection of a cantaloupe to resist the rust injuries, has been made, resulting in encouraging progress.

Seed selected from hills showing this tendency were planted on a plat subject to rust conditions, and the results revealed the value of such a line of selection. Seed from many individual melons from this plat have been saved to carry this investigation to a more complete success. Extensive field observations on this line of investigation were also made. The relative merits of the strain of seed in which this resistant tendency was discovered, and the marked results from the seed selection for this object during the past two years, seem to warrant the publication of the information thus gained. Accordingly a more extended review of this investigation has been made in bulletin 104.

2. The problem of improvement in quality by seed selection, has also been given attention, and advance in this work is shown in the results of each succeeding year.

3. Testing of hot beds for starting early cantaloupes has been under investigation for several years, in co-operation with several growers but the results do not warrant the practise to any extent of such a plan.

4. The control of the melon louse has been a field study in co-operation with growers and the Department of Entomology, during the past season. An experiment was tried on several farms, in which carbon bi-sulphide was used to destroy the lice; the infested hills were covered with a common tub, and a small piece of sponge or cotton saturated with carbon bi-sulphide, was placed on a stick under the tub, and after drawing a little earth around the outside of the tub to prevent the escape of the poisonous gas, the hill was left for a time to kill the lice. The results were only a partial success in destroying the lice, as when the gas was strong

enough to kill all the lice, it also killed the vines. And when used weak enough to prevent injury to the plant, the lice were not all destroyed, many under the leaves escaping. Varying amounts of poison, and different lengths of time were tried, but with no satisfactory results. The lice seem to harbor under hedge rows and brush over winter, so that clean field conditions and a careful attention to detect and destroy the lice on their appearance, seem to be the only means of control which have been thus far determined for our conditions in Colorado.

BEETS.

1. A similar line of investigation to develop a beet which will be resistant to disease, has been instituted, but owing to the fact that it takes two years to grow beet seed, and that some seasons the disease does not appear, the advance in this investigation is slow.

The past season a small plat of beets were grown from seed produced from a beet that, in 1903, seemed to withstand the attacks of the "Curly Top." The plat produced a very fine uniform lot of beets which have been siloed for future use as mother beets.

2. Methods and conditions for successful beet seed production have been studied in conjunction with co-operative tests of beet seed growing for Dr. C. O. Townsend of the U. S. Department of Agriculture, who is investigating the single germ seed ball, and other questions of beet culture.

A fine lot of seed was produced from a small plat, not especially planned for seed yield but to test the yielding traits of different types. The results of this and other tests of previous years, seem to indicate that a profitable beet seed crop could be grown in Colorado, if attention were paid to the selection of special seed yielding types, and the freedom of the mother beets from disease. Also that the attacks of the false chinch bug can be avoided if mother beets are set in clean soil conditions and are not surrounded by a harbor of weeds or other crops on which the insects thrive. It has been observed that mother beets which were surrounded by grain, were not injured by insects of any kind.

ALFALFA.

A line of investigation regarding the improvement of alfalfa by seed selection has been instituted. A small nursery of about a thousand individual plants were started the past season. The variation of different plants promises a good foundation to work on.

Seed was selected from a large number of individual plants for future planting to carry on the work; also a study of the methods employed and the conditions which now affect the production of alfalfa seed, was made.

There are conditions which seriously affect the production of alfalfa seed. Under direction and in co-operation with Prof. C. P. Gillette, the insects which work injury to alfalfa, as well as those which work injury to other crops have been studied.

Some interesting advance was made in a plan to control the grasshopper in the alfalfa fields by the use of a hopper dozer; a detailed report of this has already been submitted.

CORN.

About an acre of corn was planted with fourteen varieties for a comparative test. This work was carried on for Prof. C. P. Hartley of the U. S. Department of Agriculture.

The attacks of the corn worm completely destroyed the crop.

The above, with the Merelological observations which have been kept, constitutes an outline of the work of the past season.

Respectfully submitted,

PHILO K. BLINN.