

S41
.E6
31st
1918

VIRGINIA POLYTECHNIC INSTITUTE, VIRGINIA POLYTECHNIC INSTITUTE
LIBRARY, AGRICULTURAL BRANCH LIBRARY
BLACKSBURG, VIRGINIA

THE STATE AGRICULTURAL COLLEGE
OF COLORADO

The Thirty-First Annual Report

OF

The Agricultural Experiment
Station

1918



THE STATE AGRICULTURAL COLLEGE
OF COLORADO

The Thirty-First Annual Report

OF

The Agricultural Experiment
Station

1918



U18402 8014138

The Colorado Agricultural College

FORT COLLINS, COLORADO

THE STATE BOARD OF AGRICULTURE

	Term Expires
HON. CHAS. PEARSON	Durango, 1919
HON. R. W. CORWIN	Pueblo, 1919
HON. A. A. EDWARDS, President of the Board.....	Fort Collins, 1921
HON. J. S. CALKINS	Westminster, 1921
HON. H. D. PARKER	Greeley, 1923
MRS. AGNES RIDDLE	Denver, 1923
HON. J. C. BELL	Montrose, 1925
HON. E. M. AMMONS	Denver, 1925

PRESIDENT CHAS. A. LORY,
GOVERNOR JULIUS C. GUNTER, } Ex-Officio

L. M. TAYLOR, Secretary

CHAS. H. SHELDON, Treasurer

EXECUTIVE COMMITTEE

A. A. EDWARDS, Chairman

E. M. AMMONS

H. D. PARKER

OFFICERS OF THE EXPERIMENT STATION

CHAS. A. LORY, M.S., LL.D., D.Sc.	President
C. P. GILLETTE, M.S., D.Sc.	Director
LD CRAIN, B.M.E., M.M.E.	Vice-Director
L. M. TAYLOR	Secretary
MABEL LEWIS	Executive Clerk

STATION STAFF Agricultural Division

C. P. GILLETTE, M.S., D.Sc., Director	Entomologist
W. P. HEADDEN, A.M., Ph.D.	Chemist
G. H. GLOVER, M.S., D.V.M.	Veterinarian
W. G. SACKETT, Ph.D.	Bacteriologist
ALVIN KEZER, A.M.	Agronomist
G. E. MORTON, B.S.A., M.S.	Animal Husbandman
E. P. SANDSTEN, M.S., Ph.D.	Horticulturist
B. O. LONGYEAR, B.S.	Assistant in Forestry
I. E. NEWSOM, B.S., D.V.S.	Veterinary Pathologist
W. W. ROBBINS, M.A., Ph.D.	Botanist
INGA M. K. ALLISON, E.B.	Home Economics
DAVID D. GRAY, B.S.A., U. S. Expert-in-Charge	Horse Breeding
RALPH L. CROSMAN	Editor
R. E. TRIMBLE, B.S.	Assistant in Irrigation Investigations
EARL DOUGLAS, M.S.	Assistant in Chemistry
S. ARTHUR JOHNSON, M.S.	Assistant in Entomology
P. K. BLINN, B.S., Rocky Ford	Alfalfa Investigations
L. C. BRAGG	Assistant in Entomology
MIRIAM A. PALMER, M.A.	Delineator
J. W. ADAMS, B.S., Cheyenne Wells	Assistant in Agronomy, Dry Farming
RALPH L. PARSHALL, B.S., U. S. Irrigation Engineer	Irrigation Investigations
*R. A. MCGINTY, B.S.	Assistant in Horticulture
BREEZE BOYACK, B.A., M.S.	Assistant in Agronomy
CHAS. R. JONES, B.S.	Assistant in Entomology
GEO. M. LIST, B.S.	Assistant in Entomology
†CARL ROHWER, B.S., C.E.	Assistant in Irrigation Investigations
†G. HEMPHILL, B.S.	Assistant in Irrigation Investigations
†THOS. H. MCCARTHY, B.S., C.E.	Assistant in Irrigation Investigations
CHAS. I. BRAY, B.S.A., M.S.	Assistant in Animal Husbandry
†H. E. VASEY, A.M.	Assistant in Botany
EVELYN G. HALLIDAY, B.S.	Assistant in Home Economics
THOMAS L. DOYLE	Assistant in Irrigation Investigations
G. E. EGGINTON, B.S.	Seed Analyst
WM. MAY	Assistant in Botany
LETO M. MERKER, G.N.	Assistant in Bacteriology
DON W. STUVER, B.S., C.E.	Assistant in Irrigation Investigations

Engineering Division

LD CRAIN, B.M.E., M.M.E., Chairman	Mechanical Engineering
E. B. HOUSE, B.S. (E.E.), M.S.	Civil and Irrigation Engineering
L. S. FOLTZ, B.S. (E.E.), M. S.	Electrical Engineering

* On leave of absence.

† In their country's service; on leave of absence for duration of the war.

S41
.E6
31st
1918

21703

LETTER OF TRANSMITTAL

To His Excellency, Julius C. Gunter, Governor of Colorado:

In accordance with the law of Congress, I have the honor to transmit to you herewith the Thirty-first Annual Report of the Colorado Agricultural Experiment Station.

The financial statement is for the government fiscal year ending June 30, 1918. The other portions are reported substantially for the state fiscal year of 1917-18.

C. P. GILLETTE,
Director.

Agricultural Experiment Station,
Fort Collins, Colorado,
December, 1918.

FINANCIAL REPORT OF THE COLORADO AGRICULTURAL EXPERIMENT STATION FOR THE FISCAL YEAR ENDING JUNE 30, 1918

DR.

From the Treasurer of the United

States as per appropriation for the Hatch

fiscal year ending June 30, 1918, un-

der acts of Congress approved March

2, 1887 (Hatch Fund) and March 16,

1906 (Adams Fund).....\$15,000.00

Balance on hand July 1, 1918.....

Other sources than U. S.....

Total receipts.....

By

Salaries.....

Labor.....

Publications.....

Postage and stationery.....

Freight and Express.....

Heat, Light, Water and Power.....

Chemicals and Lab. supplies.....

Seeds, Plants and Sundry Supplies.....

Fertilizers.....

Feeding stuffs.....

Library.....

Tools, machinery and appliances.....

Furniture and fixtures.....

Scientific apparatus and specimens.....

Live stock.....

Traveling expenses.....

Contingent expenses.....

Buildings and land.....

Total expenditures.....

Balance.....

Receipts

State Mill

Levy Fund

Adams Fund

Hatch Fund

Un-
der acts of Congress approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund).....

Balance on hand July 1, 1918.....

Other sources than U. S.....

Total receipts.....

Disbursements

Salaries.....

Labor.....

Publications.....

Postage and stationery.....

Freight and Express.....

Heat, Light, Water and Power.....

Chemicals and Lab. supplies.....

Seeds, Plants and Sundry Supplies.....

Fertilizers.....

Feeding stuffs.....

Library.....

Tools, machinery and appliances.....

Furniture and fixtures.....

Scientific apparatus and specimens.....

Live stock.....

Traveling expenses.....

Contingent expenses.....

Buildings and land.....

Total expenditures.....

Balance.....

Grand Junction Drainage Fund

Horse Cash Fund

Pure Seed App'n Fund

Special Fund

Sales Fund

State Mill Levy Fund

Adams Fund

Hatch Fund

Un-
der acts of Congress approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund).....

Balance on hand July 1, 1918.....

Other sources than U. S.....

Total receipts.....

Disbursements

Salaries.....

Labor.....

Publications.....

Postage and stationery.....

Freight and Express.....

Heat, Light, Water and Power.....

Chemicals and Lab. supplies.....

Seeds, Plants and Sundry Supplies.....

Fertilizers.....

Feeding stuffs.....

Library.....

Tools, machinery and appliances.....

Furniture and fixtures.....

Scientific apparatus and specimens.....

Live stock.....

Traveling expenses.....

Contingent expenses.....

Buildings and land.....

Total expenditures.....

Balance.....

REPORT OF THE DIRECTOR

To the President:

I am presenting herewith the annual report of the Agricultural Experiment Station for the state fiscal year closing November 30, 1918. The financial statement is for the government fiscal year closing June 30, 1918.

The interference with station work because of war conditions has been greater than in 1917, but in no case has the head of a section entirely deserted his station work because of war conditions. Eight station employees have left the station work for war service, including two, Mr. Carl Rohwer and Mr. Thomas McCarthy, who left before the beginning of the present fiscal year, and Messrs. J. T. Copeland, I. C. Hoffman, W. P. Little, H. E. Vasey, Thos. Doyle, and Leonard Doyle. I regret to report that Mr. Vasey died while in service, Dec. 10, 1918. Four of these men were giving full time to station work, the remainder part time only. Some of our men who have remained at home have done so because of urgent requests from the director of the station and department heads, who assured them that they could serve their country more efficiently in their specialties and in the promotion of agricultural production than they could in the trenches. Some of the heads of sections have worked heavily over time in order to give freely of their services to aid the County and State Councils of Defense, the Red Cross and other patriotic organizations. It has been difficult to secure men to fill the positions that have been vacated and several are still open. However, the work has not been seriously disorganized in any section, but some of the projects have been partly or wholly held in abeyance and a few new lines of work have been undertaken for the purpose of increasing crop production and conserving food products.

In this connection, it might be well to mention the very efficient work done by Prof. Kezer as chairman of the seed committee and of the tractor committee of the State Council of Defense; of Prof. Morton as vice-chairman of the live stock committee of the State Council of Defense; of Mr. Parshall's work in starting the movement for a more economic and efficient use of irrigating waters in the State, especially for the maturing of grain and other food crops, and of the efforts of Prof. House in getting the farmers who had a liberal supply of water, some of which could be spared, to allow a part to go to their neighbors who had a real shortage. Dr.

Sandsten did much to enable the farmers to get good seed potatoes and plenty of them, and also to encourage a better grading and storage of potatoes and the building of home and community evaporators for the saving of fruits and vegetables. The Entomology Section gave considerable attention to the control of grasshoppers and rodents in the State and to determine a better method of controlling the spotted bean beetle, which has been doing extreme damage to the beans in Eastern Colorado in recent years.

In all departments of the experiment station work, it has been the plan to emphasize those investigations that promised to give early results in increased crop production, and to give out as much practical information as possible through bulletins published by the Station and the Extension Service. Experiment station men have also offered their services rather freely in extension work during the year.

A new division has been added to the experiment station organization, under the title of "Engineering Division", with Prof. L. D. Crain as vice-director in charge of the work. Out of the station funds for the year, \$10,605 has been set aside for use in the Engineering Division. To the present only one project, "Road Materials in Colorado", is being carried.

An Animal Pathology Section has been started by dividing the work that was formerly carried by the Veterinary Section, and making an independent section with Dr. I. E. Newsom as the head. A chemical laboratory for the use of the Home Economics Section has been fully equipped and is now in use.

Mr. V. M. Cone, who was in charge of the co-operative work in irrigation investigations, left the station employ early in the year and Mr. Ralph L. Parshall has taken his place. Four assistants in this work have also left to join the army during the year, which has interfered very seriously in carrying out the work as planned.

Because of a balance from last year's funds and a somewhat enlarged millage, we were able to set aside a budget of \$94,885 for the support of experiment station work during the present government fiscal year, besides \$6,520 that has been paid on land indebtedness.

The co-operative work that we have been carrying on with the Department of Agriculture, through the bureaus of Animal Husbandry, Plant Industry, and Public Roads, has been continued with satisfaction to all parties concerned so far as I am aware. It has been decided, however, by the State Board of Agriculture, that the co-operative horse-breeding work at this institution shall be discontinued at the end of the present fiscal year.

I am anxious to provide for the increase of some of the improved strains of wheat and other grains and alfalfa that have been developed in the Agronomy Section, so that they may be put into the hands of the farmers in sufficient quantities to have them thoroughly tried out in the different agricultural sections of the State. I believe the fields now being used by the horse-breeding investigations, should be used, at least in most part, for this work as soon as these lands can be released.

I am gratified at the results reached in the high-altitude crop work at Fort Lewis during the past summer and am fully confident that to get the best results from these investigations, it will be necessary to employ a man who can give his full time and attention to the investigational side of the work. Such a man could look after the crops in charge of the Agricultural Section and also the fruits and vegetables that are being tested out by the Horticultural Section.

With the present prospects for increased demand for meat and dairy products and especially for breeding animals, we think we should strengthen our investigations of Colorado-produced feeds for live stock and especially those that may be substituted for grain and other feeds shipped into the State. In my judgment we should take up investigations that may aid in developing the sheep growing industry in Colorado as soon as funds will permit.

The nitre and alkali troubles continue to be serious in many sections of the State and are requiring almost the entire time of the Chemical and Bacteriological Sections of the Station. There seems to be little likelihood that these problems will subside in the near future.

The appropriation of \$5,000 for the drainage of the Teller Indian School Lands has been expended, we believe, to the best possible advantage. The amount of the appropriation was only sufficient to put in the main outlet up to a point near the buildings and provide a diversion canal for the ditch that had been changed from its course in order to provide an outlet for the drain. We believe that any further attempt at the drainage of this tract should be joined to and made a part of the United States Reclamation Service drainage district, in which the Indian School lands lie.

Fifteen station bulletins have been published during the year, making the number to date, 249. In addition to these, one information circular has been published. For a full statement concerning the publications, see the report of the Editor.

EXPERIMENT STATION FUNDS JULY 1, 1917, TO JUNE 30, 1918

The station funds available during the last budget year are summarized as follows:

Federal Support	(Hatch	\$15,000.00	
	(Adams	15,000.00	
	(Sales	1,151.47	
			<hr/>
			\$31,151.47
State Support	(Mill Levy	49,193.52	
	(Special	11,539.08	
	(Horse Cash	2,102.77	
	(Indian Drainage	5,000.00	
	(Pure Seed	9,500.00	
			<hr/>
			77,335.37
			<hr/>
Grand Total			\$108,486.84

The funds for the Teller Indian School Drainage and for the Pure Seed project can hardly be considered to be primarily for experimental work, but these moneys have been expended under the direction of the Experiment Station. Deducting these amounts from the total fund of \$108,486.84 leaves \$95,486.84 for the investigational work of the Station.

PROJECTS IN FORCE DURING YEAR

The projects that are allotted to the different sections of the Experiment Station and which are alive at the present time are listed as follows:

Chemical Section

Niter Studies. Adams Fund.

Bacteriological Section

A Bacterial Study of Alkali Soils in Relation to Nitrogen Fixation. Adams Fund.

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

Associative Action of Bacteria in Soils. Adams Fund.

A Bacterial Disease of the Wragg Cherry. Hatch and State.

Food Poisoning in Sheep and Cattle. Adams Fund.

Pathology Section

Necrotic Stomatitis. State Fund and Hatch.

Contagious Abortion. State Fund and Hatch.

Chicken Diseases. State Fund.

Sheep Losses in Feed Lots. Hatch Fund.

Entomological Section

Plant Louse Investigations. Adams Fund.

Life Habits of the Syrphus Flies. Hatch Fund.
Control of Insects by Egg Treatment. Hatch and State Funds.
Codling Moth Studies. Hatch and State Funds.
Grasshopper Control. State Fund.
General Insect Investigations. State Fund.

Irrigation Investigation Section

Drainage of Farm Crops and Drainage Factors. Adams Fund.
Pump Irrigation. Hatch Fund.
Seepage. Hatch Fund.
Evaporation Experiment. Hatch Fund.
Duty of Water in the Poudre Valley. State Fund.
Grand Junction Indian School Drainage. Appropriation.
Current Meters. Adams Fund.
The Venturi Flume. Adams Fund.

Agronomy Section

Relation of Soil Moisture, Structural Development and Acre
Yields in Small Grains. Adams Fund.
Correlation of Characters in Grain. Hatch Fund.
Alfalfa Breeding. Hatch Fund.
Methods in Selection Breeding. State Fund.
High Altitude Crops. State Fund.
Feed Crop Improvement. State Fund.
Rotation of Crops for Colorado. State Fund.
Plain Crops and Management. State Fund.
Methods of Handling Hay. (In co-operation with Animal
Husbandry Section.) State Fund.

Horticultural Section

Hardy Stock for Apples. Hatch and State Funds.
Pear Growing in Eastern Colorado. Hatch and State Funds.
Potato Investigations. Hatch and State Funds.
Fruits and Vegetables for High Altitudes. State Fund.
Hardy Tree Fruits for High Altitudes. State Fund.
Seed Potato Growing in High Altitudes. State Fund.
Effect of Diseased and Ill Shapen Seed Potatoes on Succeed-
ing Crop. Hatch and State Funds.
Dehydration of Fruits and Vegetables. State Fund.
Fruit Survey of Fremont County. State Fund.

Horse Investigations

To Establish an American Breed of Carriage Horse. State
Appropriation Fund in co-operation with Bureau of Animal In-
dustry.

Animal Husbandry Section

Acre Value of Pasture for Dairy Cows. State Fund.
Steer Feeding Experiment. State Fund.
Lamb Feeding Experiment. State Fund.
Methods of Handling Hay. (In Co-operation with Agronomy Section.) State Fund.

Botanical Section

Native Vegetation as an Indicator of Crop Possibilities. Hatch Fund.

Microscopy of Stock Poisoning Plants. Hatch Fund.

Irrigation Water as a Disseminator of Weed Seeds. Hatch Fund.

Hard Seed of Alfalfa. State Fund.

Anatomical and Microscopical Study of Flinty and Yellow-berry Wheat Kernels. Hatch Fund.

Colorado Forage Grasses. State Fund.

Fungous Disease Investigations. State Fund.

Proso Millet Smut. State Fund.

Whorled Milkweed Control. State Fund.

Forestry Section

Studies in the Decay of Wood. Hatch Fund.

Irrigation Engineering Section

Duty of Water on the College Farm. State Fund.

Sub-irrigation Investigations. Special Fund.

Home Economics

Utilization of Fruit Juices. State Fund.

Engineering Division

Road Materials and Road Building in Colorado. State Fund.
(Civil and Irrigation Engineering Section).

Brief reports of the heads of sections are given on the following pages.

Respectfully submitted,

C. P. GILLETTE,

Director.

REPORT OF THE AGRONOMIST

To the Director:

I am submitting herewith my annual report for the Agronomy Section for the period ending November 30th.

In answer to the questions of Dr. E. W. Allen of the Office of Experiment Stations:

2. Our working program has only been a little modified by war conditions. We were obliged to reduce parts of our work at Fort Lewis. At the home station war conditions hurried the adop-

tion of a general seed improvement program. This program had been fairly well worked out before the war but there is no doubt that war conditions hastened its approval by local authorities. This program made it possible to put into use some of the really worthy creations of our plant-breeding efforts. The war program also hastened the starting of work with corn and sorghums—work which had been contemplated and well outlined previous to the war.

3. The station work with rotations and types of crops adapted to different regions enabled the Station to give sound advice on the standardization of crops in order to get the highest production during war time. Our work had also gone far enough so that we could quite definitely advise every section as to well adapted crops. All of this material was collected in pre-war times and was useful in peace time but the stress of war conditions put more of it into use and made a greater call for it.

4. The wheat-growing sections of the State standardized on practically three varieties of wheat, Turkey Red winter wheat, Deliance spring wheat, and Marquis spring wheat. Marquis was introduced by the Station from Canada. Deliance was originated and distributed from the Station. Turkey Red came in thru the ordinary channels of trade but its place in our agriculture was accurately determined by the Station. Farmers, altho in the habit of trying new things, accepted advice of the Station and grew only standard tried sorts. This resulted in a very great saving in marketing because it cut down mixtures. It resulted in a measureable increase in crops because it caused the varieties best adapted to various sections to be grown. Similar results were obtained with Kherson oats and Colorado 37 oats. There was quite a tendency of farmers to take advantage of high wheat prices and high hay prices. This tendency, if unchecked, would have resulted in a greater acreage of wheat and alfalfa than was justified nationally or locally.

The advice of the Station on rotations was followed to a sufficient extent to preserve the balances between land in legume crops and land in till crops.

The work of the Station in farm management in the dry-land regions enabled us to distribute widely the most successful methods in those sections. This work resulted not only in an increase of crops in the dry-land regions but stabilized living conditions. How important this was will be seen when it is taken into consideration that we had two very dry years in 1916 and 1917 which probably

reached the maximum drouth cycle. The year 1916 was the driest since 1894, being even drier than 1911, the driest year with which 1916 could be compared.

5. The head of the Agronomy Section was a member of the Federal Sugar Beet Commission for Colorado. On this work he spent seven weeks in the field and preparing the reports as secretary of the commission.

The head of the Agronomy Section also served as chairman of the seed committee and chairman of the tractor committee of the State Council of Defense. In such capacity surveys of the seed situation were made. Seeds were located for growers and dealers. The work was successful enough so that no really worthy planter went without the proper seed. Advantage was taken of the chairmanship of the seed committee to assist the propaganda for the best adapted seeds. The tractor committee made a survey of tractors of the State for two years in succession and sent out a great deal of information to tractor owners and operators. It also assisted, to a considerable extent, in keeping tractors productively employed. In 1916 there were about 800 tractors in Colorado. By the close of 1918 there were nearly 3,000 in the State. The committee supplied some experts and held some training schools in co-operation with the Extension Service.

6. The head of the Agronomy Section is responsible for extension work as well as station work in agronomy and at the present time directs the work of an assistant in farm management demonstrations and agronomic demonstrations.

7. During the year, E. R. Gross, in charge of farm mechanics work and J. T. Copeland, who handled the department experimental work at Fort Lewis both resigned, one to go to another state to accept a more lucrative position, the other to enter war service. Carl P. Hopkins, station assistant during the summer months, resigned to enter the army. His place was filled by Harold C. Blackburn. Mr. John W. Sjogren was employed to look after the station farm mechanics work together with teaching work.

8. The position left open in farm mechanics remained open thruout the summer season, when one project was under way. An assistant to carry this work was not obtainable until in October. The engineering investigations of the department were therefore considerably crippled for the summer season. The resignation of Mr. Hopkins did not so seriously affect the Station, as he had prac-

tically completed the station work for the season and had started his teaching campaign.

The work of the department has been carried on at the following permanent locations: Fort Collins, Rocky Ford, Cheyenne Wells, and Fort Lewis. Fort Collins remained the headquarters of the work. The work at Fort Collins is supported by Adams, Hatch, and state funds. The work at Rocky Ford was supported almost entirely by Hatch funds; that at Cheyenne Wells and Fort Lewis by state funds.

At Fort Collins the Adams work consisted of a continuation of the investigations on critical periods in crop growth for moisture. It now looks as if we might obtain as useful results for the dry lands as for irrigation. A study has been made of the rainfall distribution and amounts as far back as the Station has records. As many Weather Bureau records as possible were secured for further study. This work is not completed but it looks as if for a number of crops it might be possible to increase the chances of a harvest by controlling the time of planting, which control would control state of development at which the crop arrived at the most probable rainy period.

Owing to exceedingly severe and heavy storms, some of our plat work was rendered useless for the year by spoilage of some of the potometers and some of the small plats.

The correlation project was still further cleared up and a very elaborate technical bulletin resulting from some of the data is in press at this writing. Some of the data are not ready for publication, needing further accretion.

Two lines of work were carried on state funds. The pure seed work was inaugurated by planting increase plats of a number of strains which had been bred out in the nursery. Tests were also started with corn, beans and root crops at several points in the State in order to first eliminate the undesirable types for those sections. This piece of work promises more from the standpoint of popular touch than any other at present carried.

The engineering project carried by the department concerned itself with methods of handling the hay crop both in the field and in the feed lots. Owing to the fact that we had no assistant during the summer, the field work was barely started, altho a little progress was made. A feed lot experimental shed for handling the hay in the lot was designed and built. This provides four different methods of handling the hay inside and gives an opportunity to

compare each. We have twice changed the design in some small particulars since the shed was completed and can make further improvement by still further small changes on the most successful of the four designs mentioned. This work is important enough to carry forward but it will require more help than we have had in order to make it forceful.

At Rocky Ford Mr. Blinn has continued his plant improvement and strain work in alfalfa. He has been running a complete set of concrete-tank experiments. The season has been very unfavorable for seed production so that we have not been able to make increases of the most desirable sorts. It is positively shown that some strains will produce seed under almost any conditions; thus it is apparent that inheritance is an important factor in this problem of getting the very best types combined with a sufficient seed producing ability to enable the types to be propagated. There is evidently, however, a soil factor other than moisture which influences seed production in alfalfa which we have not yet determined. This soil factor is evidently a problem within itself in connection with the alfalfa situation. Some bean improvement work was started and considerable corn type work inaugurated this season at Rocky Ford.

The work at Cheyenne Wells has gone forward on practically the same plans as the previous two years, viz: The production of the best feed crops and their utilization by means of the silo thru dairy animals. As an experiment, a silo was filled in 1917 with bundled corn without running it thru the cutter. Mr. Adams took a very great deal of pains to thoroly tramp the bundles as they were put into the silo. The silage came out in good shape. Generally, in the neighborhood where corn was put into the silo in bundles an excessive amount of spoilage occurred. This was evidently due to insufficient packing. It takes a great deal more packing to drive the air out. Excess air, carrying extra oxygen, permits the fermentation to go too far and become acid. The results showed that it was possible to silo corn without running it thru a silage cutter. They also showed that the corn had better be run thru the silage cutter from the standpoint of the farm and labor economy.

Alfalfa has not been a success at Cheyenne Wells. We have had a patch out for eight years. It has remained alive and occasionally produced a crop but has not produced enough to pay from

a farm standpoint, consequently the planting was broken up in the fall of 1918.

Mr. Adams reports that there is some danger of his leaving the Station. If that should occur it would require some rearrangement of the work. It is very doubtful if we could find another man with whom we could make the arrangements which have been so successful with Mr. Adams. By putting a little more money into it we could probably get a good deal more data and demonstration out of it altho the demonstration feature has been of very great importance to that end of the State and Cheyenne County in particular. Our present plan of operation under the present management has accomplished what we hoped to accomplish. It has shown a feasible method of permanent agriculture on the dry lands of the plains in that section. In addition to carrying on some experimental work, the proposition has paid from a standpoint of a farm business. The Station has only put into the project in recent years enough to partially compensate Mr. Adams for time which the Station used outside. The present plan, however, is dependent upon some such personality. More exact data by different methods would probably be best when Mr. Adams should leave. There are certain repairs to buildings—the house, the barn, the hog and calf shed—which should be made no matter who is upon the place. These repairs include some carpenter work and a great deal of painting. A machinery shed should also be erected.

At Fort Lewis, in addition to peas, alfalfa, and grain work previously carried, a number of early varieties of corn for type work were put out and a very successful test was made of root crops. Altho there was not over three-fourths of a stand, due to dry weather at planting time, the average root production was sixteen tons per acre.

It would be highly advisable for us to change our plan of operation at Fort Lewis. We should have an assistant looking after the experimental work who is not encumbered with teaching and who could be on the ground before the planting season and stay until threshing is completed.

The station work, with the exception of that of Fort Lewis, has gone with more vigor this season than previously because we have had more means with which to make progress. I am seriously contemplating putting assistants in charge of particular pieces of work under the general direction of the head of the department

on the theory that they will do better work on a single program and still better work where they have something to look forward to as their own.

With the closing of the horse-breeding plant it will be desirable to throw the land occupied by that plant to the use of our crop improvement program. We are co-operating in the furnishing of land to the Office of Sugar Crop Investigation. Such co-operation will assist in furnishing the desired rotation to keep the land clean but it also means that we must have greater acreage in order to effect those rotations advantageously.

On the whole we can report a good year's work.

Respectfully submitted,

ALVIN KEZER,

Agronomist.

REPORT ON ANIMAL INVESTIGATIONS

To the Director:

The following work has been carried on during the year:

RATION EXPERIMENTS WITH STEERS

Lot Number.	Ration.
1	Pulp, cake, syrup, alfalfa.
2	Silage, cake, syrup, alfalfa.
3	Silage, syrup, barley, alfalfa.
4	Silage, barley, alfalfa.
5	Barley, alfalfa.
6	Corn, alfalfa.

The steers used in this experiment were Colorado range-bred steers. The object of the experiment was to continue the work of two previous winters feeding, in an attempt to arrive at a comparative feeding value of the six rations named. Ration No. 1 is a ration commonly used in the feed lots around the sugar factories in this State. Rations Nos. 2, 3, and 4 were tried out with a view to compare rations containing corn silage and to see whether silage could replace beet pulp as a succulent feed in the ration. Rations Nos. 5 and 6 furnish a comparison of hay and grain rations with the rations containing succulent feeds. The past winter's work completed three years work upon these same rations, and we now have data complete enough so that we can publish results. In general we may say that the sugar beet pulp ration is the most economical. The amount obtainable for feeding operations is limited.

Ration No. 2 has shown it is economical enough to supplement or replace the pulp ration where pulp is limited and grains are unobtainable. Some of the other rations produced good gains in live weight, but their economy depends very much upon the price of hay and grain; and in general the grain rations without succulent feeds are not as promising as those with pulp and silage.

RATION EXPERIMENTS WITH LAMBS

Lot Number.	Ration.
1	Whole barley, alfalfa hay.
2	Whole barley, beet molasses, alfalfa hay.

This experiment was conducted for the purpose of determining whether sugar beet molasses is a satisfactory and economical feed stuff in conjunction with barley and alfalfa hay. This is the first year's work along this line, and should be duplicated before publishing. This year's results indicate that sugar beet molasses may be used in limited quantities to replace grain in the ration.

GENERAL FEATURES OF WORK

Following are some of the general features of our work for the past year:

We have attempted to modify our experimental work, and with a view to producing meat upon cheaper feed stuffs than grain. The war has shown the tremendous importance of grain for use as human food, and has educated our people in the use of other grains than wheat, so that it will be very desirable from now on to produce as much of our meats as possible upon coarse feeds and by-products.

The ration experiment with lambs cited above was an attempt to aid in the solution of this general question. Our steer feeding work as planned for the coming year is along the same lines.

The teachings of the Station with regard to commercial feeding of live stock have been liberally adopted, as regards the use of barley for fattening lambs and the use of silage for fattening steers. At the time we began our propaganda concerning the use of silos, there were only three silos in the State of Colorado, so that the entire development of silos and the use of silage has been in pace with our teaching. In the northern Colorado section there has been a tendency the last two years to overestimate the value of silage, and it has sold for \$10 and \$12 per ton in the silo which is too high a figure in comparison with the market price of other feed stuffs.

The Animal Investigation Section has aided in the war work program of the State through the chief of the section being vice-chairman of the live stock committee of the Council of Defense, and also, as representative of the Station and College, having direction of the dissemination of information as to the needs of the country with regard to supply of meat animals. This has been done through the Extension staff and Service.

T. E. Leiper, who has been assistant in the Animal Investigations during the past year has resigned to take the management of a ranch in this State, and his place has not yet been filled. There is some difficulty in finding a suitable man.

Respectfully yours,

G. E. MORTON.

Animal Husbandman.

REPORT OF THE BACTERIOLOGIST

To the Director:

I have the honor to submit herewith a brief annual report of the work of the Bacteriological Section of the Experiment Station for the year 1918.

From October 1, 1917, to September 1, 1918, the writer was on leave of absence at the University of Chicago. One-half of his time was devoted to station work and the other to graduate studies in the university.

The project under investigation during that time pertained to the relation of milk sickness to the poisonous properties of *Eupatorium urticacifolium*. These studies will be published in a forthcoming number of the Journal of Infectious Diseases. A summary of the results follows:

1. Both the fresh, green *Eupatorium urticacifolium* and the dried leaf powder contain an active ingredient which is poisonous for rabbits.

2. The active poisonous principle is present in plants grown in the greenhouse, as well as under natural out-of-door conditions.

3. The active constituent is soluble in 95 per cent alcohol, and its solution yields a solid extract on evaporation which is poisonous for rabbits, but not for guinea pigs.

4. The active ingredient is soluble in a mixture of ether, chloroform and ammonia, and its solution yields a solid extract

on evaporation which is poisonous for rabbits, but not for guinea pigs.

5. The active ingredient is not yielded by extraction with physiological salt solution.

6. The active principle is present in the leaves, but not, or only sparingly so, in the stems and roots of dried plants.

7. There is no indication of anaphylaxis.

8. So far as is shown by these experiments, neither the leaf powder nor the different extracts are poisonous for guinea pigs.

9. The viscera and meat from rabbits which had died from *Eupatorium* poisoning, when fed to a cat, were without harmful action.

10. No difference in poisonous properties could be noted between plants from a "milk sick" and "non-milk sick" area.

11. The fatal dose of the leaf powder differs with the different animals, ranging from 4 to 17 grams; whereas, the ether-chloroform-ammonia extract from 15 g. given in 3 doses 24 hours apart invariably caused death in four to six days.

12. Rabbits suffering with *Eupatorium* poisoning usually manifest the first symptoms on the third or fourth day (E. C. A. Extr.) They refuse to eat, sit humped up, eyes half-closed, and often keep the body swaying from side to side; the respiration is usually shallow, rapid and jerky; on the following day (fourth or fifth) a flaccid paralysis of the head, neck and front legs ordinarily develops; this is followed by complete prostration and death in 24 to 36 hours.

13. The principal pathological changes occur in the kidney, liver, and heart where fatty degeneration and hyperemia are very marked.

14. Poured agar plates made from the heart's blood, liver, and kidneys were invariably sterile.

At present, we are studying two other phases of food poisoning and are continuing our work on associative action in soil.

The personnel of this section has been increased by an assistant bacteriologist in the person of Miss Leto M. Merker whose able and efficient services I take pleasure in acknowledging at this time.

During the writer's absence in Chicago, much of the routine work of the laboratory was taken care of by Mrs. Sackett.

Finally, I wish to express to the Director my sincere appreciation of the opportunity afforded me to pursue graduate work at the University of Chicago during the past year.

Very respectfully submitted,

WALTER G. SACKETT,

Bacteriologist.

REPORT OF THE BOTANIST

To the Director:

I am submitting herewith the annual report of the Botanical Section of the Experiment Station for the year 1918.

During the past year, the section has concerned itself with the following projects:

1. *Microscopy of Stock-Poisoning Plants* (Robbins).—Through an histological study of the principal poisonous plants of western ranges, a basis is being laid for the microscopical examination of the stomach contents of animals with a view of aiding in determining the cause of death. A part of the results obtained to date was published in Bulletin 246, "A New Poisonous Plant—The Whorled Milkweed" (*Asclepias verticillata*). In a number of instances during the season just passed, the stomach contents of animals which died on the range where examined and the cause of death satisfactorily ascertained by such examination. Immediate application of our results has been made. A considerable body of material pertaining to this project is now on hand.

2. *Hard Seed of Alfalfa* (Robbins and Egginton).—As is well known, alfalfa seed usually contains a percentage of hard seed. There is marked variation in the hard seed percentage of the different lots of alfalfa seed. There are a number of factors affecting this percentage, which factors may be grouped as follows:

(1) External or environmental factors, such as moisture, heat, etc.

(2) Internal or hereditary factors.

(3) Mechanical factors, such as method of threshing, etc.

The object of these investigations is to find out, in so far as possible, the part hereditary factors play. Preliminary studies this past season have shown that there is a considerable variation in the hard seed content of seed from individual plants of any alfalfa strain, growing under as uniform conditions as obtain in the field, and threshed in a uniform manner by hand. More extended investigations are under way.

3. *Irrigation Water as a Factor in the Dissemination of*

Weed Seeds (Robbins and Egginton).—The Colorado weed problem involves a consideration of irrigation water as an important factor in weed seed dispersal. The project has many aspects and aims to give us exact data as to, (a) What weed seeds are carried by irrigation water, (b) When carried, (c) Distances carried, (d) Seed dispersal and irrigation methods, (e) Vitality of soaked seeds, (f) Vegetation of ditch banks, (g) Seeding of ditch banks, and other methods of controlling weeds of ditch banks. One season's work has been done on this project, methods of procedure have been improved, and a body of data accumulated. The results secured up to date justify continuation and extension of the work. The equipment of the Seed Laboratory is being utilized in prosecuting this work.

4. *Whorled Milkweed* (May). Four sections of the Station are co-operating in this project—Veterinary, Pathology, Bacteriology, and Botany. The Botanical Section is investigating methods of eradicating the weed. Mr. May spent the past summer in western and southwestern Colorado, during which period a thorough survey was made of the distribution of whorled milkweed, its habitat relationships, its growth habits and life history. Infested tracts of land were secured, and various eradication methods started. These methods include (1), Clean cultivation by means of deep plowing and disking; (2) grubbing followed by hoeing; (3) spraying with various chemicals; (4) smothering; (5) several cropping methods. One or two more seasons of field work will need be done before definite results can be obtained.

In view of the serious losses resulting each season from milkweed, it seemed advisable to issue a preliminary bulletin that stockmen might become familiar with the plant and put themselves on guard against it. This bulletin (No. 246) was, in fact, issued as war emergency information.

5. *Forage Grasses of Colorado* (Robbins and Morrill). Conducted in co-operation with State Forester W. J. Morrill. This project is in the bulletin stage.

6. *Millet Smut Investigations* (Vasey). The results to date of this project are embodied in Bulletin No. 242, "Millet Smuts and Their Control," by Professor H. E. Vasey. Further work on infection methods was started but temporarily held up on account of the fact that Professor Vasey left for military service.

7. *Fungous Disease Investigations* (Vasey and Robbins). The section carried on co-operative seed injury tests in the spring of 1918, with a number of states, under the direction of a committee of the War Emergency Board of American Plant Pathologists. A summary of facts concerning seed injury by standard treatments

was issued in August by the committee. This war emergency information has been disseminated to the county agents.

8. *Native Vegetation of Colorado in its Relation to Crop Possibilities* (Robbins). Work on this project was suspended during the past season. A lack of assistance on the campus during the summer as a result of war conditions made it impossible to get into the field on this project.

The Botanical Section workers have been connected with the following special outside activities during the past year:

(1) *Plant Disease Survey* of the Bureau of Plant Industry, U. S. Dept. of Agriculture. Two members of the section are acting as collaborators.

(2) *Barberry Eradication Campaign*, in co-operation with the office of Cereal Investigations, Bureau of Plant Industry, U. S. Dept. of Agriculture, and with Office of State Entomologist. A number of important towns of northern Colorado were surveyed by a scout this past season. The work is being kept alive during the winter by the employment of high-school and college instructors working on part time. Another season of work should see the elimination of the common barberry from the State. Extension Bulletin No. 147, "Eradicate Common Barberry," was issued as an aid to the campaign. The co-operation of high-school teachers of science and agriculture has been solicited.

(3) Co-operative seed injury tests under direction of a committee of the War Emergency Board of American Plant Pathologists.

(4) Tests of medicinal plants under our climatic conditions in co-operation with Office of Drug-Plant and Poisonous-Plant Investigations, Bureau of Plant Industry, U. S. Dept. of Agriculture.

Relation of Section to Extension Service.—Necessarily, a close relation between this section and the Extension Service has been maintained. The state-wide project, "Better Seed for Colorado," presented to and adopted by the county agents as an emergency measure, has enlisted the services of three members of the staff: the botanist, assistant botanist and pathologist, and seed analyst. Thus there has been secured an intra-departmental co-ordination of activities, as well as an extension of the station work to the farmers, and to the workers in the field.

The following extension publications were issued during the year:

No. 134, "The Prevention of Smut in Grain by Seed Treatment," by H. E. Vasey.

No. 136, "Potato Diseases and Methods of Control," by H. E. Vasey.

No. 139, "Water Hemlock, a Poisonous Plant," by W. W. Robbins.

No. 147, "Eradicate Common Barberry," by W. W. Robbins and H. E. Vasey.

STATION PUBLICATIONS

No. 238, "Cleaned, Treated and Tested Seed for Colorado," by W. W. Robbins, H. E. Vasey, and G. E. Egginton.

No. 242, "Millet Smuts and Their Control," by H. E. Vasey.

No. 246, "A New Poisonous Plant—The Whorled Milkweed," by Geo. H. Glover, I. E. Newson, and W. W. Robbins.

No. 249, "Alfalfa Dodder in Colorado," by W. W. Robbins and G. E. Egginton.

Colorado Seed Laboratory.—The work of the laboratory is embodied in a special annual report, the first annual report being issued as Colorado Seed Laboratory Bulletin, Vol. 1, No. 2.

I wish to take this opportunity to express my appreciation for the efficient services of Miss Caroline Preston, whose delineation is proving an important asset in our work.

Very respectfully submitted,

W. W. ROBBINS,

Botanist.

REPORT OF THE CHEMIST

To the Director:

I present the following report on the activities of the Chemical Section of the Station.

No new work has been undertaken. We have addressed ourselves to some features of the nitre question which vary a little in different sections.

In the Waverly and Wellington districts north of this place we find nitrates widely distributed and prevalent in the waters of surface wells. They are also becoming abundant enough in some places to injure vegetation and some animals have, in the past, been killed by drinking well water.

In the Arkansas Valley a large number of cherry trees have died this season, even more than died last season, 1917. The cause of this is not as yet definitely ascertained. It seems probable, however, that it is a feature of the nitre trouble.

In the San Louis Valley the nitre question is not abating, on the contrary is apparently increasing. In this section there are two features associated with it which we have not as yet been able

to solve. One of these is the occurrence of calcic and magnesian chlorids. At the present time we do not believe these occurrences have any relation to one another, but we are endeavoring to ascertain the facts in the case.

In the Grand Valley we have done but little work. Conditions there have not improved. The effects of the nitrates are more general than heretofore and are making their appearance in the territory recently brought under irrigation by the Highland Canal.

We are not only studying these occurrences, but are still giving consideration to the source or origin of them, especially nitrates found in the alkalis deposited on sandstones, or in accumulations beneath them, or in the cavities in the face of cliffs, etc.

A question has arisen especially in connection with the observations of the past two seasons in regard to the action of different salts of nitric acid, as we sometimes find cases in which there is no question in regard to the principal nitrate present, sometimes it is clearly magnesian nitrate with more or less calcic nitrate. Our work in the Arkansas Valley presents the possible importance of this question so forcefully that I now judge it the most promising line on which to continue the work on the questions presented in this section of the State.

Our working program has not been materially modified by the war.

The only special work that we have done bearing directly on the war was a series of experiments to ascertain the fitness of emmer flour as a substitute for wheat flour, wholly or in part. We found the emmer flour an excellent substitute. Our results were presented in Extension Bulletin, Series 1, No. 143, July, 1918.

Station bulletins published were the following:

No. 237, "Properties of Colorado Wheat," March, 1918.

No. 239, "Alkalis in Colorado," May, 1918.

No. 244, "A Study of Colorado Wheat," Part IV, June, 1918.

No. 247, "A Study of Colorado Wheat," Resume, July, 1918.

The following papers were read before the Colorado Scientific Society and will appear in the societies report for the years 1917-18.

"Vitality of Alfalfa Seed as Affected by Age."

"A Contribution to the Hydrology of the San Luis Valley."

"Mineralogical Notes, No. IV."

We are at the present time one man short in our station force. We have been unable to obtain the services of anyone who promised to be satisfactory.

Respectfully submitted,

WM. P. HEADDEN.

Chemist.

REPORT OF THE ENTOMOLOGIST

To the Director:

The experimental work in the Entomological Section has been confined to the lines covered by the projects approved for the year. Most attention has been given to the "Codling Moth" investigations, "Plant Louse Studies," "Bean Betle Studies," and "Grasshopper Control".

We have carried through another year's records on the life history of the codling moth in the Grand Valley, near Grand Junction, in co-operation with the Bureau of Entomology, and at Paonia, in Delta County, in co-operation with the State Entomologist fund. Mr. Leo Antles, of the Bureau of Entomology, was in immediate charge of the work at Grand Junction and Mr. J. H. Newton, from the office of the State Entomologist, was in immediate charge of the codling moth work at Paonia. Mr. Geo. M. List has had an active part in the direction of the work from this office. The data that have been accumulated for several years as a result of our codling moth studies, are now being compiled for publication.

War activities have interfered somewhat with the work of the section during the year. Mr. Chas. R. Jones has been called upon so heavily that he has been able to give very little time to his "Syrphus Flies" project or to the "Grasshopper Control" work which were in his charge. However, Bulletin No. 233 on "Grasshopper Control" was written by him and we were very fortunate in being able to secure the services of Mr. James Morrison to look after the grasshopper work in the State during the summer and fall months.

The following papers have also appeared from this section during the year:

"Additional Notes on Heredity and Life History in the Coccinellid Genus *Adalia* Mulsant," by M. A. Palmer, *Annals Ent. Soc. of America*, Vol. X, 1917, p. 289.

"*Aphis Bakeri* and Some Allied Species," by C. P. Gillette and L. C. Bragg, *Jour. of Economic Ento.*, Vol. 11, p. 327.

"*Aphis Saliceti* (Kaltenbach), *Siphocoryne Pastinacae* (Linn), and Allied Species," by C. P. Gillette and L. C. Bragg, *Canadian Entomologist*, Vol. L, p. 89.

"The Black Cherry *Aphis*," C. P. Gillette, *Canadian Entomologist*, Vol. L, p. 241.

"Some Grass-Root Aphids," by C. P. Gillette, *Entomological News*, Vol. XXIX, p. 281.

"Life History of Pemphigus Populi-transversus," by Thomas H. Jones and C. P. Gillette, Jour. of Agr'l Research, Vol. XIV, p. 577.

While my work as State Entomologist is not included in experiment station projects, it might be well to refer briefly to the work that has been carried on during the past year for the control of the alfalfa weevil, which has gained a foothold in Delta County, this State.

Thorough scouting has revealed the presence of the weevil about four miles further to the west down the North Fork Valley from Paonia than we were able to locate it last year. Scouting up the North Fork and its branches enabled us to locate this insect in every alfalfa field to the limit of alfalfa planting, which is about 20 miles northeast of the city of Paonia. Fortunately there seems to be little danger that it can spread farther in that direction. The alfalfa weevil work has been in immediate charge of Mr. Claude C. Wakeland. It has consisted of life history studies, control measures and the enforcement of a rigid quarantine. A full report upon this work will be found in the report of the State Entomologist for the year just closing.

Respectfully submitted,
C. P. GILLETTE,
Entomologist.

REPORT OF THE ENGINEERING DIVISION

To the Director:

I submit herewith the first report of the Engineering Division of the Experiment Station.

This division was created for the purpose of carrying on engineering experimentation and, as the funds were limited, it was decided that only one project could be undertaken for the year. The project decided upon was "Road Material and Road Building" in Colorado, and the project was assigned to Professor House. This work has not progressed far for the reason that war conditions have made it impossible to obtain the necessary apparatus up to the present time. The work will proceed as soon as the apparatus can be obtained.

Professor House has submitted a brief report of his station activities which is appended hereto.

Because of the lack of funds, the work in Electrical Engineering Section and Mechanical Engineering Section has not been started. There are, however, several projects in each of these two

departments that could be started, and are of great importance. As soon as funds are available, they should be undertaken.

With the close of the war and the demobilization of the S. A. T. C. units at this institution, there will be time to devote to this line of work, and especially now when the attendance is small.

Respectfully submitted,

LD CRAIN,
Vice-Director.

To the Vice-Director LD Crain:

I submit herewith the report of the Civil and Irrigation Engineering Section covering the experimental work done during 1918.

This department is divided into two parts, (A) Civil and Irrigation Engineering, having charge of the teaching work done in the department, and, in addition, carrying some experimental and extension work, and (B) Irrigation Investigations, which devotes its entire time to experimental work in co-operation with the U. S. Department of Agriculture. This section will submit a separate report to the Director.

Section A, has had three projects under consideration during the year, viz., "The Duty of Water on the College Farm," "Sub-irrigation With Porous Tile," and "Road Materials of Colorado".

The first, by order of the Director, has been turned over to the Farm Dept., the second has been finished and a bulletin (No. 240) published. The third is a new project and the work has been held up on account of the impossibility of obtaining necessary apparatus. We expect, however, to secure this machinery in time to get the work started by Jan. 1st, 1919.

Respectfully submitted,

E. B. HOUSE.
Civil and Irrigation Engineer.

REPORT OF THE FORESTER

To the Director:

I herewith submit the annual report of the experiment station work done in the Section of Forestry.

One project, only, has been carried during the past year, that of the "Study of Decay in Timber." This project, which has been fully described in the two reports preceding this, is practically completed along the lines originally planned, with the exception of three species of woods. The results in some cases have been quite surprising, some species which have hitherto been highly

esteemed for their durability having made a relatively poor showing in this experiment.

Some rather puzzling results have been obtained, especially as the material reaches an advanced stage of decay. It is evident that greater accuracy may be secured by using a larger set of wood specimens of fewer species at one time with the equipment employed. On the whole, the method used in the experiment seems to offer a far more accurate means of determining the relative durability of woods than those commonly used.

Tests of the fuel value of wood in various stages of decay were begun in co-operation with the Mechanical Engineering Department, but were not carried out on account of interference of war conditions in that department. This work, however, may be taken up again under the return of peace conditions.

It is proposed to continue the experiment with other species of woods than those formerly used, and to test the effects of different types of soils upon the rate of decay in certain species first employed.

The principal significance of practical importance, derived from the experiment, has been to show the weakening effects of a relatively slight degree of decay upon timber employed for structural and mechanical purposes and to emphasize the need of protecting such material from decay. This applies especially to the use of wood in the construction of farm implements which are too often allowed to stand out in the weather under conditions favoring deterioration and decay.

No special connection with war work has been held during the year and no changes in personnel have occurred in this section. The work on the project carried has been done entirely within the section and practically without extra help. No women have been employed during the year other than the regular stenographic service of the department.

Very respectfully submitted,

B. O. LONGYEAR.

Forester.

REPORT OF HOME ECONOMICS SECTION

To the Director:

The work in the Home Economics Section of the Experiment Station was to have been begun July 15, but, owing to delays caused by rush of war work, the laboratory was not made usable until the middle of the first week in September, and at this date, November 15, is still incomplete in several important details. Because of this

delay, the project at first outlined, "Utilization of Cherry and Plum Juices," has had to be considerably modified, and an additional problem, "Study of Apple Juices," added.

All of this work is still in progress, but none of it is in a condition to be reported upon.

Respectfully submitted,

EVELYN G. HALLIDAY,

Assistant in Home Economics.

REPORT OF HORTICULTURIST

To the Director:

I beg to submit the following report on the work in progress in the Horticultural Section during the past year.

PEAR GROWING IN NORTHEASTERN COLORADO

This project started in 1914. Twelve different varieties of pears grafted on quince roots were purchased and planted. The trees were given the common care given to pear orchards. During the first and second years, the trees made good progress and only two trees died. During the winters of 1917 and 1918, all the trees died, with the exception of three. The exceptionally hard freezes in October and November lowered the vitality of the trees to such an extent that they were unable to recuperate. The tops died first, while the roots and trunk below ground lived to the following summer. The union where the scion was placed on the quince root was greatly constricted and showed that the trees were dwarfed by the limited root growth of the quince. None of the trees suffered from blight, which heretofore has been looked upon as the limiting factor in pear growing in northeastern Colorado. The sudden changes in temperature, during October and November, 1916 and 1917, when the temperature dropped to 14° Fahrenheit below zero before the wood had reached full maturity, was the apparent cause of death. The work will be continued, using trees grafted on pear stock.

GROWING HARDY STOCK AND HARDY APPLES FOR NORTHEASTERN COLORADO

This project was started in 1914 with every promise of success, but the low temperatures in the fall of 1916 and 1917 killed practically every tree in the orchard. They were not replanted the following spring, but permitted to start from buds above the graft. These were again killed back in 1917 and again permitted to grow from buds above the graft. This made the orchard look ragged, and some trees will have to be replaced next spring. Yet, most of the trees have come thru, and with proper pruning, will

make good trees. Thus far, it is apparent that the hardiness of the stock or root has no relation to the winter-killing. The factor most responsible for the winter killing of fruit trees in Colorado is the low temperature early in the fall. The trees continue to grow until late in the season, and when low temperature occurs soon thereafter, the wood is not in condition to resist the cold. Also, the influence of low temperature with dry winds causes the tree to dry up and die. The root system in no case has been found injured from low temperature. This work will continue indefinitely, as it is difficult to obtain reliable data on which to form a conclusion.

GROWING VEGETABLES AND SMALL FRUITS IN HIGH ALTITUDE

This project has been carried on at the Fort Lewis School of Agriculture in La Plata County. The work was started in 1916 and has been in progress ever since. Much valuable data has been obtained and recorded. Material will be prepared for a bulletin in the very near future.

SEED POTATO GROWING IN HIGH ALTITUDE

This project is also carried on at the Fort Lewis School of Agriculture. Most of the work done has been confined, first, to the selection of suitable varieties that would properly mature in the short season; also, selection of seed from typical hills, with a view of obtaining pure and high-yielding strains of the varieties grown. Considerable progress has been made in this work and the outlook is very promising.

FRUIT GROWING IN HIGH ALTITUDE

This project is also located at Ft. Lewis and carried on in connection with the projects on vegetables and potatoes. Hardy varieties of apples and plums were obtained in Minnesota and planted. Considerable damage to the orchard was done during the first winter by rabbits and mice. A fence has now been provided and no trouble is expected from these pests in the future. From the work thus far, it appears that many varieties of hardy apples can be grown at an altitude of 7,500 feet, especially if the trees are fully matured before freezing weather sets in in the fall. Credit is due to Professor McGinty for the careful superintendency of the work at Ft. Lewis.

POTATO GROWING IN THE VICINITY OF FORT COLLINS

This project was inaugurated for the purpose of studying the limiting factor in potato growing in northeastern Colorado. The belief among farmers that potatoes could not be successfully grown on the heavier lands led to an investigation as to the probable causes for this belief and the failures experienced. This work has now

been in progress for the last three years. The result obtained shows conclusively that even the heavier soils will produce a good crop of potatoes under right cultural conditions. While temperature is a limiting factor, it can be largely overcome by proper cultivation and irrigation. The different types of soil have a considerable influence upon the development of the tuber. The lighter soils permit a freer development of tubers, but at the same time the lighter soil invariably attains a higher temperature, which, during a season of prolonged high temperature, is detrimental. The heavier lands, if properly cultivated, have a lower temperature and the plants grown on such soil retain their health and vigor better.

In connection with this project, other lines of work have been carried on, with special reference to the influence of different kinds of seed, upon yield and quality. Some interesting results have been obtained in the planting of gnarly, knotty potatoes such as are ordinarily not used for seed. It appears that so long as these gnarly or knotty potatoes are produced by healthy vines and that the gnarliness or knottiness is due to cultural conditions, the use of them for seed has not proven detrimental, and smooth tubers have been obtained from them and yields equal to those of selected seed. The longer this work continues, the more convinced we are of the necessity of emphasizing the cultural side of potato growing. This does not mean that one should neglect the selection of seed and the planting of the best seed obtainable, but the cultural side needs to receive equal emphasis from the Station. No matter how good the seed may be, the result will be disappointing unless proper cultural conditions are carried out.

The work of studying the effect of poor seed versus good seed has been carried on both at Ft. Collins and on the farm of Mr. R. A. Chisholm, of Del Norte, Colorado. This work will be continued for at least another season before publications will be made.

Additional work not yet fully formulated has been carried on with tomatoes. The department has long felt the need of some definite information as to varieties best suited for Northern Colorado. Fifty varieties obtained from different sources were grown during the last summer. Results obtained have been tabulated and the work is to be continued for at least one more year before the results are published.

Work has also been carried on in the forcing of vegetables in the greenhouses.

DEHYDRATION OF FRUITS AND VEGETABLES

(Started this year)

Two types of driers were built. One of these was taken to the Western Slope for demonstration. This drier gave satisfactory

service in every particular. The other type of drier was in operation at the Domestic Science Department and used as a community drier and for the drying of vegetables grown on the horticultural grounds. Professor Kirkpatrick took hold of this work in the latter part of August and has been carrying on some experiments in the drying of different vegetables. No publication on the experimental side can be given this year. We are now building a drier better suited for drying. Provisions have been made for this drier thru an appropriation from the State Council of Defense. A popular bulletin has been prepared by Mr. Kirkpatrick which undoubtedly will be published, possibly under the Extension Service, or by the State Council of Defense. It is not the type of bulletin that could be published by the Experiment Station. This work will be continued under better controlled conditions next year, when accurate data will be taken and the project, as outlined, carried out. The work thus far has been more of a preliminary nature.

A FRUIT SURVEY OF FREMONT COUNTY

(Another project not formulated, but carried out jointly under the State Horticultural funds and Experiment Station.)

This survey has been completed and the data will be published this fall. Some very interesting facts in connection with fruit growing in this section were obtained. One which might be of interest is that of the size of the orchards. The majority of the orchards are small, ranging from 1 to 5 acres. Not only are fruit trees grown in these orchards, but small fruits and vegetables are grown between the trees. This practice has had a disastrous effect upon the growth of the trees, and also upon fruit production. One of the reasons for the hard times that so many of the fruit growers in Fremont County have experienced, is due to too limited acreage, and not to any inherent difficulties in fruit growing as a business.

PUBLICATIONS

During the past year, only two bulletins have been published:

"Potato Culture in Colorado," by E. P. Sandsten.

"The Home Vegetable Garden," by R. A. McGinty.

In addition to carrying out the regular work, considerable time has been devoted by the department in food production and conservation. Two pamphlets on storage and on growing vegetables were written for the Home Economics Department. Also, considerable work was done in the State along the line of potato production, and considerable good results were obtained, especially in the way of the improvement in quality of the potatoes grown. Efforts were made to standardize the varieties grown in different sections and numerous trips were made to different sections to

inspect and advise in the selection of suitable seed. The potato growers responded very favorably to this work. Most of this work was done at the expense of the State Horticulturist funds, and little or no work was done in connection with the Extension Service. Very few calls for work from the Extension Service were received.

Assistant Professor I. C. Hoffman left the department last September to enter the military service. His place was filled by the appointment of E. L. Kirkpatrick, who takes up his duties December 1st.

In conclusion, I wish to thank you for the liberal support of the work in Horticulture, and for your co-operation and aid.

Respectfully submitted,
E. P. SANDSTEN,
Horticulturist.

REPORT OF HORSE-BREEDING INVESTIGATIONS

To the Director:

The stud organized by the U. S. Department of Agriculture in co-operation with the Colorado Experiment Station at Fort Collins, Colorado, is now composed of 82 horses, as follows:

Males:

- Two three year old stallions.
- Seven aged stallions.
- Four two year old stallions.
- Nine yearling stallions.
- Seven suckling stallions.
- One gelding three years old.

Females:

- Twenty-five aged brood mares.
- Three three-year old mares.
- Seven two year old fillies.
- Seven yearling fillies.
- Eleven suckling fillies.

Of the entire number, 76 animals are at the Station at Ft. Collins, and the remaining six animals leased to responsible parties as follows:

Stallions:

- Stallion Highball leased to O. A. Talbot, Montrose, Colo.
- Stallion Jerome leased to Hon. J. A. Delfelder, Riverton, Wyo.
- Stallion Defender leased to W. H. Wyman, Shell, Wyo.
- Stallion Hickman leased to Howard Jay, Longmont, Colo.

LEASING STALLIONS

It has been customary in the past to send out stallions that were not needed for the work in the stud for the purpose of improving the horse stock in different sections and for the purpose of yielding some revenue to the Experiment Station. Since the first of the year the proposition has been systematically worked on in an effort to bring it before the people of the states near Colorado, through the medium of the county agents. A great many form letters were sent out and many letters of inquiry received. In many cases the writers of such letters would consider a horse for the next season and it is probable that enough stallions could be put out in Wyoming, Colorado, New Mexico, and the Dakotas to yield a good income to the Station as well as to aid in the introduction of better horses on the range. Two stallions have been placed by this effort and many favorable letters regarding leasing stallions in the future have been received. It is possible in a few years of systematic work to make the project practically self supporting.

The system of leasing stallions has been in vogue for several years but it has not been pushed as a source of revenue and advertisement to the project. It is reasonable to assume that a good many stallions might be placed with responsible parties without in any way weakening the work of the experimental breeding at the home station.

PROGRESS AND FUTURE OF THE EXPERIMENT

The first systematized and organized effort to establish a strictly American breed of carriage horse was first begun in 1906 by the U. S. Bureau of Animal Industry in co-operation with the Colorado State College and Experiment Station at Fort Collins, Colorado. It is doubtful if a more ideal location in which to breed horses could have been found in the confines of all the U. S. The winters at Fort Collins are, as a rule, not severe and the summers never have the intense heat and number of flies that are prevalent in some other localities. The mildness of the winters makes it possible to run the animals out of doors most of the winter and thus the young horses grow to maturity under natural conditions and become rugged healthy individuals. The limestone qualities of the soil tend to produce a hoof of tough resistance and hard, flinty bone. The native grasses are rich in sustenance and the alfalfa and oats produced under irrigation are of excellent quality. In fact the location of the government horse breeding station is ideal for horse production.

From the standpoint of the production of an American carriage horse, the experiment has been unusually successful. When one

considers the great number of years that have been necessary to establish the other breeds of stock, it may be truthfully said that wonderful results in the establishment of a type and the consecutive reproduction of the type have been accomplished in the thirteen years that the experiment has been running. A strain of horses has been established that are superior to the Orloff of Russia, the coach of Germany and France and the hackney of England. Our horses have been shown at the Western National Stock Show and compare very favorably with the greatest harness show horses in America.

But while the breeding work was going on in Fort Collins another industry has developed to make the carriage horse, except within rather narrow limitations, a thing of the past. That was the growing popularity of the automobile. So that it is now hardly essential to go on breeding a strain of carriage horses. Thus it was necessary to change the attitude of the experiment to some extent.

It is the opinion of many high in authority, inasmuch as the motor has come to stay and that it is becoming within the reach of all, that the extra large horse will eventually lose his place on the American farm, and that, despite the large sums paid annually for heavy drafters, it stands to reason that the horse weighing from 1200 to 1400 pounds is a more satisfactory horse for farm work under all kinds of conditions than the great ton horse.

A few of the advantages might be summed up as follows:

The medium weight horse:

1. Requires less feed.
2. Is less distressed by the heat.
3. Is not subject to collar sores.
4. Handles himself with less distress.
5. Can be used on the road at a good gait if necessary.
6. Can move almost as much on a straight pull and handle the load much quicker.
7. Is much more satisfactory in soft ground.
8. On such work as haying and cultivating he is much superior.

Therefore, if the medium weight horse can do the work of the ton horse and do it quicker and cheaper, then why should the economical farmer in these days of intensive farming feed an additional five or six hundred pounds of excess weight?

With these points in view the work at Fort Collins is a very essential agricultural project. The stallion Albion weighs 1450 pounds in fair flesh, can do any work on the farm that the ton horse can, yet Albion's feed bill will not be half the amount of the ton horse. The time is ripe here to select the mares of the larger size

and breeding qualities and to select another stallion of similar breeding, but no smaller than the stallion Albion, if the work is to go on producing horses of greater size and a little less of the nervous temperament. The pair of mares mentioned in the report at another place are giving good satisfaction at all kinds of farm labor. There is only one disadvantage, that is, the high-strung, nervous temperament of all the horses in the stud that makes them unsatisfactory for the average farmer unless worked hard and continuously, or by some experienced horse man. The farmer cannot always get satisfactory help in this matter and the future farm horse developed here should be bred with the idea in mind that care should be taken in the selecting, as regards temperament, as well as size and stamina. Another phase of the experiment, and to my mind, the most important of all, is the adaptability and qualifications of our horses for both cavalry and light artillery purposes. No one can foretell, but it is safe to assume that an army of formidable size will be maintained for perhaps a generation to come and it has further been demonstrated that the present struggle requires one horse for every four men in a war. Where are these future war horses to come from? The allies have drained America, and those remaining are nondescripts. During the past few months a number of army officers have called to see the stallions at Fort Collins and have been loud in their praise as to the qualifications of the stallions for siring army horses. If stallions such as Carnegie, Hickman, Carmon, and Highball could be mated with ordinary mares of the proper conformation, and the country is full of them, a strain of uniform army horses could be soon developed that would make the United States mounted service second to none. America is the only one of the allied nations that has not been breeding her own war horses for generations past, and it is a plausible prophecy that she will do so in the future. No one can foretell the outcome of the war, but a large standing army and navy was the best assurance of lasting peace. The American army and navy will doubtless never diminish to the size that it was before the war.

CONCLUSIONS

1. The results obtained by the co-operative horse-breeding experiment at Colorado Experiment Station as regards the establishment of a type and reproduction of same have been phenomenal in view of the short period of time in the establishment of the type.
2. There will always be some demand for the light-weight horse, especially in cattle countries and in countries where the big horse and the tractor are at a disadvantage.

3. It is exceedingly doubtful if there will ever be a system of farming that does not call for some horse labor.

4. If the motor displaces most of the horses on the farms, the essential horse will be one of fair weight combined with a reasonable amount of agility.

5. The saving of feed should be a strong factor in favor of the medium-weight horse for the farm.

6. The keeping of livestock on farms is the greatest essential of permanent soil fertility.

7. The medium-weight horse has many points in his favor as previously pointed out earlier in this report.

8. The stallions produced in this work are adapted in many ways for the production of suitable army remounts both for cavalry and light artillery.

9. In the above case, care should be taken in the selection of mares for the crossing with stallions of the type raised in connection with this experiment.

10. If a strictly farm work horse is to be produced in the future of this project, an infusion of cold blood is essential to replace the high degree of quality with a little more substance and less of the nervous temperament.

Very respectfully yours,

DAVID D. GRAY,
U. S. Expert In Charge.

REPORT OF IRRIGATION INVESTIGATIONS

To the Director:

The following is the report of the work of the co-operative Irrigation Investigations for the year of 1918.

The most particular phase of our work has been the loss of practically the entire personnel of our staff of workers. From the standpoint of investigation it has been a serious loss and in addition it has been very difficult to secure assistance to carry on the work of this office. As a matter of fact, little or no work has been done on a number of our projects, due to the fact of insufficient help. Mr. V. M. Cone, in charge of the investigation, resigned on April 1 of this year. In the loss of Mr. Cone the work has naturally suffered because of the number of projects initiated by him that are not completed. Mr. Carl H. Rohwer and Mr. Thos. H. McCarthy are on leave of absence, having entered the Officers' Training School in January and at present are commissioned officers with our forces in France. Mr. Jas. D. Bell, who has been with our work for a number of years, also resigned. Both Thomas and

Leonard Doyle have gone to training camps. However, we have been successful in obtaining Mr. D. W. Stuver, who has been assisting in the work since August 1. Mr. Stuver has been assisting Mr. Hemphill on the Poudre Valley investigation and also was engineer on the Grand Junction Indian School Drainage work during September and a part of October.

The following projects have received more or less attention for the year 1918, but no work has been completed.

The Poudre Valley project received most of our attention and consideration. During the past summer some additional field work was necessary to substantiate our records of the past two years. The vast amount of data collected, together with the interpretation and tabulation, are resulting in rather an extended study and it will be some time yet before a final report can be made. Observations were made early this summer, for a short period, on the transportation losses of canals, which will form a part of the Poudre investigations.

The project on current meters has received little consideration. A number of meters were rated, however, for the State Engineer's office and these ratings form a part of the data to be used in the investigation and study of current meters. A new electrical installation has been made at the laboratory in connection with the rating of meters. This new system has proved to be an improvement over the one formerly used, and consists of an additional trolley to the rating car and three additional wires over head.

To the Venturi flume project has been added a number of tests on flumes of various sizes as well as under various conditions. Early in June there was calibrated near Hudson, Colorado, a venturi flume with a trapezoidal cross section, having a capacity of flow of about 30 second feet. This calibration was made under field conditions and proved that this type of flume possesses desirable features which should lend itself admirably to the measurement of irrigation water. This scheme for the measurement of flowing water has not come into general use, but throughout the irrigated west many of these flumes have taken the place of the old rating flume as well as other types of measuring devices.

Due to the restricted capacity of the hydraulic laboratory the investigation of the larger-sized flumes could not be carried out here, therefore arrangements were made with the authorities at the Cornell University laboratory to carry out a series of tests on the larger sizes. Last spring and summer a number of observations were made on these larger flumes of various cross sections and sizes with a maximum capacity of approximately 300 second feet. The results of their investigations, for the most part, have been for-

warded to this office. It is expected that these data will be assembled with what additional work we have done, into a more extended report, which will be supplemental to the bulletin issued by Mr V. M. Cone in 1916.

The work in meteorology has been carried on continuously throughout the year and consists in taking daily temperatures, air pressure, wind, humidity, and other observations. In June, a special electrical cable was installed from the anemometer on the roof of the Civil Engineering Building to the instruments in the office on the first floor. The old cable gave no end of trouble and greatly interfered with the permanent records. The new cable enables us to obtain a reliable, unbroken record and eliminates uncertain and questionable readings. "Climatology of Colorado," a bulletin by R. E. Trimble, issued in June, was the only publication put out by the Irrigation Investigation Section this year.

The Grand Junction Indian School drainage project was revived after an interval of two years. During September and part of October another attempt was made to install a system of drains to relieve the condition which is a menace to the foundations of the various buildings. The results obtained in correcting this condition were practically nil, as our whole effort was expended in the attempt to provide an adequate outlet drain for the tile lines which were to be placed adjacent to the buildings. Due to insufficient funds and the extremely difficult construction encountered, only approximately 25 per cent of the proposed construction was completed. A report on all the drainage work that has been done at the Grand Junction Indian School has been prepared and is on file at this office.

At the hydraulic laboratory there has been carried on, at various times during the season, a special investigation of instruments and water-measuring devices. During July and part of August, Mr. A. T. Mitchelson, irrigation engineer of the Bureau of Public Roads, carried on a series of observations with a small model of a siphon. This work was done to study the action of siphons of various dimensions in order to provide definite data and information for the correct design of spillways for dams, such as are used in irrigation development. During October, observations were made on a Sanborn gage register. The study of this instrument was made in conjunction with a barograph, thermograph, and a standard Gurley register acting as a check instrument. The results of this study have not yet been determined.

At present there is being tested at the laboratory, a Reliance irrigation meter. This particular meter records in acre feet the quantity of water passing through the device and has a capacity of

approximately 4 second feet. The laboratory has not been in continuous operation this season, due to the lack of assistance and, further, it was thought more advisable to spend considerable time on outside work in the promotion of agricultural production.

Due to the pressing need of food production and the possibility of a shortage of water for irrigation purposes, a conference of irrigation men and farmers was called. This meeting was held on April 3, at which time special committees were appointed to carry out the purpose of the conference. The work of these committees, I believe, has accomplished a great deal of good for the farmer. Special mention may be made of the results in the diversion of stored water from Lake Chessman to farmers of the Henrylyn District east of Denver. The state committee covered the entire irrigated area of Colorado and I have been informed that their efforts resulted in an increased yield in the various visited localities, especially in the cereal crops. It is to be hoped that this committee may be able to continue the work next season in assisting in the production of food. As there is yet a possibility of great need in agricultural products aside from this, however, it is still desirable from an economic standpoint.

Outside work in the State has consisted, for the most part, in giving assistance to farmers in drainage matters. This office has assisted in the organization of a small drainage district at Olney Springs under the Colorado Drainage Law. In North Park there has been constructed a reinforced concrete division box on the Wolfer Ditch. The design of this box was worked out in this office to properly satisfy the division of irrigation water to farmers, who, heretofore, have been in controversy concerning the correct and proper division of the water.

A special report was made in October to Dr. Samuel Fortier, chief of the Irrigation Division of the Bureau of Public Roads, on the Larimer Water Company, at Laramie, Wyoming. This company has in its possession a large irrigation system capable of irrigating several thousand acres of land. The report was made especially with the view of presenting the actual workability of the system and its capability of providing water for the season of 1919.

The project on evaporation has been dormant so far this year, but at this time it is planned to secure some additional data this winter which will be supplemental to the already large amount of data we now have. This experiment has been in progress for some time and attempts have been made to unravel and correlate these data, but so far with little progress. It is expected that with some improved apparatus, which we can make here, operated under con-

trolled conditions, we can secure additional information which will throw some light on the work already done.

It is not expected that any new work will be undertaken. However, there is being discussed at this time a possible new project which embraces the investigation of the South Platte Valley of this State. At present, nothing definite can be said other than that the proposed work is to be done under a co-operative agreement between this office, the State Engineer's office and the office of Irrigation Investigations, at Berkley, California.

The conditions of war have imposed upon our section the reduction of assistance which has been a serious restriction to work done or results accomplished. More time has been given to outside interests in the State in the promotion of agricultural activities. The policy of individual help and assistance has been held to be of importance and at times rather extended trips have been made to accomplish this purpose.

The projects now being worked out were initiated before our entrance into the war and only special work has been done which has a direct bearing on the promotion of agriculture during the period of our participation in the world's strife. In this respect assistance has been given to individual farmers as well as communities in drainage matters. The creation of the committees for the conservation of irrigation water was very pertinent and timely in safeguarding our water supply and in increasing production. The work on the projects has only indirectly assisted in the agricultural activities, but it is expected that when this work is completed, our results will materially assist in the phase of the measurement of water as applied to irrigation.

This office has advanced, at various times, suggestions, advice, and helpful hints to the farmer in the matter of drainage, irrigation, measurement of water, pumping, etc. I think the efforts in this direction have been helpful in a measure to a more efficient practice of farming in this State.

No members of this office have been connected with commissions or committees for the betterment of agricultural conditions, but we have assisted in the promotion of a productive campaign.

The workers of this office have not engaged in any active work with the Extension Service. However, I think that when additional assistance is provided we should be capable of helping the farmer with his problems in a much more direct way through the channels of the Extension Service.

Since January this office has lost from its personnel the head of the department and six assistants, of which four have entered the military service.

Due to the nature of our work, the matter of filling vacancies has not met with any marked degree of success. At present only one assistant has been secured to replace the loss of our men. The nature of our work precludes the possibility of employing women, first, because of lack of training and second it is thought that laboratory and field work would hardly be in keeping with the physical strength and endurance of the average women. The extent of the employment of women in our work is only in the capacity of stenographic assistance.

Respectfully submitted,
RALPH L. PARSHALL.
U. S. Irrigation Engineer.

REPORT OF THE VETERINARY PATHOLOGIST

To the Director:

Since the Section on Pathology was created on July 1st, our report can only cover the period since that time. Under that date we took over from the Veterinary Section the projects on "Necrotic Stomatitis," "Contagious Abortion," "A Peculiar Disease of Chickens," and "Sheep Losses in the Feed Lots". No work has been done upon necrotic stomatitis. Merely routine blood examinations have been made for contagious abortion. The work has been continued on chicken diseases but without definite results.

Most of our time has been given to the determination of the value of vaccination for hemorrhagic septicemia in sheep, and to assisting the Veterinary Section on its milkweed project. The sheep work, we believe, will become of the utmost importance to the lamb feeding industry of the State and we shall expect to continue this work for a considerable time. The work on the milkweed project will be reported by the head of the Veterinary Section.

I am sorry to report the death of Dr. E. W. Alkire on October 17th. He was a man of unusual promise and would undoubtedly have been of great value to the Station could he have remained with us. Since his death, we have been unable to put on a man for full time work because men were so scarce on account of the war. We have, however, appointed Dr. W. H. Feldman for half time on the station work and will continue on this basis with a view to putting on a full-time man at a later date.

Our work has been definitely in line with the conservation of live stock and as a consequence did not require any special change on account of the war. We only wish that more assistance might

have been available, as we believe these projects to be of the utmost importance.

Respectfully,
I. E. NEWSOM.
Veterinary Pathologist.

REPORT OF THE VETERINARIAN

To the Director:

During the past fiscal year the Veterinary Section worked on the following approved projects: "Necrotic Stomatitis," "A Disease of Chickens," "Contagious Abortion," "Sheep Losses in the Feed Lots," and "The Whorled Milkweed". Realizing that, with the limited assistance and facilities for work, possibly too many projects had been undertaken, consideration was first given to those that were of the most vital importance from the standpoint of food conservation and that gave promise of an early conclusion. To this end, effort has been centered on the two projects, "Sheep Losses in the Feed Lots," and "The Whorled Milkweed as a Poisonous Plant". Practically nothing has been done on the Necrotic Stomatitis project, and only routine agglutination tests were made for contagious abortion. One rather extensive trip, covering portions of five counties in eastern Colorado, was made by Dr. I. E. Newsom, pathologist, in the interest of the chicken disease project, and much valuable data were secured. This disease is characterized by blisters on the feet and head, followed by distortion of the feet, a stunted growth, and death in many cases. In the aggregate the annual losses within the State run into the thousands of dollars, but as yet we have nothing definite to offer either as to cause or means of control.

SHEEP LOSSES

The heavy loss of lambs in the feed lots for the last few years has been a serious handicap to the lamb-feeding business. This loss had been generally attributed to change of environment, change of feed, and overfeeding. Circumstances arose which made it appear that the bulk of this loss could not be accounted for in this way. We have definitely determined that much of the sheep losses can be attributed to hemorrhagic septicemia. Under our recommendation and observation some thirty thousand sheep were vaccinated within the State last year. The results fully warrant the conclusion that vaccination is generally satisfactory in controlling this disease. We are inclined to think that, should the disease continue, vaccination will become a routine procedure for all those handling lambs in feed lots during the winter.

THE WHORLED MILKWEED

We were able to show that the whorled milkweed (*Asclepias verticillata*) was poisonous for sheep and rabbits. The smallest amount of the plant which killed a sheep in our experiments was 63 grams. It was found that 200 grams would kill a yearling lamb in most instances. We received parcels of milkweed every two weeks during its growing season and have fully demonstrated that each lot was highly poisonous for sheep. One preliminary bulletin has been published in collaboration with the Botanical Section.

THE WORKING PROGRAM

Beginning with July 1, 1918, the Section on Pathology was separated from the Veterinary Section, following which the milkweed project remained with the Veterinary Section, and the others were taken over by the Section on Pathology. This change was not made particularly to conform to the war program. All of our projects are directly concerned with conservation of live stock and our working program was modified only to the extent that our efforts were centered on those projects that gave the most promise of immediate practical results.

The head of the Veterinary Section was called in consultation with the State Council of Defense on matters pertaining to animal disease control with special reference to hog cholera.

The experiment station veterinarians have worked harmoniously with the extension staff. A conference of all state employees concerned especially in live stock conservation, was held at the office of the director of extension. At this meeting definite arrangements were made as to division of labor and plans for co-operation. Among other things it was agreed that the regulatory work in animal disease control should be under the direction of the state veterinarian; the educational work should be done by the regular extension veterinarian and other veterinarians of the college; and that the station veterinarian and pathologist should confine their work to investigation and research, co-operating with the others to the fullest possible degree. This arrangement was previously well defined but not always well understood and getting together for a conference was found to be very helpful.

Dr. E. W. Alkire, after being released from the army because of physical disability, improved in health and was employed as laboratory assistant in the Veterinary Section. He had a relapse however, and passed away on October 17. Dr. W. H. Feldman has been employed temporarily on half time with the college to take

his place. No women were employed in the Veterinary Section, except for stenographic work.

Respectfully submitted,
GEO. H. GLOVER.
Veterinarian.

REPORT OF THE EDITOR OF PUBLICATIONS

To the Director:

During the year 1917-1918 fifteen bulletins and one information circular, totaling 593 pages, and a combined edition of 137,000 copies, have been published. Compared with last year, this is an increase of one bulletin, 172 pages, and 35,000 copies.

Including the information circular, which was published in bulletin form, there were eleven bulletins of a popular character designed to be of practical use to the farmer; the remaining five were purely technical or semi-technical.

The information circular was a preliminary report on the steer-feeding experiments carried on during the years 1914 to 1917. It gave the results of experiments in which five combinations of feeds available in Colorado were used, providing some very valuable information for the stock feeders of the State.

Among those containing practical information directly resulting from investigations and experiments were "A New Poisonous Plant; The Whorled Milkweed", "Irrigation By Means of Underground Porous Pipe", "The Dandelion in Colorado", "The Properties of Colorado Wheat". The first named was especially effective because it contained positive information to show that the whorled milkweed is a deadly poison for livestock, especially sheep, thousands of which have been killed by the plant in Colorado during the past two years. This fact had not been definitely established before and the circulation of the information in the bulletin will result in the saving of large sums annually by sheep breeders and feeders. The other bulletins were more in the nature of information bulletins.

"Beans in Colorado and Their Diseases" was a revised edition of Bulletin No. 226, the title of which was identical with the new edition. The supply of the original edition had become exhausted and demands for the information contained therein necessitated a further publication.

In the technical group, "Mendelian Inheritance in Wheat and Barley Crosses" gives the results of experiments which have been carried on since 1911. It contains a large number of tables giving the results of many crosses made in the experiments and con-

tains nine pages of colored plates, six pages of halftones, and one of zinc etchings as illustrative material. This is the largest bulletin published by the Station in a number of years.

"Colorado Climatology" is of a semi-technical nature, consisting principally of tables showing temperatures, precipitation, evaporation, and other climatological data as observed at the Station and at a number of other points in the State of Colorado. It brings the information published in Bulletin No. 182, of the same title, published in April, 1912, down to date, including the record for 1917.

Following is a list of the bulletins published during the year just closed, together with the number of pages in each, and the number of copies printed:

POPULAR BULLETINS			
Bulletin No.	Title and Author	No. Pages	Number Published
234	"Beans in Colorado and Their Dis- eases" By Alvin Kezer and Walter G. Sackett	32	10,000
236	"The Dandelion in Colorado" By B. O. Longyear	35	10,000
237	"The Properties of Colorado Wheat" By W. P. Headden	31	12,000
238	"Cleaned, Treated and Tested Seed for Colorado" By W. W. Robbins, H. E. Vasey and G. E. Egginton		
240	"Irrigation by Means of Under- ground Porous Pipe" By E. B. House	15	8,000
241	"The Home Vegetable Garden" By R. A. McGinty	36	12,000
242	"Millet Smuts and Their Control" By H. E. Vasey	22	8,000
243	"Potato Culture in Colorado" By E. P. Sandsten	35	14,000
246	"A New Poisonous Plant; The Whorled Milkweed" By Geo. H. Glover, I. E. Newsom and W. W. Robbins	16	7,000
248	"Alfalfa Dodder in Colorado" By W. W. Robbins and G. E. Egginton	15	9,000

"Preliminary Report on Steer Feeding Experiments, 1914-1915 and 1916-1917"

By G. E. Morton and T. E. Leiper

8 3,000

Totals

285 103,000

TECHNICAL BULLETINS

239 "Alkalis in Colorado (Including Nitrates)"

58 10,000

By W. P. Headden

244 "A Study of Colorado Wheat"

32 5,000

By W. P. Headden

245 "Colorado Climatology"

64 4,000

By Robert E. Trimble

247 "A Study of Colorado Wheat"

15 10,000

By W. P. Headden

249 "Mendelian Inheritance in Wheat and Barley Crosses"

139 5,000

By Alvin Kezer and Breeze Boyack

Totals

308 34,000

Grand Total

593 137,000

Respectfully submitted,

RALPH L. CROSMAN,

Editor of Publications.



