

THE STATE AGRICULTURAL COLLEGE  
OF COLORADO

---

THE SEVENTEENTH ANNUAL REPORT

OF

The Agricultural Experiment  
Station

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For 1903-4

## LETTER OF TRANSMITTAL.

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To His Excellency,

JAMES H. PEABODY,

Governor of Colorado:

In accordance with the requirements of the act of Congress providing for Agricultural Experiment Stations, I have the honor to present herewith my report for the fiscal year ending June 30, 1904, it being the seventeenth annual report, together with accompanying documents which give an indication of the activities of the Station.

The publication of the experiments is in separate form, as bulletins, and widely distributed to the agricultural population of the State.

Respectfully submitted,

L. G. CARPENTER,

Director.

The Agricultural Experiment Station,

State Agricultural College,

Fort Collins, Colorado,

December, 1904.

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
MRS. ELIZA F. ROUTT, Denver.....	1907
HON. JAMES L. CHATFIELD, Gypsum.....	1909
HON. B. U. DYE, Rocky Ford.....	1909
HON. B. F. ROCKAFELLOW, Canon City.....	1911
HON. EUGENE H. GRUBB, Carbondale.....	1911
GOVERNOR JAMES H. PEABODY,	
PRESIDENT BARTON O. AYLESWORTH, } <i>ex-officio.</i>	

EXECUTIVE COMMITTEE IN CHARGE.

P. F. SHARP, CHAIRMAN. B. F. ROCKAFELLOW.  
JESSE HARRIS.

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
W. PADDOCK, M. S.....	Horticulturist
W. L. CARLYLE, B. S.....	Agriculturist
GEO. N. GLOVER, M. S.*.....	Veterinarian
R. E. TRIMBLE, B. S.....	Assistant Irrigation Engineer
A. H. DANIELSON, B. S.....	Assistant Agriculturist
F. M. ROLFS, B. S.....	Assistant Horticulturist
F. C. ALFORD, B. S.....	Assistant Chemist
EARL DOUGLASS, B. S.....	Assistant Chemist
S. ARTHUR JOHNSON, M. S.....	Assistant Entomologist
P. K. BLINN, B. S....	Field Agent, Arkansas Valley, Rocky Ford
J. E. PAYNE, M. S.**.....	Plains Field Agent, Fort Collins

\*From June, 1904.

\*\*Resigned April 1, 1904.

OFFICERS.

PRESIDENT, BARTON O. AYLESWORTH, A. M., LL.D.  
L. G. CARPENTER, M. S..... DIRECTOR  
A. M. HAWLEY..... SECRETARY  
MARGARET MURRAY..... STENOGRAPHER AND CLERK

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

RECEIPTS.

Dr.	U. S. Fund	Special Fund	Totals
From the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1904, as per act of Congress approved March 2, 1887.....	\$15,000.00	.....	.....
From various sources.....	.....	\$ 1,313.59	.....
Total receipts .....			<u>\$16,313.59</u>

DISBURSEMENTS

Classification	U. S. Fund	Special Fund	Totals
Salaries .....	\$12,277.45	\$ 100.00	\$12,377.45
Labor .....	164.45	.....	164.45
Publications .....	709.31	.....	709.31
Postage and stationery.....	111.61	6.15	217.76
Freight and express.....	6.94	.....	6.94
Heat, light, water and power.....	6.75	.....	6.75
Chemical supplies .....	2.50	.....	2.50
Seeds, plants and sundry supplies.....	52.65	15.79	68.44
Fertilizers .....	5.00	.....	5.00
Feeding stuffs .....	.....	38.05	38.05
Library .....	75.28	.....	75.28
Tools, implements, machinery.....	.....	.....	.....
Furniture and fixtures .....	.70	.....	.70
Scientific apparatus .....	455.01	180.00	635.01
Live stock .....	.....	.....	.....
Traveling expenses .....	1,006.35	494.20	1,500.55
Contingent expenses .....	26.00	.....	26.00
Buildings and repairs .....	.....	.....	.....
Total expended .....	<u>\$15,000.00</u>	<u>\$ 834.19</u>	<u>\$15,834.19</u>
Balance .....		479.40	479.40
			<u>\$16,313.59</u>

## REPORT OF THE DIRECTOR.

To the Executive Committee, State Board of Agriculture:

Gentlemen—I have the honor to present the following report as Director of the Experiment Station, and, omitting details, confine myself to the principal matters for your consideration or action.

Brief Summary of the History of the Station—The Experiment Station was organized in February, 1888, in accordance with the "Hatch Act" of Congress. Each state receives fifteen thousand dollars per year for an experiment station. The Legislature of Colorado provided that several branch stations should be established at different points in the State, specifying five in number. These were located at Cheyenne Wells, Monument, Rocky Ford, Monte Vista and Delta.

The one provided for near Delta was never organized. The Legislature made no provision for the support of these stations. For a number of years the maintenance required a large part of our revenue, and crippled the main station to a very great extent. Altogether, some sixty thousand dollars were expended in these branch stations. It was finally decided by the national government that this use was not authorized by the Hatch act, and that one Experiment station only was provided for. During the administration of the present Director we have withdrawn from the entanglements of these sub-stations to a great extent, and at present no money is required for their maintenance, and the work is of a great, if not greater, value than came during the great expenditure of money. This result has been a work of patience and care in order to allay local prejudice, and to withdraw without local opposition, which, even if ineffective, might still be serious to the Station.

During this time the rights in the land at Monte Vista, including instruments, have been disposed of, and the greater part of the money due has been paid.

At Rocky Ford, the lease of the two hundred acres of land has been relinquished to the State, the improvements of that portion of the farm sold. The remaining forty acres furnish a headquarters for the Field Agent, and gives an opportunity for some local experimentation, which has been without cost to the Station. There is still some money coming to the Station from the sale of these improvements.

The Monument Station has been disposed of by agreement, and the deed is in escrow in the bank at Colorado Springs, but

the questions concerning the title of the land have not been completely settled, and the sale has not been closed out.

The land at Cheyenne Wells was furnished by the railroad company for the purpose of a station for investigation on the plains. The station was originally termed "The Rain Belt Station," an unfortunate designation. The title of Superintendent was changed to Field Agent, and his work enlarged to cover the Eastern Plains, and the costly forming of portions relinquished. No money for the Station proper has been used, except that necessary to keep the buildings in repair. For the past two years the grounds and buildings have been leased to Mr. J. B. Robertson, who was the first Superintendent. Mr. Robertson lives on the place and raises such crops as he can, reporting the results to us. It is considered that the rent which is furnished him in the use of the house and barn is repaid by the work which he does. It seems that we obtain substantially the same results as when the cost amounted to some hundreds of dollars per year.

The Field Agent was set free for investigation on the Plains. The investigations resulted in a number of bulletins, four of which are just issued from the press. The work on the Plains, as was pointed out a year ago, was approaching an end, or change in plan, and would require more money than was available. Some negotiation for private means to take up the Plains problems on a larger scale were entered into, but these did not develop the last year. Mr. Payne was offered a more lucrative position and resigned last April. This leaves the Plains work not quite completed, but substantially so.

The problem of the Divide, and the raising of potatoes on the Divide, and general farming on the Divide, had been under consideration and preliminary reconnaissance and reports had been made for two successive years with a view of completing it this summer. Four bulletins, Nos. 87, 88, 89 and 90, on "Cattle Raising on the Plains," "Dairying on the Plains," "Wheat Raising on the Plains," and "Unirrigated Alfalfa on Upland," have been issued, and to a large extent round out this work. Until these bulletins were distributed, I have not thought the time propitious to discuss with those supporting the Station, the abandonment. The Plains Station has, perhaps, reached its limit of usefulness as a field for experimentation. As the greatest usefulness of the Station has been in the investigations, it is possible that we can withdraw from Cheyenne Wells entirely. In such case several questions arise. The title to the land seems to be in the railroad company. We own the buildings and improvements. If the land be transferred we ought to obtain something for our improvements. It is not at all likely that a sum anywhere near the cost of the buildings can be realized. We should have to reach a friendly arrangement with the company.

The results of the work of the Field Agent for the past few years have been very satisfactory, and while the former work upon the sub-station was costly and apparently without result, yet we should not forget, after all, that without this previous work much of the subsequent results could not have been obtained. In all scientific investigation a large part of the effort is what may be termed dead work, without immediate result, and does not show in the final conclusions, yet is unavoidable, and just as necessary as the final productive work.

The Office of Experiment Stations at Washington suggested that it would have been a good time to have withdrawn from this Station when Mr. Payne resigned. As there were some bulletins relating to the work on the Plains then in contemplation, and soon to be issued, I thought it would be better to let the discussion of this matter wait.

At Rocky Ford Mr. Blinn has continued as Field Agent, and a most excellent one he has been. The work has been on the problems of the Arkansas valley, and is still essentially on the lines laid out some years ago, that is, on the problems relating to sugar beets and to cantaloupes. It was desired to give more attention to co-operative work with the people of the valley. As Mr. Blinn has been doing well with the investigations which were being conducted more closely under his own supervision, I have not pushed the matter.

#### GENERAL NEEDS OF THE EXPERIMENT STATIONS.

When the Experiment Station was organized the revenue from the government was the same as now. For a number of years its effective revenues were taken by the sub-stations without material benefit.

During the past few years it has been the aim of the director to arrange the finances so as to obtain a working capital. The station has an equipment of men and instruments. The improvement in work is partly a question of arranging conditions to obtain the best results from this equipment. One of the important things is to have a working capital to go upon. In this we have succeeded to some extent, but careful watchfulness is necessary, both on the part of the Director and the Board. The national government is frequently reminding us that the margin between our income and our fixed charges is small, ought to be larger, and that we ought not to become responsible for more departments than can be well supported. The scale on which we have been carrying the work for a number of years requires sixteen to eighteen thousand dollars per year. The excess over the amount received from Congress has been received from several sources, partly from the sale of the improvements of sub-stations. The revenues from these sources continued for several years, but will soon come to an end.

There is considerable effective help derived from the College which does not appear in our financial statements—janitor service, heat, light, work on the farm and garden and various other expenditures are made directly from the College funds, and do not show in our statements. After one or two years, we shall receive no more revenue from the sub-station improvements. We should foresee the condition which confronts us, which is that we must lessen our expenditures, and this means a decrease in the work, or the securing of additional revenue. While our needs have been growing we have had a fixed income. Every person connected with the Experiment Station sees opportunities for valuable and important work. There are frequent requests to enter upon new lines of investigation, which are all proper, many of them desirable. The trouble is that they require more funds. Knowing the needs of the work, we have not seen how we could support new lines of investigation, and therefore have seen no other way but to report against expansion when the matter has come up.

It should be remembered that the indirect expenses are often greater than the direct. The salary of an investigator is but one of the expenses involved. In order that his time may be effective, he must have room, apparatus, help, traveling expenses, stationery and postage. In addition there is the cost of printing the bulletins which may be the result of the work. Every active investigator requires an available expense revenue of one to two thousand dollars per annum as a minimum. The larger sum is nearer the correct amount, and is about the present expense per section. I therefore do not see how we can expand the lines of work for which the Station is responsible unless a revenue of approximately two thousand dollars per section is obtainable, and then the fact that greater returns are apt to come from additions to facilities of the old sections which have been crippling along. The Department of Agriculture has admonished us of the risks involved, and that it would be better to increase the facilities for work of the sections than to start new sections.

There is great opportunity for workers in this State, the field is large, it is interesting, it is varied in its problems. I have in a previous report called attention to the fact that this State is as large as New York, and all of the six New England States; that its climate varies from that of Charleston to northern Alaska. Besides the varied problems, the agricultural population lacks the acquired experience of the East, which is a guide to what may be grown. Besides there are the problems brought in irrigation which make some forms of engineering a direct and necessary part of agriculture. There are now seven Agricultural Experiment Stations in that area supported by the general government. The States support the two independent Experiment Stations, and supplement the appropriation of \$105.-

000 of the national government by State appropriations, amounting to much more.

A very important consideration for us, therefore, is the increase of revenue. The additional revenue which has helped the Experiment Station for a few years past will soon be at an end. The sources of revenue may be considered as from the Board of Agriculture, or the College, from the State Legislature and from Congress. The fundamental act establishing the Board of Agriculture recognizes investigation as within the scope of the Board of Agriculture. The Experiment Station, to a great extent, relieves the College from demand upon the College revenues for this purpose, but it is called to your attention that it is a proper line of activity of the Board, if you so consider, and that some of the revenues of the Board could be used in investigation if you think proper.

The Hatch act recognizes the Experiment Station as a part of the College, and the increasing tendency is to recognize it as the investigational side of a development of what is often termed the "University Idea," which is that of investigation. or, to use the motto of the Smithsonian Institution, it is "For the Protection and Dissemination of Knowledge."

A second possible source of revenue might be by direct legislative appropriation. This is called to your consideration, and whether effort should be made in that direction.

The third is the probable action of Congress in increasing the appropriation for Experiment Stations. It is hoped with considerable reason that the bill which has been before Congress for some time will be favorably considered this winter. If so, the effect will be to raise the income of the Experiment Station by five thousand dollars the first year, increasing that amount by annual additions of two thousand dollars until it reaches fifteen thousand dollars per year. The bill attaches some limitations.

#### RELATION OF THE STATION TO THE COLLEGE.

As above stated, the Station is defined in the Hatch act as "A Department of the College." The act does not specify what is meant by "Department." In this institution "Department" is used in a special sense, which may be, but probably is not, the same as intended in the act; at any rate, the act implies a close union between the Station and the College, and, as before suggested, its duties are primarily for investigation and the dissemination of the results of its investigations. The College has recognized at all times the close union between the purpose of the Experiment Station and the purpose of the College, and that the Experiment Station is one of the most valuable features of the College in securing a broader purpose of the institution.

There is undoubtedly an increasing tendency to recognize the work of experimentation as one of the most important which the institution can do, and to arrange conditions so as to favor experimentation. There has always been a desire in this institution to help in the same way. The College has given a good deal for experimental purposes by indirect expenditures, and at times has appropriated money to the various departments for this purpose. A logical recognition of the Experiment Station as the investigational branch of the institution has not followed. We have not obtained the credit with other states and with the government authorities which such activity would justify, from the fact that the financial records of the Experiment Station do not show the amount that has thus been expended. The appropriations of the Board in such way are proper and to be commended. It is likely that greater need will be felt in the future, and that the Board will not only continue to appropriate for this purpose, but increase the amount. The conviction in my mind has been emphasized by the discussions relating to the bills now before Congress, that it might be well to recognize the Experiment Station organization as the investigational part of the institution in such a way that all investigational work relating to agriculture should be associated with the Experiment Station under the same general regulation and requirements as the work paid for directly from the Hatch fund, and that it would be an advantage in our financial records if these appropriations were made, or shown, as an appropriation to the Experiment Station Department, just as other appropriations are made and charged to the mechanical or other departments. This also would relieve the Director, and I presume the President of the College, of certain other embarrassments, and might prevent difficulties which the situation will be apt to cause in the future, though they have not yet arisen. I refer to questions of divided authority and divided responsibility. As it is, there are several in the College whose work is principally experimental. They are not paid from the Hatch fund because of lack of funds. One is on the staff of the Experiment Station, though not paid from that fund. Several others are not on the staff, but their questions relating to experimentation are brought to the Director for consultation. The Director is under embarrassment, in such matters, and uncertain as to where his authority extends or where it is expected to extend.

The Station does not have their names on its staff, though to all intents and purposes they should be so considered, and the Station and these individuals lose the credit attached thereto. It is probable that in such cases the question of experiments would not be taken up by the President of the College, and therefore there arises a condition where the worker may not feel responsible to the Station or to the College, and where both the President and the Director feel some delicacy in making

suggestions or directions, and might easily lead to a situation where the worker could have means for experimentation without the responsibility. Fortunately such conditions have not resulted, but it is well to consider the condition.

The suggestion which I would therefore present for your consideration would be that the appropriations for experimental purposes be considered as an appropriation to the Experiment Station, and should show in its financial record as "other sources of revenue;" that the amount required for these investigations should be placed to the credit of the Station, or arranged in such a way that it would be expended in the same way as other Experiment Station funds, and should show in the account. That in the case of men like Mr. Olin, Mr. Griffith or Dr. Glover, that a certain portion of their salary be considered as paid from Experiment Station funds, and should show in the financial account of the Station. Their names could then be added to the Station staff, to the mutual credit of the worker and the Station, and their work could be carried on under definite approved plans as in the case of other members of the Station staff, and the cost to the College will be no greater than it has been, and probably less. It is certain that the institution has not received credit for its activities in this line, and it is probable that the members of the Board themselves have not realized the amount. Some such method would simplify the problem of the Station and probably that of the College, would recognize the investigational work as a proper function of the College, and would tend to organize it in such a way that would be beneficial and effective.

#### PUBLICATIONS.

The publications of the Station during the year just past include Bulletins from 84 to 92, inclusive, and there are now two in press—one by Prof. Gillette, and an important one by Dr. Headden on digestion experiments, which reports the work being carried on for a number of years. A number of other bulletins are nearly ready for publication. The standard edition is about 9,000. We hope that the present report may be published without expense to us.

#### BILLS BEFORE CONGRESS.

There are now two bills before Congress which affect the activities of the Station. The first is the Adams bill, increasing the Hatch fund. This provides that the Stations shall each receive an increase of \$5,000 per annum, and an annual increase of \$2,000 per annum thereafter, until the total of \$15,000, which would be at the end of five years. This will enable the Stations to gradually increase their work by natural growth instead of by a sudden expansion, which is apt to be wasteful. It is greatly hoped that this bill may be passed. Considerable work needs to be done before Congress and by the Stations. There is a

limitation in the bill which prohibits this fund being used for salaries.

The other bill is the bill introduced as the Mining School bill, and which largely by your support has been amended so that it is also available for agricultural and irrigation engineering and forestry. The bill is introduced now in this latter form, and has passed the committee, and is on the calendar. Half of this fund would be available for our institution. This is a case where one-half is probably better than the whole, because the half which we receive materially aids the fundamental purposes of the institution, while were the whole amount to be received it would involve a change of work and increase of obligation, which would require all of the fund for mining work. The bill provides for a separate organization analogous to the Experiment Station, with considerable elasticity in its relations to publication and investigation. The superintendence of this work would not be under the Department of Agriculture. The additions to the bill are drawn so that any state other than mining states would find useful application for the money. It was not expected that all of the topics mentioned in the bill would be taken up by any one state. This bill provides for an appropriation starting at \$10,000, and thence increasing by \$1,000 per annum until it reaches \$20,000. Under this our appropriation will start with \$5,000, increasing thereafter \$500 per annum until it reaches \$10,000. This bill is pushed by a different house committee from the one favoring Experiment Stations. There is some reason to hope that this may also pass, but, of course, there are many uncertainties involved and which can not be determined until actually passed. This bill would be an aid to the Experiment Station, because it would be an additional endowment for lines of work which have been recognized as being fundamental for agriculture in this State.

#### THE KANSAS-COLORADO CASE.

It is proper to call special attention to this case, because it is such a radical attack upon agriculture of the State. It is not, as has often been supposed, a contest for priority of use on the same stream. On the other hand, the complaint by the state of Kansas involves the denial of the right to irrigate by the people in the Arkansas valley, and if the principle were recognized there, it would involve the right to irrigate on the Platte, the Rio Grande and the Grand river, and would affect almost every stream in the State. It has properly been viewed by the Board as a fundamental question in our agriculture. The previous work of the Experiment Station has been instrumental in outlining and shaping the lines upon which Colorado has rested its case. This case is the first one in which there has been a square conflict between the eastern doctrine of riparian rights

and the doctrine of appropriation, which all peoples have recognized in arid countries.

Since the last regular meeting of the Board the Kansas-Colorado case has been in process of hearing. A commissioner was appointed by the United States Supreme Court. Sessions were held at the various towns in Kansas and Colorado for the presentation of evidence by Kansas. The defense by Colorado was begun in Denver in October, and is now continuing at various towns in the Arkansas valley. It will be several months before the testimony is concluded. As a summation of the situation so far, it may be said that Kansas attempted to show that the Arkansas had decreased or dried up since the construction of ditches in Colorado; that this decrease has affected navigation, and the crops in the bottom lands; that it has affected the underflow, and that Kansas has a claim for damages for past injuries, but also a right for the ordinary flow of the stream in the future.

The Colorado defense essentially denies this view of the law, but, granting that it is true, it denies that the river is drier than it used to be; that the construction or taking out of ditches or the diversion of water in Colorado has had any effect on the water of the Arkansas; that the evidence of a change of river presented by Kansas is a mistake, or, at any rate, that the river has been habitually dry from Lamar to Great Bend, and that ditches in Colorado have had no appreciable effect upon the river in eastern Kansas.

The government apparently takes the view—

1. That the doctrine of appropriation is a proper doctrine for this country, in that respect agreeing with Colorado; but that the doctrine should be recognized irrespective of state lines. There is some indication that the government may desire to take control of the interstate streams and distribute water therefrom, a situation which might be almost as harmful as the original contention of Kansas.

#### FLORA OF COLORADO.

The bulletin on the Flora of Colorado, which was to include the work done by the Experiment Station for a number of years, and to complete that investigation, seems to be now ready for publication. The work of the preparation of the manuscript has been done by Dr. Rydberg, of Columbia College, and the New York Botanical Gardens at Bronx Park, New York City, who is recognized as the highest authority on Rocky Mountain Flora. The arrangement practically was that we should pay for the clerical work; that we should have the advantage of his knowledge, and he the use of this collection. The work of preparation has extended over several years. The manuscript was expected to be available a year and a half ago. The special appropriation made by the Board of \$1,000 has been held available in order to cover the anticipated cost of this publication. A re-

cent letter from Dr. Rydberg says that the manuscript is now practically ready, and arrangements need to be made for its publication.

The publication of this bulletin of 400 pages involves several questions. It will be a standard work and in great demand. The cost of publication will be considerable, and a free distribution to all who want it would manifestly be beyond the means of the Experiment Station. The Station could not afford to print as many copies as would be required. The Station can not accept any money for its publications. It has therefore been a subject of serious consideration as to how to treat this proposition. A discussion with the Office of Experiment Stations has resulted in this conclusion—that a limited edition can be printed by the Experiment Station sufficient to distribute and fulfill the requirements of the law. This would be an edition not to exceed 2,000 copies; that, then, an additional edition with a change of title page could be issued in the name of the College, and these bulletins sold at some price dependent upon the cost of publication. In this way the needs of those who want the Flora, and are willing to pay for it, could be met, and the cost would be relatively moderate, and the extra edition could be made to at least partially pay for itself.

The alternative is an appropriation sufficient for this purpose, and the matter is referred to you for consideration.

The 2,000 copies of the bulletin will cost in the neighborhood of \$1,600 or \$1,800. The price for which the copies could be sold by the College would be \$1 or \$1.50.

#### BUILDINGS.

A pressing need of the Station as a whole is a building wherein its work can be carried on. The building planned for the Irrigation Engineering Department was adapted for this purpose, and had what is very much needed—two ample fire-proof vaults. The records of the Station are of very great value, and those which depend upon time could never be replaced. The loss of such data as we have obtained would represent the loss of some sixteen years of effort, and could not be replaced at any cost. It is therefore a matter of great importance to the Station that some suitable means be available for some storage and preservation of such records, and at the same time that they may be available, and if no loss takes place no damage will have resulted. If, however, fire does occur, it would be absolutely impossible to replace them. Some of this data is unpublished, inasmuch as the investigations bear upon matters which have been in dispute between Colorado and some of the adjacent states.

I attach herewith reports from the different sections of the Experiment Station, giving the reports for the current year, all

of which are commended to your attention. From the Station staff I asked for a summary rather than a detailed report—a summary of such character as to give an understanding of the scope of the work and of the character of the results obtained.

Respectfully submitted,

L. G. CARPENTER,  
Director.

## REPORT OF THE ENTOMOLOGIST.

To the Director :

I have the honor to present herewith a brief summary of the work of the Entomological Section of the Agricultural Experiment Station for the year 1904. I am also appending an invoice of the Experiment Station property held by this section, a proposed outline of work to be undertaken during the year 1905, and an estimate of the amount of money that will be required to properly carry on the work.

## INSECTS OF THE YEAR.

*The Codling Moth (Carpocapsa pomonella)*—The more active work of the section to determine the habits and remedies for this orchard have come to a close with the work of the past year. The main points in the life habits of the insect in Colorado are now well established. Those who have followed closely the advice of this Station in the treatment of their apple orchards the past year have not averaged more than five per cent. of wormy fruit, as indicated by actual counts in many orchards. Orchards adjacent to those treated, but which were neglected, have suffered a loss of from 50 per cent. to 95 per cent. of their fruit from the attacks of the worms. Arsenate of lead was used in many orchards in the State the past summer, and has met with almost universal praise. Our experiments and observations are all to the effect that the first treatment, if made thoroughly when the petals have just fallen, is of more value than all the spraying that can be done after the calyces have closed, and that more than two or three sprayings are seldom advisable. A bulletin on this insect is in preparation.

*The Beet Web-worm (Lorostege stiticalis)*—This insect did quite extensive injuries to sugar beets in Colorado the past summer and fall. It did noticeable injuries in all the beet-growing sections, except those above Loveland and Longmont. We have gathered valuable data upon the life history of this insect, and also upon remedies that may be used for its destruction. We are planning a bulletin to be sent to the beet-growers early in the spring.

*Cutworms.*—Cutworms belonging to the genus *Chorizagrotis* were very destructive to young beets and other cultivated crops in 1903 in northern Colorado, but gave no special trouble the past year. On August 19th. of this year, Mr. P. K. Blinn took the writer into an alfalfa field at Rocky Ford where the larvae (cutworms) of *Peridroma saucia* were very numerous under

cocks of alfalfa hay. The species seems to be partial to alfalfa in this State. From the worms taken at Rocky Ford moths appeared in our breeding cages September 13th and later.

*Mountain Crickets (Anabrus simplex)*—This large, black, wingless grasshopper, commonly called "Mormon Cricket," "Idaho Cricket," and "Mountain Cricket," has been on the increase for some years past in Routt county, and the past summer was a serious and formidable pest in portions of that country where cultivated crops are grown. Mr. S. A. Johnson, first assistant in this section, accompanied a camping expedition from the Experiment Station through the infested districts and accumulated much valuable information in regard to the habits of the insect this year and the history of its marching armies in past years. The writer spent several days in a badly infested section and made a study of the life habits and remedies that might be used to prevent future depredations. The outlook at present is very bad for those ranchmen who live in the immediate vicinity of any of the breeding grounds of the cricket, as eggs were deposited in perfectly enormous numbers last fall, and to the present writing are wintering well, samples of eggs having just been received from two parties, Mr. W. W. Miles, of Eddy, and Mr. J. H. Yoast, of Dunkley, and in both instances the eggs were nearly all healthy in appearance and contained little crickets ready to hatch when warm weather of spring should come.

We have a bulletin upon this insect planned for publication during the latter part of the present winter.

*Grasshoppers*—The common destructive grasshoppers, or locusts, have been less numerous than common the past year, very little complaint having been received at this office.

*The Potato Flea-beetle (Epitrix cucumeris)*—This little black flea-beetle was especially abundant in the potato fields of the Greeley district in the past summer, where they caused many thousands of dollars of loss to growers. The injuries were not so much to the tops as to the tubers themselves. The larvae (worms) were very numerous, eating holes into the potatoes during September, causing the latter to become scabby and unsalable on a slow market. Mr. S. A. Johnson prepared press bulletin 23 upon this insect, which was issued during September. He is also preparing a fuller account of the habits and remedies of this insect, along with one or two other potato pests, with a view of publishing the paper as a regular bulletin during the coming year.

*The Woolly Apple-louse (Schizoncra lanigera)*—Considerable work has been done upon this insect during the past year, and we hope to continue our work with it the coming season, as it has become one of the most dreaded apple tree pests in the State. Among other things, we are testing supposed resistant varieties of apple trees.

*The Green Apple-louse. (Aphis pomi)*—This insect is also a serious pest in many of the apple orchards on both sides of the range. Many orchardists are considering it a worse pest than the codling moth, because they have learned to control the latter insect with comparatively little trouble and expense. This louse seems to be equally bad upon pear trees. We have found nothing better than kerosene emulsion for its destruction, but tree-soaps and tobacco decoctions may also be effectually used against it.

*Lice Affecting Pine and Spruce (Chermes sp.)*—Yellow pine (*Pinus ponderosa*), Pinyon, or Nut-pine (*Pinus edulis*), and our common spruces (*Picea pungens*, and *Pseudotsuga douglasii*) all have species of lice belonging to the genus *Chermes* that attack the leaves and new growths, doing considerable injury to the trees and making them unsightly, particularly when planted in lawns. The presence of these lice is recognized by the galls, or the distorted leaves that they cause, or the white waxy secretions that hide the lice and their eggs. The habits of these lice have been studied and a paper treating of them is about ready for publication, and will be fully illustrated.

*The Black Peach-aphis. (Aphis persice-niger)*—This insect is becoming more and more troublesome each year in the peach-growing sections. I believe it is important that the Station should take up a study of the habits of this insect, along with the testing of remedies for its destruction on both the tops and roots of trees. Most complaints of injuries have come from Canon City and Delta.

*The Cottony Maple Scale (Pulvinaria innucmabilis)*—Mr. S. A. Johnson has had in charge experiments for the destruction of the cottony maple scale in one of the parks in Denver, where he has worked in conjunction with the park authorities. This scale has become a serious pest upon both soft maple and locust trees from Boulder south to Pueblo. The experiments have resulted quite successfully and will be reported upon by Mr. Johnson. This section is much indebted to Mr. Schultze, superintendent of parks, and to one of his foremen, Mr. W. B. Smith, for permission and assistance in carrying on the work.

*The Rose Scale. (Aulacaspis rosae)*—The first examples I have seen of this insect in Colorado were sent me by Mr. Scott, upon blackberry canes, from Boulder. The canes sent were badly infected.

Respectfully submitted,

C. P. GILLETTE.

Entomologist.

Fort Collins, Colorado, December 10, 1904.

## REPORT OF THE CHEMIST.

To the Director :

The work of the Chemical section since my last biennial report has touched some very important questions of our Western agriculture, and a few of interest to the State in a still more general way. The most important work completed during this period is the study of the ground waters, drain waters and return waters already published in two bulletins, Nos. 72 and 82. These will soon be followed by one on some digestive experiments made with our Colorado boys. This bulletin, however, will not complete the amount of work done on this subject, as we are extending it to include a study of their digestibility, taking the portions soluble in different menstrua, i. e., cold water, alcohol, etc., as our units. We are extending the work to an attempt to determine the digestibility of the pentosans. This work will be completed in the near future, and a bulletin containing the results obtained will be presented in the latter part of the spring or early summer of 1905.

In this connection it seems advisable to determine the calorific values of the different fodders and dungs. I have already asked for quotations on a calorimeter, and find that with clay capsules, etc., it will cost about \$130.00, but, with combustive capsules of platinum, about \$210.00. I believe that the determination of the calorific values of fodders will be more frequently made in all digestion experiments in the future than has been the case up to the present time. I would, therefore, request permission to purchase one.

Several years ago we collected and analyzed a number of artesian waters from the San Luis valley. This work has not been published, and for some reasons I do not regret it, because it seems to me to be of sufficient interest to justify us in taking it up again to study more fully the composition of these different waters. The work already done has served a good purpose already, though unpublished. The United States Geological Survey has done some work on these waters, but, to the best of my knowledge, there is neither conflict with our work nor even a repetition of it. I would respectfully suggest that it is perfectly legitimate and proper for us to obtain large samples of waters from typical wells, for it is out of the question for us to analyze all of the wells and submit them to a much more thorough examination than was possible with the small samples formerly taken.

The brown water from Mosca, for instance, proved to be very interesting, indeed. We have already done more work on

this water than on the other well waters, and almost as much as on the San Luis Lake waters, whose composition also presents some interesting questions.

While the time and labor necessary to give a reasonable degree of completeness to this work is quite considerable, I believe that it is of sufficient interest to justify us in doing so. We attempted, at the time we took samples of the well waters, to obtain samples of the Rio Grande del Norte water at different points in the course of the river to study the changes in its composition, as we have subsequently done for the Cache a la Poudre. So long as we have already obtained partial results of this river, I think that it would be proper for us to extend and complete them, at least to such an extent as to make them available as an independent study of the Rio Grande waters. The amount of work which this would require would depend upon how far down the river we took samples. My idea relative to the work on this subject is that we might extend it sufficiently to make what we have already done of some more value and complete so far as it should go, but I would scarce follow the stream further down than the mouth of the Rio Hondo, and in this case it would not be advisable or practicable to take more than one or two samples, at the most, between the State bridge and this point.

During the past years we have made a few analyses of mineral waters, some of which are of sufficient interest—perhaps I should say merit—to justify their publication. These waters are of interest to the State at large, though they may at the present time be the property of individuals. Any interest that these analyses may possess would, of course, appertain to the State of Colorado, or be of a purely scientific nature. I shall be pleased to prepare this material for publication in some future report.

The lines of work now being pursued by the Station are:

First—On the digestion experiments of some of our Colorado hays, as already stated.

Second—On the deterioration of farmyard manures under our Colorado conditions. We believe this to be an important question for this State, as the time is already here when it behooves the farmer to husband every means by which he may maintain or increase the fertility of his land.

Bulletins which can reasonably be expected from this department are one on digestion experiments, by early summer; one on methods of extracting beeswax by early fall; one on alkalis, provided we can obtain certain material which has been promised us. Samples from various parts of the State have already been analyzed and considerable material has been accumulated for this bulletin, which will be a brief one. I am very anxious to obtain the collection of material which has been

promised me. If it can be obtained it will add very much to the interest and value of the bulletin.

I have no other requests to make or recommendations to offer at this time.

Respectfully submitted,

W. P. HEADDEN.

Chemist.

Fort Collins, Colorado, December 8, 1904.

## REPORT OF THE HORTICULTURIST AND BOTANIST.

To the Director :

I have no other requests to make or recommendations to offer of Horticulture and Botany for the past year :

Our work with potato diseases has progressed satisfactorily, and we are now able to state positively that the usual failures of the potato crop, such as the production of vines with no tubers, or a cluster of little potatoes, and in many instances a poor stand of plants, are caused by the attacks of a certain plant disease. But no successful method of combating the disease has yet been devised. Our soil in Colorado seems to be so thoroughly impregnated with the fungus that the usual methods of seed treatment are usually of no avail. We are now bending our energies toward the production of a strain of potatoes that will resist the attacks of the fungus. With this end in view we have tested numerous varieties of potatoes by growing them on diseased soil; a number of seedlings have been produced which are also being tested; and the next year about fifty varieties of potatoes will be tested in co-operation with the Department of Agriculture. These varieties were obtained in Europe, and were selected because of their vigor and freedom from disease.

Most of the work of investigating the nature of this fungus has been done by Mr. Rolfs, and he has been able to establish several facts which were new to science. Notable among these is the fruiting stage of the fungus. For a long time this fungus has been regarded as sterile, or non-spore bearing. We find that it produces spores abundantly, and culture experiments have shown the connection that exists between the two stages in the life history of the plant. Bulletins Nos. 70, 91 and 92 treat of this subject.

In connection with our work with potatoes some experiments were conducted in seed treatment and seed selection, as well as with commercial fertilizers. These experiments were all on a commercial scale, and were carried on in co-operation with the Bliss Brothers, of Greeley.

The results of these experiments are given below without comment. The ground had been in potatoes the previous season thus making this the second successive crop. In all cases five rows are equivalent to one acre of ground. The results include only the salable sorted potatoes.

Table I. Results of treating seed with corrosive sublimate solution and of seed selection.

No. of rows	Treatment	No. of sacks	No. of pounds
6	Treated with corrosive sublimate.....	73½	8,820
6	Some evidence of Rhizoctonia on all seed.....	69½	8,240
2	Choice selected seed .....	24	2,880
2	Cull seed .....	22	2,640
6	Check .....	63½	7,620

The Banner variety was used in the above experiments.

Table II. Results of the application of commercial fertilizers.

No. of rows	Material applied	Yield	
		No. of sacks	No. of pounds
5	Nitrate of soda, 100 lbs.....	39	4,475
5	Bone meal, 150 pounds.....	60	6,960
5	Sulphate of potash, 75 lbs.....	40	5,680
5	Nitrate of soda, 100 lbs.; bone meal, 150 lbs.; sulphate of potash, 75 lbs.....	42	4,870
5	Nitrate of soda, 100 lbs.; bone meal, 150 lbs.....	42	4,870
5	Nitrate of soda, 100 lbs.; sulphate of potash, 75 lbs....	37	4,240
5	Bone meal, 150 lbs.; sulphate of potash, 75 lbs.....	59	6,870
5	Bone meal, 75 lbs.; sulphate of potash, 50 lbs.....	57	6,650
5	Check .....	50	5,880

Pearl seed, grown in the mountains, was used in the above experiments.

#### SHADE TREES.

Much time has been given to studying the shade trees of Denver with the idea of publishing our observations, together with photographs, in bulletin form. More attention has been given to tree planting in Denver than in any other locality in the State. As a result there are at least sixty-six kinds of trees growing within the environs of Denver that are foreign to the State. The result of the experience with some of the more promising kinds will be of great value to prospective tree planters.

#### CORN BREEDING.

At the request of Mr. F. L. Pickett, of Edgewater, we entered into a co-operative experiment with him in breeding a type of field corn that will be suited to our conditions. Mr. Pickett has been growing a variety of corn for a number of years that usually

ripens and yields fairly well. But it lacks a well-defined type, and needs improvement in many respects. A number of the best seed ears were selected and plats were planted on the College grounds and on Mr. Pickett's farm.

The seed from individual ears was planted in separate rows, as a basis for selection. A great amount of variation was seen in the different rows when the corn came to maturity. Some of the rows did not produce a single ear of merit, while on others a number were selected for future planting.

The results of this preliminary test are so promising that it seems highly probable that a corn can be developed in a few years that will ripen in this locality, and that will yield paying crops.

This experiment has now been turned over to the Professor of Agronomy, who proposes to carry it through to completion.

#### A NEW APPLE DISEASE.

An apple disease, which is probably new to science, has been observed in various parts of the State. The fungus causing the disease (a species of *Alternaria*) has been studied, and inoculation experiments have proven that it is the cause of this apple decay. While this disease has not been at all serious, it is nevertheless desirable that the nature of the fungus be understood. If at any time it should become destructive, Bordeaux mixture will undoubtedly prove an efficient remedy.

#### PEAR BLIGHT.

Some studies have been made of the relation of soil moisture to the prevalence of pear blight. It was proven by experiment, a number of years ago, that if one could control the water supply he could check the ravages of pear blight. No orchards have yet been found where experiments of this kind could be tried on a commercial scale, but studies were made in an abandoned pear orchard, and the conditions which exist there prove that pear trees can thrive on much less water than is ordinarily supposed, and indicate that much may be done in checking blight by withholding water.

We hope to publish the result of these observations in bulletin form.

It is the expectation of horticulturists, however, that blight-proof varieties of apples and pears will eventually be produced. With this end in view, we have secured a quantity of apple seed from Mr. J. S. McClelland. The seed is from the Utter Red, a fall variety that has never been known to blight in this locality. This will be planted next spring, and the resulting seedlings will be grown to bearing age in the hopes that at least one among them may prove to be a winter apple of merit and blight resistant.

## HORTICULTURAL CONDITIONS OF THE STATE.

A number of trips were taken during the season through the fruit districts of the State for the purpose of keeping in touch with the fruit growers and studying the varying conditions that exist. Much valuable information and data is secured in this way which is of inestimable value to the department, and which we also hope results in some good to the fruit growers.

Respectfully submitted,

W. PADDOCK,  
Horticulturist and Botanist.

## REPORT OF THE AGRICULTURIST.

To the Director :

Sir—I have the honor to submit herewith a brief summary of the experiment work undertaken in this department during the past year.

As you are aware, the funds available for the carrying on of experiment work in this department are very small, consequently, the work has not been as thorough nor as extensive as it might otherwise have been. On the whole, however, we have accomplished something that will be of substantial benefit to our farmers in the way of investigations along animal husbandry and agronomy lines. In an accompanying report, prepared by Mr. Danielson, my assistant in experiment work in agronomy, is given a summary of the work done along this line. The work of agronomy, we expect, will be materially broadened and extended during the coming year, particularly in co-operative work with farmers throughout the State. Professor Olin will have charge of this work in the future, and will have Mr. Danielson as his aid and assistant. Mr. Olin has very extensive plans for the immediate future, and a full report regarding it has been submitted to the Board of Agriculture with the Agricultural College report, a copy of which accompanies this. We feel very much the lack of funds for carrying on the investigation work in agriculture, which is probably the most extensive line of investigation. We trust that a special appropriation for the carrying on of the proposed co-operative experiments undertaken by Mr. Olin may be forthcoming from the Legislature the coming winter.

The following brief summary of the experiment work in animal husbandry, which has been carried on with the assistance of Professor C. J. Griffith, is presented at this time :

*Experiments in Fattening Steers Upon Beet Pulp.* During the early part of last winter a somewhat extensive feeding experiment was undertaken in conjunction with the Great Western Sugar Company and the Department of Agriculture, at Washington. Owing to the lack of funds for carrying on this work by the Experiment Station, the Great Western Sugar Company very generously provided the steers and all the equipment, including the feed and labor for carrying out of the experiment. The Department of Agriculture, through Secretary James Wilson, agreed to pay the salary of the expert to take charge of and direct the experiment and to compile the resulting data. The results of this experiment are already very well known throughout the State through the medium of a brief press bulletin. The full report of

the work is now ready for the printer, and will be published in bulletin form in the near future. I may briefly say that 150 steers were fed on the experiment, weighing approximately 900 pounds each. These were divided into three lots of fifty each. Lot No. 1 was fed beet pulp, alfalfa hay and a mixture of ground oats and ground barley, while Lot No. 2 received beet pulp, alfalfa hay and ground corn. Lot No. 3 had a ration of beet pulp and alfalfa hay, without grain feed of any kind. All of the steers in each lot had all of the pulp that they would consume at all times, without waste. The steers in Lot No. 2, fed upon a ration of beet pulp and ground corn, made the greatest gain during the experiment, and the steers fed on beet pulp and alfalfa hay made the least gain, while the lot fed on a ration of beet pulp, alfalfa hay, barley and oats, was intermediate between the others as to the amount of gain. An accurate account was kept of the different kinds of feed eaten by the steers in the different lots, and record was made of the weekly weights and gains of each lot of steers. It is interesting to note that at the close of the experiment, when everything had been charged to the steers and the total gains credited at market prices, that the lot fed pulp and alfalfa hay only, returned a profit of \$16.60 for each steer; the lot fed upon a ration of pulp, hay and corn returned a profit of \$15.45; while the lot fed a ration of pulp, barley, hay and oats made a profit of \$12.55 each. The final results were not such as anyone who visited the steers during the experiment expected, since the lot fed upon corn in conjunction with other feed was considered to have a big lead upon the other two lots. The reason for the poor showing of the lot fed barley and oats, in comparison with the lots receiving the other feeds, may be attributed somewhat to the prevailing high price for these two varieties of grain. The steers were marketed in Denver, and were subjected to a slaughter test in the Western Packing plant, the results of which were even more surprising than the results of the feeding test. The expert buyers in the stock yards very kindly consented to grade the steers according to their market value on foot, and, while the steers fed pulp and hay were considered less valuable, per hundred weight, than the steers in the other lots, and when dressed out, a smaller percentage of dead meat to live weight, yet, when the meat of a representative steer from this lot was compared with a representative steer from each of the lots fed upon grain, it was found that it was equal, if not superior, in juiciness and flavor, and had superior edible qualities generally. The practical value of this experiment has been clearly demonstrated in northern Colorado in the past few months in the unprecedented demand there has been for beet pulp for feeding purposes. Before the beets were harvested the entire supply of pulp from the various sugar factories had been contracted for in advance and the many feeders who wished to feed cattle and sheep upon beet pulp from the factories had to be turned away because of the fact that there was not enough pulp available to supply them, while last year

there was very little demand for pulp for feeding purposes, and hundreds of tons were left at the silos at the factories that could not be disposed of. An experiment somewhat more extensive has been planned in conjunction with the Great Western Sugar Company to be carried on the coming year at the Fort Collins factory. This, it is hoped, will give us a more definite idea of the comparative value of beet pulp for fattening purposes.

*Feeding Experiments With Western Lambs.* A small experiment has been undertaken in fattening western lambs for market. Owing to the many inquiries that were received from farmers in several of the higher valleys in Colorado as to the feeding value of field peas for fattening lambs, a small experiment was started along this line at the College early last spring. A small area, such as could be spared from the College farm, was set aside for the growing of field peas. These were sown somewhat late in the season, and when the crop was ready for harvesting, 100 head of lambs were purchased from a ranchman in Wyoming, consisting of fifty Merinos and fifty Black Faces, and turned upon the peas as they were grown upon the land. During the seven weeks that the lambs were fed on the pea field the 100 lambs gained approximately 1,700 pounds in weight, or an average of seventeen pounds each. The lambs did very well, and cleaned the field of peas perfectly, with practically no waste. The feeding of the lambs has been continued in yards at the College barn, using corn with alfalfa hay for one of the lots, and speltz with hay for the other. We expect to market these lambs in a couple of weeks, as they are in very good condition at the present time.

*The Production of Pork in Colorado.* In the last annual report of the Denver Stock Yards it was shown that of the 130,000 hogs marketed, over 100,000 came from Kansas and Nebraska. This would seem to be a very serious condition of affairs concerning the pork production on the farms of our Colorado people. In order to get some light on the subject that would be of value to those of our people who might engage in this industry, ten sows, heavy with pig, were purchased on the Denver market, early in the spring of the past year. One hundred and ten dollars was paid for these sows, and we were fortunate in securing some seventy-six pigs from the lot. These pigs were fed in different lots, of twenty-four each. One of the lots had a pasture of alfalfa hay, another of rape, and a third of barley and peas. An accurate account was kept of all the grain fed to the sows from the time of their arrival on the farm until they farrowed, and from weaning until they were marketed. The total amount of feed fed to each lot of pigs and of their dams, while sucking them, was also carefully tabulated, and a brief summary of the results is given, as follows:

The sows ate of feed, before farrowing, 972 pounds of a mixture of equal parts of ground wheat, ground barley and shorts, that was worth approximately \$1.00 per hundred weight. From

the time the sows were weaned of their pigs until they were marketed, they consumed 3,738 pounds of a mixture of equal parts of ground corn, ground barley and shorts, worth approximately \$1.00 per hundred weight. The total cost of the feed for the sows from the time of arriving at the farm until sold, except during the period while they were nursing, was \$47.10. The sows when put on the market, realized 5 cents per pound, the weight being 3,167 pounds, amounting to \$188.55. After deducting the first cost and the cost of feed while nursing pigs, which amount was charged as feed of pigs, the sows returned a profit of \$31.25. As before stated, the ten sows farrowed seventy-six pigs. Four of these were lost before weaning time, from one cause or another. Seventy-two of the pigs were fed on an experiment, in three lots of twenty-four each. One of the lots pastured on alfalfa with grain additional; one on rape pasture with grain, and the other on a barley and field pea pasture, also with grain feed additional. The three lots of pigs were fed a mixture of ground grains composed of one part wheat, one part barley and two parts of shorts, until two months before marketing, when the grain feed was changed to a mixture of one part corn, one part barley and two parts shorts. During the last three weeks before marketing the feed consisted of one part corn and one part shorts. The total amount of grain feed eaten by the pigs from birth until marketed, including the amount eaten by the sows while nursing, was 44,936 pounds. The pigs, when sold, weighed 13,103, requiring, therefore, approximately 3.5 pounds of feed for one pound of grain. The price received was \$5.25 per hundred weight, the total amount received from the sale being \$697.91, leaving a profit over cost of feed for the pigs of \$248.55. The profit of the sows over the cost of the feed was \$31.25, making the total net profit of both sows and pigs, over the cost of their feed, amount to \$279.80. This experiment has demonstrated that there is a good profit to be made in the rearing of young pigs, since the prices charged for the grain feed was above the market quotations, and the brood sows can usually be reared on the farm at less cost than we had to pay for them immediately before farrowing.

We expect to prepare a full report of this experiment for publication in the near future, and hope to duplicate the work on a more extensive scale the coming season, as it is apparent that the farmers of Colorado are neglecting one of the most valuable features of their animal husbandry in not raising more hogs upon their farms.

*Horse-Breeding Experiment.* Owing to the conditions under which we are attempting to carry on the experiment work in the Agricultural Department, I see more and more clearly the importance of following your suggestion in confining our work to two or three main lines and making those strong, rather than attempting to cover too much ground, and not being able to do the work thoroughly and get results that are conclusive. Owing to the introduction of the extensive co-operative experiment between

the Department of Agriculture, through the Bureau of Animal Industry, with this College, in the breeding of horses, I am of the opinion that it would be wise to confine our work to two or three main lines of investigation, which, together with the necessary expense and labor entailed in the experiment breeding work, which should probably have first place in our endeavors during the next few years at least. We will hope to continue our investigations as to the feeding value of beet pulp for cattle during the coming year. In fact, arrangements have been made with the sugar factory in Fort Collins, to have an extensive experiment along this line carried on the present winter. We should, also, I think, continue with our investigations in the feeding and rearing and fattening of pigs. Outside of these main lines of endeavor we may be able to carry on some minor work along animal husbandry lines, but will not attempt anything very extensive, or that will require much expenditure until more funds are available for these lines of work.

Respectfully submitted,

W. L. CARLYLE,  
Agriculturist.

## REPORT OF THE VETERINARIAN.

To the Director:

My association with the Experiment Station dates from June, 1904. On the 15th of the same month I received the appointment as Expert Investigator of Scabies in Cattle, from the Secretary of Agriculture, temporarily, for the summer months. Primarily, this was for the purpose of making a careful investigation into range conditions with special reference to cattle mange on the plains of the eastern section of the State, and poison weed losses in the vicinity of Roaring Fork and Gunnison rivers.

As this appointment came through the Secretary of Agriculture, and separate and distinct from the Experiment Station, the report of this work will be made in due time, directly to the Department of Agriculture at Washington.

There is a great work for the Veterinarian in this State. While our flocks and herds are as free from disease as can be found anywhere on earth, yet the annual mortality in the aggregate is quite large, and much greater than it should be. The following diseases, named in the order of their importance, are responsible, in a great measure, for this loss: Mange (cattle and sheep), poisonous plants (loco, larkspur, camas, etc.), symptomatic charbon (black leg), fungoid diseases (actinomycosis and actinobacillosis), contagious abortion, epizootic keretatis. During the coming year I have planned to specialize on the first two subjects named.

## SCABIES IN CATTLE.

I have, on the College farm, some cattle affected with mange, which were furnished me by some parties in Yuma county, to be used for this work.

The other things we especially wished to determine in this connection are as follows: 1. The life history of the parasite. 2. Can the eggs survive the dip, and thus infect other animals following through the vat? 3. To experiment with various crude oils, and determine if there be a dip that will suffice with one application. At the present time it looks as though the extensive dipping of range cattle during the past two years, combined with the unusually favorable conditions last season, had gotten the disease well under control in many of the worst infected sections of the State. I am satisfied that much of the trouble is due to lice, and not to the mange parasite.

## POISONOUS PLANTS.

Although the various poisonous weeds on the range are a constant menace to the stockmen, and have cut down the profits in many cases to the point of bankruptcy, yet there seems to be no general knowledge as to the identity of these plants, or the best means of contending with them. As fast as I can get to the various sections of the State, I am locating the various toxic plants which are doing the most damage. When the map is completed I hope, with your approval, to issue a bulletin locating the sections where various poisonous plants are known to exist; cuts with full description to aid the stockmen in their identification, suitable antidote, and, what is of vastly more practical importance, the time of year when they are to be especially avoided.

Respectfully submitted,

GEORGE H. GLOVER,  
Veterinarian.

## REPORT OF THE IRRIGATION ENGINEER.

To the Director:

During the sixteen years that this section of the Experiment Station has been under my charge, the same general plan of investigation has been carried on, as given in one of the earliest reports. It was soon realized that the plan then given was one which would require a long time, even with abundant means, and, with lack of means, as was the case, that the whole scheme as then planned could not be taken up at once. Nevertheless, it has been the guiding plan. It has been the attempt to take up various phases of the general investigation, and these special investigations, fairly complete in themselves, nevertheless are parts of a larger and more comprehensive plan. Some of the more recent investigations have had extensive bearings, and their publication has been held for complete results. Some of these investigations have been largely depended on to protect the State, and whole irrigated West, from the attacks based largely on a lack of knowledge of conditions. They are serious, inasmuch as the proper solution of the question depends on the facts of investigation.

The investigations of the year have been largely: A continuation of the investigations to determine the amount of water actually used in irrigation, by maintaining a careful and constant record of the whole amount of water used on selected canals; an investigation of the amount of water returned from irrigation, this extending over a large part of the State; a study of the relation of the forests to the maintenance and preservation of the water supply. In addition to these there have been numerous subsidiary investigations, as well as the continuation of the regular observations in meteorology.

The relations to the office of State Engineer have put at our disposal a large amount of records, which, while not having been made for the particular purposes of our investigation, have value as rendering a means for the comparison of our results with larger field, and co-operation has been possible which has been helpful to both.

In the further measurements of seepage, these have been extended to all the tributaries of the Platte, and the basin, as a whole, has now been measured, and the records for several years available. The forecast made in Bulletin 33, based on the investigations then made, have been more than made good. The amount of such return waters has been shown to be constantly increasing, and has become of increasing importance in the public wealth of the State. More than one hundred thousand acres in the val-

ley of the Platte is thus enabled to be irrigated, and, with the development of the means of utilizing this supply, two or three times as much is possible.

For a number of years some attention has been given to the study of the relation of the forest areas on our mountain watersheds to the water supply, and, therefore, their important function in the agriculture of the State. The observations of the earlier years led to the growing belief that their importance lay in their relation to snow preservation. Some of the earlier observations were embodied in Bulletin 55, and the attempt was there made to render the condition of some of the inaccessible regions evident by the aid of photographs. Since then there has been the desire to make study of the higher elevations during other portions of the year, as during the winter. The higher elevations are then deserted by human life: they are inaccessible except to the adventurous of great physical endurance, and the visitor attempts them at the risk of his life. The question had been occasionally discussed for some years with mountaineers, and especially with Mr. Enos A. Mills, who had been an observer for the Experiment Station for a number of years. Some arrangements were discussed in detail in the fall of 1902, and arrangements made for a joint trip in midwinter. As it happened, other pressing duties took me from the State, and made it necessary for me to give up the attempt, but Mr. Mills made a series of trips to high elevations, including the top of Long's peak, and gained encouragement in the attempts. The State Engineer is required by law to make investigation of the snowfall and determine the probable flow of the streams, and, with the combination of the two purposes and the funds available from the two sources, it was possible to arrange with Mr. Mills to devote a large part of the winter of 1903-4 to study of this kind. A camera was a constant attendant, and a series of unique photographs secured of the winter conditions at high altitudes. Trips were made on snowshoes, and are often of extreme danger. It is doubtful if such an investigation will again be undertaken soon, for the combination of qualities is unusual, and the risks are so great that no pay can be compensation.

Some co-operative investigations were begun with the United States Department of Agriculture. These included the measurement of water, and the use of concrete in hydraulic structures of irrigation. Mr. S. S. L. Boothroyd was entrusted with the first, and Mr. P. J. Preston with the second. Before the first was completed, though much of the field work had been done, Mr. Boothroyd resigned, in order to accept a position as instructor at Cornell University.

Some of the important lines of investigation are completed. The selection of lines has been directed in the past by the fact that there was neither laboratory nor funds, and consequently we were forced to take up investigations in the laboratory available in

the surrounding canals. This has had both advantages and disadvantages. To obtain the best results, room for laboratory investigation is necessary, and now some of the most important part of the investigations to be made should be with laboratory assistance. In the course of the work of the series of years, a large amount of valuable records have been obtained. In case of loss these could never be replaced. The loss would not be one to the investigator, or the station, but to the State, because many of the important questions now affecting the interests of the State depend, to a large extent, on these investigations. The building provided by the last Legislature, but for which the funds were unavailable, was to have increased rooms for these investigations, and safety vaults, and both are very much needed.

Respectfully submitted,

L. G. CARPENTER.

## REPORT OF THE ARKANSAS VALLEY FIELD AGENT.

To the Director:

I desire to submit the following report as a general outline of the work of the field agent for the season of 1904:

The work has largely been a continuation of the work of previous years in co-operation with farmers, and to a limited extent, experimental work that did not involve expensive labor bills, was conducted on the Experiment Station property by the field agent, or in co-operation with the tenant.

Some of the co-operative work has not been very satisfactory in securing specific results, as they are so affected by factors that are beyond control. As it is impossible to dictate if a farmer changes his plan, even if it seriously affects an experiment, although the field work has been of great value in getting general results, and keeping in touch with the work that farmers are doing in the experimental line.

A brief resume of the work might be given, as follows:

*Beets.* Under this topic several lines of investigation might be classed. 1. A plan to further study the development of "curly top" in beets was prevented by the fact that there was no "curly top" developed in the beet fields in this section of the State the past season; and the reason why it did not is as much a mystery as the appearance was last year.

2. Some injury to beets was caused by insects; "the garden web worm" infested several fields around Rocky Ford. We assisted in spraying several fields, and reported and sent in material of the work to the Department of Entomology of the College.

3. Notes and observations of some fertilizer on beets have been made, but as the harvest is not complete the results have not been secured. This work is being conducted by the United States Department of Agriculture, and, under the same direction, and at their expense, about one acre of land on the Experiment Station was sown to beets with the seed that was produced here in 1903. About two tons of mother beets of several types have been secured and siloed.

*Resistant Beet Seed to "Curly Top."* About one hundred specimens of practically normal beets were selected from the blighted fields in 1903. These were set out on the Experiment Station, and all but three died with curly top that still affected them. The three others all produced seed, and did not appear to be injured by anything. One of the three produced a pound

of good seed. It was apparently a "survival of the fittest," and if the product of this seed should prove as resistant as the mother beet, this pound of seed will be a valuable acquisition to the beet industry.

*Early Cantaloupes.* A study of cantaloupe fields was made to determine some of the elements that were essential to early melons, and some very interesting conclusions were reached in relation to root growth, methods of cultivation, irrigation, and fertility. Hot beds were tested to produce early cantaloupes and field observations were made on the effects of commercial fertilizers. We desire to furnish a more extended report on this topic for publication as a bulletin.

*Rust Resistant Cantaloupe.* Continued field observations were made to develop a resistant cantaloupe. A comparative test of five different strains of seed was made on the Station, with the conditions uniform. The season was especially favorable for the development of rust and the fields around Rocky Ford were entirely dead and dried up three or four weeks before the first frost occurred. One strain of seed revealed marked resistant traits. The rows of this kind were green when all the other varieties in the test were dead and brown. This contrast is shown in Plate 56, that shows adjacent hills taken September 24. This same fact was noticed in several fields where this variety was planted, and in this variety some hills were much more resistant than others, and from these most favorable hills seed of different individual melons was saved to carry on this experiment, which promises great value to the melon industry.

*Alfalfa Sown With Cantaloupes.* The seeding of land to alfalfa is usually the loss of a season's profit on the land, as the first year's hay crop, either with or without a grain nurse crop, does not more than pay the cost of seeding on the small farms. A plan to sow alfalfa seed with cantaloupes, just before the vines begin running, was tried on eight acres of the Experiment Station. The seed was sown with a broadcast seeder, July 1, just as the vines were starting. The seed was cultivated in, and the melon rows furrowed out and irrigated. As far as the water soaked, a perfect stand of alfalfa resulted. The alfalfa did not injure the cantaloupes, as the alfalfa was too small till the vines died in the fall, when the alfalfa made a good growth. Had the melons been furrowed with two furrows and irrigated, a perfect stand of alfalfa would doubtless have resulted. With one furrow, just about one-half of the ground has a good stand. The cantaloupes yielded about at the rate of 150 crates per acre, and, from present prospects, with very little alfalfa sown in the spring, three good crops of hay can be cut in 1905 from the land that grew a good crop of cantaloupes in 1904, which plan will practically gain a year in a crop rotation of alfalfa and other crops.

Other observations and tests were made in co-operation with the Department of Entomology of the College, on thrips, on toma-

toes and alfalfa, and several tests were made on the carrying quality of cantaloupes picked at different stages. There has been a continued call by the commission men to pick melons greener. The result of our few tests was that the green melon is inferior in quality. There is need of some more work along this line to establish just to what stage of ripeness and greenness the market will stand. There is but little doubt that the past season's market disasters were due, in part, to green, unmarketable melons.

Respectfully submitted,

PHILO K. BLINN.

Rocky Ford, Colo., November 15, 1904.

## THE PLAINS SUB-STATION.

To the Director:

I have the honor to submit herewith a report for the year 1904, of the Experiment Sub-Station of the Plains.

*General Conditions.* We had a very dry winter and spring. The first moisture to speak of was a rain on the 24th day of April, putting the ground in fair condition, and farm work was commenced at once. There were seven acres of White Australian corn planted on the 17th and 18th of May, which gave a yield of twenty-five bushels per acre.

On May the 20th there was planted one acre of corn of a large variety seed grown in Clark county, Illinois, which failed to produce ears, except on some low land, where it had the benefit of an extra amount of water during the rainy season. This made good ears, but was rather soft when frost came, on the 13th day of September. This will be planted next season, to see what the result will be by becoming acclimated. Further results from above mentioned planting was one ton of good fodder.

On the same date there was planted two acres of Kaffir corn, which was cut September 9, and yielded two tons per acre.

There was also planted, on the same date, one acre of Pencilaria, the seed being very small. I think it was covered too deep, as the ground was very mellow. Result, a very poor stand.

This plat of ground was planted to cane on July 1, which grew to the height of five feet, and formed heads; was cut September 15, making about one and one-half tons of dry feed.

On May 21 there was planted five acres of cane, of a very early variety, name unknown; yielded about one and one-half tons to the acre. This is one of the best canes that I have ever found for late planting, as it can usually be planted any time before the first day of July, and will ordinarily mature.

There was planted, on July 22, five acres of cane, seed from Barteldes, billed "Kansas Orange," a very good cane yielding two tons per acre.

On the 23d day of May there was planted five acres of cane, seed Early Orange, which yielded about the same as above, but very little of the seed matured, and only a portion of it showed heads. Result, ten tons of fodder.

All cultivated crops were put in with the lister drill, well harrowed and cultivated twice; cut between September 9 and 15.

From September 27 to 30, over four inches of water fell, accompanied by a heavy wind, thereby damaging much of the feed in the shock.

There was sown, on June 10, ten acres of millet. The ground had been previously plowed at a depth of four inches, and packed with a Campbell sub-surface packer. Seed was sown broadcast and harrowed in. This crop was cut August 27, yielding about one thousand pounds per acre.

*Potatoes.* There was planted, on the 1st of April, four bushels of Early Ohio potatoes, which produced tubers fit for the table June 27. From the 7th to the 17th of July there were sold eleven hundred pounds, at  $3\frac{1}{2}$  cents per pound.

*Orchard.* The orchard has done well during the last year. The trees have been well cared for, but not pruned as heavy as they should have been. The growth of wood has been very prolific.

In regard to fruit, there was about one hundred pounds of plums, three hundred pounds of cherries, and thirty bushels of apples, some very fine. The principal bearers this season were the Ben Davis, Winesap and the Jenneten.

We had a few peaches, the first ever grown in the county, which were fair size and of a very delicious flavor; variety unknown, as I have no chart of the trees.

There have been ten acres of wheat and rye sown at the Station this fall. While sown late, it looks very promising.

Respectfully submitted,

J. B. ROBERTSON,  
In Charge.

Cheyenne Wells, Colo., December 16, 1904.