THE STATE AGRICULTURAL COLLEGE
OF COLORADO

THE FORTY-THIRD ANNUAL REPORT

— OF —

The Colorado Agricultural Experiment Station

FOR THE SHORT PERIOD 1930

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The Colorado Agricultural College

FORT COLLINS, COLORADO

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FINANCIAL REPORT OF THE EXPERIMENT STATION

For the Year ending June 30, 1930

	Hatch Fund	Adams Fund	Purnell Fund	State Mill Levy Fund	Special Fund	Pure Seed Fund	Irrig. Cash Fund	Total Funds
DR.								
Balance July 1, 1929	.....	.....	.....	$9,512.07	$ 11,792.83	$ 13,267.22	($ 383.48)*	$ 34,188.64
From the Treasurer of the United States as per appropriations for the fiscal year ending June 30, 1930, under acts of Congress approved March 2, 1887, (Hatch Fund), March 16, 1906, (Adams Fund), and February 24, 1925, (Purnell Fund)	$15,000.00	$15,000.00	$60,000.00	.....	.....	.....	.....	90,000.00
Other sources than the United States				113,389.65	33,105.35	3,500.00	4,505.00	154,500.00
	$15,000.00	$15,000.00	$60,000.00	$122,901.72	$44,898.18	$16,767.22	$4,121.52	$278,688.64
CR.								
To Salaries	14,738.17	15,000.00	50,790.17	28,432.54	17,696.11	6,505.66	3,232.90	136,395.55
Labor			2,065.66	26,820.49	879.19	755.86	230.00	30,751.20
Stationery and Office supplies			152.65	1,761.76	275.99	134.40	48.90	2,373.30
Scientific supplies, consumable			610.35	2,053.39	946.27	52.36	4.92	3,667.29
Feeding stuffs			163.13	11,427.71	230.48	.....	.....	11,821.32
Sundry supplies			192.56	3,858.98	347.46	54.43	3.10	4,456.53
Fertilizers			20.00	162.62	.....	.....	.....	182.62
Communication service			90.04	1,410.91	50.18	10.47	6.45	1,568.05
Travel expense			3,832.23	8,894.50	1,713.49	735.19	586.90	15,762.31
Transportation of things			21.07	1,020.39	18.07	1.23	.....	1,060.76
Publications	261.83		129.18	3,449.92	183.37	.....	.....	4,024.30
Heat, light, water, power			.....	731.12	.....	.....	.....	731.12
Furniture, etc.			586.17	1,024.36	13.59	122.43	.....	1,746.55
Library			122.02	965.02	53.85	11.00	.....	1,151.89
Scientific equipment			531.56	2,484.50	742.20	246.38	.....	4,004.64
Livestock			104.10	11,604.32	58.50	.....	.....	11,766.92
Tools, machinery, appliances			4.75	3,606.43	3.25	.....	.....	3,614.43
Buildings and land			570.01	6,149.70	1,342.74	102.65	2.35	8,167.45
Contingent expenses			14.75	208.87	28.10	35.16	6.00	292.88
	$15,000.00	$15,000.00	$60,000.00	$116,067.53	$24,585.84	$8,767.22	$4,121.52	$243,539.11
Balance on hand June 30, 1930	.....	.....	.....	6,834.19	20,315.34	8,000.00	.....	35,149.53
Grand Total	$15,000.00	$15,000.00	$60,000.00	$122,901.72	$44,898.18	$16,767.22	$4,121.52	$278,688.64

(* Overdraft)

LETTER OF TRANSMITTAL

To His Excellency, William H. Adams, Governor of Colorado:

In accordance with the law of Congress establishing Agricultural Experiment Stations, I have the honor to transmit the Forty-third Annual Report of the Colorado Agricultural Experiment Station.

The report contains brief summaries of the work done by those in charge of the different sections of the Experiment Station, as well as a full list of projects upon which work has been done. However, because of the change in the state fiscal year to make it conform to the federal fiscal year, the present report covers the 7-month period from December 1, 1929, to June 30, 1930, only.

C. P. GILLETTE, Director

Agricultural Experiment Station
Fort Collins, Colorado
June 30, 1930.

AGRICULTURAL DIVISION

Report of the Director

To the President:

I am presenting the forty-third annual report upon the work of the Colorado Agricultural Experiment Station for the 7 months ending June 30, 1930. The report also contains a financial statement of all funds received and disbursed during the same period.

The changes in personnel of the station staff have been few. The spirit of cooperation among the workers, and between the various sections and the branches of the United States Department of Agriculture, has been good and some very important results have been reached. Some of these results have already been published in station bulletins, or in scientific journals of the country. The number of bulletins giving the results of investigations has been larger than for any like period in the history of the station.

There are no indications that we shall receive, either from federal or state funds, any increase in our revenues during the coming fiscal period to enable us to meet the demands for additional lines of research in the interests of agriculture, home economics and mechanic arts. We shall be compelled to confine our growth to greater efficiency in the expenditure of present funds without attempting a larger program than has been carried during the past year.

In accord with the spirit of modern agriculture and the recommendations of the Federal Farm Board, it shall be our effort to improve the agricultural conditions of our state thru researches that will improve quality rather than quantity production upon the farms and ranches and in the orchards of the state.

The station projects upon which work has been carried during the past year, including a few new ones which have recently been approved, are as follows:

AGRICULTURAL DIVISION

Agronomy Section

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

Correlation of Characters in Grains. Hatch and State funds.

High-altitude Crops. State funds.

Plains Crops and Management. State funds.

Improved Seed. State funds.

Control of Excessive Soil Nitrates in the Arkansas Valley. Purnell and State funds. (Cooperative with Bacteriology).

Studies in the Control of Bacterial Wilt and Winter Killing. Purnell and State funds. (Cooperative with Bacteriology).

Laboratory Methods of Measuring Soil Fertility. Purnell and State funds. (Cooperative with Bacteriology).

Animal Investigations Section

Ration Experiments with Cattle. State funds.
Summer Cattle-fattening Experiments. State funds.
Range and Pasture Improvement. State funds. (Cooperative with Botany).
Ration Experiments with Lambs. State funds.
Cornfield Lamb-feeding Experiment. State funds.
Summer-fallow Experiment at Akron, Colo. State funds.
Winter Maintenance of Breeding Ewes. State funds.
Poultry Experiments. State funds.
Beet By-products for Fattening Beef Calves. Purnell fund.
Comparative Value of Different Kinds of Molasses in Lamb-fattening Rations. Purnell and State funds.
Hog Feeding in the San Luis Valley. State funds.
Utilization of Dryland Feeds. State funds.

Bacteriology Section

Heat-resisting Bacteria in Fresh and Canned Vegetables. Adams fund.
Value of Certain Carbon Compounds as Sources of Energy for Azotobacter. Adams fund.
Natural Innoculation of Colorado Soils with Legume Bacteria. Hatch and State funds.
Winogradsky Method of Testing Soil Deficiencies. Purnell fund.
Control of Excessive Soil Nitrates in the Arkansas Valley. Purnell and State funds. (Cooperative with Agronomy).
Studies in the Control of Bacterial Wilt and Winter Killing. Purnell and State funds. (Cooperative with Agronomy).

Botany Section

Range and Pasture Improvement. Purnell and State funds. (Cooperative with Animal Investigations).
Cereal and Field-crop Disease Studies. Hatch and State funds.
Truck-crop Disease Studies. Hatch and State funds.
Weed Control. Purnell and State funds.
Indentification of Species of Beta and Brassica. Purnell fund.

Chemistry Section

Deterioration of Hays Resulting from Rain. Adams, Hatch and State funds.

Entomology Section

Plant-louse Investigations. Adams fund.
Ants in Relation to Plant Lice. Hatch and State funds.
Codling-moth Studies. Hatch and State funds.

Codling-moth Control by Means of an Egg Parasite. Purnell and State funds.

Grasshopper Control. State funds.

Potato Flea-Beetle. State funds.

General Insect Investigations. State funds.

Rodent Poisoning. State funds.

Rodent Life Habits. State funds.

Colorado Insect Fauna. State funds.

Resistance of Bees to American Foulbrood. State funds.

Relation of the Honey Bee to the Production of Seed in Red Clover. State funds.

Range Insects. State funds.

Economics and Sociology Section

An Economic Study of the Peach Industry in Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

An Economic Study of Farm Organization and Management in the Greeley area in Northeastern Colorado. Purnell fund.

A Study of Costs and Methods of Producing Cattle and Sheep on the Range in Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

A Study of the Social Status of the Spanish-speaking People in Rural Colorado. Purnell fund.

A Study of Taxation in Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

A Study of the Methods of Storage and Marketing Practices which obtain in handling Potatoes on Farms in the San Luis Valley. State funds. In cooperation with Colorado Division of Markets.

An Economic Study of the Apple Industry of Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

An Economic Study of Land Utilization in Northwestern Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

A Study of the Major Types of Cooperative Organizations of Associations in Colorado. Purnell fund. In cooperation with U. S. Dept. of Agriculture.

Home Economics Section

The Baking of Flour Mixtures at High Altitudes. Part II. Purnell fund.

Horticultural Section

Potato-variety Testing and Improvement by Selection. Hatch and State funds.

Garden-pea Variety and Breeding. Purnell and State funds.

Spanish Onion Breeding Work. Purnell and State funds.
Development of a Tipburn-resistant Variety of Head Lettuce. Purnell fund.
High-altitude Vegetable Production. State funds.
Orchard Management including Cover Crops. State funds.
Raspberry Investigations. State funds.
Small Fruits. State funds.
Certified Seed Potatoes. State funds.

Irrigation Investigations Section

Measurement of Water. Hatch and State funds.
Evaporation. Hatch and State funds.
(a) From a Free Water Surface.
(b) From Moist Soils.
Meteorology. State funds.
Pumping for Irrigation and Drainage. State funds.

Pathology Section

Sheep Losses in Feedlots. Hatch fund.
Contagious Abortion. Hatch and State funds.
Coccidiosis in Cattle. Purnell fund.
Death Losses in Lambs on Heavy Grain Feed. Purnell and State funds.
Icterohematuria. State funds.
General Disease Investigations. State funds.

Veterinary Section

Animal Diseases. State funds.

ENGINEERING DIVISION

Civil Engineering Section

Frost Heaving Investigation on Concrete Slabs. State funds.
Pavement Cores and Subgrade. State funds.
Light Asphaltic Road Surfaces. State funds.
Road Materials of Colorado. State funds.
Road Oils. State funds.

Mechanical Engineering Section

No active projects. Work in abeyance during past 7 months.

Following are brief reports from the heads of sections concerning the work of the past months.

Respectfully submitted,
C. P. GILLETTE, Director

REPORT OF THE AGRONOMIST

To the Director:

I am submitting my annual report for the fiscal year ending June 30, 1930.

The staff of the Agronomy Section has consisted of: Alvin Kezer, chief; D. W. Robertson, associate; G. Warren Deming, assistant; R. D. Hockensmith, assistant and Warren H. Leonard, assistant. Mr. Robert Robertson and Mr. Deming are full-time research workers. Mr. Hockensmith and Mr. Leonard are primarily teachers but render valuable assistance on the research problems. I should not neglect to mention Mr. John W. Sjogren; while he has not been officially on the experimental staff, he has been a constant producer. One bulletin has come from his work during the present year and nearly enough material for another bulletin has been collected. All of these workers are stationed at the home plant.

Mr. Adams is still in charge at Cheyenne Wells. Mr. Robert Gardner is in charge at Rocky Ford and Mr. Dwight Koonce is at Fort Lewis.

At Fort Collins, the work of the year has been a continuation of the critical period, residual effect of irrigation water, improved seed, methods of determining fertilizer needs, alfalfa-disease control, and other minor projects. Work on two new projects, each in cooperation with the United States Department of Agriculture, is under way—one at Rocky Ford on the clover crop and one on sugar beets, work on which will be located both at Rocky Ford and Fort Collins.

Under the improved-seed project, we are carrying on variety tests of cereals, pasture crops and a large portion of our breeding work. We hope during this coming year to complete the test of pasture crops and pasture mixtures so far as determining the adaptability of varieties to our climatic conditions and their growth behaviour with irrigation can determine their value. We have tried mowing the plats frequently to imitate the grazing of animals. We appreciate that such frequent mowing is not exactly the same as animal grazing but it does give us an idea of the behaviour of the different crops. We believe that we have carried these tests long enough to establish which are the better adapted varieties and which are the better adapted mixtures. We have also learned considerably about the seeding and care of such crops. The next procedure on irrigated pastures, it seems to us, is the actual grazing of some of these different mixtures to determine the effect of the tramping and selective biting of animals.

We need to do with dryland crops a greater amount of work than we are now doing to try to find the best adapted dryland mixtures. So far, we do not know of any tame grasses adapted generally to our dry uplands. Our present pasture possibilities under cultivation on the dry uplands are annual pastures.

We have carried a very large amount of small-grain selection and hybridization work. From some of this work we have gained some new genetic facts, both on wheat and barley. The hybrid work has given rise to one publication during the year and another paper has been accepted for publication. Hybrid work is somewhat slow in producing new and valuable varieties. We have promising selections coming on in our hybrid progenies. With the wheats and barleys, especially, we take certain of these hybrids to Akron yearly to let the most severe climatic and soil conditions exercise selection. Each year, we have about 1,000 of such progenies which we take to Akron.

The methods-of-measuring-soil-fertility project is carried on in cooperation with the Bacteriology Section. We can report progress on this project. In all cases in 1929, field applications of fertilizer gave field results in perfect accord with the laboratory predictions based upon laboratory tests. The field program has been somewhat enlarged this year by phases along the same lines as previously reported.

The alfalfa-disease control project, also in cooperation with the Bacteriology Section, is being vigorously pushed. We have nearly 20 acres of plats, testing both varieties and fertilizer-application methods upon the Agronomy farm. We also have plantings of promising resistant varieties in fields on farms in Larimer, Boulder and Weld counties. These farm fields were selected because they were known to be in regions where alfalfa wilt had destroyed previous alfalfa crops. The need for this work is growing because 1930 has seen an increase in the loss area. Considerable winter killing and disease killing has taken place in Morgan, Logan and Sedgwick counties in Northeastern Colorado and in Crowley, Otero, Bent and Prowers counties in Southeastern Colorado. The department has been making trips into these regions and assisting farmers in every way possible to improve their alfalfa crop conditions.

This year, we have taken up two new major projects. One is on clover investigations which is being conducted in cooperation with the Forage Office of the United States Department of Agriculture. Most of the work on this project will be conducted in the Arkansas Valley. Observations will be made in other localities. The other project is on sugar-beet-investigations, in cooperation with the Sugar Office of the United States Department of Agriculture. This work is being carried on both at Fort Collins and at Rocky Ford. At Fort Collins the work is requiring the use of about 60 acres of land in 1930. A part of this land is rented by the government from the County Farm to the east of our own experimental farm. A part of it is on our own experiment station farm and a part is located upon the lands of private farmers because we can get their conditions which we do not have upon either of these farms. At Rocky Ford, the project has available 40 acres of land—all of this is in use, but not all in sugar beets as a rotation must be followed in order to keep down nematode and other beet diseases.

These experiments are covering tests in a large number of methods, of planting methods, of thinning methods, of cultivating methods, of irrigation methods and a complete series of fertility tests.

The work at Akron is concentrated on the rate and date of planting, small grains, corn, forage crops, forage-crop varieties and cultural tests, and rotation and tillage-method tests. So far, in the variety tests of wheat, Kanred has proved superior for a series of years altho some other sorts of the Crimean or Turkey group are close contenders. The winter of 1929-30 was unusually severe. Accordingly, some of the less hardy of the winter types such as Blackhull have been severely damaged by winter killing. Such winters bring out the superiority of the Kanred, Karkov and Standard Turkey group.

New barleys upon which we reported last year are being increased for distribution to farmers. The best adapted dryland strains are Club Mariout, a selection from White Smyrna and Flinn. All of these are narrow-leafed barleys. When it is realized that one year with another, barley will produce as much feed grain per acre as corn, one realizes the importance of this crop in our dryland economy, as it can be handled readily and cheaply with tractor-drawn implements, thru requiring only a very small amount of hand labor.

We believe we have sufficient data on hog millet to publish an information bulletin this season. The feeding experiment with hog millet has brought out an unusual demand for this crop. I think it is unfortunate that it was called Hershey in some of our feeding publications. Hershey happens to be the name applied locally in two or three of our Northeastern counties. Everywhere else it is known as hog millet or proso. The use of this name was unfortunate because it has made farmers, agricultural writers and others unfamiliar with the crop, believe that we have here an absolutely new crop.

The cooperative studies on nitrate control at Rocky Ford have been conducted under the immediate charge of Mr. Robert Gardner. If this year's results turn out favorably and of the same order as for the past several years, we hope to publish on a number of phases of this work. The program at Rocky Ford has been enlarged to include clover investigations.

High-altitude agriculture is the main work being conducted at Fort Lewis. Our present studies there consist in variety, cultural and irrigation practice work with grains, pasture, meadow and forage crops.

Data from Fort Lewis have already appeared in one bulletin and further data will be used in forthcoming bulletins which are now being prepared to offer for publication.

The Cheyenne Wells work is of necessity being carried simply on a rental basis as we have no appropriation to support the work. We have supplied Mr. Adams with some cherries, plums, ornamental

trees, brambles and some shrubbery to assist in keeping the place up. Cheyenne Wells is making an excellent demonstration but cannot contribute in a research way without better financing.

We are serving the dryland needs thru cooperative arrangements with the Office of Dry Land Agriculture, United States Department of Agriculture at Akron. Akron being further north in the state and higher in altitude, does not permit studies on many of the sorghums and other crops adapted to regions further south and east in the dryland area. The dryland area contributes much more to our agriculture than is ordinarily recognized. Over 70 percent of the wheat production, about 80 percent of the corn and around 70 percent of the barley are grown upon our drylands. Millets, sorghums—both grain and forage—are practically confined to the drylands. In addition, judicious production of feeds and forage crops enables large numbers of livestock to be grown and matured. The needs of this great region justify more attention and heavier financing than we have been able to give.

The picture of agricultural practices on the plains has changed markedly in the past few years. Horses are being used less and less. Tractors are increasing in reliability and in use. Consequently, tractor-drawn and tractor-operated implements are quite generally replacing horse-drawn implements. We need to know not only relative costs of horse and tractor operations but we need to be making studies on the better methods of using tractor-drawn implements. The used of the tractor is making possible the very great enlargement of the area which a single man can cultivate. Heretofore with horses, the amount of land a grower could prepare for seeding and the amount that he could harvest constituted his limits. With tractor-drawn implements, the same limitations hold. But, with tractor-drawn implements both the seeding and harvesting area can be enormously increased. Tractors do not have to stop to rest for by shift in operators they can be worked 24 hours a day. Thus, much larger areas can be prepared for seeding and can be seeded than was possible with horse-drawn or animal-drawn implements. At harvest time the introduction of the combine, tractor-drawn and tractor-operated, with the introduction of the truck for the delivery of the product, enormously increases the amount a given number of persons can harvest. Methods of best using such equipment should be investigated. We should be able to supply farmers this information instead of having farmers subjected to the necessity of each individual working out all of the problems connected with such power use.

Our laboratories during the year have been considerably strengthened so that we are in much better position to do certain technical operations and soil studies. Many of our people have felt that our soils, being new, were inexhaustible in fertility. Fifteen or even 10 years ago commercial fertilizers in general gave no returns. But, at the present time in the older irrigated regions, phosphate fertilizers

are giving returns on better than 70 percent of the lands. This is simply a fore-runner of what we are facing in soil problems. These problems comprise problems of fertility, problems of management in connection with the use of irrigation water, problems of fertility in relation to types of minerals in composition. All of these and many others are presenting new phases which have an influence on the production of crops. We cannot expect to solve all of these but we are equipped to make a start.

I am pleased to say that in Mr. Robert Gardner and in Mr. Roy D. Hockensmith, we have two well-trained young men whom we are starting on these problems.

Respectfully submitted,
ALVIN KEZER, Agronomist.

REPORT OF THE ANIMAL HUSBANDMAN

To the Director:

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

Experiments conducted between Dec. 1, 1929 and May 15, 1930

Ration Experiments With Cattle.—E. J. Maynard, Geo. E. Morton and H. B. Osland.—Six lots of steer calves were fattened during a 185-day winter feeding period. A study was made of the comparative feeding value of wet beet pulp, corn silage, cull potatoes and a silage composed of a mixture of cull potatoes and dry corn fodder cut together into the silo. In certain years a surplus of potatoes at low prices may find a large supply of culls and markets held into the spring of the year on the farm. Tests at the station indicate that these potatoes, with some dry filler included, may be cut into the silo (which is usually empty at this time of year) and may be safely carried thru the summer for feeding operations the following fall and winter. A basal ration consisting of ground barley, cottonseed cake and alfalfa hay has been used in this experiment. This is the first test of the current series. In connection with this work a study was made of the comparative shrinkage of pressed beet pulp when stored in an open pile, in a trench silo and in a straw silo.

Summer Fattening Experiment With Cattle.—Geo. E. Morton and E. J. Maynard.—Beef calves were fed thru the winter largely on available roughages with a limited amount of concentrates in order that they might be in fleshy condition for a quick finish with grain on irrigated pastures during the summer. A comparison of corn silage and composted beet tops was made during the winter feeding period, each being fed along with ground barley, cottonseed cake, wet beet

pulp and alfalfa hay. The cattle will be finished for an early fall market on irrigated pastures of alfalfa and Morton's pasture grass mixture with and without a concentrated protein supplement.

Rations for Fattening Lambs.—E. J. Maynard and H. B. Osland.—A comparison was made between cull potatoes, cull-potato-and-corn-fodder silage and siloed beet pulp fed as supplements to basal rations of whole barley and alfalfa hay and whole barley and alfalfa hay and cottonseed meal for fattening lambs. Alfalfa meal (13 percent protein) and alfalfa stem meal (9 percent protein) were compared in a self-fed mixture of ground barley, cottonseed meal, molasses and alfalfa.

Field Lamb Feeding.—E. J. Maynard and H. B. Osland.—Lambs were pasture on stock beets for 43 days during the fall. During this period they were fed alfalfa hay in drylot at night and one lot received whole barley while the other lot got no grain. A check lot was fed whole barley and alfalfa hay in drylot. All lots were finished during a 70-day period on a standard ration of barley, wet beet pulp, cottonseed meal and alfalfa. The stock beets yielded 15.26 tons per acre. The final feed costs were lowest for the lambs fattened in drylot. A study of comparative yields of blocked and unblocked stock beets is being made in cooperation with the Agronomy Department.

Range Management.—E. J. Maynard and H. B. Osland.—A study of early spring protection to forage and rotation of cattle between two pastures as factors affecting vitality and increased production of forage plants on low foothill range of Northern Colorado; to compare effects of no protection to forage, early protection to forage and early protection plus rotation by grazing regulation of cattle; to study winter maintenance rations and general management problems.

Summer Fallow Experiment With Sheep at Akron.—Geo. E. Morton, E. J. Maynard and J. F. Brandon.—A study of sheep maintenance on dryland farms. The grazing of weed growth on summer fallow and consequent labor reduction for summer tillage. A study of the carrying capacity of weed growth on summer fallow and stubble land and of rye pasture and native sod. A 10-year period (1920 to 1930) has been completed in this work.

Utilization of Dry Land Feeds.—Geo. E. Morton, E. J. Maynard and J. F. Brandon.—(a) Winter Hog Feeding.—A comparison of the fattening grains; corn, barley and proso or hog millet, fed singly and in combinations along with a standard protein supplement. A comparison of different protein supplements and protein supplement vs. no protein supplement.

(b) Winter Lamb Feeding.—A comparison of corn, proso or hog millet and a combination of the two fed with sorgho fodder and a protein supplement to fattening lambs. A comparison of protein supplements for fattening lambs in non-irrigated sections. Ground vs. unground millet for fattening lambs.

(c) Summer Hog Feeding.—Summer fattening tests with hogs on a succession of annuals (fall-sown rye, spring-sown barley and sudan grass) along with grain and a protein supplement.

(d) Pastures for Non-irrigated Sections.—Some tests with sweet clover both as a pasture and as a hay crop have been made. A perennial dryland mixture has been grown.

Fattening Hogs in Peafield in the San Luis Valley.—H. B. Osland and E. J. Maynard.—A study of the value of different protein and carbonaceous supplements including tankage, skimmilk, alfalfa meal and barley fed to hogs pastured in peafields in the San Luis Valley. Preliminary work in an attempt to determine the most efficient supplements with which to balance peas pastured in the field.

Maintenance of Ewes.—B. W. Fairbanks.—The second year's work on the ewe-maintenance experiment under its present setup was completed at noon on May 5. All figures have been collected and compilation will take place as soon as the opportunity presents itself, which will no doubt be immediately after vacation. At that time we can check the work and come to a definite decision as to whether the experiment should be completed with 2 year's work or whether a third year is advisable.

All-Mash vs. Mash-and-Scratch Laying Rations.—C. N. Keen.—Two lots of birds were put on rations, lot 1 on all-mash ration, and lot 2 a mash-and-scratch ration. The number in each lot was 67 birds. Comparison of the two methods of feeding has been made to find the result upon laying, the condition of the birds and the cost of each method.

Advanced Registry Testing.—B. W. Fairbanks.—Following is a summary of the work done since May 1, 1929:

Month	1-Day	2-Day	7-Day	Fees
May	16	45		$15.25
June	15	45	3	18.00
July	19	51	6	23.50
August	20	51	2	19.75
September	20	46	4	20.50
October	22	38	5	20.00
November	18	42	1	16.00
December	18	39	3	17.25
January	38	21		14.75
February	47	5		13.00
March	75	7	1	17.75
April	59	3		15.50
	367	393	25	$211.25

Respectfully submitted,

GEO. E. MORTON, Animal Husbandman.

REPORT OF BACTERIOLOGIST

To the Director:

I have the honor to submit herewith the report of the Bacteriological Section of the Experiment Station for the period December 1, 1929 to May 31, 1930.

A complete summary of our work up to December 1, 1929, covering the first half of the new fiscal year, was presented as a part of my annual report for 1929, and, accordingly, the present statement pertains only to the activities of this section for the past 6 months.

At this time, I desire to call your attention to three lines of investigation which we have been conducting:

1. Alfalfa Wilt-Resistance Tests.
2. Winogradsky Soil-Deficiency Tests.
3. Niter Studies at Rocky Ford.

Alfalfa Wilt.—While it is a little early to predict the losses from this disease this year, it may be a matter of interest to note that the wilt is already making its appearance in the old stands.

Our variety tests in Boulder, Larimer and Weld counties came thru the winter in excellent condition in spite of the severe cold weather. The outstanding difference to be observed at this time among the several varieties under study is the marked susceptibility of the Common strain to mildew. The yellow foliage, resulting from this disease, is so conspicuous that the plots planted to Common can be distinguished easily from the other varieties at a considerable distance. The same susceptibility, but to a lesser degree, exists in the Argentine. The stands are now 1 year old, and while to date none of the varieties shows wilt, there appears to have been dying out during the winter by Hardigan, Canadian Variegated and Ladak. From the standpoint of growth and vigor, the Canadian Variegated looks very promising; the Cossack and Grimm are close seconds; the Ladak is thrifty but appears to be more of a prostrate than an erect type; Hardigan, Argentine and Utah Common are also included in the test.

Winogradsky Soil Tests.—Owing to the fact that this test requires only 72 hours, we have been able to furnish many farmers with information on their fertilizer needs in time for spring planting. Since March 1, we have examined soil from 214 fields and orchards, and the samples are still coming in. This has meant nearly 2,000 tests. While it has taxed our laboratory force to the limit to keep up with these, we have been able to get returns to the farmers in less than 10 days after the receipt of the samples. To help defray the expense of the work, a nominal charge of 50 cents per sample has been made. Altho this

does not begin to pay for the actual cost of making the tests, it helps and also serves as a deterrent to the idle curious. The bacterial soil plaque is used in determining the phosphate and potash deficiencies, but chemical methods are employed for the nitrate, lime and acid analyses.

The results of the tests are reported on a card and tell the grower if his soil needs potash, phosphate, nitrate or lime, and if it is too acid. It also carries a recommendation for treating the soil based upon these results. One copy of this card is kept in the laboratory files, a second is sent to the farmer, and a third goes to the county agent. The form we use follows:

SOIL FERTILITY TEST
(Farmer's Card)

Name.....Address.....
Sample No.....Date.....

RESULT OF THE TEST

Phosphate.....Lime.....
Potash.....Acid.....
Nitrate.....Basic.....
Recommended Application.....
.....
.....
Past History.....
.....
Present Crop.....

The results from 196 soils examined this spring show 74 percent to be deficient in phosphate, 3 percent in potash, 17 percent in nitrate and 21 percent in lime; 15 percent are slightly acid, 76 percent basic and 9 percent neutral.

By way of checking our laboratory results, we have put out five test plots. Four of these are planted to sugar beets and one to barley. In this work we are endeavoring to determine the relative value of different amounts and kinds of phosphate for producing the maximum yield of sugar beets and the value of phosphate alone and in combination with ammonium sulfate for barley and alfalfa.

Dr. D. W. Robertson of the Agronomy Section is cooperating in this work.

Niter Studies.—The beneficial effect of different crop residues and sawdust in controlling the formation of excessive soil nitrates has been so striking that we have continued this line another season. In the past this series of plots has been kept fallow. This year they will be planted to a crop in order to determine the effect of the residue treatment on crop production. If this method of handling these high niter soils proves as effective as our laboratory tests indicate, we shall have found a very simple and practicable solution for the difficulty.

Our soil-nitrate determinations, made over a period of 6 years and now numbering more than 20,000, have proved conclusively that there is a marked increase and accumulation of nitrates under cultivated crops during the growing season which reaches its peak early in August. It has been our contention, and still is, that these nitrates owe their origin to the oxidation of the organic nitrogen contained in Azotobacter cells which in turn have obtained this element from the air by the fixation of atmospheric nitrogen. In order to make our theory absolutely conclusive, we are making determinations of the organic nitrogen this season in addition to the nitrate. We expect to be able to show by this that the curve for the organic nitrogen follows much the same course as that of the nitrate, except that the former reaches its peak somewhat in advance of the latter.

Miscellaneous

1. Bacterial Blight of Beans.—Bacteriosis or bacterial blight is unquestionably the most serious disease of beans in Colorado. This year we are carrying on resistance tests at Rocky Ford with six varieties obtained from the U. S. Department of Agriculture thru the courtesy of Dr. Zaumeyer. These beans, under eastern conditions, have shown more or less freedom from blight and we are hopeful that they will exhibit the same resistance here.

2. Extension Service.—At the invitation of the Extension Service, I gave one radio talk over Station KOA on alfalfa failures. In January, I gave six lectures on soil questions in connection with soil schools which were held at Fruita and Grand Junction; at this time I gave two additional talks on Tularemia and Food Poisoning before the Fruita High School and Fruita Extension Women's Club respectively.

An exhibit illustrating our work in testing soils for fertilizer needs was prepared for the Weld County Farmers Institute held in Greeley in January. At this time I described the use of the soil plaque and discussed our soil deficiencies.

At the National Western Stock Show, held in Denver in January, we set up a laboratory for making soil tests and demonstrated our work with the soil plaque in determining soil deficiencies. In a second booth,

we showed graphically the fertilizer needs of our common crops and exhibited a large assortment of commercial fertilizers. In connection with this, we featured the manufacture of treble superphosphate.

3. College Instruction.—At the invitation of the Horticultural Department, I gave lectures on vinegar making and soil fertility before the horticultural classes; a similar lecture on soil bacteriology was given before the class in industrial chemistry.

4. Swimming Pools.—With the installation of liquid chlorine as the purifying agent in the women's swimming pool, it has become necessary to make daily tests of the water for residual chlorine and acidity. The purity of the pool has been faultless under this treatment. The present system of circulating the chlorinated water before it enters the pool is not satisfactory since all of the water enters at one end thereby producing too great a concentration of chlorine at that point. Some method of introducing part of the water at the north end should be worked out in order to give more uniform distribution of the chlorine.

We have continued the weekly examination of the men's pool and have found the quality to be satisfactory with the violet-ray purification with the exception of the times when the pool is overloaded, as is the case during high-school meets.

5. Laboratory Needs.—As the scope of our work broadens and the volume of our routine increases, we feel greatly the need of larger quarters. We should have additional library and office space, separate laboratories for individual research and a laboratory for biochemistry. It is to be hoped that in the next building program, some provision will be made for enlarging the Horticultural Building so as to take care of this much needed expansion.

In the various phases of the work reported here, I have been assisted by Miss Laura C. Stewart, Mr. Robert Gardner, Dr. D. W. Robertson, Mrs. Mildred Brown Carpenter, Mrs. Alpha Powell Head and Miss Esther Elliott, whose efficient services I am pleased to acknowledge.

In conclusion, I desire to express my very great appreciation of the opportunity afforded me of attending the eleventh annual meeting of the Southwest Division of the American Association for the Advancement of Science held at Tucson, Arizona, April 21 to 25, 1930, and for the honor of representing the college at the inauguration of President Shantz.

To the Director I am very grateful for his continued interest in the welfare of the Bacteriological Section and for the support he has given our work.

Respectfully submitted,
WALTER G. SACKETT, Bacteriologist.

REPORT OF THE BOTANIST

To the Director:

I beg to submit the following report of the work carried by the Botanical section for the past fiscal year.

Range and Pasture Improvement.—Study is being made of reseeding, of the results of continuous and deferred grazing, of the effect of soil and climatic conditions, also the results of early pasturing, trampling and poisonous plants.

The following are phases of range improvement being investigated:

1. Carrying capacity of grama-buffalo grass vegetation for sheep.—This study is being carried on cooperatively with the Animal Husbandry department at the U. S. D. A. Field Station. The data covering the entire period of experimentation is being prepared for publication.

2. Ecology and improvement of mixed prairie cattle range at an altitude of 5,000 feet, Ft. Collins.—Along the base of the eastern foothills is found a type of vegetation composed of a great variety of grasses and weeds. The dominant grasses are *Stipa* spp., *Agropyron Smithii, Bouteloua gracilis,* and *Bulbilis dactyloides.* A thoro study of this type of vegetation in relation to grazing practice is being made. The Department of Animal Husbandry is cooperating in this thru feeding experiments. Data covering 9 years' study of this range are being prepared for publication.

3. Improvement and management of upper foothill cattle range at an altitude of 7,000 feet near Virginia Dale.—Areas plowed up by homesteaders and then abandoned have been greatly improved by seeding to smooth brome grass, slender wheatgrass, crested wheatgrass and yellow sweet clover. A vegetation map is being prepared as a basis for evolving the best management plans of such regions.

Basic ecologic data are being gathered to aid in solving problems such as eradication of poisonous plants, prevention of erosion, determination of proper carrying capacity, and other phases of range improvement and management.

4. Improvement of sagebrush (*Artemisia tridentata*) range.—This study has been conducted in the Laramie River Valley for 3 years. Four-to-eight-fold increase in forage has been secured in this time due to natural revegetation following burning. The damage done by rodents has been shown to be very great. This work is now being extended to North Park where a comprehensive experiment and demonstration has been laid out in cooperation with the Extension Service.

5. Succession and competition of plants in irrigated pastures in relation to pasture management.—A number of different seed mixtures and the resulting pasture stands each year following seeding have been analyzed. Part of this study is in cooperation with the Department of Agronomy. These pastures are under a great variety of soils and treatment. A large amount of data on the habits of plants, especially in regard to competition and succession, has been gathered. This information is valuable in deciding the proper mixture to sow as well as in the management of the pasture.

Weed Control.—The weed-control work is centered around the study of chlorate sprays under Colorado conditions and some of the physiology involved in their use. They are now being tried on bindweed, poverty weeds, Canada thistle, Russian knapweed, perennial peppergrass, larkspur, seedling barberries and willow. A brief study is also being made of various chemical treatments for dandelions.

Truck-Crop Diseases.—During the past year, study has been made of onion diseases in the Arkansas Valley. A substation has been established there during the summer for following the development of neck rot and purple blotch.

Cereal Diseases.—Studies on stinking smut of wheat have been continued. Work on infection has been accepted for publication. Other physiological studies are prepared for publication.

Observations and study of the foot rot of wheat are being continued. This disease made its appearance in 1928 and again in 1930 following severe winter with little snow.

Cooperative Work.—In cooperation with the office of Cereal Crops and Diseases, U. S. D. A., work on barberry eradication has continued.

The Office of Sugar Crops, during the past year, established cooperative work with the Botanical Section in studying sugar-beet diseases.

Miscellaneous pieces of work have been carried on in addition to the above formal projects. Reports of these studies are indicated in the bibliography of Botanical Publications here attached.

Seed Testing Work

For the fiscal year beginning July 1, 1929.
Report of Seed Samples Tested

	Purity	Germination	Examination	Identification
Current samples	1357	3201	7	31
Certification service	168	386		
Inspection samples	651	985		
Sugar-beet investigations		27		
Wild-oat study		120		
Longevity studies		113		
Other investigations	57	150		
Total samples	2233	4982		

All samples of peas and beans have been checked by greenhouse tests.

Numerous samples of cereals which were found to be dormant when tested by the usual methods, were tested at low temperatures to test the degree of dormancy.

All samples exhibiting unusual or unsatisfactory behavior when tested by the method suitable to the species, have been retested in daylight, in sand, soil, greenhouse or by several of these methods.

1929-1930 Publications of the Botanical Department

Durrell, L. W. A new Pathology Text (review)
Principles of plant pathology by Charles E. Owens.
Phytopathology. 19:177.

Hanson, Herbert C. Range Resources of the San Luis Valley.
Colo. Agr. Exp. Sta. Bul. 335:1-60.

———— Grazing Types in Colorado.
The Cattleman 15:57-63 (April)

———— Reseeding Waste Range Land.
The Cattleman 15:31 (May)

———— Intensity of Grazing in Relation to Proximity to Isolation Transects. Ecology 10:343-346.

———— Analysis of Seeding Mixtures and Resulting Stands in Irrigated Pastures of Northern Colorado.
Journal Am. Soc. Agronomy 21:650-659.

———— Discussion on "Eradication of Brush and Weeds from Pasture" by A. E. Aldous. Jr. Am. Soc. Agronomy 21:666.

———— Pasture Plants for Sheep.
American Sheep Breeder, July.

———— With F. E. Clements and J. E. Weaver
Plant Competition. Carnegie Inst. Publ. No. 398.

———— The struggle for existence among Range Plants.
The Producer. 11:5-7.

———— Grazing Types in Colorado.
The Cattleman 15:57 (March)

———— Ecological Bases for Grazing Studies.
Abstract Published in Journal of Colorado-Wyoming Academy of Science. Vol. 1.

———— Pasture Plants for Sheep.
American Sheep Breeder, July.

———— Reseeding, Range Lands.
The Natl. Wool Grower, October.

———— Improvement of Sagebrush Range in Colorado.
Colo. Agr. Exp. Sta. Bul. 356.

———— Importance of Western Grazing Land.
The Cattleman, March.

LeClerg, E. L. Some Common Diseases of Ornamental Plants. Colo. Sta. Bul. 351.

LeClerg, E. L. Neck Rot of Onions. Colo. Agr. Exp. Sta. Bul. 301.

Rogers, Charles F. Canada Thistle and Russian Knapweed and their Control. Colo. Agr. Exp. Sta. Bul. 348.

Smith, E. C. Some Phases of Spore Germination of Myxomycetes. Amer. Jr. Bot. 16:645-50.

———— Longevity of Spores of Myxomycetes.

Journal Colorado-Wyoming Academy of Science Vol. I No. 2.

LeClerg, E. L. Observations on Some Onion Diseases of Colorado.

Ashton, Ruth E. Preliminary Observations on Revegetation of the Twin Sisters Burn in Rocky Mountain National Park.

Smith, E. C. The Longevity of Myxomycete Spores.

Hanson, Herbert C. Improvement of Sagebrush Range in Colorado.

Smith, E. C. Trametes Peckii, a Destructive Parasite in Apple Orchards.

Love, L. Dudley and Herbert C. Hanson. Relation of Environment Factor Data to Range Management.

Bodine, E. W. The Effect of H-ion Concentration Upon Spore Germination and Growth of *Tilletia laevis* (Kuhn.)

———— Method of Culturing and the Growth of *Tilletia laevis.* (Kuhn.) on media.

Lungren, E. A. Progress of Barberry Eradication and Black Stem Rust Investigation in Colorado.

Hatfield, Ira and Charles F. Rogers. A Chemical Indicator for the Diffusion of Carbon Disulfide Through the Soil.

Submitted or in Press.

LeClerg, E. L. Cultural Studies of Some Soil Fungi, Soil Science.

Hatfield, Ira and Charles F. Rogers. Formula and Apparatus for Measuring the Liquid-to-Gas Volume Change, Plant Physiology.

Rogers, Charles F. and Ira Hatfield. A Chemical Indicator for Testing in the Field the Diffusion of Carbon Disulfide Gas Through the Soil, Plant Physiology.

Publications Submitted or in Press.

Durrell, L. W. Diseases of Corn.
Symposium, Botanical Society of America, A. A. A. S.

Bodine, E. W. and L. W. Durrell.
Inoculation of Wheat with *Tilletia laevis.* Phytopathology.

Howe, Mary F. Germination and Infection with *Sclerospora graminicola.* Abst. Mycologia.

Lute, Anna M. Distinction between Seeds of White and Yellow Blossom Sweet Clover in Mixture. Proc. A. O. S. A.

Lyon, Mildred E. and Albina F. Musel. A Direct Method of Testing Seed. Proc. A. O. S. A.

Hanson, Herbert C. and L. Dudley Love. A Comparison of Methods of Quadratting. Ecology.

———— Pastures for Spring and Fall Grazing in Mountains of Colorado.

———— Improvement of Grazing Lands.
The Forester.

———— Range Reseeding.
The Producer.

———— and Richard V. Lott. Root Systems of Strawberry Varieties Under Irrigation at Fort Collins, Colorado.

LeClerg, E. L. Onion Diseases of Colorado.

Smith, E. C. Ecological Observations on Colorado Myxomycetes. Myc. Section, Am. Bot. Society.

———— Trametes Hispida, a Destructive Parasite in Colorado Apple Orchards. Mycologia.

Respectfully submitted,
L. W. DURRELL, Botanist.

REPORT OF THE CHEMIST

To the Director:

During the time covered by this report, this section has finished the project entitled "Sources of carbon dioxid in soils cropped to alfalfa or clover and its relation to soil changes and plant growth."

This project was extended in order to follow the development of the carbon dioxid in the soil during the first year after these crops had been plowed under. The whole series of plots, fallow as well as cropped, was studied.

A small section, representing the whole series, was planted to wheat the spring after the crops were plowed under, but the rest of the land was fallowed in order to follow the carbon dioxid. The results of these experiments have not yet been published. The manuscripts are now in your hand.

The results of our observations on the amounts and distribution of the carbon dioxid, present too many features to permit presentation in this report, but the crops obtained the first year after alfalfa and clover were instructive. The seeding was at the rate of 90 pounds per acre. After the alfalfa, the wheat grew rank and tillered freely but the grain was shrunken and the yield the smallest of the four plats which stood in the following order: After fallow 58 bushels, after corn 56, after clover 46, after alfalfa 40.

The protein content after alfalfa, 19 percent, after fallow, 17.25, after clover, 17.5, after corn, 12.75.

The succeeding year, 1929, the whole piece was planted to wheat, the same variety as in 1928, but the seeding was made 40 pounds to the

acre instead of 90 because we surmised that the tillering and rank growth after alfalfa might be the cause of the relatively adverse results after alfalfa. The growth in 1929 did not show the differences observed in 1928, but was very good and uniform and the yields satisfactory, but the alfalfa plots fell below the fallow by 5 bushels, probably not a significant difference.

We made a small experiment with ground rock phosphate, superphosphate and gypsum. The gypsum was used, not because there is any lack of it in this soil, but to get an idea of the effect of the gypsum in the superphosphate, if it had any.

Of these three, gypsum alone produced an evident effect on the growth of the plants and gave the highest yield obtained, 57.5 bushels. All other details of this project will be given in the bulletins presenting the results obtained in this study.

The project being studied at the present time is "the deterioration of alfalfa hay due to wetting by rain in the field while curing." This project will not be completed until the samples of 1930 have been studied.

This project was undertaken because there seems to be but little positively known about the subject, and the facts given in Bulletin 35 of this station, published 34 years ago, seem to be but little known.

Some statements made in Bulletin 35 are reproduced in the following:

"The total rainfall between May 28th and June 12th, the respective dates of cutting and putting into the mow, was 1.76 inches. The weather during this time ranged from 72 to 81 degrees. Any calculations based upon the above (analysis) without further data would evidently be liable to lead to erroneous conclusions, but it suffices to show that the popular estimate of the value of such hay is not far from correct; i. e., about one-half that of good hay. The damage is not simply the amounts of proteids and nitrogen-free extract (carbohydrates) lost, but also the loss of those general qualities recognized as essential to good hay."

The whole subject of vitamins has been developed since these sentences were written, and these must be taken into consideration. Feeding experiments with white rats are being made to establish the loss of these factors, which seems to be very large indeed.

The details of this study are too extensive to properly find place in a general report.

Respectfully submitted,

WM. P. HEADDEN, Chemist.

REPORT OF THE AGRICULTURAL ECONOMIST

To the Director:

During the year ending June 30, 1930, the Section of Agricultural Economics and Rural Sociology has continued its studies on nine projects, eight of which have been approved for development with Purnell funds.

Project No. 1.—An Economic Study of the Peach Industry in Colorado.—This work was initiated in 1926-27 in cooperation with the Division of Farm Management and Costs, Bureau of Agricultural Economics, U. S. Department of Agriculture, and it has been carried during the past 2 years in cooperation with the Extension Service of the Colorado Agricultural College. The original records dealt with labor and material costs in producing peaches. More recently attention has been given to a study of the farm business as a whole.

Farm-business analysis records for the year 1928 were secured during the summer of 1929. The necessary calculations have been made on these records; the information has been transferred to office sheets and the results have been set up in tabulated form. At this stage complete records covering 2 years have been made available. A preliminary report in which comparisons are made for the years 1927 and 1928 is in preparation. Copies of this report will be returned to cooperating farmers during the current year.

Project No. 2.—An Economic Study of Farm Organization and Management in the Greeley Area and in Northeastern Colorado.—This study was begun in 1922 and records have been maintained continuously in this region for a period of 8 years. The project was developed during the early years in cooperation with the Division of Farm Management and Costs, Bureau of Agricultural Economics, U. S. Department of Agriculture. Within the past 4 years the work has been developed entirely by this department.

There are four phases of economic endeavor under consideration at the present time. These include (1) a continuation of detailed farm-accounting records on some 15 or more farms which have been a part of this enterprise since 1922; (2) a detailed study of some representative dairy farms, starting with the calendar year 1929; (3) financial farm records on irrigated farms continuous since 1922; and (4) financial records of representative non-irrigated farms for the years 1927, 1928 and 1929. In addition to the purely statistical material which has been assembled, much valuable information has been secured with reference to farm organization methods, farm practices and farm returns.

A manuscript dealing with the cost of feeding cattle in Northern Colorado has recently been prepared and will be available for publication in the near future.

Project No. 3.—A Study of Costs and Methods of Producing Cattle and Sheep on the Range in Colorado.—Four departments are represented in the study and analysis of this project, and two distinct but closely related regions are involved. The cooperating agencies are: The Bureaus of Animal Industry and Agricultural Economics in the U. S. Department of Agriculture, the Wyoming Experiment Station and this department. Approximately 20 records are being maintained for the North Park area in Colorado and 22 records for the Saratoga Valley in Wyoming.

To date, records have been assembled and checked for 19 ranches. Practically all of the accounts for the year 1929 have been closed and summary statements have been prepared so that cooperating ranchmen may have available financial summaries for the past year. The route man has made an average of six visits per ranch during the past year. A preliminary report relating to the cost of producing hay on North Park ranches is being prepared and will be distributed to cooperating ranchmen early this season.

Project No. 4.—A Study of the Social Status of Spanish-speaking People in Rural Colorado.—Within the past year the collection of material relating to this subject has been completed. A number of meetings dealing with Spanish problems have been attended; a number of conferences in which the leader of the project has participated have been held; a rather extensive list of references has been examined and further observations have been made in the field. The material collected was assembled in the form of a manuscript. This manuscript has been rewritten and worked over in part several times. Within a few days the last chapter dealing with conclusions and suggestions will be completed. This outline will then be submitted for publication.

Project No. 5.—A Study of Taxation in Colorado, Particularly in Its Relation to the Agricultural Industry.—This project has been carried on a cooperative basis with the Division of Finance, Bureau of Agricultural Economics, U. S. Department of Agriculture. During the current year this division has prepared a large amount of statistical information with reference to public-school finance in Colorado.

A beginning has been made in the study of county government. Our local county was selected for the initial work. Colorado Station Bulletin 361, entitled "The Cost of Local Government," has been published and will be distributed shortly. Another manuscript dealing with the cost of public schools in this county has been prepared and is in the hands of the editor. Mr. N. E. Woodard, a graduate student, is making an analysis of the feasibility of establishing a centralized purchasing department for Colorado counties, particularly in con-

nection with securing school supplies. Thus far he has reviewed the literature on the subject published in the United States and Canada and is attempting to secure as much information as possible from several foreign countries.

Project No. 6.—A Study of Methods of Storage and Marketing Practices in Handling Onions on Farms in the Arkansas Valley.—This project was organized in the beginning for the purpose of making a study of marketing practices and storage costs in handling potatoes in the San Luis Valley. The entire enterprise has been developed in cooperation with the Division of Markets, State House, Denver, Colorado.

The results of our investigation, covering a 3-year period in the San Luis Valley, have been completed and the assembled materials are being placed in manuscript form for publication. During the past autumn and the early part of the present year, cost-of-production records have been obtained from some 15 or more farm operators in Otero County. Storage information has also been assembled for these farms and in several cases complete farm-business analysis records have been obtained. It is our intention to prepare and submit a preliminary report dealing with the cost of producing onions and a report likewise on some of the major storage features of this study.

Project No. 7.—An Economic Study of the Apple Industry in Colorado.—In its inception this project was conducted in cooperation with the Division of Farm Management and Costs, Bureau of Agricultural Economics, U. S. Department of Agriculture. During the past 2 years the field work has been developed in cooperation with the Extension Service of the Colorado Agricultural College. The preliminary reports have been prepared and returned to cooperating farmers in this general region. Our work on this project now includes financial studies for 3 years and several types of farming have been considered in this analysis. Material is available for a 3-year preliminary report which will be returned during the summer of 1930.

Project No. 8.—An Economic Study of Land Utilization in Northwestern Colorado.—This enterprise was undertaken in 1927 in cooperation with the Division of Land Economics, U. S. Department of Agriculture, and includes a study of land utilization in Northwest Colorado. Farm-business analysis records have been assembled in Moffat, Routt and Grand counties for 3 successive years. For 2 years preliminary reports have been prepared and returned to cooperating farmers. The Division of Land Economics has given attention to materials collected from the Forest Service, the U. S. Land Office and from county records relative to land utilization in this region.

Project No. 9.—A Study of the Major Types of Cooperative Organizations or Associations in Colorado.—This enterprise was

developed in its early stages in cooperation with the Division of Cooperation, Bureau of Agricultural Economics, U. S. Department of Agriculture. There are now 24 cooperative grain elevators that are furnishing information with reference to such items as number of stockholders and patrons, amount of capital stock, amount and source of working capital, indebtedness, physical properties of each elevator, grading-equipment used, buying and selling policies, cooperative features, etc.

Prior to the development of this study dealing with cooperative elevators, data were obtained from approximately 80 cooperative associations in the state. This manuscript is now in the preliminary stages and will be submitted in bulletin form in the near future. It is our intention, however, to make some further study of these cooperative units before the final outline is published.

Respectfully submitted,

L. A. MOORHOUSE,

Agricultural Economist.

REPORT OF THE ENTOMOLOGIST

To the Director:

Following is a brief report upon the work carried by the Entomology Section of the Experiment Station during the past year:

The only important change in personnel has been the placing of Mr. Louis G. Davis in charge of the work at the Mesa County field station in Grand Junction in place of Mr. Wm. P. Yetter, Jr., who left a year ago to take a position with the U. S. Bureau of Entomology.

Much of the research work in Entomology is carried in cooperation with the funds of the State Entomologist and the Department of Entomology, to the advantage of all three lines of work, as it makes it possible to secure more competent men, and the three phases of the work are very closely related to each other.

The bulletins that have been published from this section during the year are:

No. 352, The Sulphide Sulphur Content as a Basis for Diluting Lime-sulphur for Spraying, by George M. List.

No. 354, Some Factors relating to the Feeding Habits of Grasshoppers, by George S. Langford.

Press Bul. No. 72. Preliminary Notes on the Action of Strychnine on the Wyoming Ground Squirrel (*Citellus elegans elegans*), by W. L. Burnett.

The losses from insect pests during the year have not been unusual as compared with previous years. Among the insects causing heavy losses were: Grasshoppers, cut-worms, and the alfalfa weevil to general farm crops; the codling moth, several species of plant lice and scale insects to the fruit crop; the oyster-shell-scale, elm scale and bark borers to forest and shade trees; and cut-worms, plant lice, the red spider, flea beetles, the onion maggot and the cabbage worms, to garden crops. Experimental work for the purpose of finding better control methods for many of these pests and some others is in progress.

I am giving below a few notes on the projects upon which more or less work has been done during the year, or which have been approved for work during the coming year.

Plant-louse Investigations.—This is an Adams project, carried by Miss M. A. Palmer and the writer. Two technical papers have resulted from the work during the year, giving habits and descriptions of several new species. One of these papers has been published in "Annals" and the other has been accepted for publication and will appear soon. A large amount of work has also been done in the preparation of an illustrated list of Colorado *Aphididae*, Part I of which is about ready for the printer.

Ants in Relation to Plant Lice.—This is a Hatch project in charge of Dr. C. R. Jones. Progress has been made in the gathering of data on life histories and in methods of control. The work will be continued along these lines during the coming year.

Codling-moth Studies.—This project is supported cooperatively on the funds of the State Entomologist and the Experiment Station, the work being chiefly in the nature of comparative tests in the field for the control of the codling-moth in Mesa and Delta counties. In this work we are cooperating with the Bureau of Entomology in the testing of the Siegler treated band for the capture and destruction of the larvae of this insect. The tests to date have given excellent results. The project is in charge of Mr. George M. List, with Mr. J. H. Newton and Mr. L. G. Davis as helpers.

Codling-moth Control by an Egg Parasite.—This is a Purnell project which is carried in cooperation with the State Entomologist's funds, and is in charge of Mr. List. Many difficulties have arisen in the work of breeding this parasite, to overcome which has called for much ingenuity and perseverance in devising apparatus and methods of securing proper temperature and humidity to insure success. At present about 30,000 parasitized eggs are being shipped daily to be used in the orchards of the State to determine what effect may be secured by this parasite in the reduction of wormy apples and pears.

Grasshopper Control.—The work in this project has been in cooperation with the Bureau of Entomology and in charge of Mr. Frank

C. Cowan, and has been directed chiefly to the control of the Mormon Cricket in Northwestern Colorado. Very gratifying results have been secured, and it now seems probable that, by the end of the coming summer, this insect will be eliminated as a serious pest to the settlers in Moffat, Routt and Rio Blanco counties of this state, for several years to come.

Potato Flea Beetle.—This project, which is being supported wholly on state funds, has been in charge of Mr. L. B. Daniels who has been able to add materially to our knowledge of the life habits of this insect and its methods of control during the past year. The investigation will continue during the coming season.

Resistance of Bees to Foulbrood.—Mr. R. G. Richmond, who has been in charge of this project, considers it practically completed except for the assembling of his data and the publication of results.

Colorado Insect Fauna.—This project is in charge of Mr. Sam McCampbell, who has made good progress in accumulating additional data on Colorado insect fauna and related host plants.

Relation of the Honey Bee to Clover-Seed Production.—This project, in charge of Mr. R. G. Richmond, is supported cooperatively by Experiment Station and State Entomologist funds. It was started last summer, and already much important information has been secured. It seems probable that Mr. Richmond will be able to complete this investigation during the present summer.

Range Insects.—This is a new project to be supported on state funds. It has been placed in the hands of Mr. L. B. Daniels, and is for the purpose of determining the extent of insect injury to the more important native range areas in the state and the practicability of economic control.

General Insect Investigations.—This project is kept alive from year to year to enable the Entomology Section to meet any emergency that may arise unexpectedly for the control of an insect pest not included in the regular program. But little work was called for on this project the past year.

Rodent Life Histories.—This project is in charge of Mr. W. L. Burnett and has for its purpose the securing of additional data that may help in devising methods of control for injurious rodents. Fair progress has been made in this work during the year.

Rodent Poisoning.—Control of our most destructive rodents in Colorado is accomplished largely thru the use of food poisons. Mr. W. L. Burnett, who is in charge of this project, has obtained some very significant results in his experiments, especially in the use of "Colorado Formula 46," which were published in Press Bulletin 72 from the station.

The most important results were that prairie dogs and Wyoming ground squirrels, at least, are not repelled in the least by strychnine or other ingredients used in this formula, and that they eat the poisoned grain more freely than they do the unpoisoned when the two are placed side by side, even to the point of taking a fatal dose. This was true even when the poisoned grain was taken in less than fatal doses for many days before the lethal dosage was reached.

Respectfully submitted,
C. P. GILLETTE, Entomologist,

REPORT OF THE HOME ECONOMIST

To the Director:

The project underway during this year is one on the Baking of Flour Mixtures at High Altitudes.

The manuscript reporting on the technical work of the project is now in the hands of the printer.

During this fiscal year, the major part of the time has been spent in the preparation for the second phase of the project; the interpretation, from a physical chemistry standpoint, of technical results reported in the manuscript.

In preparation for this interpretative work, it was necessary to secure better control of all variables. The insulation of the laboratory, more accurate control of oven temperature, more uniform distribution of heat within the oven, and humidity control—these are some of the problems that have required much thought and time.

Early in April, Miss Florence Schott, leader in research, and Miss Margaret Scheve, were accorded laboratory privileges at the University of Minnesota. There they have access to scientific apparatus we are scarcely justified in purchasing.

Their studies include surface film, surface tension and foam behavior of constituents and combinations of constituents of cake mixtures.

Respectfully submitted,
INGA M. K. ALLISON, Home Economist.

REPORT OF THE HORTICULTURIST

To the Director:

I submit herewith a brief report on the work on the different horticultural projects. The report will necessarily be short since not much has been done on the project since the last report. However, a brief statement on each project will give you an idea of what is being done.

Spanish-Onion Breeding.—This work is carried on both at Fort Collins and at Rocky Ford. A number of crosses between the Valencia and the Brown Australian onions were made last year and the seed has been sown this spring from which selections will be made at the end of the season. Also, for 2 years we have been doing selection work with the Valencia onion, using a definite type, both as to shape and to color. Several thousand selected bulbs have already been planted and are doing well. The season has been very favorable for the seeding and for the setting out of the bulbs and we anticipate fine results during the season.

Development of Tipburn-resistant Varieties of Head Lettuce.—This work is carried on at Fort Collins. A number of crosses have been made between the variety known as New York, the common type of head lettuce, and the small-headed purple-leaved variety known as Mignonette. The results of these crosses, from the last 2 years' work, have given us a supply of seed that was planted this spring and the plants are now growing in the garden. There will be considerable work during the season in the way of selection and roguing out of undesirable types and the fixing of those crosses or hybrids that have proved acceptable. It is hoped that we shall be able to produce a variety or varieties that are tipburn resistant. It is a well-known fact that a variety like the Mignonette is highly resistant to this disease. This work is progressing very satisfactorily.

Potato-variety Testing and Improvement by Selection.—This project has been in progress for a number of years and will be continued. The work is done at Avon where conditions are favorable for this type of work. There is a wide variation in varieties and also in strains of each variety. We hope by careful study of the varieties collected and grown, as well as the strains, to bring out superior yielding varieties and varieties that are more resistant to disease.

Strawberry Investigation.—The work of this project has been in progress for the last 3 years. We have been having considerable difficulties with most of the varieties under observation for the reason of root yellows, a disease that is becoming very prevalent in Northern Colorado and is spreading to other sections. Some varieties seem to be more resistant than others. We are mainly concerned in selecting individuals that appear to be resistant, to propagate these for increase and to test them out in larger areas.

General Variety Testing of Tree Fruits.—This project is carried on at Austin in Delta County, Colorado. It is of long duration and the reason for its inception was the constant addition or additions of new varieties to our fruit list. Some of these individuals have commercial possibilities and in order to test them out and be in position to advise the growers, we have provided for space so that all new varieties can be

tested out and fruited and the desired information obtained. This work has been going on now for the last 6 years and some really promising varieties of fruit in the way of new varieties have been brought out. This work will be indefinitely extended and publications will be forthcoming when we have a sufficient number of kinds to report.

Grape Growing.—The grape-growing project on the Western Slope, especially with reference to European varieties, has also been in progress for 4 or 5 years. We have demonstrated that European grapes can be grown successfully in Western Colorado, provided proper care is given the vines and also proper protection during the winter. If these precautions are taken, most of the standard varieties of European grapes can be grown with profit. We should be in position to give definite information within a year or so.

Orchard Management.—The project of general orchard management, including cover crops, etc., has been carried on at Austin in connection with the work of the State Horticulturist. The results of this work have been very encouraging. The increase in production and increase in quality under a system of orchard management has been very noticeable. The fruit growers of Delta County are watching the work and are gradually adopting the method we are using. We expect to publish a bulletin on this work during the year.

Raspberry Investigations.—This project started 2 years ago, using varieties that we had in the garden and also by adding new varieties. There has been considerable controversy as to the present methods of pruning and thinning the canes of raspberries. The results, as tabulated during the winter months, show conclusively that pruning should not be excessive; that the number of canes to the hill should be reduced and possibly, instead of setting the plants in hills, they should be spaced individually in the row, giving a better chance for lateral growth of the canes. From the data obtained, we believe that a better system of handling raspberry plantations should be worked out and with better results to the growers. Preparation has been made to check on last year's work and to get a larger amount of data on which to base final conclusions.

This covers the main projects as outlined.

In addition, we have the variety testing and selection of garden peas, a project that we have been carrying for the past 3 or 4 years and we hope to reduce the number of varieties under observation and to increase the stock and make further selections. This work has been of considerable value in developing more productive and disease-resistant strains of peas, particularly varieties like the Dwarf Telephone.

Respectfully submitted,

E. P. SANDSTEN, Horticulturist.

REPORT OF THE IRRIGATION ENGINEER

To the Director:

During the year ending June 30, 1930, the following projects have been actively pursued:

Measurement of Water.—Since the development of the smaller sizes of the improved Venturi flume in the hydraulic laboratory, considerable interest in the use of larger flumes has been manifested. The performance of the 40-foot improved Venturi flume on the Fort Lyon Canal has been such as to fully verify the accuracy and constancy of this device in measuring large flows under adverse conditions of sand and silt carried in the streams.

Because of the practicability of the several large flumes in operation in the Arkansas Valley last year, others have since been constructed, mostly of reinforced concrete, while in the valley several other canals are to be equipped with this type of measuring device very shortly.

For previous large installations an automatic discharge indicating mechanism was provided, consisting of a graduated metel ribbon tape actuated by means of a float. To completely indicate the discharge thru the improved Venturi flume, two depths or heads, H_a and H_b, are required, and recently an instrument has been developed which records these two heads on a graduated chart by means of two pens, using different-colored inks; also incorporated in this instrument is a simple means of indicating the values of the heads, H_a and H_b in feet, as well as showing the rate of discharge in second-feet. The indicated rate of discharge is only true for condition of submergence not exceeding about 80 percent. Twelve such instruments are being built at the hydraulic laboratory and are being installed on a number of the large flumes now in commission in the Arkansas Valley.

The requirements of measuring flowing water have necessitated the design and calibration of a 3-inch improved Venturi flume. The 40-foot flume has a maximum capacity of more than 2,000 second-feet, while the small 3-inch size will accurately measure about 0.02 second-foot as a minimum. This great variation in range of discharge permits meeting practically all requirements from an irrigation standpoint.

The adjustable tube meter, which has been developed at the hydraulic laboratory, is to be installed in the Arkansas Valley on a small channel of flat grade having bad sand and silt conditions. Laboratory tests indicate that this device is well suited for the measurement of flowing water where little loss of head is available, and also where deposits in the channel are contending factors.

An extensive accumulation of current-meter data has been computed and compiled with the intention of preparing a report suitable for publication as a bulletin.

This project is supported by Hatch and State funds.

Pumping Projects.—The study of the relative costs of irrigation by pumping and that supplied as ditch or reservoir water made in Weld County during the summer of 1929, shows that under the more favorable conditions for pumping the cost per acre-foot of water delivered is practically on a par with the cost per acre-foot delivered by the ditch. A similar study is under way for the summer of 1930 in the Arkansas Valley near Fowler. It is not expected that the costs of water by pumping and that delivered by ditch for the present set-up will be as close in agreement as those found in Weld County last year.

Maps of various sections of the state have been prepared on a suitable scale, showing the location of existing wells used for irrigation supplies. Each well is numbered, and by reference to a filing card all pertinent information may be had as to any particular well, such as depth, diameter, probable yield, cost, and, where available, the log of material encountered.

Observations are being made on the possibilities of drainage by means of pumping on two farms near Eaton.

Evaporation from a Free Water Surface.—This project has been virtually closed. The excellent report by Carl Rohwer covering this extensive study has been completed and submitted for publication. This project was carried out cooperatively with government funds and the report is now being considered as a bulletin to be issued by the United States Department of Agriculture. In connection with this project, some special observations are being carried on the evapo-transpiration losses from blue grass and swamp grass grown in tanks with the water-table at 6, 12 and 18 inches. Fallow tanks are being maintained in each of these series and also two tanks having a free water surface. Meteorological data are observed in connection with this study.

Meteorology.—This project has been a continuing one for many years and is supported wholly on state funds. The meteorological data, observed each day at 7 a.m. and 7 p.m., constitute a very popular source of information. Unusual weather conditions bring many inquiries as to maximum and minimum temperatures, as well as intensities of storms. Daily temperature and precipitations are published in the local paper.

Project Work for the Coming Year.—It is expected that the present installation of large improved Venturi flumes in the Arkansas Valley and elsewhere in Colorado will provide facilities for the complete study of this subject. Observations on canals in the Arkansas Valley and other places in Colorado indicate the seriousness of the effect of sand and silt deposits from the standpoint of operation. Numerous methods are now employed in combating this menace which, in many cases, appear to be ineffective. The satisfactory solution of this problem is most urgent and it is especially recommended that attention be given to the study of this important matter.

To more ably recommend the proper location, depth and size of wells for irrigation supplies, some attention is now being given to the possibility of investigating the problem. In general, it is proposed to sink several wells of various depths and diameter, in a selected area, and then study the effect on yield and draw-down, as well as perforation of casing. From these data it is expected that more assurance can be placed on suggesting to the farmer the proper requirements of well and equipment in producing an efficient water supply.

Respectfully submitted,
RALPH L. PARSHALL, Irrigation Engineer.

REPORT OF THE VETERINARY PATHOLOGIST

To the Director:

Following is a brief report by projects of the work being carried by the Veterinary Pathology Section:

Sheep Losses in the Feedlots.—The unusual prevalence of coccidial dysentery has given us an opportunity to write up nine successive outbreaks, and submit this material for publication.

We have accumulated a considerable number of cultures from cases of pneumonia, which are waiting time for their determination.

The paper detailing the work on thallium poisoning in sheep will be published in the Journal of the American Veterinary Medical Association for June.

Death Losses in Lambs on Heavy Grain Feed.—We have carried 10 lambs in an attempt to reproduce the condition of over-eating, making weekly observations on the sugar content of both the blood and urine, but so far we have not succeeded in reproducing the typical condition.

Contagious Abortion.—A recent test on the college herd shows that it is still clean. After the re-infection of the range-management herd, it now seems to have been freed of all re-actors.

The herd at Fort Lyon still continues to give us trouble, but we have finally found an explanation of the reason for the perplexing conditions that have prevailed there during the last 3 years. Two animals in that time have aborted that have been negative at the end of the 30-day observation period, and have been returned to the clean herd, only to become positive at some later time. This seems to indicate that returning aborting animals to the clean herd, even tho they are negative, is a dangerous practice. Our experience in the college herd, where five negatively re-acting aborters were found, indicated that this was a safe procedure. Another problem that has been fraught with disaster in the Fort Lyon herd is the aborting of animals previously clean, and then becoming re-actors at the next test.

General.—There is an increasing demand for service work in the production of abortion-free herds in the state.

Because of the interest in undulant fever in man, we have, up to date, run blood tests on 30 patients, which have resulted in the finding of seven positive cases. All of these have been mature, the youngest being 19 years of age. Two out of the seven have been veterinarians. There has been one death.

Among poultry diseases, infectious bronchitis in baby chicks and leukemia in mature fowls ought to be mentioned as of unusual prevalence.

Tabulation of our diagnostic work done in the laboratory follows:

Avian	145	Feline	3
Bovine	33	Ovine	46
Canine	12	Swine	7
Equine	4	Rodents	5
Miscellaneous	51	Human	117
Milk for abortion test 2	2 Pos.	Water	2

Baby chicks examined for White Diarrhoea—131 lots, 79 positive

Examination for rabies 20 7 positive

Blood Tests

Contagious abortion	2,176	453 positive	20.81 percent positive
White Diarrhoea	4,592	342 positive	7.44 percent positive
Undulant Fever in man	15	5 positive	33.3 percent positive

Publications

"Coccidiosis in Cattle," by I. E. Newsom. Veterinary Medicine, Vol. XXIV, No. 10, October, 1929, pp. 429-431.

"Pathogenic Spore-Bearing Anaerobes in the Carcasses of Sheep," by I. E. Newsom, Floyd Cross and Herta S. Dobbins. Jr. of Inf. Dis., Vol. 45, No. 5, November, 1929, pp. 386-392.

"Sheep Diseases," by I. E. Newsom. Vet. Med., Vol. XXIV, No. 12, December, 1929, pp. 526-532.

"Paratyphoid Dysentery in Lambs Again," by I. E. Newsom and Floyd Cross. Jr. of the A. V. M. A., Vol. LXXVI, N. S. Vol. 29, No. 1, pp. 91-92.

Respectfully submitted,

I. E. NEWSOM, Veterinary Pathologist

ENGINEERING DIVISION

To the Director:

I am submitting herewith the reports from the Engineering Division of the experiment Station for the year ending June 1, 1930.

Very truly yours,
L D CRAIN, Vice Director

REPORT OF THE CIVIL ENGINEER

To the Vice Director:

Following is the annual report of the Civil Engineering Section of the Experiment Station and covers the work done by this section from June 1, 1929 to June 1, 1930.

Usually the heavy work in the Road Materials Laboratory comes during the summer time when much material is sent in by the State Highway Department to be tested. The summer of 1929 was no exception and the usual amount of testing work on road materials was done. Late in the fall, however, about 400 soil samples were sent in, together with a lot of oil samples, and this kept the force extremely busy all winter and spring of 1930.

This work is completed at this writing and we are ready for the concrete cylinders and aggregates which are now coming in and will continue to come in thruout the summer.

During the past year 1,737 concrete cylinders representing all bridges, pavement and culverts constructed by the state have been tested. It is interesting to note that a careful control of field mixes based on the results of tests made in this laboratory has increased the average strength of Colorado concrete pavements from 3098 pounds per square inch in 1926 to 3618 pounds per square inch in 1927, and 4023 pounds per square inch in 1928. These figures were compiled by Mr. Roy Randall, Office Engineer of the State Highway Department. This increase in strength of concrete in our highway pavements means lower maintenance costs and better wearing road surfaces for Colorado in years to come. The above cooperative work with the State Highway Department constitutes the bulk of the work done in the roads laboratory. There are, however, several experimental projects upon which data are being gathered.

No. 1. The Frost Heaving Project has been carried forward thruout the year. The changes in elevation of points on two concrete slabs are being recorded and periodic tests of moisture content of the subsoil taken. This work was started in December, 1928, and has now been carried thru two winters and one summer. We should be able to draw some tentative conclusions from this data by next spring.

No. 2. Pavement Cores and Subgrade.—During the summer of 1929 the State Highway Department continued to take core samples from Colorado concrete pavements and corresponding samples of subgrade on the Denver-Colorado Springs Highway. Two hundred and twelve cores and 423 samples of subgrade soil were sent in during the fall and were tested during the winter period. It is intended to write a summary of the results of these tests and the conclusions drawn, early next winter.

No. 3 Light Asphaltic Road Surfaces.—This is a new project which gives much promise of good results. It is intended to carry out, under field conditions, the construction of several miles of oiled graveled road and then watch the wearing qualities of this road, sections of which are to be treated with different oils. This summer six, half-mile sections of this kind of road will be constructed between Eaton and Nunn, Colorado. Each section to have the same subgrade and aggregate, the only variable being the oil to be used. From the wearing qualities of these sections will be picked two or three of the best oils. These selected oils will be used the following summer on another experimental road and the type of aggregate will be varied on the different sections. In this way we hope to find the best oils and the proper aggregate to use on oiled graveled roads for different sections of the state.

No. 4. Road Materials of Colorado.—Work on this project during the year has consisted of testing samples of surfacing materials and a smaller number of samples of concrete aggregate sent to the laboratory by resident engineers of the Highway Department.

No. 5. Road Oils.—Oiled gravel surfaces for all secondary roads in Colorado seem to solve the problem if properly constructed and maintained. This type of road has been very successful in several of our Western States. At the end of the summer of 1930 Colorado will have approximately 200 miles of this kind of road. During the past year 218 oil samples were tested in the laboratory as it is found that certain qualities of the oil are essential to successful wearing qualities of this type of highway.

A number of samples of Asphalt wearing surfaces for bridges have also been tested in the laboratory during the past year.

Taking it all together the year has been a busy one. We were unfortunate in having to change testing engineers during the year. Mr. Don Tripp resigned on September 1 to take a position with the Missouri State Highway Department and Mr. Carl Carpenter took up the work on October 1, 1929. A change of this kind always disrupts the work to a greater or less extent. Mr. Carpenter, however, has shown himself to be a capable man and after becoming acquainted with the nature of the work, has carried it on in a satisfactory manner.

The work has been done by himself and three student assistants,

altho it was necessary to put on an extra full-time man for about 6 weeks during the heavy testing period.

There is a good deal of drudgery connected with this work for it consists in making the same tests over and over again on different samples.

Altho the work piled up on us last fall and early winter, it is now all cleaned up and we are taking care of the tests as the samples come in, without delay.

Respectfully submitted,
E. B. HOUSE, Civil Engineer

REPORT OF THE MECHANICAL ENGINEER

To the Vice Director:

Following is the annual report from the Mechanical Engineering section of the Experiment Station for the year ending June 1, 1930.

The Mechanical Engineering Section has done no work during the past year due to the fact that Mr. Logan, who was the assistant in charge of the work, resigned to take a position at the Kansas State Agricultural College, and that a suitable successor has not been selected up to the present time.

The coming year we hope to do considerable work in the section as a man has been selected and if he is approved by the board, will be in charge of the work.

Respectfully submitted,
L D CRAIN, Mechanical Engineer

REPORT OF THE EDITOR

To the Director:

Less than the pro-rata number of bulletins were printed during the 7-month period, December 1, 1929, to July 1, 1930, probably because the main rush of publications usually comes at the close of the summer vacation. There were, however, 332 bulletin pages with a total edition of 26,000.

Approximately one-fourth of the news and information stories sent out from this office were about experiment station workers and activities. In addition to the newspapers of Colorado, we are now sending the "blue sheet" to about 185 farm and home magazines thruout this country and Canada. Inquiries from without the state, and especially returns from our clipping service, prove that this out-of-state circulation is decidedly worth while.

The editor had charge of the experiment station exhibit at the National Western Stock Show in Denver during January. Considerable new decorating had to be done.

Following are the publications issued during the 7 months:

Bul. 354—Some Factors Relating to the Feeding Habits of Grasshoppers. 53 pages. 1,500 copies.

Bul. 357—The Home Vegetable Garden. 45 pages. 5,000 copies.

Bul. 359—Ideal Types for Colorado Standard Potato Varieties. 23 pages. 5,000 copies.

Bul. 360—Pastures for Spring and Fall Grazing in Mountains of Colorado. 12 pages. 2,000 copies.

Bul. 361—The Cost of Local Government in Larimer County, Colorado. 84 pages. 4,000 copies.

Bul. 308 (Revision)—Adobe Brick for Farm Buildings. 30 pages. 3,000 copies.

Press Bul. 71—Corn and Hog Millet for Fattening Lambs. 6 pages. 2,500 copies.

Press Bul. 72—Action of Strychnine on Wyoming Ground Squirrels. 4 pages. 1,500 copies.

Forty-second Annual Report. 75 pages. 1,500 copies.

Respectfully submitted,

I. G. KINGHORN, Editor

REPORT OF THE VETERINARIAN

To the Director:

In the Veterinary Section there is but one project, that of Animal Diseases. This is a general project supported by state funds, and it contemplates incidental investigation of animal-disease outbreaks, and the cooperation with state and national authorities in their control.

Progress in the knowledge of diseases which afflict the domesticated animals is possible only by eternal vigilance and painstaking investigation. New disease conditions are constantly arising and must be met by adequate prophylactic and therapeutic measures.

In a general way livestock conditions in Colorado, from the standpoint of health, are normal at the present time. Just now the abortion disease of cattle is in the limelight. It has been stated, and is generally accepted, that contagious abortion in cattle is causing as much or even greater financial loss than tuberculosis. The progress made in the last 12 years in the control of tuberculosis marks an outstanding achievement in this line of endeavor.

Malignant Catarrhal Fever, which was troublesome during the early winter months has subsided. At the present time the diseases of animals that are of most economic importance may be summarized as follows: Contagious abortion in cattle; coccidiosis in several species of farm animals; paratyphoid conditions, especially of hogs; hog cholera; anemia of pigs; preparturient paralysis of ewes; chronic progressive pneumonia of sheep; white diarrhoea of chicks; blackhead disease of turkeys; lamb losses in the feed lots; poisonous plants.

Respectfully submitted,

GEORGE H. GLOVER, Veterinarian