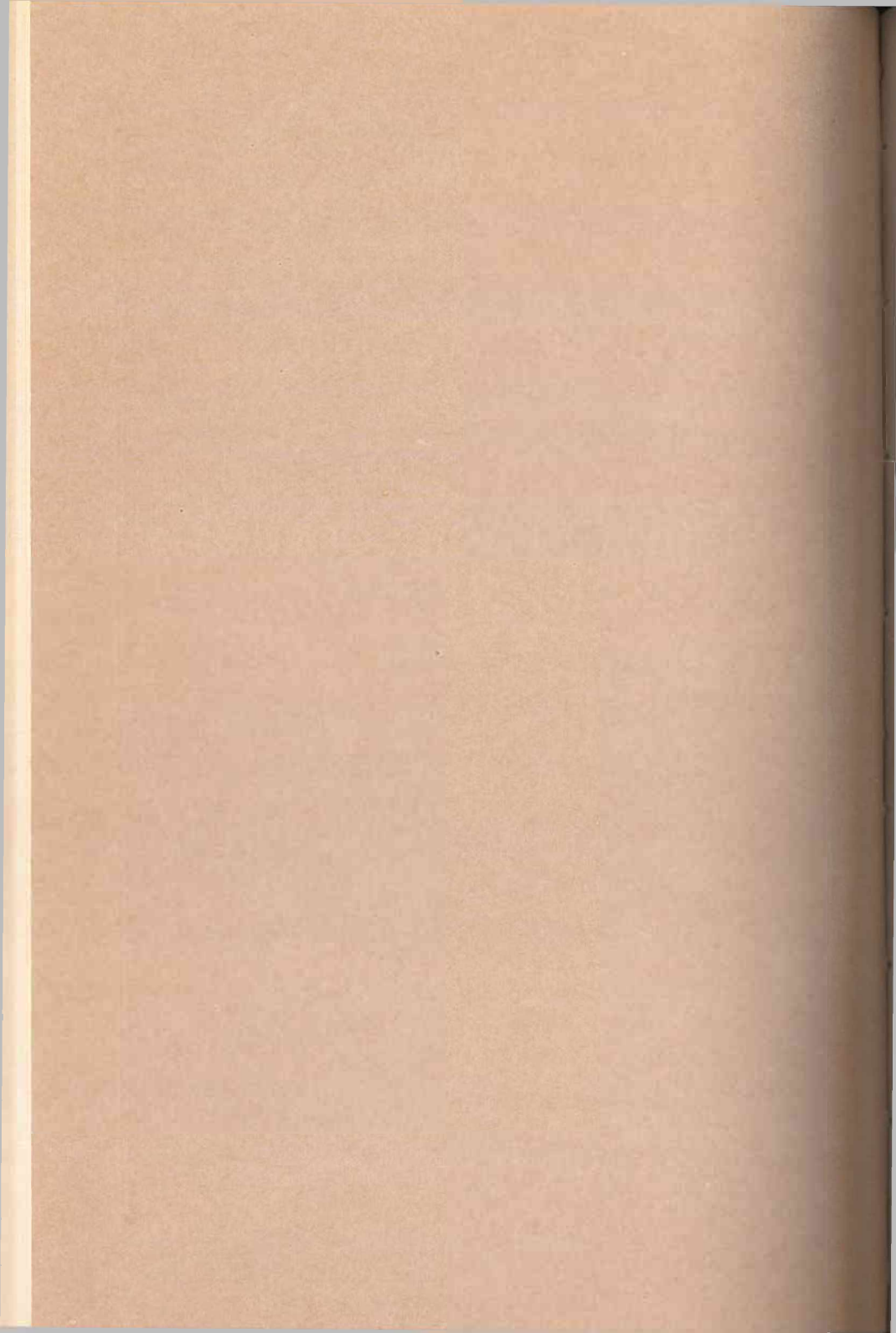


THE STATE AGRICULTURAL COLLEGE  
OF COLORADO

The Thirty-Eighth Annual Report  
*of*  
THE  
COLORADO AGRICULTURAL  
EXPERIMENT STATION



FOR THE YEAR 1925



THE STATE AGRICULTURAL COLLEGE  
OF COLORADO

The Thirty-Eighth Annual Report  
*of*  
THE  
COLORADO AGRICULTURAL  
EXPERIMENT STATION



FOR THE YEAR 1925

# The Colorado Agricultural College

FORT COLLINS, COLORADO

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J. W. ADAMS, B. S., Cheyenne Wells.....	Assistant in Agronomy, Dry Farming
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CHARLES R. JONES, B. S., M. S.....	Associate in Entomology
GEO. M. LIST, B. S., M. S.....	Associate in Entomology
CHARLES I. BRAY, B. S., M. S.....	Associate in Animal Investigations
E. J. MAYNARD, B. S. A., M. S.....	Associate Animal Husbandman
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FLOYD CROSS, D. V. M.....	Assistant Veterinary Pathologist
WM. H. FELDMAN, D. V. M.....	Assistant Veterinary Pathologist
J. H. NEWTON, B. S.....	Assistant in Entomology
CAROLINE PRESTON.....	Artist in Botany Section
J. L. HOERNER, B. S.....	Assistant in Entomology
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IDA WRAY FERGUSON, R. N.....	Assistant in Bacteriology
ROSS C. THOMPSON, B. S., and M. S.....	Assistant in Horticulture
DWIGHT KOONCE, B. S.....	Assistant in Agronomy
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G. A. CUMMINGS, B. S.....	Assistant in Mechanical Engineering

## LETTER OF TRANSMITTAL

To His Excellency, Clarence J. Morley, Governor of Colorado:

In accordance with the law of Congress establishing Agricultural Experiment Stations, I have the honor to transmit herewith the Thirty-eighth Annual Report of the Colorado Agricultural Experiment Station for the state fiscal year, December 1, 1924, to November 30, 1925, and the financial statement for the federal fiscal year, July 1, 1924, to June 30, 1925.

The report contains a full financial statement of all receipts and disbursements, and brief summaries of the work done by those in charge of the different sections of the Experiment Station. There is also given a full list of projects upon which work has been done during the year.

C. P. GILLETTE,  
Director.

Agricultural Experiment Station  
Fort Collins, Colorado  
December 1, 1925

**FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION  
FOR THE FISCAL YEAR ENDING JUNE 30, 1925**

DR.	Hatch Fund	Adams Fund	State Mill Levy Fund	Special Fund	Pure Seed Fund	Special App'ns.	Total Funds
Balance July 1, 1924.....	\$ .....	\$ .....	\$ 11,657.93	\$19,188.92	\$ 1,467.98	\$1,324.45	\$ 33,639.28
From the Treasurer of the United States as per appropriation for the fiscal year ending June 30, 1925, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams Fund)...	15,000.00	15,000.00	.....	.....	.....	.....	30,000.00
Other sources than the United States.....	.....	.....	106,132.53	24,317.24	12,000.00	4,000.00*	146,449.77
	<u>\$15,000.00</u>	<u>\$15,000.00</u>	<u>\$117,790.46</u>	<u>\$43,506.16</u>	<u>\$13,467.98</u>	<u>\$5,324.45</u>	<u>\$210,089.05</u>
<b>CR.</b>							
To Salaries.....	14,679.74	14,373.55	47,252.09	20,956.68	3,255.00	.....	100,517.06
Labor.....	27.30	134.70	14,204.41	1,816.14	789.60	171.60	17,143.75
Stationery and office supplies.....	7.40	16.14	1,223.00	61.97	119.80	.....	1,428.31
Scientific supplies, consumable....	8.25	25.07	846.55	3,830.81	14.07	.....	4,724.75
Feeding stuffs.....	.....	10.40	9,723.25	657.80	.....	.....	10,391.45
Sundry supplies.....	9.00	12.66	3,612.91	739.17	36.48	6.80	4,417.32
Fertilizers.....	.....	.....	130.97	.....	.....	.....	130.97
Communication service.....	.....	.20	889.99	25.61	117.36	.....	1,033.16
Travel expense.....	.....	121.45	9,132.57	831.54	522.05	.....	10,607.61
Transportation of things.....	.....	.53	1,084.64	95.09	5.85	300.00	1,486.08
Publications.....	.....	.....	1,819.15	14.00	.....	.....	1,833.15
Heat, light, water and power.....	.....	.....	165.61	27.40	.....	.....	193.01
Furniture, furnishings and fixtures.....	.....	.....	1,599.87	80.70	5.50	.....	1,686.07
Library.....	42.11	19.70	806.12	.....	5.00	.....	872.93
Scientific equipment.....	226.20	284.83	3,941.59	531.18	17.78	.....	5,001.58
Livestock.....	.....	.....	2,350.95	4,977.15	.....	.....	7,328.10
Tools, machinery, appliances.....	.....	.80	2,182.14	110.78	.....	.....	2,293.72
Buildings and lands.....	.....	.....	3,644.94	4,610.35	.....	846.95	9,101.34
Contingent expenses.....	.....	.....	303.17	1,720.55	.....	.....	2,023.72
Total expenditures.....	<u>\$15,000.00</u>	<u>\$15,000.00</u>	<u>\$104,913.92</u>	<u>\$41,086.92</u>	<u>\$ 4,888.49</u>	<u>\$1,324.45</u>	<u>\$182,213.78</u>
Balance on hand June 30, 1925.....	.....	.....	12,876.54	2,419.24	8,579.49	4,000.00	27,875.27
Grand total.....	<u>\$15,000.00</u>	<u>\$15,000.00</u>	<u>\$117,790.46</u>	<u>\$43,506.16</u>	<u>\$13,467.98</u>	<u>\$5,324.45</u>	<u>\$210,089.05</u>

## Report of the Director

To the President:

I have the honor to present herewith my annual report as Director of the Colorado Agricultural Experiment Station. The report contains brief statements from heads of sections concerning the projects and work upon which these sections have been engaged during the state fiscal year, December 1, 1924, to November 30, 1925. A list of all station projects in force and upon which some work was carried during the year, and a financial statement compiled by the accountant which shows all receipts and disbursements for the government fiscal year, July 1, 1924, to June 30, 1925, is also included.

Some of the money from the Purnell Fund, which became available July 1, 1925, has been used in carrying on investigations that are here reported, but none of the expenditures under this Act will be found in the financial statement.

It will be noted that the total expenditures given in the financial statement amount to \$182,213.78. It should be explained, however, that, of the receipts, \$24,317.24 was derived from sales in the various departments, including a revolving fund of \$6,065.20, used in the control of rodent pests. The receipts of the Seed Laboratory, aggregating \$13,467.98, were not used for experimental purposes, neither was the sum of \$5,324.45 under Special Appropriations, this having been used for buildings and land purchase at Cheyenne Wells and Greeley. The total net budgets allowed all of the sections for investigational work during the year amounted to \$149,763.00.

The total budget for investigational work seems fairly liberal for a new state like Colorado, with a bare 1,000,000 population. It is also true that our agricultural problems are, many of them, new to science and large in numbers because of the varied conditions of soil, climate and rainfall under which our agriculture is carried on, so that every head of a section of investigational work in the station feels the urgent need of increased funds to carry on more adequately the investigations of his department. There is no doubt but what a far larger sum could be profitably spent annually in a solution of the numerous problems of agricultural production and distribution in Colorado for the betterment of our farm classes, and whatever would help in this direction would better the conditions for all of the citizens of the state,

I will not attempt to bring together any of the information given in the reports of heads of sections which follow. I believe you will find them full of interest and indicating that a large amount of investigational work has been conducted during the year.

There have been more projects completed and bulletins published giving the results of the investigations than at any other time during the history of the station. Two sections, Forestry and Home Economics, have completed their entire schedules, and no projects have since been approved for the continuation of investigational work in these sections. New work is being planned, however, and in all probability both the sections will continue in investigational work the coming year. Dr. N. E. Goldthwaite, having completed her investigations in Home Economics, resigned August 1, 1925, and her successor has not been appointed.

The Chemistry section has completed its work on soil-niter studies and is now engaged upon a similar soil study for the determination of the part played by carbon dioxide in plant nutrition.

It will be noted that several new projects have been added during the year, among them four in Economics and Sociology, that are being carried on the Purnell Fund.

The spirit of cooperation among the sections of the Experiment Station has been excellent during the year, and several projects of a cooperative nature are being carried.

During the year, the station has completed its payments for the purchase of the supplementary water supply for use on college and station lands at the home plant, and a farm of some 160 acres, 100 of which are under cultivation, situated near Avon, has been purchased for the use, in the main, of the Horticultural Section in carrying on experiments for the purpose of determining the best crops and methods of growing truck crops in high altitude areas in the state.

Investigational work in the Irrigation Investigations Section has been somewhat curtailed this year in order to make it possible to correlate the data that have been accumulated during many years and prepare them for publication. However, a rather large amount of field work has been continued in the testing out of the improved Venturi flume in several of the irrigated areas in the state.

The Entomology Section reports a rather widespread infestation of the alfalfa weevil in southeastern Wyoming, which threatens rather seriously the agricultural area in this state on the eastern slope, and may result in many quarantines against the shipment of alfalfa from Colorado into states further east in the near future. However, up to the present time, there have not been recent quarantines from states lying east of Colorado that affected any portion of the land on the eastern slope of the mountains.

It is believed that the experimental feeding that is being carried on by the Animal Investigations Section in the San Luis Valley can be completed during the coming winter. According to present



prospects, we shall be able to give advice to the feeders that will enable them to control, for the most part, the losses that they have sustained in past years in their lamb feeding.

The reports of the sections in the Engineering Division are made to the Vice-director.

I am giving below a list of projects that have been in force in the station during the year.

## AGRICULTURAL DIVISION

### Agronomy Section

Relation of Soil Moisture, Structural Development and Acre Yields in Small Grains. Adams and State funds.

Correlation of Characters in Grain. Hatch and State funds.

Methods of Selection Breeding. State funds.

High-Altitude Crops. State funds.

Plains Crops and Management. State funds.

Arkansas Valley Niter Control. (In cooperation with Bacteriology). State funds.

Improved Seed. State funds.

### Animal Investigations Section

Ration Experiments with Steers. State funds.

Rations for Fattening Lambs. State funds.

Cornfield Lamb Feeding. State funds.

Death Losses among Lambs in Feedlots in the San Luis Valley. State Funds.

Range Improvement. (In cooperation with Botany). State funds.

Summer-Fallow Experiment with Sheep at Akron, Colo. State funds.

Winter Maintenance of Breeding Ewes. State funds.

Acre Value of Irrigated Pasture. State funds.

Incubation Tests. State funds.

Advanced Registry. State funds.

Mineral Feeding. State funds.

### Bacteriology Section

Heat-Resisting Bacteria in Fresh and Canned Vegetables. Adams fund.

Value of Certain Carbon Compounds as a Source of Energy for Azotobacter Adams fund.

Arkansas Valley Niter Control. (Cooperation with Agronomy). State funds.

Bacterial Disease of the Wragg Cherry. Hatch fund.

### Botany Section

- Cereal and Field-Crop Disease Studies. Hatch and State funds.  
 Truck-Crop Disease Studies. Hatch and State funds.  
 Physiology of Seeds. Purnell and State funds.  
 Root Disease of Alfalfa. Adams fund.  
 Range Improvement. (In cooperation with Animal Investigations).  
 State funds.

### Chemistry Section

- The Part Played by Carbon Dioxide in Crop Rotation. Adams fund.

### Entomology Section

- Plant-Louse Investigations. Adams fund.  
 Ants of Colorado in their Relation to Plant Lice. Hatch and State funds.  
 Codling-Moth Control. Hatch and State funds.  
 Grasshopper Control. State funds.  
 General Insect Investigations. State funds.  
 Alfalfa-Nematode Studies. State funds.

### Economics and Sociology Section

- Farm Organization and Cost of Production Survey in Typical Peach-growing Districts. Purnell fund. Cooperative with U. S. Dept. of Agriculture.  
 Detailed Farm Accounting and Farm Organization Research on 26 Irrigated Farms in the Greeley Area. Purnell fund. Cooperative with U. S. Dept. of Agriculture.  
 Costs of Methods in Producing Cattle and Sheep in Colorado. Purnell fund. Cooperative, U. S. Dept. of Agriculture.  
 The Social Status of Spanish People in Colorado. Purnell fund. Cooperative, U. S. Dept. of Agriculture.  
 A Study of Child-Labor Conditions in Several Typical Beet-growing Districts. (Cooperation with National Child Labor Bureau, New York City).  
 A Study of the Cost of Producing Milk in the Vicinity of Denver. (Cooperative with State Division of Markets and State Dairy Commission). State funds.  
 A Study of the Causes which Contributed to the Rejection of Carlot Shipments of Fruits and Vegetables Sent out of Colorado, 1923-24 and 1924-25. (Cooperative with State Division of Markets, Denver). State funds.  
 Costs and Methods of Marketing Cantaloupes in the Arkansas Valley During the Autumn of 1924 and 1925. (Cooperative with State Division of Markets, Denver). State funds.

### Forestry Section

Studies in the Decay of Wood. State funds.

### Home Economics Section

The Cooking Quality of Colorado Potatoes. State funds.

Bread-making Qualities of Colorado Flours. State funds.

Principles of Making Fruit Jellies. State funds.

### Horticultural Section

Orchard Management on College Farm at Austin. State funds.

Variety Tests, College Farm, Austin. State funds.

Potato Investigations. State funds.

Head Lettuce, Method of Cultivation and Irrigation, at Avon. State funds.

Tip-burn of Lettuce at Avon and College. State funds.

Tomato Crosses at Manzanola, Colo. State funds.

Commercial Production of Hardy Vegetables in High Altitudes, Avon. State funds.

General Vegetable Work at College. State funds.

Fertilizer Experiments. State funds.

### Irrigation Investigations Section

Measurement of Water as Applied to Irrigation. Hatch and State funds.

Loss of Water by Evaporation. Hatch fund.

Meteorology. State funds.

### Pathology Section

Sheep Losses in Feedlots. Hatch fund.

Contagious Abortion. Hatch and State funds.

General Disease Investigations. State funds.

### Veterinary Section

Animal Diseases. State funds.

## ENGINEERING DIVISION

### Civil Engineering Section

A Study of the Effect of Beet Pulp on Portland Cement Concrete and Mortar. State funds.

Sub-grade Soils of Colorado. State funds.

Road Materials of Colorado. State funds.

Service Tests of Materials for Maintenance of Expansion-contraction Joints in Concrete Pavements. State funds.

### Mechanical Engineering Section

Humidifying Air in Buildings. State funds.

Treatment of Alkali and Other Waters for Domestic Use. State funds.

The Effect of Artificial Lighting on Egg Production. State funds.

The Temperature of Various Types of Poultry Houses. State funds.

The Causes of Poor Incubation of Eggs at High Altitudes. State funds.

Respectfully submitted,

C. P. GILLETTE,  
Director.

### Report of the Agronomist

To the Director:

I am submitting a brief report of the investigational work carried by the Agronomy Section for the state fiscal year, December 1, 1924, to November 30, 1925.

The Agronomy Section staff has consisted of Alvin Kezer, chief; D. W. Robertson, associate; G. W. Deming, assistant, located at Fort Collins; J. W. Adams, specialist at Cheyenne Wells; P. K. Blinn, specialist, and Justus C. Ward, chemist in cooperation with bacteriology at Rocky Ford, and Dwight Koonce, assistant in high-altitude agriculture at Fort Lewis.

The projects in force on the home station at Fort Collins have been critical periods in the development of crop plants for water, commonly called "Critical Periods"; improved seed, correlation of plant characteristics with performance. The improved-seed project is divided into sub-projects of corn improvement, oat, wheat and barley improvement, pasture mixtures and legume improvement.

We are cooperating in dryland agriculture with the Office of Dryland Agriculture and the cereal office of the U. S. Department of Agriculture at Akron. Our cooperation consists in furnishing land for the use of the government and in furnishing seeds and methods for dryland testing. We are supplied with complete reports of the work done by the government at Akron. In addition we are using Akron as a testing station where we can test out the hardiness of types of winter grains especially bred up in the improved-seed work at Fort Collins, and where we can also test the dryland adaptability of spring seeded crops.

Work at Cheyenne Wells is all dryland in nature. Test plats were put out in 1923 and 1924 for forage crops and mixtures and for a number of small grains. Owing to the failure of appropri-

tions, no new plats were seeded in 1925. A portion of the perennial crop plats, however, have been continued.

The work at Rocky Ford has been in cooperation with the Bacteriology Section, and consists in the study of ways and means of controlling nitrate production in Colorado soils.

The work at Fort Lewis has been almost completely high-altitude crop testing and improvement. In addition to these regular projects, we have been carrying on a study of adobe as a building material for a number of years. Prof. J. W. Sjogren made a special study of adobe as a building material during the summer of 1925.

With the exception of the adobe studies, we shall desire to continue all lines of investigation under way the coming year.

During the summer we have published a bulletin (303) on Colless barley. We have prepared for publication a manuscript on adobe as a building material. This is ready for publication except final editing. We have also prepared a detailed manuscript on our critical-period work with wheat. I would recommend that these manuscripts be published in some of the technical journals and that a popular bulletin or summary bulletin be published by the Experiment Station. The critical-period work is quite technical and detailed.

Prof. D. W. Robertson, in conjunction with Prof. H. K. Hayes, published in the *Journal of Agronomy*, Volume XVI, No. 12, December, 1924, an article entitled "Inheritance of Grain Color in Wheat." The data were combined from the Minnesota and Colorado Experiment Stations for this paper.

Our studies on critical periods in plant development for moisture requirements are developing some interesting points in relation to the use of irrigation water; the time of application, and the amount of application of water and its effect upon the yield of grain in the growing crop. The time of application of water to the land also has a considerable effect upon the yield and development of the crop following the next year. There must be water enough in the soil to germinate the crop. But with wheat, if there is water enough in the soil to germinate the crop and keep the wheat growing, the most critical period in the development for water is the period just before heading. Water applied at this period has a bigger effect than at any other one period in the growth of the plant. If the soil is dry and kept dry late in the season, it affects the early development and the amount of water required the following season. A great deal more water is needed the following spring where soil goes into the fall thoroughly dried out by a growing crop and not afterwards fall-wetted by the application of irrigation water or by natural precipitation.

In our improved-seed work we have been making a large number of crosses with wheats, barley and oats in the effort to incorporate valuable factors of yield and quality found in separate parents so that we may have these qualities combined in some of the offspring. These cross progenies require an enormous amount of work because the handling of large numbers increases the possibility of getting the Mendelian combinations necessary for valuable offspring. We are making the crosses and carrying the first generation and usually the second generation at Fort Collins. On our winter varieties we are sending the third generation and some of the second generation to Akron because the winter conditions are much more severe there.

In 1925 we had something over 500 such cross progenies at Akron. In the fall of 1925, for the 1926 crop, we have something over 1,000 progenies at Akron.

We have added to the work at Akron cooperatively in the fall of 1925 by having a number of plats put out for different soil treatments. We are using, especially, the so-called duck-foot and the lister drill. At Archer, Wyoming, which lies just a short distance north of the Colorado line, the use of these two implements has made wheat growing possible where it was deemed impossible before. Accordingly, we have added a series of tests with these implements to our Akron work. The fundamental behind the duck-foot is to till the land and leave a cloddy surface, small cloddy to be sure, but nevertheless cloddy. The lister drill spaces the drilled rows of grain twice as far apart as the ordinary drill and plants the seed in the bottom of a furrow, which resembles in appearance listed furrows. The drill we have in use spaces the furrows 12 inches apart. This method of drilling has made it possible to move northward the winter wheat belt, because wheat which is lister-drilled will stand the winters apparently much better than wheat planted with the ordinary drill. This series of tests will show for our plains conditions the desirability of special soil preparation and lister-drill planting for northeast Colorado.

The season at Cheyenne Wells has been unusually unfavorable. Rains came in the neighborhood and good crops were produced in some instances within five miles. But a very short crop was obtained at Cheyenne Wells because of the summer drouth. Pasture and forage crops were cut heavily in yield, also very greatly increasing the difficulties of sustaining the dairy herd on the Cheyenne Wells farm. Owing to the fact that our 1925-26 appropriation falls in the third class, we have been unable to continue the plat work started in the previous biennium.

Our work at Rocky Ford in the control of the production of soil nitrates as originally planned was to be taken up in two phases. The first phase was to be a comprehensive study over a five-year period of the effect of crop cover and crop sequence on nitrate production in the soil. Along with this work some effort was made to study the effect of manure applications and some fertilizer treatments. The second phase of the work was planned to study a rotation system and methods of chemical control and their economy in the nitrate problem. We have four years' results now on the first phase of the problem. These results are all of the same order. They show that nitrates are relatively low under a crop which covers the land and is not tilled, and that nitrates are relatively high under crops which are tilled and under fallow. During this period we have had one very wet year. In fact, the year was so wet that it broke the previous high rainfall records by over five inches; two very dry years, and one normal year. The curve of nitrate production is of the same order for all of these seasons. It would look, therefore, that four years would be sufficient because all four years give results of the same order. Of course, the nitrate production is not the same in any two seasons, but when plotted in a curve, the curve has the same general trend for all of the four seasons. We expect because of this fact to take up the rotation systems and chemical control as the next phase of the problem. In the first phase it was necessary to study the conditions under which nitrates were formed. The next phase we will have to determine economic practices and chemical amendments or control.

There are enough data accumulated at present to make several excellent papers. I believe these should be prepared by the two sections and a number of papers published in the Research Journal, Soil Science, or the Journal of the American Society of Agronomy.

At Fort Lewis the work has been designed to determine first, crop types adapted for high altitudes of the southwest, and second, to determine or discover the best varieties within those types. Work is being done with small grains, sunflowers, corn, pasture and meadow crops. A special and rather detailed study is being made of peas. It is hoped that enough data will be accumulated in the next two years to publish a short monograph on peas for the southwest region. The information obtained on this crop would be generally applicable over the mountain sections. In addition to this type and variety work, we are beginning to make cultural studies of the best way of handling the several crops.

Respectfully submitted,

ALVIN KEZER,  
Chief Agronomist.

## Report of the Animal Husbandman

To the Director:

Following is a report upon the various projects carried on by this section:

### PROJECTS CONDUCTED DURING THE YEAR 1924-25

- Ration Experiments with Steers**—E. J. Maynard and Geo. E. Morton.
- Rations for Fattening Lambs**—E. J. Maynard.
- Cornfield Lamb Feeding**—E. J. Maynard.
- Death Losses Among Lambs in Feedlots in the San Luis Valley**—E. J. Maynard.
- Range Improvement**—E. J. Maynard, in cooperation with the botany department.
- Summer-Fallow Experiment with Sheep at Akron**—Geo. E. Morton and E. J. Maynard.
- Winter Maintenance of Ewes**—Chas. I. Bray.
- Acre Value of Irrigated Pasture**—Geo. E. Morton.
- Incubation Tests**—O. C. Ufford.
- Advanced Registry**—C. N. Shepardson.
- Mineral Investigations**—Chas. I. Bray.

### PROJECTS WHICH WE DESIRE TO CARRY DURING THE PRESENT YEAR

They are the same as the list of last year, with a difference in rations in some cases.

**Cornfield Lamb Feeding**—E. J. Maynard.

Lot 1 Corn and alfalfa.

Lot 2 Cornfield and alfalfa.

Lot 3 Cornfield, half-sugar-beet field and alfalfa.

Lot 4 Dried molasses pulp, barley, corn silage, cottonseed

**Death Losses Among Lambs in the San Luis Valley**—E. J. Maynard.

Lot 1 Pastured at will in peafield, corraled at night.

Lot 2 Pastured at will in peafield, fed cull spuds and alfalfa hay in corrals night and morning.

Lot 3 Herded in peafield, fed alfalfa hay in corrals.

Lot 4 Herded in peafield, fed cull spuds and alfalfa hay in corrals.

Lot 5 Pen-fed shelled corn and alfalfa.



**Rations for Fattening Calves**—E. J. Maynard and Geo. E. Morton.

- Lot 1 Wet pulp, barley, ground corn fodder, cottonseed cake, alfalfa.
- Lot 2 Wet pulp, barley, corn silage, cottonseed cake, alfalfa.
- Lot 3 Dried pulp, barley, corn silage, cottonseed cake, alfalfa.
- Lot 4 Dried molasses pulp, barley, corn silage, cottonseed cake, alfalfa.
- Lot 5 Dried pulp, barley, corn silage, linseed cake, alfalfa.
- Lot 6 Dried pulp, corn, corn silage, linseed cake, alfalfa.

**Rations for Fattening Range Cows**—E. J. Maynard.

- Lot 1 Wet pulp, corn fodder, straw.
- Lot 2 Wet pulp, corn silage, straw.

**Rations for Fattening Lambs**—E. J. Maynard.

- Lot 1 Corn (twice daily), alfalfa hay
  - Lot 2 Corn (thrice daily), alfalfa hay
  - Lot 3 Corn (hand-fed to self-fed), alfalfa hay
  - Lot 4 Corn, ground corn fodder, linseed oil cake, alfalfa.
  - Lot 5 Corn, corn silage, linseed oil cake, alfalfa.
  - Lot 6 Corn, dried pulp, cottonseed cake, alfalfa.
  - Lot 7 Corn, dried pulp, linseed oil cake, alfalfa.
  - Lot 8 Corn, wet pulp, alfalfa.
  - Lot 9 Corn, dried molasses pulp, alfalfa.
  - Lot 10 Corn, dried pulp, alfalfa.
- } Methods of  
feeding grain.

**Range Improvement**—E. J. Maynard, in cooperation with the botany department.

Studying the value of early protection and early production plus rotation in building up low foothill range in Colorado.

**Summer-Fallow Experiment with Sheep at Akron**—Geo. E. Morton and E. J. Maynard.

Studying the advisability of maintaining sheep upon dryland farms for the purpose of grazing-off weed growth on summer fallow and thereby reducing labor required for summer tillage; also to study the carrying capacity of native sod.

**Winter Maintenance of Ewes**—Chas. I. Bray.

Investigation to determine the best methods of maintaining winter ewes.

**Acre Value of Irrigated Pasture**—Geo. E. Morton.

Investigation into the carrying capacity and value of irrigated pastures for dairy cows.

**Incubation Tests**—O. C. Ufford.

An investigation of moisture and aeration conditions required for hatching hen's eggs at this altitude.

**Mineral Investigations**—Chas. I. Bray.

The use of minerals in livestock rations.

**Advanced Registry Testing**—Chas. N. Shepardson.

All of these experiments are experiments covering a series of years, and so results for last year are not final.

We believe we are finding a remedy for death loss among lambs in the San Luis Valley in the feeding of cull potatoes in connection with peafield and drylot rations.

Our grazing investigations are now beginning to show results favoring late grazing and rotational grazing.

Our ration experiments with calves are showing that wet pulp can be used satisfactorily for calves as well as for older steers; also that dried pulp makes a satisfactory substitute for part of the grain ration.

Results from the first year's feeding with ground corn fodder showed a feeding value in the combinations we used about equal to the feeding value of alfalfa hay.

Annual results are given out yearly at the close of experiments to feeders who gather for the annual cattle feeders' day and annual lamb feeders' day held on the campus.

Respectfully submitted,

GEO. E. MORTON.

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## Report of the Bacteriologist

To the Director:

I have the honor to submit herewith the annual report of the Bacteriological Section of the Experiment Station for the state fiscal year ending November 30, 1925.

As indicated in a former report, we are endeavoring to concentrate our efforts upon fewer projects than in previous years. With this in mind, we have confined our investigations to two lines of work supported by the Adams fund, one by the Hatch fund and one by state funds. Material progress has been made on all of these, and the Hatch project has been completed.

As any one line of investigation is pursued, it inevitably happens that closely related questions arise which were not anticipated when the project was drawn originally. Because of the necessity of studying these secondary matters, which may even exceed the main topic in importance, we have been unable to complete as many of our investigations as we had hoped, and find it necessary to continue them into next year. However, several of these subordinate

problems have been studied and conclusions reached. No new projects are planned for the coming year.

### ADAMS FUND PROJECTS

#### 1. Vegetable Spoilage:

As conducted in the previous year, this work has been carried on in cooperation with Miss Sheridan of the Extension Service. Further data have been secured on the temperature lag in vegetables canned at altitudes from 4000 feet to 9000 feet and new vegetables have been added to the list. A different basis for determining the lag than that used in 1924 has been employed. This work is preliminary to compiling a time table for canning in the high altitudes.

In connection with the Western Live Stock Show held in Denver January last, we featured botulism poisoning in our exhibit. Press Bulletin 61, "Botulism Poisoning," was issued at that time.

#### 2. Azotobacter Energy Studies:

The chemical reaction of a soil and adequate carbonaceous material to furnish energy are regarded as two important factors in the fixation of atmospheric nitrogen by *Azotobacter* in soil. Accordingly, any agencies which modify these limiting factors should influence the ultimate nitrogen content of the soil. Four lines of work bearing upon this point have been studied, namely:

1. The relation of soil reaction to the natural occurrence of *Azotobacter*.
2. The effect of organic crop residues, sulphur and acid phosphate upon soil reaction.
3. The value of organic crop residues as a source of energy for *Azotobacter* as measured by ultimate nitrate production in the soil.
4. The utilization of soil algae by *Azotobacter* as a source of carbon.

### HATCH FUND PROJECT

#### A Bacterial Disease of the Wragg Cherry.

A disease of the Wragg cherry, characterized by brown spots on the leaves and by watery green spots on the green fruit which become black and sunken as the malady progresses, producing an irregular, mummified cherry at maturity, has been shown to be due to a yellow, viscid, motile, rod-shaped micro-organism, previously undescribed, and named, *Phytomonas cerasi Wraggi*, n. sp. (*Pseudomonas cerasi Wraggi*, n. sp.).

The damage to both fruit and foliage can be reduced materially

by spraying with either bordeaux mixture or lime sulphur, but an undesirable dwarfing of both results if this practice is followed.

This project has been completed.

### STATE FUND PROJECT

**Rocky Ford Niter** (Sections of Agronomy and Bacteriology co-operating).

Based upon the work of previous years, which we feel has progressed to a point where we can begin to apply the knowledge gained, we have formulated and instituted a crop-rotation schedule designed to control and utilize high soil nitrates. The scheme is commercially practicable and scientifically correct. How it will work out in practice time alone can tell. The success of this experiment will be judged both by crop yields and soil nitrate determinations.

Dry crop-residues, green manures, sulphur and acid phosphate have been applied to certain plots as a possible means of controlling nitrogen fixation and nitrate formation by effecting a slight change in soil reaction (pH 7.7 to pH 6.5). The large amount of carbonate present appears to have neutralized any acid that may have been formed, and the results of one year's experiments indicate that little benefit can be expected from this source. The plots will receive the same treatment in 1926.

A brief report by Mr. Ward, chemist in charge of the Rocky Ford laboratory, follows:

"To the Director:

"The Colorado Experiment Station Laboratory at Rocky Ford, Colorado, has pursued the investigation of the excess nitrogen problems of the Arkansas Valley along several different lines during the past year.

"Results of the established project for the year confirmed the earlier findings in that again the cultivated crops all permitted the decided accumulation of nitric nitrogen in the soils on which they were grown, while the non-cultivated crops consistently retarded nitrogen formation. The laboratory has now noted these facts throughout the varying climatic conditions of 1922, a dry year; 1923, a very wet year; 1924, a very dry year; and 1925, a more nearly normal year. This would seem to prove conclusively the basic effects of the various crops upon nitrate production in the soil, and would obviously suggest rotation of crops as a feasible control system.

"In addition to the regular work, the laboratory took up the problem of noting the effects of various fertilizers upon the soil nitrate content. This project was carried out in cooperation with the research department of the American Beet Sugar Company; and the samples were taken from the fertilizer test plots set out by the United States Department of Agriculture on the sugar company research farm. The findings were of such nature as to make a continuation of this work very desirable.

"Also, a special project was started on the Colorado Experiment Station farm to determine the effect on the nitrates of incorporating various organic and crop-residues with the soil. The materials used were blood meal, corn fodder, barley straw, and alfalfa hay. The variations in nitrate values were very slow in starting, so little may be said as yet concerning any results.

"With these major interests, together with the tests of rotational effects begun last year, there was little opportunity for outside work. Nevertheless, samples were obtained from eight privately-owned farms in the Rocky Ford territory at fairly regular intervals for the purpose of following the soil nitrate variations on land farmed according to customary methods.

"The laboratory analyzed 2,121 soils for both nitric nitrogen and chlorine, which made a total of 6,363 separate determinations for the year, as the nitrate samples were run in duplicate.

"Present results indicate it would be well to follow the effects of nitrate accumulation upon crop yields, the effects of various fertilizers upon the nitrates and upon crop yields, and to continue to follow the effects of rotation upon the nitrates and upon crop yields. And also it would seem well to continue the work upon crop residue incorporation. An examination of the factors noted is planned for the coming season."

## MISCELLANEOUS INVESTIGATIONS

### 1. Foulbrood:

In cooperation with the Entomological Section, we have carried on bacteriological studies in connection with an investigation of methods for disinfecting foulbrood combs.

What was thought to have been a previously undescribed disease of bees also received some attention.

### 2. Frozen Eggs:

The frozen-egg industry has been operating for some time in the East, but only recently has it made its appearance in Colorado.

This year, for the first time, The Sterling Ice and Cold Storage Company has entered the field and has called upon us to make bacteriological examinations of their pack, by which the quality of their product is judged. The eggs tested were frozen in April and examined in late October.

### 3. Alfalfa Root Rot:

The Bacteriological and Botanical Sections have been cooperating since last fall in the study of a crown or root rot of alfalfa. Several bacterial cultures were found associated with diseased roots, and at least one of them, when inoculated into healthy plants, has produced a discoloration of the root. None has caused the wilting of the stems and leaves as observed in the field. It is possible that the wilting results from the plugging of the water ducts by a gum-like substance which has been noted in diseased roots. Whether this deposit of gum is the result of bacterial action or some other agency remains to be demonstrated.

### Vinegar Studies:

The possibility of utilizing waste cantaloupes and honey-dew melons from the seed-producing districts of the state for vinegar stock has been investigated. The cantaloupes yielded a legal vine-

gar testing 4.4 per cent acetic acid, but the honey-dew was considerably below the legal requirement. The flavor of each is so different from that of apple vinegar that it is doubtful if either could compete with the apple product even if the acid were up to standard. Both melons have possibilities as a source of commercial alcohol.

In the laboratory work I have been ably assisted by Mr. Justus C. Ward, Miss Ida Wray Ferguson, Mrs. Elaine Hendricks Burnett and Miss Vernice Ewart, whose efficient services I take pleasure in acknowledging. As stenographer, Miss Alpha Powell has performed her duties in a manner both pleasing and satisfactory.

Finally, I desire to express to the Director of the Experiment Station my sincere appreciation of the opportunity afforded me of attending the meeting of the Society of American Bacteriologists at Washington, D. C., last December, and of his continued liberal support of our investigations.

Respectfully submitted,

WALTER G. SACKETT,  
Bacteriologist.

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## Report of the Botanist

To the Director:

Herewith I submit for your consideration a report of the activities of the Botanical Section for the year ending November 30, 1925.

1. Projects engaged in during the past fiscal year:

Cereal and Field-Crop Disease Studies.

Truck-Crop Disease Studies.

Physiology of Seed.

Root Disease of Alfalfa.

Range Management.

2. The section desires to continue on these projects.

3. Under the above projects the following subjects have been studied the past year by different members of the staff:

Many of the results have been of particular interest; for instance, in the study of oat smut it was found that the  $\text{CO}_2$  from live plant tissue or germinating seed, stimulates the germination of the fungus spores by producing an optimum acid reaction. The same results have also been obtained with spores of other fungi and pollen grains. Studies of the surface tension of the infection drop are also being made. Measurements of the tension indicated that lowered tension increases germination of certain fungus spores.

In studies of black stem rust, it has been found that the sum-

mer spores remain viable thruout the winter within the leaf sheaths of wild barley. The spores survive only in moist conditions bordering lakes or sloughs, but do not reinfect the new plants in the spring, as the enclosure of the sheath prevents dissemination. Studies of the migration of stem rust shows its invasion of this state from Oklahoma and Texas. The barberries have been eliminated from the eastern grain section of the state; infection, therefore, comes in from neighboring states. The invasion is slow, however, and is approximately two weeks later than infection from local barberries. These two weeks in normal years allow the grain to escape rust. In connection with rust studies, 1200 Colorado strains of wheat were this year tested for resistance to rust, both in greenhouse and the field. In a similar way, 1500 Colorado strains of barley were also tested for Barley Stripe.

Bunt of wheat has been studied at ten localities over the state, where test plots of various seed treatments are being conducted. The success of copper carbonate as a treatment for bunt has recommended it for general use. On a 1500-mile trip thru the eastern wheat region of the state this treatment was brot to the attention of 8000 farmers. To further the use of this material, demonstrations and exhibits were conducted at several county fairs, at the state fair, and the Colorado Springs seed show. Extension Circular No. 1 was published covering this method of wheat-seed treatment.

Other studies of interest are, ecological measurements of Morton's and other grass mixtures growing for several years on the station farm and indicating survival of brome grass and other grasses under irrigation. Hard alfalfa seed is being studied with evidence of this character being heritable.

Wild oats, formerly thought to germinate only after a long rest period, has been germinated at maturity. The seed of sorghum, generally found to be low in germination, is being studied. Evidence of seed injury with resulting low vitality and fungus invasion is suggested by the work to date.

Inoculations on varieties of squash with the wilt organism are being made in search for possible resistant sorts. Several varieties of yellow-resistant celery were tried out at Denver, Littleton and Pueblo.

Histological studies on the alfalfa roots indicate that local wilting of these plants, common in some fields, is due to lack of water, because of plugging of the vascular system of the root by a gum-like secretion.

#### 4. Articles Published.

*Berberis fendleri*, an alternate host of *Puccinia graminis tritici*. Phytopathology—in press.

A Root Rot of Alfalfa, Science, July 7.  
Changes in Hydrogen-ion concentration induced by carbon dioxide in relation to the germination of spores of *Ustilago levis*. Abst. Phytopathology.

Respectfully submitted,

L. W. DURRELL,

Botanist.

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## Report of the Chemist

To the Director:

The Chemical Section has been engaged on the following projects during the year from December 1, 1924, to November 30, 1925.

We had a good deal of work backed up on us in connection with the potato project at the beginning of the year. This has been completed and the manuscript of a bulletin covering the work of about three years is about ready for delivery into your hands, probably about the first of January or shortly thereafter.

You are aware of the fact that there was a delay in getting started on the project relative to "The Part Played by Carbon Dioxide in Crop Rotation." We finally got started, however, and planted our plots to alfalfa, clover and wheat, respectively. We have been able to follow the development of carbonic acid for several months and to do some work on the soil, but it is only a beginning. We have no other project which is now active.

During the year we prepared a bulletin covering the question of nitrates, intended for farmers. This is the only bulletin that will appear to our credit during 1925.

In December, 1924, I had an article on "Luminescence in Ingle-side Calcites Affected by Acids," in the American Journal of Science, and Mr. Vail had an article on "Celestial Chemistry" in the August, 1925 number of the Journal of Chemical Education.

Respectfully submitted,

WM. P. HEADDEN,

Chemist in Charge.

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## Report of the Entomologist

To the Director:

Below is a brief report of the work carried on in the Entomology Section during the past year.

The year has not been a very serious one from the standpoint



of insect injuries. However, several of the pests that are with us every year did their usual damage, and, on the whole, perhaps the loss from injurious insects was fully up to normal. Following is a list of the projects covering the entomological work of the year, with brief comments concerning the work done under each.

### **Plant-louse Investigations**

Work has been principally confined to the assembling of data preparatory to the publication of an annotated list of the aphidae of Colorado. One technical paper describing a few new species of aphids and giving their life habits has been prepared by Miss M. A. Palmer and the writer, and will appear in the December number of *Annals of the Entomological Society of America*. On the whole, the plant-louse injuries of the year have been rather less severe than is usual.

The Pea aphid (*Macrosiphum pisi*) did considerable damage to alfalfa fields locally, but fewer complaints were received of the injuries of this aphid than in most recent years. The Woolly aphid (*Eriosoma lanigera*) has been very abundant in many of the orchards of the Western Slope in Colorado this year, and is almost universally present in the apple orchards of the state. The Rosy aphid (*Anuraphis sorbi*) which was doing rather serious injury to the apple orchards in Mesa County a few years ago, has almost disappeared as an orchard pest in that section, according to the reports of Mr. William Yetter, Jr., who is stationed at Grand Junction during the growing season of the year. The Melon louse (*Aphis gossypii*) has done very little damage in the melon-growing sections of the state the past summer.

### **Ants of Colorado in Their Relation to Plant Lice**

Professor C. R. Jones, who has this project in charge, has made progress in his investigations during the year, and at present is pursuing advanced work under this project at Iowa State College, Ames, Iowa, in the department of entomology.

### **Codling-Moth Studies**

The work with codling-moth life history and methods of control has been continued on the Western Slope, having been carried on by Mr. William Yetter, Jr., in the vicinity of Grand Junction, and by Mr. J. H. Newton in Delta county. The apple losses in Mesa county from this insect continue to be serious, in spite of the fact that thoro spraying is done by most of the orchardists, the usual number of arsenical sprays being from six to nine.

### **Grasshopper Control**

The Mormon Cricket (*Anabrus simplex*) promised to be a pest of some importance in portions of Moffat and Rio Blanco counties

early in the season, but less damage was done by this insect than for several years past. The numbers did not become sufficient to seem to justify putting on a campaign for control.

Grasshopper losses were not as acute in infested areas as they were the previous season, but the injuries were widespread and possibly as much real damage to crops was done as in normal years. In some areas in northeastern Colorado active control measures were employed. The Entomology Section, in cooperation with the office of State Entomologist, furnished approximately 1000 packages of grasshopper poison for the destruction of grasshoppers, a large proportion of which went to County Agent H. H. Simpson in Weld county, and County Agent J. E. Morrison in Logan county. Never have we had such universal satisfaction in the use of arsenic-bran mash as during the past summer, there being almost no complaints of failure to kill the grasshoppers. The past season the arsenic was used in double strength; that is, 2 pounds of the sodium arsenite to 100 pounds of bran. While one pound of poison gives good results, it does not kill quickly enough to satisfy the farmers who use it, so that it has been found advisable to use the poison in double strength for satisfaction. Some experimental work has been carried on by Mr. George Langford and Mr. John Hoerner to determine the best methods of poisoning the grasshoppers, and the results will be published later either as a station bulletin or as a circular from the office of the State Entomologist.

#### General Insect Investigations

The Mexican Bean-Beetle (*Epilachna corrupta*) is rapidly extending its area of infestation on the Western Slope in this state, and has become a serious pest to the growing of beans in Delta, Montrose and Mesa counties. It is probable that more attention will be given to the control of this insect in the near future. The Oyster-Shell Bark Louse continues to be a serious pest to ash, willow and cottonwood trees and purple lilac bushes in portions of northeastern Colorado, where it has been introduced. In some instances the trees and bushes have been entirely killed by this pest.

A rather serious outbreak of the Army Cutworm (*Chorizagrotis auxiliaris*) occurred in the northeastern corner of the state in the early spring. Complaints were received of army worms crossing the highways in large numbers, a habit that never had attracted the attention of the farmers before. Losses to fall grain were serious in a number of instances, but the injury was so localized that it could hardly be considered as a major insect pest of the season.

Respectfully submitted,

C. P. GILLETTE,  
Entomologist.

## Report of the Agricultural Economist

To the Director:

During the year ending November 30, 1925, the Department of Economics and Sociology gave attention to the development of eight projects. Four of these projects have been approved and are to be carried under Purnell funds within the year ending June 30, 1926.

Project No. 1. Farm organization and cost of production survey in typical peach-growing districts; in cooperation with the Bureau of Agricultural Economics, U. S. Department of Agriculture.

Project No. 2. Detailed farm accounting and farm organization research on 26 irrigated farms in the Greeley area; in cooperation with Office of Farm Management and Farm Economics, U. S. Department of Agriculture.

Project No. 3. Costs and methods in producing cattle and sheep in Colorado; in cooperation with the Office of Farm Management and Farm Economics, U. S. Department of Agriculture.

Project No. 4. The social status of Spanish people in rural Colorado.

Project No. 5. A study of child-labor conditions in several typical beet-growing districts; in cooperation with the National Child Labor Bureau, New York City.

Project No. 6. A study of the cost of producing milk in the vicinity of Denver; in cooperation with the State Division of Markets and the State Dairy Commission.

Projects No. 7. A study of the causes which contributed to the rejection of carlot shipments of fruits and vegetables sent out of Colorado, 1923-24 and 1924-25; in cooperation with the State Division of Markets, Denver.

Project No. 8. Costs and methods of marketing cantaloupes in the Arkansas Valley during the autumn of 1924 and 1925; in cooperation with the State Division of Markets, Denver.

It is our purpose to continue projects 1 to 4, inclusive, during the coming year. Projects 5, 6 and 7 have been completed. The field records have been assembled in connection with project No. 8 for the year 1925, but the tabulations and summaries have not been finished. This autumn records are being assembled in cooperation with the Division of Markets in Denver relative to methods and costs of storing and marketing potatoes in the San Luis Valley.

Project No. 3 involves a study of costs and methods in the production of range cattle and sheep. This work has been carried in cooperation with the Office of Farm Management and Farm Eco-

nomics, U. S. Department of Agriculture. Thus far it has not been possible to do very much in a constructive study of the range-sheep business. If the funds which have been assigned to this project can be supplemented somewhat during the coming year, it may then be possible to expand in the direction of this enterprise.

Research work in the study of farm organization and production costs was begun during the month of September in cooperation with the Office of Farm Management and Farm Economics and the Division of Fruits and Vegetables, U. S. Department of Agriculture, on the Western Slope. The records which were assembled last autumn will be tabulated by the federal department. This survey constituted a part of a national project embracing the more important peach-producing sections of the country. Additional records relating to farm organization and production costs will be assembled in a few typical districts during the coming year. These records will supplement the information which has been obtained in cooperation with the national department.

During the year several preliminary reports were issued and distributed to farmers who are cooperating in the Greeley area in keeping a detailed account of their business. One of these reports contained an analysis of the cost of growing sugar beets during the years 1922 and 1923. A second report included a preliminary analysis of the cost of producing alfalfa, barley, oats, beans, wheat, peas, sugar beets and potatoes on these farms. This statement also contained a review of the returns per acre for each of these commodities. A third report involved a discussion of costs and methods in feeding lambs and steers on several of these farms during the year 1924-25. Essentially four years of cooperative work in this area have been completed. As soon as information for the year 1925-26 has been assembled, final reports will be issued with respect to several of the more important phases of this investigation.

In the cooperative project dealing with costs and methods of producing cattle and sheep on the range, two business years have been completed and records have been assembled on approximately forty ranches for a third year. In the preliminary reports which have been issued it has been pointed out that production costs may change because of improvement in the quality of the production. The quality of cattle marketed in the plains and mountain areas in recent years has improved greatly. Such improvement usually means additional expenditures in the cost of production. These increases in costs may be fully compensated by higher prices or by increased quantity of beef output per acre or by low cost per calf or per pound of beef produced. In general, good quality costs more and brings better prices than poor quality, but on the whole it rep-

resents an economic saving. It seems probable that production cost for ranch products in Colorado must in the long run be conducted under an increasing scale. These increased costs must come out of larger money returns, and these are dependent for the most part upon better organization, both in the industry and on the ranch, and more efficient marketing of ranch products. The real indication of the profitableness of the range herd will be found in the returns received for each dollar of cost. Notwithstanding the very adverse conditions under which the ranch business has been operated within recent years, it is significant that a few ranches came thru the year without loss, and in some instances gains were made.

A few observations may be made in connection with the cost of producing milk in the Denver area. Crop conditions during the year 1924 were extremely unfavorable in this general area. A shortage of feed crops necessitated the purchase of feed and grain at prices somewhat above normal. This was reflected in the average current expenses for the farms studied. Moreover, receipts from other enterprises such as the sale of grain, sugar beets, etc., were abridged considerably through deficiency in rainfall under dry-farming methods and the shortage of water where the farms were irrigated. The thirty-three owner-operators in this study had receipts amounting to \$1,214 per farm from sources other than the sale of milk; owners renting additional land received \$1,331 per farm from sources outside of the dairy, while tenants reported \$1,205 per farm for these enterprises. The owners maintained an average approximating 23 cows per farm; the owners renting additional land, about 21 cows, while the tenants had an average of 22 cows per farm. The average milk receipts per cow were identical for the owner and owner-additional group, namely, \$111. The tenants had an average return not far from \$120 per cow. There appears to be evidence in these records which would suggest the recommendation that low producers be eliminated, thereby introducing one essential step in the direction of curtailing costs and ultimately increasing profits. The business for these farms for the year 1924 was discouraging to say the least. The average farm income for the owner group was slightly less than \$800 per farm. This was scarcely sufficient to compensate the operator for his labor and there was nothing to pay interest on investment. The owner-additional group did not fare nearly so well as the straight owners, while the tenant-farm operators received \$70 for their labor and there was no residue from which to pay interest on investment.

The project relating to the social status of Spanish people in Colorado was outlined and approved during the present summer.

Our efforts in the field of rural sociology within the past year have been directed toward an intensive study of child-labor conditions in the north-central part of Colorado. Our investigation has shown that three-fourths of the contract and one-half of the grower families are foreign born. One-half of the contract families and nine-tenths of the grower foreign-born families have become American citizens. Sixty-five percent of the contract parents and 90 percent of the grower parents can speak English, while 25 percent of the contract labor to 70 percent of the grower parents can read and write English. Ninety percent of the contract workers are of German and Mexican descent, the latter group gradually replacing the former in the Colorado beet fields. The percentage of school retardation is very high among contract children, particularly among those who are employed in doing the hand work in beet fields.

Preliminary statements and reports have been prepared in connection with our cooperative study of the causes which contributed to the rejection of carlot shipments of fruits and vegetables and the study relating to costs and methods of marketing cantaloupes in the Arkansas Valley. It is expected that when all of the work is completed on these two projects, that the results will be printed and published in the form of experiment station bulletins.

Respectfully submitted,

L. R. MOORHOUSE,  
Agricultural Economist.

Nov. 23, 1925.

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### Report of the Forester

To the Director:

I herewith submit the annual report of the Division of Forestry.

During the year the project on the Decay of Wood has been completed and a full report of the investigation has been prepared. This report is now in the hands of the Editor of Publications, to be published as a Station bulletin.

No further projects have as yet been undertaken, altho several are under consideration.

Respectfully submitted,

B. O. LONGYEAR.

## Report of the Home Economics Section

To the Director:

During the year 1924-1925 the work on three projects has been completed. Two bulletins have been published, a third is on the press, and the manuscript for the fourth is being written.

There follows a statement of the projects, and of publications summarizing the findings of the home economics research laboratory, for a five-year period.

Project I. The Cooking Quality of Colorado Potatoes. Two bulletins are the outcome of this study. Varieties of Colorado Potatoes, now being printed, presents the scientific data. A bulletin—Potatoes from the Housekeeper's Standpoint—has just been published.

Project II. Bread-making Qualities of Colorado Flours. A housekeeper's bulletin based on such studies is now being written.

Project III. Principles of Making Fruit-Jellies. The bulletin bearing this title embodies results of investigation by the writer in 1908-11 at the University of Illinois, together with experiments with Colorado fruits.

All of the foregoing projects and publications represent the work of Doctor N. E. Goldthwaite.

A successor to Doctor Goldthwaite has not yet been secured. Since the projects to be next undertaken involve problems in physical chemistry, effort is being made to come in touch with candidates of rather extensive training in that branch of chemistry; and it has seemed wise to lose some time rather than to enter upon important projects unpreparedly.

The next series of projects cannot be definitely stated at the present time:

Project I. High-Altitude Cookery.

A. The relation of altitude to the rate of gas expansion in leavened-flour mixtures.

B. A study of factors influencing the rate of gas expansion in flour mixtures.

Project II. Bottling fruit juices of assured jelly-making quality.

Project III. A study of some factors that affect the strength of Colorado flours.

Naturally there must be additions in the way of equipment, but the budget makes ample provision for that.

In the improvement of our facilities for research the emphasis should be on library material, making available more original-source material as well as general reference material of scientific value.

Respectfully submitted,

INGA M. K. ALLISON,  
Head of Division of Home Economics.

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## Report of Horticulturist

December 1, 1925.

To the Director:

The following is the list of projects on which active work is being carried by the Horticultural Department:

1. **Orchard Management—College Farm, Austin, Colorado**
  - a—Cover Crops.
  - b—Thinning.
2. **Variety Tests—College Farm, Austin, Colorado**
  - a—Apples.
  - b—Cherries.
  - c—Plums
  - d—Grapes.
3. **Potatoes**
4. **Head Lettuce—Methods of Cultivation and Irrigation, Avon, Colorado**
5. **Tip Burn of Head Lettuce—at Avon and College**
6. **Tomato Crosses at Manzanola, Colorado**
7. **Commercial Production of Hardy Vegetables in High Altitudes, Avon, Colorado**
8. **General Vegetable Work at College**
  - a—Variety tests and blanching processes of celery.
  - b—Selection of disease-resistant strains of Hubbard squashes.
9. **Fertilizer Experiments**

The above projects are all active, tho some of the projects are pushed more vigorously than others, especially the problems relating to vegetable production.

It seems desirable at this time to give a brief statement of the results obtained during the past year. It should be noted, however, that the results may be changed somewhat during the progress of the work, but, taking them up in order given above, the following may be noted:



1. **Orchard Management.**—The orchard-management project is confined mostly to cover crops and thinning. It is too early to give any definite data except a general statement that the use of cover crops must become a general practice in commercial fruit growing. The maintenance of soil fertility, as well as proper soil conditions, is not possible in a producing orchard without the plowing under of green crops. In the case of the experimental orchard at Austin, the improvements in growth, vigor and the production of a higher grade of fruit is very noticeable. The percentage of extra fancy fruit has increased over 25 percent the past two years.

More conclusive results have been obtained with thinning, both on apples and peaches. We have definite figures on the peaches for two years. The first year's figures show that by thinning we obtained 90 percent of extra fancy peaches from the thinned portion of the orchard, but only 60 percent from the unthinned orchard. Last year, we obtained over 99 percent extra fancy fruit from the thinned orchard and 60 percent from the unthinned. There was very little difference in the total amount of fruit from the thinned and unthinned orchards; however, there was a difference in the weight per box, which averaged 3 pounds in favor of the thinned fruit. The figures on the thinned apple orchard and the unthinned have not been tabulated, tho the increase in extra fancy from thinning was considerable.

2. **Variety Tests.**—This work was started when the college acquired the orchard at Austin. Considerable difficulty has been encountered in getting disease-free stocks of sweet cherries, which has made it necessary to replant for the past three years. However, the variety orchard is progressing very satisfactorily. I might mention a new thing that we are trying out in Colorado; namely, the growing of dwarf pear trees, which is practiced very extensively in the East. It is a common report that dwarf pears are more blight resistant than standard varieties, and we wish to demonstrate whether this is true or not under our Colorado conditions.

The variety test with grapes is interesting, because of the possibilities for commercial grape growing in western Colorado. This work was started three years ago and next season we should have the first fruit of the vines planted. We are trying out not only the standard American varieties, but several of the hardier European kinds, and thus far the indications are that we can grow a number of the standard European grapes that are now grown so extensively in California.

3. **Potatoes.**—The work with the potato has been somewhat delayed, due to the fact that the soil at Avon carries soil-borne diseases such as scab, *Rhizoctonia* and others, and we have hesitated

in carrying on selection work under these conditions. We are, however, eliminating this trouble, and aim to begin next year, principally along the line of selecting new strains of the standard varieties grown in high altitudes. Preliminary to this work, we have, during the year, carried on cooperative work with tree growers in the San Luis Valley and we hope to be able to transfer the varieties grown there to Avon and continue the work under a closer supervision than is possible where one cannot control conditions.

The work in potato certification is being pushed as fast as advisable. There has been a steady increase in acreage and in quality. We are trying to confine this particular work to a select group of growers who are willing to follow directions. Thus far, I think, we have been successful in maintaining a very high standard of certified seed.

**4. Head Lettuce.**—The cultural methods employed with head lettuce are not stabilized. Every grower is following his own inclination and the result obtained is very far from uniform. In the general work with head lettuce, one is, of course, handicapped by climatic conditions which are often very variable in the mountain sections, particularly with reference to rainfall. This fact makes it very difficult to work out a satisfactory system which the grower can follow.

The question of cultivation has been greatly modified from our former practice; that is, we are obtaining better results with less cultivation. The same is true with irrigation. Our work seems to indicate that the grower is using more water than is advisable, and that, in general, the rapid growth of the lettuce plants is advisable. This, of course, is entirely different from the practices in vogue with good vegetable growers. Yet, the head lettuce under mountain conditions, in order to produce a high-grade product, seems to require less water and less disturbance of the soil around the root system.

**5. Tip Burn.**—Experiments with tip burn, on which we have devoted a considerable amount of time and labor, have been carried on in the field and in the greenhouses. Our results are extremely interesting and we believe very significant. We have found a relationship of tip burn to the water content in the growing plant. The higher percentage of water with its corresponding succulency of the plant tissue, seems to induce tip burn, while a higher percentage of dry matter and corresponding hardness or solidity of the tissue, depresses it. Laboratory work has demonstrated this fact and the field work now will consist of carrying on the field operation so as to induce slow growth with a higher content of dry matter in the plant. If the results already obtained are verified under field prac-

tices, I believe that we can, in a measure, control this trouble which is causing a great loss to the grower. We are, of course, not ready to publish on this work, as we are now checking up and repeating the work in the laboratory and work in the greenhouses, preparatory to the out-of-door work at Avon next summer.

6. **Tomatoes.**—The work with tomato crosses at Manzanola is also being pushed, because of the improvements of tomato-canning industry in the Arkansas Valley. We have been handicapped in this work on account of not having a permanent place on which to continue from year to year. We know practically nothing about the soil and each year we are forced to change from one field to another. However, progress has been made on this experiment and we anticipate some valuable results, not only from crosses made, but also, from selections of better strains of existing varieties.

7. **Commercial Production of Hardy Vegetables.**—This project is of a general nature. We aim to demonstrate the commercial possibilities of a wide range of vegetable production in the mountains. This work is of especial interest to the farmers, because by following the methods that we are using they can learn and appreciate the commercial possibilities of a more varied line of production than is now practiced. The vegetables that are used in this general work are as follows: Pod peas, seed peas, cauliflower, carrots, rutabagas, and head lettuce. This list may be extended in the future, but for the present these commodities offer the best chance for success.

Another object of this general work is to make the grower realize that to be successful he must diversify and not devote his energies and land to one particular crop.

8. **General Vegetable Work at College.**—The general experimental work at the college is centered on three main lines. Celery variety tests, including methods of blanching. This work should be completed next season. The selection of disease-resistant Hubbard squash has also been in progress for the past two or three years, and this year we are testing out some of the selected plants for inoculation under controlled conditions in the greenhouses. In addition to these two main lines, variety tests of various vegetables are being carried on from year to year.

9. **Fertilizer Experiments.**—With the increase of vegetable production, not only in the mountain sections, but in districts around the large cities, where vegetable production is so important, it is becoming more and more evident that the small supply of animal manures is totally inadequate to maintain the fertility and production and the growers have to resort to the use of commercial fertilizers. To meet this demand, fertilizing plots were started at

Avon on head lettuce. The results obtained are rather inconclusive for the first year. The fertilizer work on tomatoes and cabbage at the college show some interesting results. The effect of fertilizers carrying a high percentage of nitrogen, upon tomato plants, is remarkable. The vine growth is greatly increased, but such growth invariably retards the ripening of the fruit and thus the grower cannot take advantage of an early market. The same effect was observed on the plot heavily fertilized with animal manure. The most satisfactory result was obtained from the use of acid phosphate, which did not delay the ripening of the fruit and did not induce excessive vine growth. From our limited work thus far, it is apparent that in using fertilizers on a crop like tomatoes, nitrogen should not be used to any large extent. The effect on cabbage would naturally be somewhat different, since in the growing of cabbage we aim to produce a leafy structure, and not the fruit or seed, and cabbage seems to be benefited by the use of fertilizer containing a considerable percentage of nitrogen. This work will be continued.

No publications have been issued by the department during the present year. Some articles have been written for magazines, particularly for the American Pomological Society, on "Hardiness of Fruit Trees from the Standpoint of Drouth," also minor articles published in the general horticultural journals.

I have no suggestions to make on the future development of our work, only to say that I do not think it advisable to take up any new lines at this time, unless some specific problem should arise that would necessitate work to be done. The number of lines now active is large enough, in fact, too large, to give the close attention that experimental work requires.

In conclusion, I wish to take this opportunity to express my appreciation for the support and personal encouragement that you have given the section, and it is a pleasure to work under the conditions that you have provided. We have the utmost freedom and are not hampered by rules and regulations which in many cases are detrimental to good work.

Respectfully submitted,

E. P. SANDSTEN,  
Horticulturist.

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## Report of the Irrigation Engineer

To the Director:

The following constitutes a brief report of the work conducted in the Irrigation Investigations Section during the state fiscal year

ending November 30, 1925. During this period the following projects have been given consideration:

1. Measurement of Water As Applied to Irrigation.
2. Loss of Water by Evaporation.
3. Meteorology.

**Measurement of Water.**—Previous investigations of the Improved Venturi Flume resulted in a design that promises to be of great importance from the standpoint of a measuring device. The earlier tests made on this device, because of limited water supply, did not permit the full range of flow conditions, and it was therefore necessary to make further tests where greater flows might be studied.

Because of the many desirable characteristics inherent in this device, calibrations were made on a small improved Venturi flume with 6-inch throat, this being suitable only for the measurement of farm deliveries. The characteristics of the small-sized flume are essentially the same as those of the larger flumes, with the exception that the limit of submergence affecting free flow is slightly less than for the larger sizes. To make the improved Venturi flume more practical in the field, an integrating instrument has been developed which makes it possible to determine, by means of dial readings, the total amount of water in acre-feet passed thru the device for any period of time. This flume, equipped with such an integrator, eliminates the necessity of current-meter ratings, the interpretation of graphic charts, and the uncertainty of various correction factors which are necessary in the old-type rating-flume devices. Because of the importance of the improved Venturi flume in successfully meeting conditions in the field, there have been designed flumes of large capacity based upon the experimental results obtained in our laboratory from smaller structures.

Tests have been conducted at the hydraulic laboratory on a divisor which will proportion on various ratios the stream flow in a channel. This problem is very common in our irrigation practice, where the flow is to be divided according to certain rights or shares held by two or more water users. A complete study of this device has not yet been made, but preliminary investigations would seem to indicate that our present apparatus will divide the flow in various ratios up to 1:10, independently of variation in the amount of water flowing, and also as to whether or not the delivery is made at high or low elevation.

In order to study measuring devices of relatively large capacity, improvements have been made at the Bellvue irrigation hydraulics laboratory such that eventually it will be possible to have practically 200 second-feet available for our studies. The improvements

made consist in the extension of the laboratory channel 50 feet downstream, this new part constituting a large weir box which accommodates a 15-foot rectangular weir, this new work being of reinforced concrete and substantially constructed.

Preliminary tests have been made on a double-hump hydraulic jump flume with the idea of increasing the degree of submergence before interference to free flow. These preliminary tests did not show marked improvement over the improved Venturi flume. However, it is believed further work on the principle of the hydraulic jump would be very desirable.

The rating station maintained at the hydraulic laboratory on the campus has been made useful on a number of occasions in the rating of instruments for the State Engineer's office, as well as for individual engineers and water companies thruout the state.

**Loss of Water by Evaporation.**—Our work on the loss of water by evaporation from a free water surface has been continued, using apparatus mounted within the hydraulic laboratory. Observations have been made to determine the evaporation loss for winds of various velocities in miles per hour, and also under still-air conditions. Observations were made as to the loss in evaporation from the supply reservoir at the hydraulic laboratory, where the exposed area was approximately 5,500 square feet. A study has also been conducted having to do with the evaporation loss from moist soils, especially relating to evaporation losses from riverbed materials. This work was conducted for the purpose of estimating the amount of loss in our river channels of Colorado.

**Meteorology.**—Meteorological observations have been maintained without interruption thruout the year. These data have been of considerable interest to the local community, as evidenced by daily reports in the newspapers and especially on occasions of extreme weather.

**Future Projects.**—**Work that should be done:** Make a comprehensive study of the economic use of water in the Cache la Poudre Valley; such a study to result in the development of plans and practical application of existing knowledge to warrant sound and rational statements as to the consolidation of interests from an irrigation standpoint.

Study the consumptive use of water in the Colorado River Basin (in Colorado) for the purpose of establishing such facts as to the use of water; this study to make available useful information in the adjustment of rights and regulations involved in the agreements now entered into by the several states comprising this great watershed.

Collect and assemble such data as are necessary to give practi-

cal information for the installation and operation of small pumping units suitable for supplying water for irrigation under Colorado conditions.

A general discussion of the improved Venturi flume has been published in the Proceedings of the American Society of Civil Engineers. Short descriptions of this measuring device have appeared in various agricultural papers.

There seems to be a general tendency on the part of scientific investigators to seek cooperation in their endeavors. It is believed that this desire to work together should be encouraged, because many problems now under study have many ramifications of such nature that one's own field is not sufficiently broad to cover the entire subject.

Respectfully submitted,

RALPH L. PARSHALL,  
Irrigation Engineer.

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## Report of the Veterinary Pathologist

To the Director :

### Projects in Force

- I. Sheep Losses in Feedlots.
- II. Contagious Abortion.
- III. General Disease Studies.

### Sheep Losses in Feedlots

During the last feeding season, daily visitations were made to feeding pens where 17,500 lambs were being handled. The object was to examine all dead lambs with a view of determining the cause of death and to bring such material to the laboratory as seemed to require further attention. The net result of this season's work seemed to indicate that most of the losses could be classified under four heads, namely :

### Overeating, Emaciation, Pneumonia and Dysentery.

The distribution of deaths from these causes indicated that death from overeating might begin rather early in the feeding period and was distributed thru it, but that it reached its peak near the end. The other three diseases were largely seen in the first month and no cases were observed after the first six weeks.

Anaerobic cultures were made from the spleens of all lambs regardless of the cause of death. These indicated that a spore-

forming anaerobe, pathogenic for guinea pigs, might be isolated in a certain percentage of cases from emaciated lambs as well as those that were fat. The proportion of such organisms coming from the fat lambs was slightly larger than those from the emaciated, but not sufficient to indicate that they might be a factor in the cause of death.

Coccidiosis in lambs was determined by us the first time in the fall of 1924. So far this year we have observed it in two flocks. The losses have not been excessive, but we look with some alarm upon its appearance, since it seems to us that it will be particularly difficult to handle under feeding conditions.

### Contagious Abortion

Work was continued with the college herd during the past year with such favorable results that we have every reason to believe that the herd is now entirely free from disease. Since beginning the work of eradication with this herd in May, 1923, we have carried out twelve complete tests. There have been no reactors since December, 1924. Since that time we have had four negative tests. A few observations may be of interest. Our records on the beef and dairy herds have been kept separately.

In May, 1923, we found that 31 percent of the beef herd reacted. These were immediately separated and the herd was tested again in July, when four new reactors developed. In September there was one new reactor; in December, two; in April, 1924, one; and in June, another. These were separated as soon as found and since the last date no new reactors have been discovered. It took, however, six tests in thirteen months to entirely eliminate the reactors from the herd.

From the dairy herd 28 percent reacted in May, 1923. In July there were two new ones; in September, two; in December, two; and in April, one. Following this we had negative tests in June and September and then a new positive in December, 1924. This cow was immediately separated and since that time there have been no new reactors in four tests. It took eight tests scattered over nineteen months to eliminate the disease from the dairy herd. These figures are interesting as showing the complicated nature of eradicating the disease by this method.

We have just now entered into an agreement to take over a private herd of purebred animals in an attempt to do the same as has been done in the college herd.

### General Disease Studies

A tabulation of the diagnostic work and blood tests carried on by this section follows:



## Diagnostic Work (exclusive of blood tests)

Poultry .....	381	Hogs .....	15
Cattle .....	55	Miscellaneous .....	86
Horses .....	27		—
Dogs .....	22	Total .....	615
Sheep .....	29		

## Blood Tests

	Number	Positive	Percent Positive
Contagious Abortion....	1,151	175	15
White Diarrhoea.....	12,464	1,352	11

Owing to the increasing demand for white-diarrhoea testing, it became necessary to make a charge of five cents per test, which has had the effect of materially reducing the number of samples submitted.

One article, entitled "An Outbreak of Paratyphoid Dysentery in Lambs." by I. E. Newsom and Floyd Cross, has appeared in the Journal of the American Veterinary Medical Association, Volume 46, page 289.

Miss Clare Mullen resigned as stenographer for the section, to take effect July 1. She has been replaced by Miss Winifred Christie.

Respectfully submitted,

I. E. NEWSOM,  
Veterinary Pathologist.

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## Report of the Veterinarian

To the Director:

The only project in the Veterinary Section is one on Animal Diseases. It is the only one on which we desire to prosecute work the coming year.

This is a general project and does not contemplate protracted specific investigations. Work of this character is carried on by the Department of Pathology. The project, however, does take care of certain phases of animal disease investigation and supervision in a very satisfactory way. It is helpful in emergency cases that happen from time to time. It helps us keep in touch with the health of animals thruout the state, and to lend assistance when called on by state and national authorities.

Numerous short articles pertaining to animal diseases have been published, such as: "Conspicuous Achievements in Animal

Disease Investigation," "Relation of the Veterinarian to the County Agricultural Agent," and "Bulbar Paralysis." A revision of Bulletin 211, "Colorado Plants Injurious to Livestock," was prepared. Cooperative work with the Department of Botany in a study of poisonous plants is contemplated in the near future.

Respectfully submitted,

GEORGE H. GLOVER.

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## Engineering Division

To the Director:

I am transmitting herewith reports of the Civil Engineering and Mechanical Engineering Sections of the Engineering Division of the Experiment Station.

Respectfully submitted,

L D CRAIN,  
Vice-Director.

## REPORT OF THE MECHANICAL ENGINEER

To the Chairman, Engineering Division:

The projects upon which the Mechanical Engineering Section of the Experiment Station have been engaged during the past state fiscal year are: (1) Humidifying Air in Buildings; (2) Treatment of Alkali and Other Waters for Domestic Use.

The projects upon which the Mechanical Engineering Section desires to prosecute work during the coming year are: (1) Humidifying Air in Buildings; (2) Treatment of Alkali and Other Waters for Domestic Use; (3) The Effect of Artificial Lighting on Egg Production; (4) Temperatures in Various Types of Poultry Houses; (5) Egg Incubation at High Altitudes.

During the investigational work on Humidifying Air in Buildings, at the Colorado Agricultural College, we have found that the relative humidity of inside air was very low, an average of 15.18 percent during the winter months, and, in extreme cases, running as low as 8 percent. The average relative humidity of inside air with an outside air temperature of 0° Fahr. was 12 percent, and as the outside air temperature increased there was an increase in the relative humidity of inside air, due to a greater opening of windows and a greater evaporation of moisture outside. When the tempera-

ture of outside air reached 50.68° Fahr. during the month of April, 1925, the average relative humidity of inside air was 19.5 percent.

The V-shaped humidifier pan designed by the department, which hangs on the back of steam or hot water radiators and extends into the radiator between the columns, evaporated 2.75 times as much water as similar pans now on the market. It was also found that increasing any dimension of the pan increased the rate of evaporation.

Let us assume that under normal conditions for a school room, by the use of the most efficient humidifier pan used on one side of the radiators only, this would give an increase of 2.1 percent in the relative humidity of the inside air. According to the best authorities, the desirable relative humidity of inside air is from 40 to 50 percent, making an increase of 2 percent unnoticeable.

The crash-fibre humidifier, consisting of strips of crash running from an upper water pan to a lower water pan and an electric fan for circulating the air, evaporated only a small amount of moisture and showed only a negligible increase in the relative humidity of inside air.

The average relative humidity of air during cold weather in a four-room private dwelling with a water pan (regular equipment) in a hot air pipeless furnace was 32.9 percent. With a circular V-shaped humidifier pan installed in the hot air pipe under the register, the relative humidity was 36 percent. With both pans in operation the relative humidity was 45 percent.

The results of the project, Treatment of Alkali and Other Waters for Domestic Use, show that domestic water supplies of Colorado as a whole are good, altho alkali waters are found in practically every section of the state. The majority of people, if forced by circumstances to use alkali water, become accustomed to drinking it without apparent injury to their health, unless the water is extremely alkaline.

Condensation is the only method by which alkali water may be purified for drinking purposes. Household water purifiers now on the market are simple, convenient to operate and inexpensive, but considerably overrated.

Common household purifiers operated continually for ten hours over a hot fire will produce from one to two gallons of purified water, but when operated on the back of the stove with an ordinary fire, as recommended by the manufacturer, insufficient drinking water is produced for an average family.

Altho nine times as much heat must be produced with a coal stove as with a gas burner to purify the same amount of water,

the water may be purified from 10 to 15 percent cheaper with coal than with artificial gas.

Boiling alkali water does not, to any extent, remove its alkalinity.

A purifier made by slightly altering a domestic hot-water system has been designed, built, and tested. The amount of purified water produced was .5 gallon per hour with an ordinary fire, and at the same time a 30-gallon tank of water was heated to a temperature near boiling in ten hours. Further work is being done on this phase of the project.

Respectfully submitted,

G. A. CUMINGS,  
Assistant in Mechanical Engineering,  
Engineering Experiment Station.

### REPORT OF CIVIL ENGINEER

To the Vice-Director:

Following is the report of the Civil Engineering section of the Experiment Station, covering the state fiscal year.

The projects upon which this section has been engaged are:

1. **A Study of the Effect of Beet Pulp on Portland Cement Concrete and Mortar.**
2. **Sub-grade Soils of Colorado.**
3. **Road Materials of Colorado.**
4. **Service Tests of Materials for Maintenance of Expansion-contraction Joints in Concrete Pavements.**

Project number one has been completed. A bulletin, Number 306, entitled "A Study of the Effect of Beet Pulp on Portland Cement Concrete and Mortar," has been published.

Project number two is under way at this time. This project was taken up at the request of the Colorado Highway Department and the United States Bureau of Public Roads. Both of these organizations are cooperating with us in this work. Work was started on this project in January, 1925. There are two general phases of this investigation: First, a study of sub-grade soils under concrete pavements, and the relation between the quality of these sub-grades and the present condition of the pavement. Second, a study of sub-grade soils on highways where the construction of hard road surfaces is contemplated. This investigation has already furnished valuable information which is being used by the engineers of the State Highway Department in the designing of improved highways for the State of Colorado.

Project number three has, for the time being, been crowded into the background by project number two. This project had for its object the location of suitable materials for road surfacing in Colorado, a determination of the quantity of these deposits and a determination of the suitability of these materials for road surfacing purposes. The project received practically our entire attention for about three years and a progress report was printed, Bulletin Number 284. At the present time the state has been fairly well covered by the field party making the survey, and all samples sent in have been tested in our road materials laboratory. At the present time the field party has been withdrawn, and materials are sent in by the State Highway Department whenever the same are required for new highway construction. We are testing these samples as they are sent in. It seems to me that there is enough data on hand at this time to warrant the publication of a supplementary report on his project.

Project number four has been carried on during the six months covered by this report. Different materials for the joints in concrete pavement are being analyzed and tested by actual service on our pavements. The data are being kept by those in charge of the work, and in a year or so we should have some pretty definite information concerning the expansion-contraction joint compounds that are suitable for Colorado's concrete paved roads.

Respectfully submitted,

E. B. HOUSE.

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## Report of Editor of Publications

To the Director:

Nearly half my time has been given to Experiment Station work the past year. In addition to editing and publishing over twice as many bulletins as usual, this office handled the station exhibit at the National Western Stock Show in Denver last January.

Before taking over that exhibit work I had heard that it was a job full of grief. However, I wish to say that never have I enjoyed a job more than I did that one. Every department gave perfect cooperation; so far as I know everyone was pleased; and I feel that the display was a success in every way, even tho it did not require as much money as heretofore. The splendid cooperation of other station workers was responsible for the smoothness and success of the enterprise.

I cannot refrain from mentioning the splendid work of Grant

C. Eddy, our photographer, in helping me plan, prepare and arrange the exhibit. His services were invaluable thruout.

The usual number of news stories concerning station work have been issued the past year. Special stories have been written for several events, including Farmers' Day at Avon, the annual sheep feeders' tour of Boulder, Larimer and Weld counties, and both Sheep and Cattle Feeders' Days here on the campus.

An effort was made to get the agricultural college editors to hold their 1926 meeting in Fort Collins, but since no representative from this campus was present at the 1925 meeting, our request was not given favorable consideration. The meeting next year will be in East Lansing, Michigan, and I sincerely hope that I may be able to attend and make another effort to get the meeting on our campus for 1927. I have already been promised the aid of several western editors.

The adoption of Mr. F. W. Beckman's "Deskbook of Style" as a guide for station publications was certainly welcome news to me. I believe it will make for much greater uniformity in our printed matter and certainly lighten the editor's work.

The editorial work this year has been particularly heavy, but more enjoyable than ever. Fourteen bulletins, the annual report and four press bulletins, totaling 475 pages, have been edited and published. This is nearly three times as much publishing as the station has done in any previous year. There is also one publication, that of Professor Longyear's on "Nature of Decay in Wood," yet in process of publication.

Following is a detailed report of publications by numbers, pages, editions and authors:

No.	Title	Author	Pages	Edition
293	Bacillary White Diarrhoea of Chicks.....	I. E. Newsom.....	8	5,000
294	Some Orchard Conditions Affected by Arsenicals, Marls and Other Factors...	Wm. P. Headden...	31	1,500
295	Make the Dairy Pay.....	F. E. Ball.....	60	7,500
296	Variations in Composition of Colorado Potatoes.....	N. E. Goldthwaite..	76	1,500
297	Potatoes from the House- keepers' Standpoint.....	N. E. Goldthwaite..	32	5,000
298	Principles of Making Fruit Jellies .....	N. E. Goldthwaite..	27	5,000
299	The Nitrate Question in Colorado .....	Wm. P. Headden...	28	1,500

No.	Title	Author	Pages	Edition
300	Colorado Pure Seed Law... (From Statutes)....		8	2,500
301	Value of the Tergite Preceding the Supra-anal Plate in Classification of Male Acridinae .....	C. L. Corkins.....	12	1,500
302	Sheep Losses in Feedlots II Parathyphoid Dysentery.	I. E. Newsom and Floyd Cross.....	18	3,000
303	Colsess Barley.....	D. W. Robertson and Alvin Kezer.....	11	6,000
304	Sheep Production in Colorado .....	C. I. Bray.....	44	6,000
305	Diseases of Colorado Feeding Lambs.....	I. E. Newsom and Floyd Cross.....	26	3,000
306	Effect of Beet Pulp on Portland Cement Concrete and Mortar.....	O. V. Adams.....	20	3,000
			409	52,000
	37th Annual Report.....		42	1,500

### Press Bulletins

59	Poisoned Grain for Prairie Dogs, Ground Squirrels, Kangaroo Rats and Other Rodent Pests.....	W. L. Burnett.....	4	2,000
60	Improved Venturi Flume...	R. L. Parshall.....	8	1,000
61	Botulism Poisoning.....	W. G. Sackett.....	4	5,000
62	Small Grain Facts for Irrigated Colorado.....	Alvin Kezer and D. W. Robertson...	8	2,500
			24	10,500
			451	53,500
			475	64,000

### In Press

307	Nature of Decay in Wood..	B. O. Longyear		
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Respectfully submitted,

I. G. KINGHORN,  
Editor of Publications.

