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COLORADO STATE DOCUMENTS

Twenty-Sixth Annual Report

OF THE

State Board of Agriculture

AND THE

State Agricultural College

INCLUDING THE

SEVENTEENTH ANNUAL REPORT

OF THE

AGRICULTURAL EXPERIMENT STATION

FORT COLLINS, COLORADO

1904

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THE STATE BOARD OF AGRICULTURE.

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* On leave of absence for two years. State Engineer, Denver, Colorado.

INSTRUCTORS AND ASSISTANTS.

GAVIN N. HOUSTIN, C. E.,
Civil and Irrigation Engineering.

ROBERT E. TRIMBLE, B. S.,
Meteorology and Irrigation Engineering.

J. H. BONEBRIGHT, M. S.,
Physics.

RALPH PARSHALL, B. S.,
Physics.

EMERY D. SEARING, B. S.,
Mechanical Engineering.

WM. ELZINGA, B. S.,
Mechanical Engineering.

ARTHUR M. GARBUTT, B. S.,
Architecture.

FRANK RASMUSSEN, B. S.,
Mechanical Engineering.

FRED C. ALFORD, M. S.,
Chemistry.

EARL DOUGLASS, M. S.,
Chemistry.

LATHROP M. TAYLOR, B. S.,
Phonography and Typewriting.

CHARLES GOLDING-DWYER, JR., B. Acct.,
Bookkeeping.

S. L. MACDONALD, B. Ped.,
Mathematics.

LEROY A. BAKER, M. S.,
Mathematics.

ELIZABETH F. RYAN,
Domestic Science.

MARGARET PENDERGAST, B. S.,
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Elocution.

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Physical Culture.

S. ARTHUR JOHNSON, M. S.,
Entomology.

B. O. LONGYEAR, M. S.,
Botany and Horticulture.

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Horticulture and Landscape Gardening.

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Agronomy.

ANDREW H. DANIELSON, B. S.,
Agronomy.

WILLIAM O'BRIEN,
Farm Superintendent.

RALPH H. HESS, M. S.,
Secretary to the President.

ARTHUR MILLIGAN,
Stenographer, Agricultural Department.

MARGARET MURRAY,
Stenographer, Directors' Office.

KATHERINE MURRAY,
Stenographer (Secretary's Office).

FLORA THOMAS,
Stenographer.

EXPERIMENT STATION STAFF.

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W. L. CARLYLE, B. S. A.....Agriculturalist
CLARENCE P. GILLETTE, M. S.....Entomologist
WILLIAM P. HEADDEN, A. M., Ph. D.....Chemist
WENDELL PADDOCK, M. S.....Horticulturist
ROBERT E. TRIMBLE, B. S.....Assistant Irrigation Engineer
ANDREW H. DANIELSON, B. S.....Assistant Agriculturist
B. O. LONGYEAR, B. S.....Assistant Horticulturist
EARL DOUGLASS, B. S.....Assistant Chemist
S. ARTHUR JOHNSON, M. S.....Assistant Entomologist
PHILO K. BLINN, B. S.....
.....Field Agent, Arkansas Valley, Rocky Ford
JAMES E. PAYNE, M. S.....Plains Field Agent, Fort Collins

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LOUIS G. CARPENTER, M. S.....Director
ALFRED M. HAWLEY.....Secretary
MARGARET MURRAY.....Stenographer and Clerk

LETTER OF TRANSMITTAL.

To His Excellency,
THE GOVERNOR:

Sir—Herewith I transmit my annual report as Secretary of the State Board of Agriculture. It is respectfully commended to your attention and to the thoughtful consideration of the General Assembly:

A. M. HAWLEY,
Secretary the State Board of Agriculture.

The State Agricultural College,
Fort Collins, Colorado, November 30, 1904.

SECRETARY'S REPORT.

REPORT OF RECEIPTS AND EXPENDITURES CONNECTED WITH THE GENERAL FUND IN HANDS OF STATE TREASURER.

RECEIPTS.

Tax Fund	$63,984.73	
Tax Fund Voucher No. 519, returned	51.80	
		$64,036.53
Annie Jones Library Fund, balance Dec. 1, 1903	$ 605.80	
Annie Jones Library Fund	1,464.61	
		$ 2,070.41
Special Fund, balance Dec. 1, 1903	$ 36.52	
Special Fund	8,250.03	
Special Fund Voucher No. 68, returned	7.50	
		$ 8,294.05
Land Income Fund, Dec. 1, 1903	$ 135.54	
Land Income Fund	6,161.61	
		$ 6,297.15
Land Income Fund overdraft, Nov. 30, 1904		$ 2,661.51

DISBURSEMENTS

Overdraft Tax Fund, Dec. 1, 1903	$ 900.23	$83,359.65
Salaries	24,175.54	
President's Office	250.83	
Secretary's Office	255.44	
Library Department	1,856.56	
Horticultural Department	2,872.43	
Agricultural Department	10,789.00	
Chemical Department	1,724.16	
Mechanical Department	2,700.23	
Mathematical Department	16.00	
Physics and Engineering Department	752.50	
Zoology and Entomology Department	194.03	
Military Department	155.14	
History and Literature Department	47.25	
English and Sociology Department	16.70	
Domestic Science Department	430.25	
Commercial Department	384.85	
Veterinary Science Department	106.85	
Constitutional History Department	20.50	

DISBURSEMENTS—Continued.

Electrical Engineering Department	$ 595.99	
Furniture	1,513.10	
Insurance	311.05	
Current expense	2,464.86	
State Board of Agriculture	1,468.85	
General repairs	2,202.77	
Permanent Improvements	9,967.23	
Text Book Department	2,632.09	
Freight and express	1,343.96	
Fuel and lights	3,990.44	
Advertising	1,490.49	
Farmers' Institutes	563.55	
Catalogues and bulletins	417.68	
A. A. A. C. and exp. stations	15.00	
Student's labor	3,862.19	
		$80,477.74
Tax Fund, balance, Nov. 30, 1904	$ 1,706.60	
Annies Jones Library Fund, balance Nov. 30, 1904	1,175.31	
		$ 2,881.91
		$83,359.65

REPORT OF RECEIPTS AND DISBURSEMENTS OF FUNDS PAID INTO THE SECRETARY'S OFFICE IN CONNECTION WITH SPECIAL FUND, 1903-1904.

RECEIPTS.

Mechanical Department	$ 5.30	
Text Book Department	2,937.60	
Domestic Science Department	7.15	
Horticultural Department	87.25	
Freight, etc., refund	103.02	
Zoology and Entomology Department	10.00	
Physics and English Department	160.00	
Chemical Department	50.00	
Agricultural Department	3,725.51	
Gymnasium fee	169.00	
Entrance fee	984.00	
Library	1.00	
		$8,250.03

DISBURSEMENTS

Paid to the State Treasurer for credit of our Special Fund, as per receipts on file	$8,250.03

REPORT OF RECEIPTS AND DISBURSEMENTS OF THE UNITED STATES MECHANIC ART (MORRILL) FUND, 1903-1904.

RECEIPTS.

Deposit by United States Treasurer	$25,000.00

DISBURSEMENTS

Salaries	$25,000.00

REPORT OF RECEIPTS AND DISBURSEMENTS OF THE EXPERIMENT STATION FUND, 1903-1904.

RECEIPTS.

Remittance from United States Treasurer, turned over to the Experiment Station Treasurer, as per receipts on file..	$15,000.00

DISBURSEMENTS

Agricultural section	$ 477.80	
Chemical section	314.08	
Stationery	46.40	
Library	50.65	
Salaries	11,424.15	
Meteorology and Irrigation section	996.83	
Director's section	419.95	
Arkansas Valley sub-station	113.04	
Entomological section	225.40	
Printing bulletins	597.21	
Horticultural section	176.98	
A. A. A. C. and exp. stations	15.00	
Plains sub-station	142.49	
		$15,000.00

REPORT OF RECEIPTS AND DISBURSEMENTS OF FUNDS PAID INTO THE SECRETARY'S OFFICE IN CONNECTION WITH EXPERIMENT STATION SPECIAL FUND, 1903-1904.

RECEIPTS.

Meteorology and Irrigation section	$ 5.00	
Horticultural section	3.85	
San Luis Valley sub-station sales	1,090.59	
Director's section	11.65	
Arkansas Valley sub-station sales	202.50	
		$ 1,313.59

DISBURSEMENTS

Paid to the Experiment Station Treasurer for credit of our Experiment Station Special fund, as per receipts on file...	$ 834.19	
Balance in hands of Secretary, June 30, 1904	479.40	
		$ 1,313.59

REPORT OF RECEIPTS AND DISBURSEMENTS OF THE EXPERIMENT STATION SPECIAL FUND IN THE HANDS OF EXPERIMENT STATION TREASURER AND SECRETARY, 1903-1904.

RECEIPTS.

Meteorology and Irrigation section	$ 5.00	
Horticultural section	3.85	
San Luis Valley sub-station sales	1,090.59	
Director's section	11.65	
Arkansas Valley sub-station sales	202.50	
		$ 1,313.59

DISBURSEMENTS

Agricultural section	$ 484.40	
Meteorology and Irrigation section	181.54	
Director's section	12.05	
Entomological section	41.15	
Horticultural section	115.05	
Balance in hands of Secretary, July 1, 1904	479.40	
		$ 1,313.59

PRESIDENT'S REPORT.

To the State Board of Agriculture:

Gentlemen—This report deals with the general situation, having for its scope the entire institution under your charge. The heads of the various departments have prepared reports which I herewith submit giving in detail the work of the past year.

For five years we have been working together in good faith and good will to make this an institution for the more rapid and permanent development of Colorado and the Rocky Mountain region. Without in the least removing emphasis from other departments, we have sought to bring animal husbandry, plant husbandry, horticulture and veterinary science up to the common level of the other courses of study authorized and demanded by the federal government.

It has been our purpose, also, to make this institution less a preparatory school and more and more a technical school of high order. This may not have appealed so much to numbers, but it has greatly improved the quality of the work done and added much to the efficiency of those completing the various courses. Not only are the graduates of this school holding high rank among those of other institutions both eastern and western, but the demand for our men and women is four times greater than the supply. This certainly proves the character of the work we have done under your direction. You will be pleased to learn that the number of students in the Agricultural department has quadrupled as compared with last year with every indication that the number will be doubled next year. Still we shall not be able to meet the demands for trained workers. There have been enough calls during the present year for farm foremen and superintendents, experimental and government workers to take nearly every student in the department were he prepared. The same is true of the Civil Engineering and Irrigation department. Thus by imposing severe entrance requirements, lengthening the courses and holding every student to a strict account of his work, we have not thought so much of the enrollment as we have of the character of our output and the world's demand for high-grade men.

It can no longer be said that the Agricultural College of Colorado is a Fort Collins institution of little more than high school grade. The catalogue will show a marked decrease in the number of students from Fort Collins, but a much more general distribution throughout the State. We require four years after

graduation from an accredited high school, or from our preparatory school. No complaint comes from the student body by reason of the severe discipline and stiffer requirements, but rather, the often expressed conviction, that you have rendered them a lasting benefaction by so ordering their work as to have brought it to professional dignity and value. At the same time, I am firmly convinced that it is our duty to provide instruction for those young men from the farm who lack preparation, and on account of age, can not prepare for and take the long course.

I recommend, therefor, that a two years' course in agriculture be order prepared by the faculty, which, while it shall make the principles of agriculture and animal husbandry the major study, shall also provide such general English and mathematical training as may be deemed advisable. Such a course in mechanical engineering has been supplied by the College. Most of the students in that department have taken the long course since they can not become proficient enough to secure good positions without thorough grounding in mathematics. I think a two years' course in agriculture would be very popular and helpful.

In my last biennial report I stated: "We are searching far and wide for an able man for the chair of Agriculture." The search continued until we were satisfied. As a result, Professor Carlyle, formerly of the University of Wisconsin, has rendered us invaluable service for more than a year. You have loyally seconded his valuable and successful work by the purchase of valuable stock and arranging for the Andrews Farm, and securing for him more assistance in the department. He himself has added to our herds by valuable gifts from well-known breeders and importers and has started the whole State on a new road of stock breeding and meat producing that will be of incalculable benefit to the arid West.

The beet pulp feeding of last winter and the horse breeding experiment now about to be inaugurated by special appropriation secured from congress, alone rank your Agricultural College with the foremost of America. The recent commendation of Secretary Wilson is worth all the efforts have cost. We have justly received recognition as the leading Agricultural College of the Rocky Mountain region. A great work has been given us to do. Steadfastly we are rising up to its heroic measure.

I must congratulate you upon the acquisition of Professor Olin, formerly of the Agricultural College of Iowa. His cooperative work as an agronomist has put new life into the "rain belt," and a greater degree of courage and hope into the entire State. His record for doing things is so well known that he has already been able to secure for the College donations of farm machinery valued at more than three times his annual salary.

The short course you ordered to be inaugurated this winter is in readiness and I herewith submit the preliminary announcement. The indications for its success are more than gratifying.

The auditorium, with a seating capacity of more than 1,000, has been built since my last report. It was thought best to add a third story for recitation rooms. With the basement gymnasium, this magnificent addition stands the best of its kind in all the West, completed at a cost of $22,000. Many improvements on the farm and in the stock yards have been made during this time.

The Department of Electrical Engineering has been put into full operation. Nearly one-seventh of the students of this year have registered for this course or are preparing for it. The requests of Professor Crain submitted in his report are deserving of careful consideration.

We have reached a point now where the demand for more revenue is imperative. While the federal government has given us nearly seventeen thousand dollars this year for a special experiment, this experiment itself will draw somewhat from our regular funds. We must ask for still greater government aid. In this connection, let me urge you to give all possible support to the bill to be re-introduced before the national Congress this winter granting an additional annual sum to the experiment stations of Agricultural colleges. It will mean an increase in the efficient work of this station of two hundred per cent. It may be wisdom to send a representative to Washington to assist the executive committee of the Agricultural colleges and experiment stations in securing its passage.

Unquestionably we must have more assistance from the State itself. The agriculture of Colorado is the wonder of the whole country. A forward movement just now will soon give Colorado rank as one of the greatest agricultural, stock, and fruit states in America. With the administration of the Department of Agriculture friendly to us, willing to aid us in every way, with opportunity looming large just before us, it would be a shame indeed if for lack of funds we were to fail of our natural destiny. In what way we shall ask the State for larger aid must be left to your wisdom. I am sure the proper procedure will bring us the help we so sorely need. We never had so many friends, individual and organized, as at the present time.

I desire just here to put on record our appreciation of the invaluable work done by Professor Carpenter as State Engineer. Not only is he putting to rights the tangled affairs of irrigation in the State, but his work in the water suit of Kansas against Colorado, for which, as a worker in this institution, he has been long preparing, means the salvation of every agricultural valley of Colorado. We could ill have spared him from the chair of Irrigation Engineering for two years except for so great a cause.

I recommend that the improvements and repairs upon the Mechanical Engineering building, asked for by Professor Lawrence in his report, be made just as soon as funds are available. Now, that other institutions in the State are seeking to duplicate

our work in engineering lines and are laying special emphasis upon this effort, we must see to it that we keep so far in the lead that no one will doubt our loyalty to the compact which the State has made with the United States government by which $25,000 per year is appropriated from the government land funds for the maintenance of a State School of Agriculture and Mechanic Arts.

While I deplore the present competitive soliciting of students, against which I have always pleaded, it seems to be forced upon us as a present necessity. The fact that institutions have installed engineering lines similar to ours, and do most of their soliciting for students for these courses, compels us to, at least, set forth in a dignified manner our superior advantages. Our farmers' institute work and frequent visits to every agricultural portion of the State, keep constantly before the youth of Colorado the decided advantages of our agricultural courses. But field work of the highest order must be done next summer along all our lines of work if we be true to our mission and our obligations to the general government. To this end, I recommend that at least three members of the faculty be authorized to give a portion or all of their summer vacation to field work.

I recommend that Professor C. F. Griffith be given the chair of Animal Husbandry at a salary of $1,500 per year, and that both he and Professor W. H. Olin, of the chair of Agronomy, be made members of the faculty.

Lack of library room is one of our greatest problems. It is becoming a calamity. One-fifth of our books are boxed and stored beyond reach for lack of space. Magazines and pamphlets, so much in demand, are filed in basement rooms. Students have no room in which to read or investigate subjects assigned them. The Librarian, efficient as he is, is at his wit's end. I can see but one immediate solution, that I recommend with the concurrence of the faculty. It is the removal of the Commercial department from its present quarters and the giving of that building to the library. This will serve for a number of years to come. The change can be made at a cost not to exceed $250 to $350. It should be made during the next summer vacation. The Bookkeeping department can be given the new drawing room above the chapel and the Typewriting department the present library rooms.

I recommend that all proper means be used to induce the coming Legislature to increase our present mill tax. The regular expenses of maintaining so great and important an institution are not adequately met by the present one-fifth of a mill. It is the common conviction that the Agricultural College is doing more for the enrichment of Colorado that any other institution. The greatest growth of the State during the next decade will be along agricultural lines, as has been true of the last decade. It is only fair and just that the State shall materially assist in directing this growth. Every thousand dollars invested now in

scientific agriculture will mean one hundred thousand dollars to the State within the next twenty years. As evidence of this, I cite our recent experiments in beet pulp feeding, the raising and milling of macaroni wheat, and sugar beet growing, as well as our experiments in feeding upon native grown foods. The proposed horse breeding experiment has attracted the serious thought of the entire nation and will mean greatly increased wealth for Colorado.

I can not close this report without a word of appreciation of the harmony and good will which prevail in faculty and student body. Despite the fact that the severe process of stricter discipline and sterner requirements in scholarship is going on, satisfaction seems to be general. We are almost ready now to begin to build a larger enrollment upon this new basis; an enrollment which will count for something. Our students will be such as will remain for a number of years, instead of so many being birds of passage. When they go from us they will go in loyalty and in enthusiastic support of the College. This, after all, is our greatest achievement.

Respectfully submitted,

B. O. AYLESWORTH,
President.

DEPARTMENT OF AGRICULTURE, 1904.

Colorado State Board of Agriculture:

I have the honor to present for your consideration the following somewhat detailed report of the Agricultural department of the Colorado Agricultural College for the year just past:

In the last annual report a number of suggestions were submitted for your consideration, looking to the improvement of this department. Some of these have been accomplished under your direction, while others of equal, if not of greater importance, have had to be held in abeyance for lack of funds with which to carry on the work. On the whole, the Agricultural department of the College has gone steadily forward, and a brief resume of what has been accomplished may prove interesting, and will lead up to some work that it seems important should be undertaken in the near future.

The teaching work in the College during the past year was not heavy, owing to the limited number of students and to the comparatively small amount of work that was offered in the department.

When the catalogue was revised for publication this year some very much desired changes were made in the course of instruction offered. The schedule of studies for first and second sub-freshmen students, which constitutes a preparatory course of study for the regular college course, remains about as it was. The mathematics required in these two preparatory years of study, and also in the freshman year of the regular college course, is much heavier than should be required of young men coming from the farms and electing the Agricultural course. It results in many of the very best agricultural students having to leave the regular course of study and either returning to their homes, going to some other school away from all agricultural environment, or going into the commercial or other special courses offered. In the old schedule no agricultural studies were offered in either of the sub-freshman years nor in the regular freshman year, while the new course now gives five hours of regular classroom work in agriculture each week during the freshman year and approximately five hours per week of practice as well.

In the sophomore year, the new course gives four hours per week of regular class work, and at least five hours per week of practice more than was offered in the old course. In the junior year, at least five hours per week more of regular class work is offered in agriculture than has been given heretofore.

Another very important change has been made in the course, whereby the students in all branches of the Agricultural department of the College are given the same course of study during the freshman and sophomore years. On beginning their junior year's work, they may elect one of five branches as their major study and specialize in that with a sufficient amount of closely allied studies to round out their course and make it strong on all points touching the major study. This plan simplifies the teaching and tends to make strong students in the particular branch which they have chosen.

We now have twenty-one students in the freshman class, all of whom, with one exception, have passed creditable examinations in this department in the last term's work, and are going steadily forward in the work of the present term.

SHORT COURSE FOR STOCKMEN AND FARMERS.

In accordance with your instructions at a called meeting of the Board, held in Denver last winter, a short course in Agriculture for mature stockmen and farmers has been offered. Over 5,000 circulars descriptive of this course have already been distributed, and the outlook is very bright for a large attendance of the leading stockmen and farmers of this State upon this course. Should this course be the success we anticipate in the matter of attendance, some provision should be made in the matter of class-rooms and other accommodations for the perfection of the course.

Farmers' Institutes. During the past year a number of farmers' institutes have been attended, and this work on the part of the College seems to be greatly appreciated. This was particularly true of the potato institutes, a number of which were held in the early part of the year. It is hoped that during the coming year this work may be broadened and extended so as to include various other branches of agriculture.

During the year, in preparation for the further development of this department and looking forward to the increase of work devolving upon it through the holding of the short course for farmers, and the call for extensive field work, Prof. W. H. Olin was secured as an assistant in Agronomy, and his work has already been very favorably received by the farmers of the State.

Before entering upon the detailed work of the department, it is with pleasure that I report the efficiency of the work performed by Assistant Professors C. J. Griffith and W. H. Olin, and Assistant A. H. Danielson, as well as the other members of the farm force, particularly of the farm superintendent, Wm. O'Brien, who has been most faithful, efficient and diligent in carrying out the detailed work of the farm. The office work in this department has grown immensely in the past year. The correspondence has quadrupled and the bookkeeping work

which has been inaugurated for farm accounts is being well carried on by our very efficient secretary, A. D. Milligan.

LIVE STOCK ON THE COLLEGE FARM.

Cattle. As your Honorable Board will remember in my last report, I mentioned the condition of the live stock on the farm. During the year a number of the poorer Shorthorns have been disposed of at remunerative prices. Two or three choice individuals of this breed have been added, and we still have a surplus, which we hope to dispose of during the next few months. Early in the spring the College secured on very advantageous terms the entire herd of imported Aberdeen Angus cattle belonging to Mr. J. C. Osgood. The first arrangement under which we secured the cattle was that the College should have such animals of this herd as they wished to keep for breeding purposes without any cost. The surplus not required by the College was to be sold and the proceeds turned over to Mr. Osgood. One-half of the produce of the animals to be kept in the College herds was to be turned over to Mr. Osgood to be disposed of by him as he deemed best. Before any part of this agreement could be carried out, Mr. Osgood very generously agreed to denote the entire herd to the College. The animals not required by the College were to be sold, and the proceeds were to be put into a loan fund, to be used in aiding deserving agricultural students who had not funds of their own sufficient to carry them through their college course. Also one-half of the produce of the animals kept in the herd from Mr. Osgood's donation were to be sold, and the proceeds to go to this fund, which was left in the hands of a committee consisting of Dr. Aylesworth, Hon. E. H. Grubb, and the head of this department. So far only one animal has been sold, for which we realized $500. This money will go into the loan fund for students. We now have on hand for sale from this herd of Aberdeen Angus cattle, two yearling bulls, two cows and five young calves of varying ages. During the year we have also added to the herd by purchase and donation, two very superior Holstein cows and a bull, two Red Polled heifers and a bull calf, a West Highland cow and a number of choice young steers, for experiment and demonstration purposes. Of these, the Grand Champion Holstein cow of the World's Fair, at St. Louis, was donated by Hon. R. M. Hotaling, of San Francisco, California. Also, the reserve to champion bull, Lakeside Missouri Chief, donated in part by Mr. Hotaling and in part by Mr. M. E. Moore, of Cameron, Missouri. One of the Red Polled heifers was donated by Andrews Brothers, of Ohio, and one by H. G. Henderson, of Central City, Iowa. The Red Polled bull was donated by Mr. J. W. Martin, of Richland City, Wisconsin. A pure bred Shorthorn steer was donated by Mr. Robert Andrews, of Fort Collins, and three Shorthorn steers were given to the College by

Cary Brothers, of Routt county, Colorado. At present we are somewhat overstocked with cattle, but when those not desired for demonstration or experiment work have been disposed of, we will have on the College farm as good a representative herd of live stock in the cattle class as may be found on any college farm in the country, with one or two exceptions.

After consulting with the President of the College and the Chairman of the Farm and Stock Committee, it was decided to offer all the surplus stock on the College farm at public auction on the 21st day of January, which date occurs midway in our Short Course. This will insure a wide distribution of the stock, and, at least, fair prices.

Sheep. At the time of your last annual meeting we had the representatives of but one breed of sheep on the College farm, and of this breed we had some twenty-six head. During the year most of these have been disposed of at remunerative prices, and only the best animals in the flock have been reserved. There has been added, partly by purchase, and partly by donation, a trio of prize-winning South Downs, from the flock of George McKerrow, of Sussex, Wisconsin. Of these, the ram was purchased, and the ewes donated. We have also secured from the same party three very choice prize winning Oxford ewes, all safe in lamb, which were secured at about one-half their value. We have also secured a trio of French Merino sheep, of mutton type, from the flock of Frank Harding, of Waukesha, Wisconsin. These animals were imported from France, and we secured the three for a little more than one-half of the cost of one of them in France. At the recent International Live Stock Show, at Chicago, two very choice Shropshire rams were donated to the College for use in our classroom work with students. One of these was presented by Dr. G. Howard Davidson, of Millbrook, N. Y., and the other by Mr. John Campbell, of Woodville, Ontario, Canada. We now have, therefore, four of the leading breeds of sheep represented on the College farm, and all of them excellent types.

Swine. Our swine department has advanced almost as much as either of the two departments before mentioned. We have secured during the year two very choice Berkshire sows, one from N. H. Gentry, of Sedalia, Missouri, for which we paid $75, although on the day prior to purchase Mr. Gentry had refused $200 for her. The other sow, equally good, was secured from Mr. G. C. Council, of Vandalia, Illinois, at about half her value. A donation of a Berkshire sow and a boar was also made by Cary Brothers, of Routt county, Colorado. We now have four breeds of swine well represented.

Horses. In the horse department we are still somewhat light in our representation, though we hope for something substantial in this department in the near future. At the recent International Live Stock Show, one of the largest horse breed-

ing and importing firms in America, Dunham, Fletcher & Coleman, of Wayne, Illinois, donated the services of one of their most valuable stallions to our College. This horse is about 20 months of age, and is loaned to us without cost except his maintenance, for demonstration, and for service on such mares as we may care to breed to him. We are to keep this horse until we can dispose of him to advantage for them, or, in case we wish to return him at any time, they will accept of him. This will be the only representative of a pure-bred horse of any kind that we have on the College farm.

Proposed Horse Breeding Experiment. At your last annual meeting, a committee, consisting of Dr. Aylesworth, Mr. Grubb and myself, were appointed to go to Washington and secure, if possible, some aid from Congress, through the Department of Agriculture, to carry on some work looking to the improvement of live stock in the Inter-mountain region. Your committee immediately took steps to accomplish this work, with a success that was very gratifying, and so generous that it was somewhat of a surprise. Twenty-five thousand dollars was appropriated by the federal government to the Department of Agriculture, to be used in carrying on experiments in the breeding of live stock in connection with the various experiments stations in the United States. Very naturally, since the idea originated with your Honorable Board, this College was the first to receive consideration at the hands of the Secretary of Agriculture. After many conferences between the Department of Agriculture and members of the above mentioned committee, an agreement has been reached, and it is submitted herewith for your approval, looking to the carrying on of extensive experiments in the improvement of carriage horses in the United States. The following is a full text of the agreement, which it is hoped may meet with the approval of this Board, in which case steps will be taken at once to inaugurate this work at our College:

UNITED STATES DEPARTMENT OF AGRICULTURE, OFFICE OF THE SECRETARY.

AGREEMENT RELATING TO A CO-OPERATIVE EXPERIMENT IN HORSE BREEDING.

This Agreement, made and entered into this 21st day of December, 1904, by and between James Wilson, Secretary of Agriculture, for and on behalf of the Department of Agriculture of the United States of America, party of the first part, and W. L. Carlyle, an officer of the Colorado Experiment Station, for and on behalf of the said station, party of the second part.

Whereas, The parties to this agreement desire to conduct a co-operative experiment in horse breeding, under the terms of the annual appropriation for "Expenses, Bureau of Animal Industry, 1905," under the subhead "Animal Breeding and Feeding," upon

the farm of the Colorado Agricultural College, and to study the possibility of evolving an American carriage horse from the American trotter.

Now, this agreement, witnesseth:

First. The party of the first part for the considerations hereinafter mentioned, agrees to and with the party of the second part as follows:

1. To secure at the earliest practicable date, at least twenty mares of carriage type and one stallion of carriage type, and to deliver the said mares and stallion to the party of the second part, f. o. b. at the railroad station nearest the said designated farm. *Provided*, That the said horses shall be purchased for the United States by a board of three competent persons, one member to be an officer of the Department of Agriculture, to be appointed by the party of the first part, one member not an officer or employe of either the Department of Agriculture, or the said station, to be appointed by the party of the first part, subject to the approval of the party of the second part; and one member who shall be an officer of said station to be appointed by the party of the second part; and, *provided, further*, That the party of the first part shall defray the traveling and subsistence expenses of the said board while the members are actually engaged in the selection of the horses, the said expenses to be governed by the fiscal regulations of the Department of Agriculture, unless otherwise ordered by the party of the first part.

2. To pay salary at the rate of one thousand dollars per annum to an expert in charge, to be named by the party of the second part, such designation to be approved by the party of the first part; to pay the salary of an expert groom. This expert groom shall be selected by the expert, with the approval of the party of the first part, and shall devote his time to the care of the said horses and be immediately responsible to the expert in charge for the care thereof, but the said groom may be required to assist in instruction in horse husbandry at the Agricultural College; and to pay a further sum not to exceed fifteen hundred dollars during the present fiscal year to partly cover expenses of equipment and maintenance.

Second. The party of the second part, upon condition that the party of the first part faithfully perform each and every provision hereof, agrees to and with the party of the first part as follows:

1. To keep and maintain in the best manner the horses covered by this agreement, and their progeny, upon the farm of the said station or upon the farm of the Colorado Agricultural College, and to furnish necessary pasture, feed, care, attention, training and equipment, without expense to the party of the first part, except as herein otherwise provided for.

2. To keep a stock record of the breeding of all horses in the stud at the said station, and of all their progeny. The said record shall contain the dates of breeding of mares, with names and numbers of mares and names and numbers of stallions to which they are bred, the dates on which foals are dropped, with names and numbers of sire and dam in each case, and the deaths and transfers of all animals. This information shall be furnished to the party of the first part as soon as it is available, and the record shall be kept on forms furnished by and in a manner satisfactory to the party of the first part; and all books and records pertaining to the experiment herein provided for, and kept by the party of the second part, shall at all times be open to the inspection of the party of the first part or his accredited agent. The party of the first part reserves the right to establish a general stud book for American carriage horses.

Third. The parties hereto further agree as follows:

1. That the progeny of the animals furnished by the party of the first part shall, except as hereinafter provided, be and become the property of the party of the second part, subject to an option in the party of the first part to purchase any and all progeny at an agreed price; but the party of the second part shall not sell any of the said progeny without the written approval of the party of the first part. When the progeny is sold, the proceeds shall be applied by the party of the second part to the continuation of the work of carriage horse breeding, subject to all conditions and limitations of this agreement.

2. That the stallion or stallions covered by this agreement may be used for service on mares not otherwise covered by this agreement, if the demands on them will, in the opinion of the expert in charge, permit such service, and if the mare is in each case acceptable to said expert. In every case the record of such breeding, including the name and owner of mare at time of service, name and number of mare and name and number of stallion, shall be forwarded immediately to the party of the first part by the expert in charge. A uniform service fee on mares not covered by this agreement shall be fixed by the said expert, the rate to be approved by the party of the first part, and the money so obtained shall be applied in the manner and for the purposes hereinbefore set out for the proceeds of the sale of progeny of the original herd.

3. That in case either party to this agreement desires to withdraw from the experiment, then six months' notice in writing shall be given to the other party thereto, in which event, all the animals furnished by the party of the first part, together with so many of the progeny as may be desired by the party of the first part for breeding purposes, and all trappings and equipment for the horses purchased with funds supplied by said first party shall revert to the party of the first part, and shall be the absolute property of the United States. *Provided*, That if any of the orig-

inal herd shall have died, a number of the progeny equal to the number of deaths shall be taken by the party of the first part without compensation to the party of the second part, but if a number of the progeny in excess of the number of deaths be desired by the party of the first part, then the party of the second part shall be compensated for the said excess at a price to be mutually agreed upon.

4. That the result of this co-operative experiment may be published by either party to this agreement, but no such publication shall be made by either party without the approval of both parties obtained in advance of publication.

5. That it is an express condition of this agreement that no member or delegate to Congress shall be admitted to share any interest therein or to any benefit to arise therefrom, and that said agreement shall be subject in all respects to the provisions of sections 3739, 3740 and 3742 of the U. S. Revised Statutes, so far as the same may be applicable.

6. That the Secretary of Agriculture may, in writing, from time to time, delegate to any officer or person in the employ of the United States of America, with the same effect as if such officer or person were specifically named herein, every right and power hereby conferred upon the said Secretary, with reference to the conduct of this experiment, and until the party of the second part shall receive notice in writing to the contrary, said rights and powers shall be deemed to be delegated to the chief of the Bureau of Animal Industry.

In Witness Whereof, The parties hereto have executed this agreement in triplicate, at Washington, on the date first above written.

JAMES WILSON,
Secretary of Agriculture, Party of the First Part.

W. L. CARLYLE,
An Officer of the Colorado Agricultural Experiment Station,
Party of the Second Part.

It will be observed that on the part of the department no mention is made of any assistance beyond the present fiscal year ending July 1. The reason for this lies in the fact that none of the departments of the federal government can enter into an agreement which anticipates an appropriation. Your committee, however, has the assurance of Dr. Salmon, who represents the Department of Agriculture in this work, that such funds as are reasonable will be forthcoming from time to time to carry on the work.

Agronomy. An outline of the proposed plan of work for the coming year in Professor Olin's department is submitted here-

with. An outline of the approximate sums of money required for carrying out of these plans as well as to provide for the accommodation of the horses to be used in the horse breeding experiment and to supply the growing needs of this department have been submitted on a separate report to your Secretary, which I trust may have favorable consideration at this meeting.

In conclusion, I wish to thank each and every member of the Board for the loyal support and aid given in furthering the work of this department. My thanks are especially due to Dr. Aylesworth, President of the College, and to Secretary A. M. Hawley, for the consideration they have shown me in carrying on the work under the enforced lack of funds that the College has experienced during the past year.

Respectfully submitted,

W. L. CARLYLE,
Professor of Agriculture.

REPORT OF THE AGRONOMY WORK OF THE DEPARTMENT OF AGRICULTURE, DECEMBER, 1904.

To Professor W. L. Carlyle,
Professor of Agriculture,

Colorado College of Agriculture.

Dear Sir—I take pleasure in submitting to you the following report of the work in the new Department of Agronomy, which the State Board of Agriculture organized in June of the present year:

I closed my work at the Iowa State College July 1, and reached Fort Collins as soon thereafter as possible.

My first care was to become familiar with crop conditions in as many parts of the State as possible. A thorough knowledge of these conditions will enable me to more intelligently direct the students in class, as they study the farm crops of this and other states.

Agronomy is a science of the field and its crop.

In our college work we shall undertake to carry out the following lines of work:

Freshman Year—Farm mechanics; *Sophomore Year*—Farm crops; *Junior Year*—Soil fertility; *Senior Year*—Farm management.

This present year we started the Agronomy work by organizing a class in farm mechanics. Farming at the present day is very largely done by the use of machinery. Hence it is necessary for the student of agriculture to study the mechanism, action and relative value of the different farm implements.

In this new course, we study farm machinery, farm buildings, farm motors, farm fences and the construction and maintenance of country roads. No provision was made for a class laboratory period, but the students devoted a part of each Saturday to this work, and I am impressed with the importance of granting an afternoon laboratory twice a week for students to perform detail work that seems essential for the complete understanding of the subjects discussed.

While studying plows, the class took part in a plowing match that awakened much interest in this very important field operation.

Each student was required to turn a back furrow and plow one-tenth of an acre.

His work was judged on the following points by Mr. William O'Brien, Superintendent of the College farm:

	Points.
1. Line of furrow	15
2. Uniform depth of furrow	15
3. Uniform width of furrow	15
4. Trash covered	15
5. Manner of handling plow and team	10
6. Top line furrow	5
7. Back furrow	10
8. General appearance	15
Total	100

I am convinced that a plowing match should become a permanent feature of our work in this course. It will help to impress upon the students the value of good plowing. For this contest Mr. W. H. Sears, general manager of the John Deere Co., Denver branch office, presented a $20 fourteen-inch walking plow to the one who was judged the best plowman at this match. Mr. L. M. Montgomery was awarded this prize. The book, stationery and notion dealers of Fort Collins presented $12 worth of merchandise for a second prize. This was awarded to George L. Penley. The implement dealers of Fort Collins presented $5 worth of merchandise as a third prize, which was awarded to Mr. Alfred Chace. Mr. John Deere presented an oxidized silver watch fob as a fourth prize. Mr. F. M. Gum was awarded this present from Mr. Deere.

Our College farm has a limited amount of farm machinery, much of it being unserviceable and therefore not adapted for use in class. I appealed to firms manufacturing farm machinery for help. Many of these kindly agreed to place machines with us for class study and field demonstration purposes. I was pleased with the interest and earnestness manifested on the part of the freshmen who took this work.

We must needs extend the length of time of shop and class instruction in farm mechanics to give the student the knowledge modern farming seems to require of its manager.

I have arranged for all freshmen students, who can do so, to spend their summer vacation on a large ranch, at remunerative wages.

During their junior and senior years of the College course, I desire these students to have employment on a well managed ranch, where general farming is practiced. They will then be asked to study the manner in which the farm is managed, preparing them to realize the importance of farm management which is given in the Agronomy work, in senior year. I feel that six

months on a well managed farm, in actual field practice, will be a valuable addition to their college work and will make our students more competent and efficient to successfully solve the practical problems of the farm.

We have already had several calls for farm managers, and I regret to state that we have not had the students prepared to take these positions. It is my purpose to make our class work in Agronomy—farm mechanics, farm crops, soil fertility and farm management—as practical and preparatory for successful farming as possible.

Thanking you for your many courtesies to me, I submit to you this brief report of work just started.

W. H. OLIN,
Associate Professor of Agronomy.

Fort Collins, Colo., November 30, 1904.

ANIMAL HUSBANDRY.

Report 1904.

Prof. W. L. Carlyle,
Professor of Agriculture,
Colorado Agricultural College.

Dear Sir—I have the honor herewith to submit the following report of the work done under your direction for the past year in animal husbandry:

As you are aware, the teaching has been increased along animal husbandry lines in the past year, and, while the work offered is still limited, and the enrollment of students small, it consumes considerable of the time of one instructor. During the fall term of 1904 I taught classes in the following subjects: Breeds of Live Stock, five hours per week; Feeds and Feeding, four hours per week; Judging Market Classes of Sheep and Swine, five hours per week; Judging Breeding Classes of Sheep and Swine, five hours per week. In the four classes there was a total of fifty-four pupils. Fourteen of these were special students, and were enrolled to do judging work with the regular students. The four valuable medals secured by your efforts, and so kindly presented by Messrs. Stubbs and Springer, of Denver, and by the Oldenburg Coach Horse Association, of Oldenburg, Germany, were contested for by twenty-nine students. The competition took place at the Colorado State Fair, at Pueblo. In the judging of Belgian draft horses, Mr. C. C. Officer won first place; Mr. N. J. Miller, second place; and Mr. C. E. Miller, third place. In the judging of Oldenburg coach horses, Mr. W. J. Morgan won first honors; Mr. L. C. Gilbert, second; and Mr. N. J. Miller, third place. The work done by all the students in this competition was very creditable, and excited considerable interest in the College.

Mr. A. H. Zenner, of the Zenoleum Disinfectant Company, Detroit, Michigan, offered a medal for the best write-up of any three classes of stock judged in the regular competition of the Fair Association. The papers presented in this competition were all good, and showed the great interest taken in the work by the students. Mr. O. L. Prien wrote the best paper, and was presented with this medal. Some valuable work was done by the students in judging rings of cattle and hogs, besides the competition judging.

Besides the above mentioned classes, I taught a special class in stock judging. This class was made up of senior and post-graduate students.

Some experimental work was undertaken, part of which has been completed.

Two sets of eggs were incubated. The first set consisted of 120 pure-bred eggs of five different breeds. Twenty-three eggs were tested out as non-fertile. A hatch of 60 per cent. of the remaining eggs were taken off. A second set of chicken and turkey eggs gave a 59 per cent. hatch of chicken eggs. The turkey eggs hatched poorly. There were a great many non-fertile eggs, and the germs of the fertile eggs seemed very weak. Out of thirty eggs put in the incubator, thirteen were non-fertile, and only five eggs hatched.

For three seasons past some work has been done in soiling dairy cows. This present year, one-eighth acre plots were put in of oats, rape, millet, State of Maine flint corn, Evergreen sweet corn, and Kaffir corn and sorghum. The oats yielded at the rate of 24,864 pounds per acre of green fodder. The millet yielded at the rate of 19,584 pounds of green stuff. The State of Maine flint corn at the rate of 32,760 pounds per acre. Sweet corn, 23,520 pounds per acre. The sorghum, 46,000 pounds per acre. The Kaffir corn did not do much, and was not weighed. The main soiling crop used was alfalfa. It was ready to use by the middle of May, and was used steadily until September 5. The other crops grown were used incidentally, and were not as palatable to the cows as alfalfa. The rape was fed to the young stock and to the sheep. It yielded in two cuttings, twenty-five tons per acre. That this system, or at least a partial soiling system, is a profitable one for our farmers to follow, can be seen from the following yields of our dairy herd:

MILK RECORD OF AGRICULTURAL COLLEGE DAIRY COWS, 1904.

Cows	May, lbs.	June, lbs.	July, lbs.	August, lbs.	September, lbs.
Black	1,653	1,463	1,417	1,297	1,096
Bessie	1,196	1,095	1,130	1,025	910
Sybil	1,446	1,367	1,289	1,068	873
Duchess	1,201	1,307	1,251	1,100	932
Total	5,496	5,232	5,087	4,490	3,811

The pig feeding experiment conducted on the farm gave some interesting results, showing that a large profit can be realized from raising and fattening hogs on our ranches. It also showed the great value of rape as a hog pasture. The lot pastured on rape and fed a liberal quantity of grain required a less amount of feed to produce a pound of gain than the lot similarly fed, but pastured on alfalfa. Some experiment work was done with feeding refuse molasses from the beet sugar factories. The pigs on this experiment were fed in a closed lot, and were given no green feed whatever. The grain consisted of a mixture of equal parts

shorts and corn. The molasses was mixed with water and the grain put in this sufficient to make a thin slop. Molasses was also put in their drinking water. This latter was relished greatly by the pigs, for, after a time, they would not drink water that did not have molasses in it. The pigs averaged 83 pounds each at the time this experiment began, and 212 pounds each at the close. They were fed 107 days. It took 3.3 pounds of grain, and 1.8 pounds of molasses, for each pound of gain. At local prices for grain and molasses, the cost of each pound of gain was 3.61 cents. Considering that no pasture was used, I think that these results show a high feeding value for molasses. The pork from these hops was very fine, both the fresh meat and the cured bacon and ham.

The records of the pure bred stock on the farm are up to date, and all stock one year old and over are recorded in the stock books of their separate associations.

Respectfully submitted,

C. J. GRIFFITH,
Associate Professor of Animal Husbandry.

REPORT OF THE DEPARTMENT OF VETERINARY SCIENCE.

To the State Board of Agriculture:

Gentlemen: The following report is respectfully submitted as an outline of work done in this department during the year 1904:

In a previous report I suggested that it would be well to determine upon a more or less permanent policy to direct the future of this department, and that upon investigation of the character of similar work in other institutions I found that one of two policies was generally in vogue: First, to properly equip and maintain a complete course leading to a Veterinary degree, with everything conserving to make this the prime object in view. Second, to limit the instruction to a short practical course of lectures adapted more especially to the students in agriculture, and with well equipped laboratories and assistants to work in conjunction with the Experiment Station, and in closer touch with the live stock interests of the whole State. To me this has been, and still is, the momentous question, whether, in substance, our goal shall be the Veterinary College, such as Ames and Cornell, or primarily experimental investigation such as at Lincoln, Nebraska, or Auburn, Alabama.

Previous to this year, not being connected with the Experiment Station, our only alternative was to strive to build up as complete a course in veterinary science as existing conditions would permit.

Our efforts to this end have not only demonstrated the need for this sort of instruction, but further, that a complete course well equipped and leading to an appropriate degree, would receive ample support.

Wishing to follow along one line or the other, and not try to stride two horses going at diverging angles and deeming the first plan not exactly feasible at this time, I recommended the other, and accordingly asked to be placed on the Experiment Station staff, and to have the course of study re-arranged to this end. This request was granted, and for which I thank you.

In the curriculum, as now arranged, all students in the agricultural division take the same work for the first two years, and at the beginning of the junior year there is the opportunity to choose between Veterinary or any of the other courses, in this division.

This arrangement is very satisfactory, and certainly insures a very high order of veterinary attainment by laying a broad and secure foundation.

The difficulty now is that there is a constant demand by both young and middle aged men for exclusively veterinary instruction, and who are not sufficiently qualified, educationally, to matriculate for the work where it is now given. We can not place the work lower down in the course to accommodate these applicants without lowering the present high standard, and encouraging charlatanism. I believe it will be well to consider the advisability of giving a two years short course for such applicants.

Largely through the effort and influence of E. H. Grubb, at Washington, I received from the Department of Agriculture a three months' appointment as expert investigator of scabies in cattle, and poison weeds on the Western Slope, beginning June 15. The College, wishing to co-operate in this work and make it as thorough as possible, several animals badly infested with scab were donated by enterprising stockmen of Yuma county, they were transported to College by the railroads without charge, and having the desired subjects accessible at all times will greatly facilitate the work. Among the important things, we wished to make a careful study of the life history of the parasite, and by the use of various crude oils, and standard dips, determine, if possible, the most economical and effective way of coping with this vexing problem.

Because of the fact that the parasite is inactive during the fall and early winter months, the work has been practically at a stand still, but will be taken up later when conditions are favorable and the report will follow in due time.

Poisonous plants on the range. I believe that it is generally conceded that there is no place on earth where the live stock industry flourishes under more favorable conditions and more unhampered by the ravages of disease, contagious and otherwise, as in this arid region of the United States.

In this State the greatest annual mortality on the open range, under the present regime, is not from disease nor perhaps from exposure, but from various poison weeds which grow native and to a less extent in cultivated fields. The stockmen have, on this account, in many cases, become greatly discouraged and quit the business or abandoned otherwise good ranges.

While one of several plants are in each case thought to be responsible, yet there will not be two men in a community who will agree as to the identity of the plants responsible, or the best means of dealing with the matter.

The annual loss from this source in the aggregate is very heavy. There is great need of education among the range live

stock men on this subject. The localities where these particular plants flourish should be defined, their identity made easy and the time of year when they are most dangerous and are to be avoided should be the subject of careful investigation.

My report to the Department of Agriculture on last summer's investigation of range conditions on the Western Slope, will be printed and made accessible in the near future.

Other diseases. The ravages of blackleg have been successfully checked wherever proper vaccination has been tried. At present it is the only hope we have of reducing the mortality of this dreaded disease of young cattle.

By an eternal vigilance on the part of our State live stock sanitary officers, glanders, southern cattle fever, and, in fact, all of the infectious and epizootic diseases have been kept under complete control. Tuberculosis among the milch cows in the dairies, supplying milk to our cities, is not an uncommon thing.

The unisity of tuberculosis in man and the bovine is settled in the minds of nine-tenths of the scientists now living, and the transmission of this dread disease by milk of the cow is generally conceded. There should be a rigid health inspection of all dairies within the State.

Needs of Department. Beyond a few incidentals, we are not in need of anything at present. Our present quarters in the basement of the Commercial building are somewhat unsanitary and are inappropriate, and in a short time will be entirely inadequate. All we ask for in the future is what we have had in the past, i. e., what we deserve and what our condition seems to demand.

Respectfully submitted,

G. H. GLOVER,
Veterinarian.

REPORT OF THE DEPARTMENT OF HORTICULTURE AND BOTANY.

To the State Board of Agriculture:

Gentlemen—I have the honor to submit the report of the Department of Horticulture and Botany for the year 1904.

The instruction for the year has followed the schedule as published in the catalogue, with the exception of nature study. Five hours per week of this work during the fall term was allotted to the department instead of the two hours that had usually been given. Arrangements were made whereby Mr. Payne, of the Experiment Station staff, was detailed to take charge of these classes. I wish to take this opportunity of expressing my appreciation of the satisfactory manner in which Mr. Payne carried this heavy term's work through to completion.

Mr. F. M. Rolfs, who has been associated with me in the department for four years, resigned in August, to accept the chair of Horticulture and Botany in the Agricultural College of Florida. The place has been filled by Mr. B. O. Longyear, of the Michigan Agricultural College. Mr. Longyear has had ten years' experience as a teacher of botany, and was for two years botanist of the Experiment Station, so he comes to us well equipped for the work.

A number of terms' work in both horticulture and botany have recently been added to the course, consequently another assistant is sorely needed. At present our time is nearly all occupied with teaching and routine duties, leaving almost no time to devote to investigation. And should one of us be called away from the College for a day, some of the classes would have to be suspended.

Campus. Some improvements have been made in the campus during the past season which need not be enumerated here. Our plan has been to make the remote corners and by-places presentable and thus make a unified whole. We are planning for some extensive improvements the coming season, but the only work for which money will be needed will be for curbing along the north and east sides of the campus. The parking outside of the sidewalks adds very materially to the appearance of any property, and this can not be done along College avenue without a curb to hold the earth in place.

Greenhouses. I desire to call your attention once more to the unsatisfactory condition of the two older greenhouses. They are hardly worth spending enough money on to put them in first-class condition. However, one man worked five weeks on these

houses this fall, getting ready for cold weather, and some money was expended for repairs.

Equipment. For the first time, I find it necessary to ask for more equipment. The increased number of students taking work in botany, make the purchasing of more microscopes and accessories imperative. We ask for an appropriation of $237.90 to meet these wants.

The equipment along other lines is adequate for the present. The only difficulty being that we do not get sufficient time in which to make use of much of the apparatus that we already have.

Respectfully submitted,

W. PADDOCK,
Horticulturist and Botanist.

REPORT OF DEPARTMENT OF ZOOLOGY AND ENTOMOLOGY.

To the State Board of Agriculture:

Gentlemen—I have the honor to present herewith the annual report of the Department of Zoology and Entomology for the year 1904:

INSTRUCTION.

Aside from the preparatory classes, the work of instruction in this department is confined to the courses in Agriculture, Horticulture, Veterinary Science, and Domestic Science. The subjects taught are as follows: To the preparatory students, Elementary Physiology; to the sophomores, Advanced Physiology for two terms, Zoology one term, and Entomology one term; to the juniors, Comparative Anatomy, Entomology and Animal Parasites; to the seniors, Embryology, Histology, Entomology, and Evolution of Animals.

The work of instruction has been divided between the first assistant, Mr. S. A. Johnson, and the writer. At the June meeting of the State Board of Agriculture, Mr. C. R. Jones was granted a scholarship in this department, but before the time came for him to begin work he was offered a better paying position by the Bureau of Entomology of the Department of Agriculture, so this department has not had his services.

Mr. L. E. Burnett, who was employed as taxidermist in this department, died last May, and his place has not been filled, so that additions to the museum have almost entirely ceased. The relatives of Mr. Burnett allowed most of the specimens of birds and mammals belonging to the deceased to remain in the College museum, and they also gave the department the tools that Mr. Burnett used in his work.

One year ago the writer was appointed Expert in Charge of Exhibit in Economic Entomology at the Louisiana Purchase Exposition, which has necessitated the expenditure of a considerable time and energy outside of the regular college work.

NEEDS OF THE DEPARTMENT.

For years the department has been in crowded quarters, and its work has been rendered inconvenient, and, to a considerable extent, inefficient, in consequence of not having suitable rooms for class and laboratory work and for the College museum.

Because of raising the grade of our college work, and the addition of new subjects to the course of instruction, and be-

cause this department has been running very low on equipment for several years, it is quite important that it should be dealt with as liberally as possible for a year or two, that it may be creditably equipped for the work of instruction and investigation that it has in hand, and that its work may compare favorably with the work done in similar institutions in other states. The subjects that are assigned to this department can not be properly taught without the appliances that are employed in all first-class institutions. We can better get along with crowded and inconvenient quarters than with inadequate equipment. I very much hope that $1,000, at least, can be allowed the Department of Zoology and Entomology during the next twelve months for equipment alone.

The department also needs another assistant, some one who could do the work of a taxidermist and act as curator of the museum during the winter season, and as general field assistant during the summer season. Such a person could probably be secured for about $800 a year. An invoice of the property in possession of the department is attached hereto.

Very respectfully submitted,

C. P. GILLETTE.

Ft. Collins, Colo., Dec. 3, 1904.

REPORT OF THE DEPARTMENT OF CHEMISTRY AND GEOLOGY.

Fort Collins, Colo., December 7, 1904.

Dr. B. O. Aylesworth,
President of the State Agricultural College,
Fort Collins, Colo.

Sir—There have been no changes in the work in chemistry during the past two years, except such as have been rendered necessary by changes in other departments. Such changes as have been made have changed the work required of the students in no material manner. The changes in the courses of study in the College have necessitated the placing of the chemistry in the junior, instead of the senior year, but the amount of chemistry offered and required has not been diminished, except in some departments, which will be specified, I suppose, in the detailed reports of the respective departments.

The course in chemistry at the present time has been reduced to the minimum, which seems admissible in an institution of our grade and character. It, however, does not seem feasible to increase it, though it would be pleasing to me were we able to do so.

The course at the present time is, considering the advancement made in this branch of study within the past few years, really very elementary, and so limited in its scope that it is scarcely commensurate with the work aimed at by the institution or the position that the Agricultural College occupies in the educational work of the State.

I have not suggested the establishment of a special course in chemistry because, in my judgment, it could not be pursued by the students of our classes except at a sacrifice of time and energy which can be more advantageously expended upon subjects already offered in other departments, and which contribute more directly to the broadening of their culture, and, perhaps, even more to their improvement, both as individuals and as citizens, and which breadth of culture is a prerequisite to their success in chemistry. Were the conditions favorable, it would be very agreeable to me to have a course in chemistry extending beyond our present course by about two years. I regret to say that in my judgment it does not seem advisable at this time to introduce any more chemistry into the course. There is a little optional work offered at the present time, but it has just been introduced into the course, and it yet remains to be seen whether the systematic work now included in the course is sufficient to give the necessary

foundation for such advanced work as is contemplated in the elective work presented.

The class work has followed the prescribed course without any changes whatever, and has been kept up to the full requirements of the catalogue. We have tried to push the laboratory work beyond its present limits, but have found it practically impossible to do so in the time allotted to this branch of work, which really seems to be as much as the requirements of the other departments permit.

During the past and present terms it has been necessary to have two instructors in the laboratory to properly wait upon and instruct the class. This, of course, curtails, almost stops, the work of the department in other directions. The result of this will not be apparent in the publications of the department for about two years, but the investigations now in hand can not be prosecuted with that consecutiveness and breadth which is required for the attainment of commendable results, which, under the best conditions, are accomplished only at a large cost of time and effort. In order to accomplish a little in our experimental work which shall be of more than passing interest and perhaps of some permanent value, it seems necessary to do a very large amount of work, a good percentage of which may in the end prove to be of comparatively little value, and yet it is necessary to do it if we wish to maintain the character of our department and to accomplish some good.

Mr. Bishopp left us last July to accept a position as professor of chemistry in another school. His place has not been filled by the appointment of another owing to our appreciation of the questions of finance with which the Board has been faced. Heretofore I have preferred to take some of our own men and train them to do our lines of work. As a rule this works well and results in their desiring to go elsewhere to round out their education in these lines. It is a practice, however, which I think unwise to follow too continuously. I am not satisfied that it is either more or less expensive in either time or salary than to obtain persons from other institutions, but with increasing classes and important lines of investigation which can be taken up, we need the help of another man in the department.

At your last meeting, June, Mr. Douglass appeared before you to present his request for an increase of salary to $900 per annum. I made no mention of the matter in my semi-annual report, not because I was in any way opposed to his receiving an increase, or because of doubt as to his meriting it, but because I knew the time to be inopportune. Mr. Douglass was fully advised as to my position in the matter, and asked my consent to present his request directly to the Board, which I readily gave. Mr. Douglass is an earnest, faithful and conscientious assistant, in every way deserving of the increase in salary for which he asked, and which I recommend be granted to him.

The building and property under my charge are in good condition, and there are no alterations or improvements desired which require special mention in this report.

I have no request to make pertaining to supplies. The only thing which would facilitate our work is a typewriter, especially one which is provided with chemical symbols. There is such a typewriter on the market advertised at $100 retail.

Respectfully submitted,

(Signed) WM. P. HEADDEN.

ANNUAL REPORT DEPARTMENT OF ENGINEERING AND PHYSICS, 1904.

To the Executive Committee,
State Board of Agriculture:

Gentlemen—I have the honor to submit the following report of the work for the Department of Irrigation Engineering for the past year:

The previous work of this department and the work of the Experiment Station carried on by the Irrigation Engineer along lines directly associated with the fundamental problems of the agriculture of the State, have made the work of great importance in the attacks which have been made upon the right to irrigate in Colorado. Accordingly, when the request to take up the work as State Engineer of this State came in 1903, and the matter was submitted to you for your consideration, it was deemed more important in your judgment for me to take up that work under leave of absence, and that the possible value to the agricultural interests of the State would justify the temporary sacrifice of some of the interests of the department.

Consequently, during the past year I have been able to give comparatively little time to the direct work of the academic side of this work, but have been able to give more or less continual supervision, and to direct the character and scope of the work.

With telephone connecting the offices at Denver and Fort Collins, direct communication can be had at almost any time, and this has helped materially during the absences which have been necessary. With the aid of able assistants, the work of teaching has been carried on on the plans I outlined, and covering the scope and character of the instruction planned in the course. A more detailed reference will be given to the work of these assistants in the course of the report.

NEEDS OF THE DEPARTMENT.

The first and most pressing need of the department is room. With the growth of the department and the increase in its work, the building has been long outgrown. This need in the department has been recognized by you for some years, and efforts have been made to procure additional room. It has been a keen disappointment that the appropriation provided for by the last Legislature was unavailable and that the work began on the proposed building had to cease before the foundation was completed.

The needs, however, are more pressing than ever. The rooms are crowded with apparatus and material which is ineffective

because of lack of room, and can not be effective without an increase of space for laboratory, class room and work of investigation. While the work of the department has been adapted somewhat to the conditions by doing as much work of investigation out doors in the field as possible, the room is still so much below the actual needs as to constantly keep us reminded of the wasteful loss of time and effort which it causes.

The work of the Experiment Station is so much hampered in the office, and what is more important, the investigations in irrigation are restricted, and the office work of reduction, which is often the most important part of the whole work, is exceedingly hampered by the impossibility of an orderly arrangement of data. In the station work a large amount of very valuable data has been acquired during the past 16 years, and it is of vast importance in many respects. It has been the basis in the defense in the celebrated Elephant Butte case, which was indirectly an attack upon the right of irrigation in Colorado. It has also been the foundation upon which the defense in the Kansas-Colorado suit now pending is based.

Aside from the fact that this data could not be replaced if lost, is the fact that it has been of material importance to the State as a whole. The new building proposed was to have ample fire-proof vaults for the preservation of such data, and the need of such safe place of depositing it is very great. There is the constant apprehension of the possibility of losing the work of 16 years, and the knowledge that the loss of this data would be irreparable, and that such data could not possibly be replaced.

I mention the above as what is economically perhaps the greatest need for additional room, only because of the value involved could it be considered as secondary to the interests of the Department of Irrigation Engineering. It is not necessarily a function of that work, but having been under the same direction, the work shaded from one into the other, and the building serving both purposes it is proper to mention it in this report, and to emphasize the possible loss that would result in case of fire under the present conditions.

In the work of teaching, the disadvantages are many. From one to two classes per day at the time when I took charge of the department, without field work, without assistants, and with almost no apparatus, the department now has from eight to twelve or more classes per day in forenoons, and from three to eight in laboratory and field work for two-hour periods in the afternoon. The need for class rooms is therefore far in excess of the room available. It is often necessary to take classes to remote parts of the grounds. Aside from the inconvenience, is the more important loss which comes from the fact that the class is remote from the instruments, apparatus, charts and diagrams which are stored in the building of the department.

The laboratory for the classes in physics has never been suitable for satisfactory work. It is in the basement, poorly lighted and so small that it requires a relatively large amount of supervision. The effect of poor laboratory facilities is shown in the character of the work. The hydraulic laboratory which was started some years ago has had to be given up and the room devoted to the storage of material. The material which we already have and the activities would require at once a building as large as has been planned and as was provided for by the last Legislature. Some of the most valuable work of the department could be done with a suitable hydraulic laboratory, and while the lack of such laboratory has been overcome to some extent by the facilities offered by the canals and reservoirs of the State, yet this causes a change in the character of the work, and makes it necessary to take up a different class of questions. Some of those which now arise are questions which need careful laboratory investigation, and where the most valuable part of the work done will be by laboratory methods.

IRRIGATION ENGINEERING.

The work in this College is the first work along the line of irrigation engineering done in this country. The title of the department was originally physics and engineering. In 1890 it was changed to irrigation engineering, and a course established by action of the Board at that time. This was the first course of the kind. Not only did the work have to be outlined, but also a great deal of the instruction had to be provided without the aid of text books. It has been our attempt to use the facilities which we had to the best advantage, and to qualify our young men so far as facilities at our disposal would permit, so that they would be both useful citizens and qualified to earn their own way. Realizing the limitations, as well as the importance of the work, we have given more attention to some of the problems of hydraulics than to the general questions of engineering.

An examination of the list of graduates from this department since 1892 will show the degree of success that has been attained. I feel still more strongly the need for such training for the best development of the State, and that such work can never be of more importance than at the present time, when our irrigation laws and customs are taking form, and when the need for young men, completely or partially trained, is felt as it never will be again. There is opportunity in this line for young men to be of material value in the development of the State, and there is a call for them not only in this State, but in all other irrigated states of the West. Consequently, I feel that the conditions are more promising than ever before, and better justify the choice of such work on the part of young men, and make it more desirable for a Board like yourselves to anticipate the needs of the agriculture of the State in preparation for the future.

In addition to the training in the physical application of water, there should be given, what at present is doubtless more important to the agriculture of the State, and that is the training of a class of young men who may be qualified for the responsible duties of the administration of water. The conditions in the past have been such that I have discouraged, rather than encouraged, them to look for employment as water commissioners. An occupation where continuity of service and compensation do not depend upon faithfulness of service and qualification, is demoralizing to young men, and I have discouraged their consideration of such work. The indications are at present that a change is likely to occur, and with the increased value of water to the agriculture of the State, there will doubtless be a development which will require qualified young men, and where the conditions will be such as to justify a young man in preparing himself for that work. With the present stage of development I firmly believe that the greatest value to the agriculture of the State may be along that line for the present. The value of a cubic foot of water per second may now be considered as $30 per day, and, consequently, based solely on the economical considerations of agriculture, and as the possibilities of extravagance are exceedingly great, by the better distribution of water in the different water districts of the State, the increased production may be very large, and the training of our young men along this line will give the greatest immediate returns. The improvement in use by farmers requires the change in the practice of individuals, and, necessarily, will be relatively slow process; so, while the improvement in the practice of individuals is of great importance, it is one slower in its results, and will show much less speedily than an improvement in distribution.

In the work in civil and irrigation engineering we have felt that the limitations in training made it best for us to emphasize the training in hydraulics and irrigation engineering rather than in the technical side of civil engineering. The conditions existing in the State have made such training of greater value and qualified our young men to take part in the work of the State. An examination of the list of our graduates will show what they have done in this respect. We have been almost the only institution that has qualified the young men even partially. The possibilities are such that it is extremely desirable to better prepare them, and I feel that we can and ought, with better facilities, to turn out young men immediately available for much of the important work of the State that can be foreseen to be necessary.

ASSISTANTS.

The department has been fortunate in having capable assistants. In 1903 Prof. W. J. Myers was Assistant Professor of Engineering. Professor Myers had formerly been connected with the Experiment Station, and subsequently was Professor of Math-

ematics in the College. He was able to come to us during last year. The work was somewhat interrupted in the spring by calls to some work in the East, and by some work which he did on the Kansas-Colorado case. Professor Myers resigned last June, to give his entire attention to some investigations in connection with the Kansas-Colorado suit, and also to take up work as special expert for the United States Census, in which he is at present employed.

With the increase of work in the spring term, Prof. G. N. Houston was engaged to assist, and upon the resignation of Professor Myers in June, he was appointed as Assistant Professor, and has held the position since that time. He was in immediate charge of the field encampment which for a number of years has been an essential part of the course.

During 1903, Mr. S. L. Boothroyd was Assistant in Physics. For a part of the summer he did some special work for the Experiment Station, and for the United States Department of Agriculture. Early in the fall, a few weeks after the opening of the fall term, he received an appointment at Cornell University, Ithaca, New York, and resigned his position with us. This came at an awkward time, and for a period of some two weeks some of the classes were without instruction. By that time arrangements had been made with Prof. J. E. Bonebright, formerly of Idaho University, and he has since been in charge of the classes in physics.

The arrangement with Mr. Bonebright at present is limited to January 1st. It must be determined whether this arrangement shall be continued for the remainder of the school year, or whether other arrangements should be made. One cause for the present arrangements was the fact that arrangements were partially made with another young man, and it was found, after arrangements had been almost completed, that his Board of Control would not release him until the Christmas holidays. That arrangement is still pending, and has not been completed. It, therefore, is a question whether it is desirable to complete that arrangement, or to engage Mr. Bonebright to continue to the end of the school year.

In the spring, Mr. Lamb helped Mr. Boothroyd in the laboratory instruction in physics. Mr. Lamb had been helping in the Experiment Station for a part of the time. He subsequently entered the work of the United States Geological Survey and left the department short-handed in that work.

Mr. R. L. Parshall, of the graduating class, has been acting as assistant during the fall term, and upon him has fallen a considerable portion of the laboratory instruction in physics under the supervision of Mr. Bonebright.

The assistants in the Experiment Station are not officially a part of the Department of Engineering, although under the same head.

The work of the above assistants has, as a whole, been very satisfactory, and the success of the work of the department is very largely due to them.

FIELD CAMP.

The class in Civil Engineering were taken for their annual field encampment in the latter part of August. The trip was again made to Estes Park, which, as a whole, offers more of the desirable conditions for field work than any other region that is within our reach. It affords a great variety of topographical conditions, running streams for hydraulic work, communication by telephone and by mail, and stores for the purchase of supplies.

The work this year was the survey of a reservoir. The class ran transit and level lines necessary to make a filing, and each member of the class has been expected to prepare complete maps for filing. This work was immediately directed in the field by Professor Houston and Mr. Parshall.

THE NEEDS OF THE DEPARTMENT.

The first and greatest need, as before mentioned, is a building such as has already been planned, the erection of which we had hoped for for a number of years. The equipment which is needed is entirely secondary to the above need. With the limitation in room every material addition to the present equipment tends to hamper the work because it decreases the available space, hence the additions of equipment are mostly small and rather along the line of current supplies.

I would call attention to the fact that during the next scholastic year we shall need to provide for additional classes. This will require some additional school room and also more instruction. Because of the change made in the College course a few years ago, one class was dropped out. A year ago we had no junior class, and this year we have no senior class. That is, last year we had freshman, sophomore and senior classes, the present year we are giving instruction to freshman, sophomore and junior classes, and next year we will have freshman, sophomore, junior and senior classes in addition to the sub-freshman classes. The additional instruction required will call for the services of another instructor for a part, if not all the time, and will also make necessary a corresponding number of class rooms. The matter of another instructor will not need to be settled now. It can be brought up at the June meeting of the Board.

DIVISION OF ENGINEERING.

Professor L. G. Carpenter:

Dear Sir—I would submit the following report of my work in this department from March 1, 1904, to date:

During the Spring Term I took charge of the following classes: Freshmen in Surveying, sophomores in Irrigation Engineering, and the freshmen, sophomores and seniors in Field Work.

There were twenty-four freshmen in the class in Surveying. This included all students taking the Engineering courses. The greater part of Raymond's Text Book on Surveying was covered in the class room, and the use of the chain, tape, compass and level in elementary problems in the field.

In Irrigation Engineering Wilson's Text Book was used. Eight sophomores reported for this class. In field work the sophomores, a class of fourteen, ran a preliminary and location survey for about two miles of railroad, it being the intention to supplement in this way the theoretical course in Railroad Engineering given in the winter term.

The senior class last year, being the last class to graduate under the old three year schedule, would correspond in standing to the present junior class. The field work of this class of six consisted of one half term in practical work with surveying instruments and one half in gauging ditches in the vicinity.

THE FIELD CAMP.

We left Fort Collins on the morning of August 25, with our camp equipment packed in three wagons, and arrived in Estes Park on Saturday morning, August 27.

Our party consisted of nine juniors, seven sophomores, Mr. Parshall (my assistant), a teamster, a cook, and myself, twenty in all.

The National Guard of Colorado kindly loaned us one fly tent, two officers' tents and one Sibley tent, which, together with my own 10x16 wall tent with fly and small tents of this department, furnished comfortable quarters this year.

The work consisted of the survey of a reservoir site. The proposed reservoir covered about 200 acres, is about one mile long, one-half mile wide in the widest part, with a maximum depth of thirty feet. The work included a traverse on the high water line, which checked within 1 in 3,500, and the obtaining of the topography by means of parallel sections run across the site on which

every five-foot contour was located. Where this failed to show the topography sufficiently it was supplemented by the transit and stadia method, based on a system of triangulation points. The traverse was worked up and a field map made.

Returning, we arrived at Fort Collins in the afternoon of September 9.

The sophomores are now, under the winter term course in Draughting, making a complete map of the site such as is required for filing in the State Engineer's office.

Before leaving this matter I would say that in order to properly do the work and maintain the good health of the party, the following additions to the camp equipment are imperative:

One officer's tent, 10x16-4′ wall with fly, 10 oz. duck.

Three Sibley tents, United States National Guard type.

One officer's tent, 10x12-4′ wall, United States National Guard type.

The present rope ridge tent and the pyramid tents can be used advantageously for store tents, cook tent, etc., as they were this year.

There should also be one light steel range.

FALL TERM.

During the fall term I have had the classes in Seminar, Higher Surveying, Mechanics of Materials, Strength of Materials, Laboratory and Field Work.

Nine sophomores reported for Higher Surveying. In this course we reviewed Raymond's Text Book and supplemented it by the descriptive matter in Pence & Ketchum's Field Manual. This occupied a little more than one-half of the term, and was followed by a course of lectures on the elementary astronomical conceptions and the mathematical calculations involved in the determination of time, latitude and azimuth with the common engineer's transit.

The field work of the sophomores in the afternoon followed in general the problems in Pence & Ketchum's Field Book under "The Transit and Level" with additional observations for time, latitude and azimuth.

Ten juniors took the course in Mechanics of Materials. Merriman's Text Book was used, the work covering the first six chapters. Owing to the fact that the testing machine is in need of repair, that it has no proper registering apparatus, and that the course was crowded into the first half of the term when the students had very little conception of the subject, the course in Strength of Materials Laboratory did not prove very satisfactory.

SEMINAR.

During the fall term two hours per week were given to Seminar by the juniors. Each man was required to prepare a paper on some important engineering topic and read it before the class, after which a general discussion took place. Under this course such matters as the work of the U. S. Reclamation Service and the construction of the Moffat road were reviewed and discussed.

WINTER TERM.

The sophomores are using Webb's Text Book in the course in Railroad Engineering as usual.

The course in Materials of Construction is given for the first time this year. It occupies the first half of this term, and covers part II in Johnson's Text Book.

The sophomore course in Draughting, as I said before, consists at present of working up and platting the notes taken on the field trip. Owing to the small quarters this class reports in two sections on alternate days, each four hours, instead of two hours per day, as scheduled. With this arrangement it is impossible to put in the full time, as no satisfactory draughting can be done after four o'clock p. m.

The arrangements for junior seminar this term are as follows: Each member of the class is to prepare a paper on an assigned subject, and read it before the engineering society. It is to be neatly written on manuscript paper, and handed to me at least three days before reading, for correction and grading.

Respectfully,

G. N. HOUSTON.

Fort Collins, Colorado, December 7, 1904.

DIVISION OF PHYSICS.

To Professor L. G. Carpenter:

Dear Sir: During the fall term of this year, 1904, the Division of Physics had in the second sub-freshman class 59 students in three sections in recitation work, and fifty students in four divisions in the laboratory work. The students in the second sub-freshman class were registered for two hours laboratory work each day, but although the laboratory was open every afternoon up to 5:30, it is impossible with four sections to give the students more than two hours laboratory work on alternate days. To make up for this, quizzes and additional drill work were provided for those students who were not in the laboratory. This arrangement of the divisions for the laboratory work is somewhat a disadvantage to the student, since he is able to attend but four hours one week and six the next. The size of the laboratory would have to be doubled to accommodate all the students with two hours laboratory work each day. Laboratory room is very badly needed.

There were 19 students registered in Mechanics for the fall term in the sophomore class. This class during the term covered the first 126 pages of Wood's Mechanics. The class was very unfortunate in having no instructor during the first month of the term, September. I began the work here the first of October.

The fall term in the second sub-freshman Physics covered the first 140 pages of Carhart & Chute High School Physics. This included mechanics of solids, and mechanics of fluids. In the laboratory the students performed from fifteen to twenty-five experiments, kept note books and passed examination on the experiments performed.

During the winter term the second sub-freshman class will be expected to reach "Electricity and Magnetism" in Carhart & Chute High School Physics. This class will probably finish, on an average, about twenty more experiments in the laboratory during the winter term.

The divisions of students in the recitation and laboratory work of the second sub-freshman class are the same as during the fall term. The number of students for the winter term is practically the same.

The class in Mechanics for the winter term consists of but fourteen students, all of whom are taking the Civil Engineering course. This class will be able to cover the remaining portion of the text in Wood's Mechanics during the winter term.

Respectfully submitted,

December 9, 1904. J. E. BONEBRIGHT.

REPORT OF DEPARTMENT OF MECHANICAL ENGINEERING.

To the State Board of Agriculture:

Gentlemen: I have the honor to submit herewith the annual report of the Department of Mechanical Engineering. The work of the department has been carried by classes as follows:

FIRST SUB-FRESHMAN CLASS.

The members of the sub-freshman class come to the department for shop work only, and they have been given instruction in the wood-working room and blacksmith shop.

SECOND SUB-FRESHMAN CLASS.

Those who begin their work in the institution in the second sub-freshman year are given instruction in the wood-working room and blacksmith shop, and those who have reported during the past year have been given such instruction.

A number of irregular and special students have taken the work with the first and second sub-freshmen.

FRESHMAN CLASS.

The freshmen have received instruction in instrumental drawing embracing 110 geometrical problems, and 50 problems in orthographic and isometric projections.

They have received instruction in lettering for mechanical drawings. Numerous drawings from copies from acknowledged authorities in engineering work have been made. The members of this class have also received instruction in tracing and blue-print work.

There have been fifty members in the class in Carpentry and Joinery and the work has consisted of a preparation, by means of a text book, for the lecture work which concludes the study.

The text book work is principally on wood-working tools, their care and use, and also on the handling of timber from the tree through the seasoning yard or kiln; later the class was given a course of lectures on contractor's work, and the use of the steel square.

They have completed work in wood-turning and pattern work extending over one and one-half terms.

SOPHOMORE CLASS.

The students in this class have received instructions in the sketching of machine parts, and during one term they made designs for screw threads, bolts, nuts, cap screws, etc. Another term was devoted to elementary machine design.

Text book work and lectures upon machine shop appliances were taken up for one term.

JUNIOR CLASS.

The members of the junior class taking the work of the past fall term have completed, in the department, the study of the elements of mechanism.

On account of the change in the course of study of the College, and being yet in the transition period from the old course to the new, there was no regular junior class last winter and spring.

SENIOR CLASS.

This year there is no regular senior class.

Last year's students in the regular senior class completed the study of the principles of mechanism, the study of steam boilers, steam engines and steam engine design.

The members of the Senior Class also did a good deal of work in the mechanical engineering laboratory.

Great interest is taken in this laboratory work, and I desire very much to see it elaborated and extended; this, of course, will require the expenditure of some money, but it certainly will be of lasting benefit to the young men about to leave the institution, as it affords an opportunity for original investigation and experimental work.

Before any more apparatus is put in this room the portion of the stone floor not completed should be attended to, as it is in a very disagreeable condition when work is being carried on.

RECOMMENDATIONS.

I would respectfully ask your attention to a few things about the department that I think should be looked after at an early date.

The completion of the stone floor mentioned above is one thing.

When the college buildings were overhauled, repaired and painted, a few years ago, the Mechanical Engineering building was not repaired or painted; it needs attention now, as the roof leaks in several places, the paint is coming off the woodwork in many places.

One of the most urgent needs of the department at the present time is a well equipped wash room for the students. The pres-

ent wash room is one provided twenty-one years ago, and is designed to accommodate six students at a time.

There are now from one hundred and fifty to two hundred students in the shops, and about half of these are liberated from their tasks at a time, and it is impossible to properly accommodate them.

My plan for remedying this is to put a glass roof over the open court between the two portions of the building, moving the foundry supplies to a place under a good sized wooden shed, which could be built at the west of the foundry. This would give a place for a good wash room, and it might be provided with a cement floor, permitting it to be washed clean, and drain into the sewer which now passes under the open court.

There would be ample room for wash sinks and coat lockers. I should be much pleased to have you look into this matter at this Board meeting. I should like to have a moderate sized skylight put on the north slope of the blacksmith shop roof, to assist in giving better light in the middle of the room.

Since more studies have been added to the Mechanical Engineering course, there will be several classes, in different subjects, requiring class rooms for their recitations at the same hour, and, as we have but one recitation room in the department, I would like to have another partitioned off the end of the machine room as soon as it can be arranged, and some desks provided.

I would respectfully request that an experienced carpenter be at once put in as assistant instructor in the woodworking room, and employed continuously; this would prove a very satisfactory arrangement, and enable us to better attend to the work which we are continually doing for the various departments of the College, and afford much needed assistance to the man in charge of the wood room, who now has ninety students in wood work, and sometimes considerably more than that number.

Respectfully submitted,

J. W. LAWRENCE,
Professor Mechanical Engineering.

REPORT OF THE DEPARTMENT OF ELECTRICAL ENGINEERING.

To the State Board of Agriculture:

Gentlemen—I have the honor to submit the second annual report of the Department of Electrical Engineering.

The first year for the department was a successful one. The sophomore work in "Elements of Electrical Engineering" was completed by the whole class in a very satisfactory manner. This work consisted of studying the principles of, and the laws governing, electric and magnetic circuits; the methods of measuring the several electric and magnetic quantities; the use of these laws and principles in the development of the dynamo, motor and transformer, and an investigation of the fundamental principles of electricity and magnetism in their application to the arts and sciences.

The work for the year of 1904-05 has progressed nicely. Laboratory work was given for the first time during the fall term. This work, as far as it could be carried, with the small amount of apparatus in the laboratory, was satisfactory.

The number of students registered for the work in Electrical Engineering, so far this year, greatly exceeds the number of last year. There are now forty-eight students of the College who are registered for this work. Of this number fourteen are in the four collegiate years, and the remaining number are in the preparatory department. The total number registered for Electrical Engineering is, therefore, over 13 per cent. of the total registration of the College.

In connection with my work at the College, the American Institute of Electrical Engineers, through its Secretary, has asked me to organize a students' branch of the institute among my students. This invitation came without any solicitation on my part, and should be considered a compliment of no mean degree. In compliance with this request the branch organization is about perfected. The associations which the students will have, through the agency of this organization, with the electrical engineers of this country will be of the greatest benefit to them.

During the summer months, by direction of the Board, I have had the electric wiring in the College buildings overhauled and put in first-class condition. As far as possible the wiring at the College is now in accord with the "National Electric Code" of the National Board of Fire Underwriters. The expense attending these changes is as follows:

Main building	$ 148.00	
Civil Engineering building	53.50	
Domestic Science building	33.00	
Horticultural building	34.00	
Mechanical Engineering building	141.00	
Commercial building	38.75	
Horticultural barns	2.25	
Agricultural building	60.00	
Farm house	1.35	
Farm barns	3.80	
Chemical laboratory	27.30	
Line and transformers	178.83	
		$ 721.78

The wires are now supported on insulators well away from iron pipes and braces, and from wooden partitions and floors. Each building has been divided into two or more circuits, thereby reducing the number of lamps on each circuit. All transformers have been taken from the building and placed on substantial poles. Cutouts, which were generally placed in dark attics and in other out of the way places, have been installed in distributing boxes where they can be easily inspected.

Since my last report I have purchased for the electrical laboratory apparatus amounting to $323.65, and for the lecture rooms apparatus amounting to $123.45. The laboratory apparatus consists of Weston volt meters and ammeters, resistance boxes, bridges, shunts, condensers, galvonometers, standard resistances and cells and laboratory keys and switches. The amount purchased was just sufficient to carry on my work up to the holiday vacation.

The importance of laboratory work in connection with the course in Electrical Engineering can not be overestimated. An engineering education should be just as practical as possible consistent with a thorough understanding of fundamental principles. The laboratory is absolutely essential to give the students a working knowledge of these fundamental principles. For these reasons it is my desire to build up a laboratory commensurate with the importance of the work and the needs of the students.

I have maintained a supply department in which are kept on hand lamps, lamp cord, switches, sockets, fuse wire, batteries and other material necessary to keep the lighting and bell systems in working order. These supplies are bought at wholesale prices, thereby saving the College considerable money. An inventory of the supplies now on hand is submitted.

I would respectfully call the attention of the Board to the needs of the department.

That the junior laboratory work may be carried on to completion, additional apparatus to the amount of about $1,000 should be obtained. A list accompanying this report gives this apparatus in detail. The apparatus on this list should be ordered as soon as possible, as a portion of it will be imported, duty free, and requires a long time to arrive.

I would recommend that the city water be piped into the Electrical Engineering building. At present there is no adequate means provided to guard against fire. The building is isolated from the other college buildings, and the danger from fire is, therefore, apparently a minimum. But the building is being heated with stoves, which increases the fire hazard. Water is now carried from quite a distance for use in the department.

Since the department was opened I have been using borrowed furniture in the office, such as desk, chairs, book shelves and typewriter desk. The rapidly growing electrical library requires shelf room. I would respectfully request that shelving be built in the office, that the office be provided with a roll top desk and a typewriter desk.

No provision has been made to protect the apparatus in the laboratory from the dust and from being handled by curious visitors. I would, therefore, request that a case be built in which the apparatus can be properly kept. The several pieces of fine and expensive apparatus will soon become injured by exposure to the dust, and by improper handling, and in a short time will need to be replaced with new apparatus. If they are properly taken care of they will last an indefinite time.

Respectfully submitted,

S. D. CRAIN,
Professor of Electrical Engineering.

Fort Collins, Colo., November 30, 1904.

REPORT OF THE DEPARTMENT OF DOMESTIC SCIENCE.

To the State Board of Agriculture:

Gentlemen—The Department of Domestic Science begs leave to submit the following report:

Since the annual meeting of the Board in December of last year the Department of Domestic Science has prospered, and here, as in the entire College, a general improvement by all the students has characterized the progress of the year.

The normal course in domestic science still attracts much attention, but on account of the prerequisites for entrance and the heavy work in the sciences, many are unable to take advantage of its opportunities, although they desire to do so. However, it is an excellent course for those who are prepared for it, and have time and money to devote two years to the varied and attractive subjects which it offers. When possible all classes have received instruction in accordance with the outline in the catalogue. As has been stated before, the building is inadequate to meet the demands of the growing department.

It has been necessary for several years for one or two classes to recite in class rooms of other buildings. This is very inconvenient, because the manual work necessitates the moving of equipment. With the excellent assistant instructors now in the department, the efficiency in all these lines of work would be materially increased if there were more room.

Hoping that your honorable body may be able to devise ways and means whereby this need can be met, I remain,

Most respectfully,

THEODOSIA G. AMMONS.

Fort Collins, Colo., December 1, 1904.

REPORT OF THE DEPARTMENT OF MATHEMATICS.

To the Honorable State Board of Agriculture:

Gentlemen—The following is respectfully submitted as the annual report of the work done in the Department of Mathematics:

During the year this department has given instruction to twenty-seven classes in mathematics. The work as outlined by the catalogue has been followed without a break and the following subjects have been taught: Arithmetic, elementary algebra, plane and solid geometry, trigonometry, descriptive geometry, college algebra, analytical geometry, and differential and integral calculus.

As a whole, the work of the students in this department has been good. There have been some failures, of course. This is to be expected. Some of these failures are the result of indifference and laziness on the part of the student, while some are due to a lack of preparation in the public schools.

In mathematics, more than in any other subject, one branch depends upon another, and when a student comes to us for college algebra, knowing practically nothing about elementary algebra, he finds himself beyond his depth, and unable to do the work. The only remedy is to send him to a lower class. This is often humiliating to him, but how much better to require him to lay a good foundation upon which to build than to allow him to continue in the higher work where he must fail and fail again until he at last becomes discouraged, and leaves College disgusted, sometimes with himself, but more often with mathematics.

I have, therefore, insisted upon making the work for the lower classes rigorous, and after thoroughly mastering the lower branches the students have very little trouble with the advanced work.

I believe in the new idea of "Laboratory Mathematics," and ever since I have been connected with the department we have invited and urged students to come to us in the afternoon, when we are not busy with class work, and get suggestions and help. This work is sometimes tiresome, but it has borne good fruit.

The following is a detailed account of the work for the year:

FIRST SUB-FRESHMAN CLASS.

Throughout the winter term of 1903 and 1904 this class continued the study of elementary algebra, begun the term before. The class was divided into two sections, and was made up of

eighty-two students. The work done during the term covered the subjects of factoring, highest common factor, lowest common multiple, fractions, and a start in simple simultaneous equations.

The spring term found sixty-four students enrolled. Those not able to do the work were dropped into an arithmetic class, and given a thorough review in this subject. The work of this term comprised simple simultaneous equations, involution, evolution, theory of exponents, and radical expressions.

When College opened again this fall a new class began the study of elementary algebra, and has been duly initiated into the mysteries of addition, subtraction, multiplication and division of algebraic quantities. The class this term numbered one hundred and twenty-eight students.

SECOND SUB-FRESHMAN CLASS.

The sixty-nine students of this class during the winter term continued the work in geometry begun the term before, and during the term they finished the plane geometry as given in Wentworth's text.

The spring term found sixty-eight students in this class, and their work in solid geometry covered the ground usually given in this work.

This fall a new class of fifty-nine students began the study of geometry. They have covered the work of books I and II of Wentworth's Plane and Solid Geometry.

FRESHMAN CLASS.

The mathematical work scheduled for the freshman during the winter term is trigonometry. There were thirty-seven students in this class, and the subject of plane and spherical trigonometry as given in Lyman and Goddard's text was mastered by most of them.

During the spring term the advanced college algebra held the boards, and the class of thirty-two students has as much pure mathematics as most young people can relish, and more than some could stand.

During the present fall term a new freshman class starts in and have just finished their fall term's work in college algebra. It is a good, hard working class of thirty-nine students, and will be a credit to the institution.

SOPHOMORE CLASS.

Students of the Engineering classes continue their mathematical studies during their sophomore year.

The winter term of 1903 and 1904 found twenty students at work on differential calculus. It was a good class, and the members were keen, hard-working young people.

The spring term was spent with the integral calculus, and the work was of the same high order as the work of the previous term.

The fall term just ended finds a class of nineteen young men finishing up analytics. They are good, level-headed boys, not as brilliant as some classes I have had, but far from being a poor class.

During the fall and winter terms the sophomores also take up the study of descriptive geometry. They take up the elementary problems of this subject, and many practical problems are given later. The class last year was a disappointment to me. They seemed to have great difficulty to get hold of the problems properly, and their drawings were poorly done—the first class I ever had that showed these symptoms.

The new class of this year are doing much better than last years' class, and it certainly is a relief, for I never worked with a class of boys as hard as I did with those of last year's class, and the results were anything but satisfactory.

During the winter and spring terms of 1903 and 1904 I had the pleasure of taking a student through some of the higher mathematics. After finishing all the mathematics taught in any of the regular courses, Miss Florence Stuver, the best student in mathematics this College ever knew, asked for more. Together, at odd times, whenever my time would permit, we took up the subjects of spherical trigonometry, solid analytics, determinants, and differential equations. She did all the extra work well, and deserves much credit for it.

I have to report harmony among the teaching force in this department. My assistants are honest, hard-working fellows, and are pounding away in hopes that some time, some day, Dame Fortune may smile upon them with an increase of salary.

In conclusion, I have to thank you, gentlemen, for the kind consideration and courteous treatment I have received at your hands.

Respectfully submitted,

E. B. HOUSE,
Professor of Mathematics.

REPORT OF THE DEPARTMENT OF LITERATURE AND HISTORY.

To the Board of Agriculture:

The past biennium has been a period of growth and progress in the Department of Literature and History. Courses in English and Mediæval History, and in the English Drama, have been added to the curriculum in the sophomore and junior years, and the enrollment, particularly in the lower classes, has been increased.

During the past year this department has found pleasant and commodious quarters in the south class room in the new chapel addition to the main building, and the efficiency of the department has thus been increased.

A commendable movement on the part of students has contributed to the decoration of the new room with art treasures, in which our College has been singularly lacking. The class of 1907, upon completing a course in American Literature, left as their contribution a portrait of Ralph Waldo Emerson, which now adorns the class room wall; the class of 1908 has contributed a bust of Shakespeare, and the class of 1909, upon completing their work in Greek History this fall, added a cast of Greek statuary to further adorn and beautify the class room for the benefit of those who will follow them.

Another forward movement in the interest of the general culture for which this department stands, is the lecture course for college girls, which was offered for the first time during the winter of 1903-1904.

The following list of entertainments was given:

"Some Other Women," Miss Frances Bridges, Chicago, Ill.

"A Day in a Girl's Life," Miss Anna Heileman, State Normal School, Greeley, Colo.

"A Place for Art," Mrs. C. H. Jacobson, Denver, Colo.

"The College Girl," Mrs. W. F. Slocum, Colorado Springs, Colo.

"Musical and Social," C. A. C. Girls.

"What the College Should Do for the Woman," Mrs. Sarah P. Decker, Denver, Colo.

"Rambles in Literary England," Miss Virginia Corbett, Fort Collins, Colo.

To the ladies who came to us from other cities, and contributed so generously of their time and talent for the benefit of

our college girls, we are glad to express our thanks and appreciation.

Another similar course of lectures has been arranged for the coming season, for which the following numbers have already been secured:

"Student Life at Wellesley," Miss Elizabeth Taylor, Minneapolis, Minn.

"An Afternoon of Readings," Miss Nanaruth Taggart, Denver University, Denver, Colo.

"Alumnæ Afternoon," C. A. C. Alumnæ.

"A Question for College Students," Mrs. H. D. Thatcher, Pueblo, Colo.

"The Making of the American Woman," Mrs. J. H. Baker, Boulder, Colo.

"Musicale and Social," C. A. C. Girls.

In addition to the changes and new features already mentioned, the regular work of the department has been carried out as prescribed in the catalogue. In most cases the classes have been large, and good student spirit and interest have been manifested.

The efficiency of the department is still greatly crippled by inadequate library facilities. We need, above all things, larger reading room space in the library, and access to the thousands of volumes stored for lack of shelf space, and to the many volumes of valuable periodicals which are now packed away awaiting funds for binding.

Respectfully submitted,

VIRGINIA H. CORBETT.

Fort Collins, Colo., December 1, 1904.

REPORT OF THE DEPARTMENT OF MILITARY SCIENCE.

To the State Board of Agriculture:

Gentlemen—I have the honor to submit the report of the Department of Military Science and Tactics.

The rosters of the different organizations show an enrollment of two hundred and fifty-eight (258) cadets, who have received instruction in the department during the present College year.

The assignment to the different organizations are as follows:

Staff	3
Band and field musicians	30
Company "A"	53
Company "B"	51
Company "C"	55
Company "D"	56
Recruits unassigned to company	10
	258

The proportion of new students being greater than usual, the preliminary training and individual instruction required has taken considerable time. In this connection a word of commendation is justly due the officers of the battalion, who have worked most faithfully in instructing those under them, and in advancing the work of the department in general. A most lively interest in the welfare of the military organization is displayed, not only by the officers, but as well by the great majority of the cadets.

The work so far in the present College year has covered, in part, the School of the Soldier, Company and Battalion, in close order. It is the plan to perfect the work in close order formation during the present term. The spring term will be devoted to drill in extended order, battle exercises, with occasional ceremonies, such as Battalion Parade, Reviews, Inspections, Escort of Color, etc.

During the fall term officers and non-commissioned officers' school has convened once each week for the purpose of study and recitation. The text book used has been the United States Infantry Drill Regulations, with the lessons and recitations covering the work as it progressed on the drill ground. These schools were very beneficial in enhancing accuracy and uniformity in the instruction given by the different drill masters.

Your Secretary, Mr. Hawley, has provided the department with a complete set of national flags for use on the College flagstaff. These are in every way similar to those in use at all army posts. A detail of three cadets are assigned each week, whose duty it is to raise and lower the flag at the proper times, and to have the care of them. This duty, I find, is enjoyed by the cadets, and is a means of increasing their respect for the nation's flag.

I would recommend that, if the change can be made with no great outlay of money, that the Springfield rifles now in the possession of the College be exchanged for the newer service rifle.

Respectfully submitted,

R. A. MAXFIELD,
Commandant.

Fort Collins, Colo., December 6, 1904.

REPORT OF THE DEPARTMENT OF RHETORIC AND PHILOSOPHY.

The State Board of Agriculture:

Gentlemen—In compliance with the laws of this State, I transmit to your honorable body, through the President of the College, the annual report of the Department of Rhetoric and Philosophy from December 1, 1903, to December 1, 1904.

During the winter term of 1903-1904 there were five regular classes conducted by the department, viz.: the freshman class in college rhetoric, in two divisions, the freshman class in themes, and the first sub-freshman class in elementary rhetoric, in two divisions.

The class in college rhetoric was composed of eighty-two students of freshman and junior commercial rank. Baldwin's *A College Manual of Rhetoric* was followed as a guide, the time being devoted to the work of description and persuasion. A leading part of the work was a series of debates in which every student enrolled for rhetoric took part. These debates were reviewed, criticised and judged by a committee of critic judges selected from the faculty of the College and from the ranks of professional men of the community. Themes were frequently written, and the class showed at all times a most commendable interest. The class in themes numbered forty-seven students of freshman rank. The work was practical, and the English of the class improved noticeably.

The class in Elementary Rhetoric was composed of eighty-seven students, who pursued the subject as presented in the pages of Scott and Denney's *Elementary English Composition*.

As the senior class of last year graduated under the old course of study, as there was, for the same reason, no junior class, the work of the spring term was principally in elementary rhetoric, the students in this study being about eighty in number. They continued the use of Scott and Denney.

During the fall term just closed, I have conducted classes in college rhetoric and elementary rhetoric. There being no senior class, the subject of logic was not taken up.

The class in college rhetoric was composed of sixty-six students of freshman rank. The text book was Baldwin's *A College Manual of Rhetoric*, the titles of exposition and narration being thoroughly covered. As a closing exercise, the students of the class elected a board of editors to whom they submitted for acceptance or rejection manuscript "copy" for a sample display magazine, divided after the manner of magazines in general into

departments, each department being under the charge of a special editor. As this work stirred up so much real effort and produced so many good results, the work done on the articles for this magazine were allowed to stand for the work of the final examination in college rhetoric. This arrangement found ready favor with the whole class, being regarded as eminently fair, and it proved one of the best devices that I have ever used in gaining from the students their best work and endeavors.

The class in Elementary Rhetoric numbered one hundred and twelve students pursuing the study from A. S. Hill's *Beginnings of Rhetoric and Composition*—a new book which is in every way a most decided improvement over any other manual of elementary rhetoric which we have ever used in our classes. A great deal of written work is asked for, and especial emphasis is laid upon diction, spelling and general accuracy in interpretation. As it is perfectly possible to notice from day to day the improvement in the work of the students of this class, their work is naturally pleasing and interesting to the instruction, as all such advancement and progress is growth and improvement.

Respectfully submitted,

EDWARD M. TRABER,
Professor of Rhetoric and Philosophy.

Fort Collins, Colo., December 6, 1904.

REPORT OF THE DEPARTMENT OF CONSTITUTIONAL HISTORY AND IRRIGATION LAW.

To the Honorable the State Board of Agriculture:

Gentlemen—I have the honor to submit herewith my semi-annual report as professor of the Department of Constitutional History and Irrigation Law.

The summer vacation immediately following the date of my last report was spent in an investigation of the irrigation laws of the seven leading irrigation states, as the same especially related to the office of State Engineer, the work being under the direction of Dr. Elwood Mead, Chief of the Bureau of Irrigation Investigation of the Department of Agriculture at Washington. This work proved of great value to me as an instructor, as it enabled me to present to the class in Irrigation Law the latest legislation on this subject, in the form of lectures, the facts contained therein being otherwise unattainable, not yet being in print.

During the fall term I conducted the classes in Commercial Geography, International Law and Irrigation Law, in all of which great interest was manifested by the students. During the present winter term I am conducting classes in Advanced History and in Political Economy. Not a little of the work that has fallen to the share of this department is the coaching of students in the matter of debates and orations. While the task is a pleasant one, it involves during the school year no small amount of time, but I am thoroughly impressed with the belief that no expenditure of time is more profitable or advantageous to the students who engage in these debating and oratorical contests. When once the proper line of investigation is pointed out to them they enter upon it with zeal and enthusiasm. The result is a broadening of the student's intellectual horizon and a toning up of the literary spirit of the entire institution.

I have but one suggestion to make in regard to the work in this department, and that relates to the present inadequate library facilities. The highest success of students in the line of studies committed to this department lies in their ability to consult various authorities in law, history and economics. These facilities are at present almost wholly lacking. The librarian is always prompt, willing and zealous in rendering all possible assistance, both to students and professors, but he can not accomplish the impossible. The library needs room so that students can have the use of tables in consulting the authorities to which they are referred by their instructor. Many of the most valuable

works in history and economics have been issued in recent years, none of which are to be found on the shelves of the library. There are no works on the history, growth and legal development of irrigation institutions in the library. Even the government bulletins on these topics, most of which are extremely valuable, are not in a shape where they can be consulted by students. The library is the real work shop of an educational institution, and its conditions can retard or advance the work of every department. In the especial interest of my own department I invoke for it your kindly attention and fostering care.

Acknowledging the constant courtesy of the President, the faculty and the entire management, I remain,

Very respectfully,

W. R. THOMAS,
Professor Constitutional History and Irrigation Laws.

The State Agricultural College, Fort Collins, Colo., December 10, 1904.

REPORT OF THE COMMERCIAL DEPARTMENT.

To the Honorable the State Board of Agriculture:

Gentlemen—The Commercial Department is taxed to its utmost capacity, both in number of students registered and equipment. Many applicants were unable to register through lack of preparation, for the work of the Junior Commercial class. Two graduates of the College are taking the course. Other graduates have made inquiries about the opportunities offered and would like to undertake the work. A number of students in the regular courses are taking special work in the department. The enrollment does not vary from year to year, since only so many can be accommodated with the present equipment and teaching force. Students in the technical work spend just double the time in practice as compared with most business courses.

Over 75 per cent. of last year's Junior Commercial class returned to complete the senior year and are candidates for graduation. The few who did not return secured lucrative employment.

There were but two failures in the work during the fall term, and in these instances the students are entitled to a re-examination. The students are intent upon their work. Such an evident and eager interest in their studies has never been so manifest. There are no malingners in the Commercial Department. The young men belonginging to the football eleven, it is gratifying to note, are among the best students and stand highest generally.

There has been one withdrawal. This student will return next year and complete the senior work.

Speaking for the students, it would be difficult to find a more earnest and energetic body of students; at all times courteous and industrious, and deporting themselves as young ladies and young gentlemen desirous of accomplishing something.

Respectfully submitted,

LATHROP M. TAYLOR.
CHAS. G. DWYRE, JR.

Fort Collins, Colo., December 1, 1904.

ANNUAL REPORT AND INVENTORY OF THE LIBRARY.

To the State Board of Agriculture.

The following is a condensation of the annual report which is respectfully submitted with reference to the library:

The Board is respectfully referred to the contents of the three previous reports for information and for requests not mentioned in this report.

We have reached our limit of storage room, vacant rooms, hallways and all available space has been used for the most compact box storage. In one room, alone, in the chemistry building, we have a solid cube of boxes (nearly 12 feet) containing about 125 boxes, with nearly 4,000 volumes. In the department libraries we have about 3,000 volumes on open shelves. In the library stackroom and reading room we have nearly 11,000 volumes on open shelves and the rooms are so small and so full that we have to do all our work on the window sills.

There is no building on the college grounds large enough to contain the library, which, at the same time, is possible for that purpose. Only two buildings can be considered in any scheme for housing the library; (1) the *Civil Building*, which is too small, not fire proof and not strong enough, (2) the *Commercial Building*, which is not fire proof and which must be "double decked" (two-story stack) in order to hold the books we are to put into it. We need immediate shelf room for 25,000, besides a reading room and a delivery room.

A steel structure in the *Commercial Building* would cost too much money ($3,500) to put into a building of that kind, yet, because of many advantages (noted), steel is what we ought to have.

Beginning with the last session of the latest Congress we became "a designated depository," and with the help of our congressman-at-large and the Superintendent of Documents we have a valuable document library which we must shelve in order to retain the designation.

An agricultural college ought to have a good working set of the publications (and they are many) of the U. S. Department of Agriculture. We have all the indexes and we ought to try to acquire a respectable set of the documents.

We have not attempted a collection of State or of foreign documents. We have no time and no money which is not absorbed and exhausted before we get to them.

Our collection of experiment station bulletins and reports are better than one usually finds in a library and we have a 25,000-card catalogue covering the collection. It ought to be bound and shelved where it may be used.

The U. S. government check lists, catalogues and indexes in this library are almost complete, including 15 shelf-feet of printed books and more than 50,000 printed cards. Our index collection is better than our document collection.

Our list of donors and donations include 49 names and 1,318 pieces added to the library records. The list should be printed here, but exceeds the space allotted for this report.

The circulation records are analyzed and discussed with reference to the problem of more room and more help.

The condition and the progress of the catalogue is set forth in detail and the necessity of more cabinets pointed out. Capacity for over 150,000 cards is required for all the catalogues, printed and typewritten. Purchase of A. L. A. and Library of Congress cards is also recommended. The growth and care of the shelflist is included in the discussion of catalogue.

Special requests for catalogue cabinets, agricultural literature (bulletins, etc.), periodical binging (2½ years), back numbers on our periodical "want list," amount to 1,215.

The inventory amounts to $30,802. Amount for books added by purchase, $975.14.

Bound volumes in the College Library.....	16,639	
Duplicates and other bound and unbound.....	7,500	
Total		24,139

I take this occasion to thank all those who have been helpful to the library and to state that the ordinary routine work has been very satisfactory during the year.

The only difficulty that meets us on all sides is the lack of room* in which to do our work and in which to serve the students and faculty.

Very respectfully submitted.

JOSEPH F. DANIELS,
Librarian.

*Since the writing of the report, the Board has ordered the Commercial Building made ready for the Library during the Christmas recess.

REPORT OF THE STATE BOARD OF AGRICULTURE

PART II.

REPORT OF

THE AGRICULTURAL EXPERIMENT STATION

THE STATE AGRICULTURAL COLLEGE
OF COLORADO

THE SEVENTEENTH ANNUAL REPORT

OF

The Agricultural Experiment Station

For 1903-4

LETTER OF TRANSMITTAL.

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, *President*, 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,	*ex-officio.*

EXECUTIVE COMMITTEE IN CHARGE.

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

STATION STAFF.

L. G. CARPENTER, M. S., *Director*.....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			$16,313.59

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	211.61	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	$15,000.00	$ 834.19	$15,834.19
Balance		479.40	479.40
			$16,313.59

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 biulding 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 fireproof 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 af 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 (Loxostege sticticalis)—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 grasshopers, 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 (Schizoneura 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 persicæ-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 innumerabilis)—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 rosæ)—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 soluable 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 alkalies, 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	Yield No. of sacks	Yield No. of pounds
6	Treated with corrosive sublimate	73½	8,820
6	Some evidence of Rhizoctonia on all seed	69½	8,340
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	Yield 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	5,830

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 exeperiment, 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 occassionally 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 Pencillaria, 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 3½ 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.