Bulletin No. 198 - Report of the Director: For the 18-Month Period from January 1, 1925, to June 30, 1926
UTAH AGRICULTURAL EXPERIMENT STATION

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GEORGE B. CAINE, M. A. ................................ Dairy Husbandman
KENNETH C. IKELEVER, M. S. ............................. Animal Husbandman
H. J. PACK, Ph. D. ...................................... Entomologist
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A. F. BRACKEN, M. S. Assistant Agronomist and Supt. Nephi Substation
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WILLIAM H. WARNER, B. S. ............................... Assistant Poultr yman
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GEORGE Q. BATEMAN, B. S. ............................... Supt. Dairy Experimental Farm
JOHN W. CARLSON, B. S. ................................ Supt. Alfalfa-seed Experimental Farm, Uintah Basin
H. V. HALL, B. S. ....................................... Supt. Sheep Experimental Farm
BLANCHE C. PITTMAN, B. A. .............................. Publications and Library
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*On leave.
INTRODUCTION

In the following report of the Utah Agricultural Experiment Station for the past eighteen months, record has been made in as much detail as space would permit. The text is intended to give the present status of the projects under consideration and to record the changes and additions since the last report.

The Legislature of 1925 appropriated money sufficient to allow starting alfalfa-seed experimental farms in the Uintah Basin and in San Juan County. In the spring of 1925 these farms were chosen. A 40-acre tract on the main road one mile north of Fort Duchesne was chosen as the farm for work in the Uintah Basin. Arrangements were perfected by which the counties pay the rental for the land, and the entire amount of money appropriated by the Legislature is being used in starting the farm and in experimental research. A tract of 40 acres of land ten miles east of Monticello was chosen as the site of the experimental farm in San Juan County. An agreement was entered into by which San Juan County would pay the rental of the farm for a period of ten years so that the entire money appropriated by the Legislature in this case is devoted to research and development of the farm so much needed in that district.

*Session Laws of Utah (1925): "The fiscal year of the State of Utah shall commence on the first day of July of each year."
The Legislature of 1925 also provided a method of purchase for the 23.5 acres of land in Davis County which has been used as an experimental farm since 1920. The fences on the Davis County Experimental Farm have been removed and adjusted and the land leveled so that the entire tract is now fully functioning to solve the problems of truck gardeners of that district. A cottage should be built on this farm for the superintendent. This is a very much needed addition.

In the fiscal year beginning July 1, 1925, the Utah Experiment Station became the recipient of additional funds through the passage by Congress of what is called the Purnell Act. In the use of additional funds the following projects carried at the time have been enlarged and transferred from the funds under which they were formerly carried to acceptance under the Purnell provision:

Project No. 25—Ground-water Development.—The studies under this project include an attempt to map the entire state to show the areas where artesian water might be developed, where under-ground water might be developed for pumping either for irrigation or for culinary supply; where the flow of individual springs might be increased; where tunneling might promise new development in water-supply; and where it is possible to develop watering places to better the range. Special effort is to be given to determine the available supply by correlating the structure, rainfall, and area of the drainage basin. It is planned to determine, if possible, the maximum water available with definite protection to those who have expended large sums for water development.

Project No. 48—Range Survey.—The general purpose of this project, as outlined, is to (1) obtain general information on Utah's range resources and (2) to determine the relative importance of specific problems. The general plan includes a classification as to forage classes and types and their extent and location, natural units for seasonal use, adaptability of types to the different classes of livestock, land tenure with its effect on management of livestock, carrying capacity, and possible improvement.

Project No. 61—Range Reseeding.—In working out this problem the following objectives are to be kept in mind: (1) Selection of valuable forage species, (2) collection of seed, (3) experimentation with seed production, and (4) selection and planting of suitable test areas on the range. An effort will be made to locate isolated areas wholly or largely protected from grazing where seed might be collected in considerable quantity at small expense. It is planned to gradually
extend the local study to other areas of the state where additional valuable species are obtainable.

**Project No. 62—Cereal Breeding.**—In the past, improvement work under this project included only the following three heads: (1) Introduction and test of promising new varieties from any part of the earth; (2) individual plant-selection work in Sevier and Dicklow at Logan and Turkey and Kofod at Nephi; and (3) hybridization of Dicklow and Sevier to unite the good qualities of both into one new sort. With the addition of Purnell funds it will be possible to enlarge this project to include studies in oats, barley, and corn (and perhaps in rye). It is even hoped to produce sorts adapted to wet land, elevated, and possibly alkali land.

**Project No. 72—Relation of Stream Discharge to Precipitation with Special Reference to Forecasting the Supply of Water for Irrigation, etc.**—In the irrigation areas of our arid lands it is now considered as important to know what the natural storage of water for the season's supply is as if it were stored in a reservoir. Even banks are governing their loans for maturing crops on the water available from the mountains for the coming year. This project, as now outlined, will aim to solve these problems.

Certain new work which funds have never permitted the Station to undertake has been greatly demanded, so part of the very strenuous requests which have been demanded has been made possible under the Purnell measure. The following projects have been approved as research projects under this new provision:

- **Project No. 77**—Investigations in Sheep and Wool Management.
- **Project No. 78**—Injurious Effects on Livestock of Sugar-beets and their By-Products.
- **Project No. 79**—Influence of Cropping Systems on Production Costs.
- **Project No. 80**—Chalcis Fly in Alfalfa-seed.
- **Project No. 81**—Factors Affecting Penetration of Ultra Violet Rays of the Sun through Animal and Vegetable Fiber.
- **Project No. 82**—Investigations of the Sugar-beet Leafhopper.
- **Project No. 83**—Food Habits of Utah Farm Families.

These projects have not been fully financed and will require more money than is at present allotted as the research develops, but probably this can be taken care of by the increase in the Purnell funds during the coming years.

There are a few additional projects which must be taken care of, and it is hoped that next year might allow research

*In cooperation with U. S. Department of Agriculture and Idaho Agricultural Experiment Station.*
in the advantages of community living as compared with the isolated farm home and in the nutrition of livestock. The research projects which have been carried for sometime are greatly in need of either some additional equipment or enlargement.

Twenty-five years ago there was installed at the Central Experiment Farm at Greenville a battery of wooden flumes for research in irrigation projects. These flumes have outlasted their normal life by many years and are in such condition that at present it is with great concern whether or not the work being done is dependable. It is very urgent that these flumes be replaced by a new water system, preferably an underground pipe system.

The soil survey work in the state is progressing very slowly. A soil survey begun in Uintah County in May, 1920, was only partially completed because of lack of funds. In addition to this there is real demand for soil classification in Davis, Sevier, and Washington Counties. These cannot be undertaken at present unless more funds are available to undertake this very important work. Neither Adams nor Purnell funds from the government can be used for soil-survey work.

The work in plant diseases has proved to be a larger problem than our present force can completely cope with. This department should be enlarged in order to meet the demands which are constantly being made to help with the ravages of plant diseases.

The Experiment Station is doing some very important work in plant breeding. More land suitable for the carrying on of this work is absolutely necessary if the work is to continue. Provision should be made by which more good land should be made available around the Central Experiment Farm.

Future demands in feeding will necessitate proper facilities for feeding cattle and sheep. Feed grounds can be provided on the Experimental Sheep Farm, but it will be necessary to build new sheds and to install a water system to properly take care of this research.

Demand is constantly being made at the Experiment Station for data to guide in the use of commercial fertilizers. The time has come when it seems imperative that commercial fertilizers must be used. This has been forced by the fact that barnyard manure is not produced in sufficient quantities to take care of the fertilizer demands. Land that is to be used for fertilizer experiments can not ordinarily be returned for other type of research. Therefore, it is very necessary that a few tracts of land be provided for work in testing
of fertilizers. This should be made possible by the purchase of tracts of land in different localities and for different purposes, such as for farm crops, truck crops, and orchards.

A new tract of land is being developed from pumping water in the Escalante Desert. The development has gone far enough to indicate that a large tract of land will be brought under cultivation in this locality. Little is known regarding pump wells and type of irrigation needed in the Escalante Desert and the types of crops which might be grown economically. It would seem that one of the most desirable contributions the state could make would be the installation of an experimental and demonstrational farm to guide the new agriculture which is developing in the desert areas. It is hoped that funds might be provided to make this possible.

The storage room formerly provided for the records of the Experiment Station is too small and does not give ample protection to these records. It is urged that a new basement room be made in the Experiment Station Building which will allow for proper storage and protection of the records and expensive material which accumulates in research.

The increased projects made possible through the Purnell fund have also tremendously increased the work in the office. In the future, this will necessitate more office help so that the normal progress of the work is neither interfered with nor retarded.

Constant request comes to the Experiment Station for analysis of irrigation water, soils, and crop products. A portion of this has been done, but the demand has grown so large that the expense incurred will permit doing only a portion of what is asked. However, if the Experiment Station is to take on this work funds must be supplied or other work slighted.

In the following report an attempt has been made to include sufficient data regarding the work of the Utah Agricultural Experiment Station to give any one interested a comprehensive idea of what is being attempted and what progress is being made.

PERSONNEL

During the past 18-month period the following changes in Station Staff personnel have occurred:

Dr. George R. Hill, Dean of the School of Agriculture and Botanist of the Utah Experiment Station, resigned his position July 1, 1925, to become Agricultural Supervisor of the American Smelting and Refining Company at Salt Lake City. Dr. B. L. Richards, who has been Station Plant Pathologist
for a number of years, was appointed Botanist in Dr. Hill's position in addition to being Station Plant Pathologist.

Dr. W. E. Carroll was granted an additional year's leave of absence to continue his work at the University of Illinois. Upon Dr. Carroll's return to the station he will have charge of Animal Nutrition work.

Dr. E. B. Brossard, who had been on two years' leave of absence from the Station, resigned his position as State Farm Economist to become associated with the U. S. Tariff Commission. This resignation was effective July 1, 1925. Professor P. V. Cardon, who was a member of the Utah Agricultural Experiment Station Staff from 1909-13, was appointed Station Farm Economist, effective August 1, 1925.

Professor Gustav Wilster, in charge of Dairy Manufacture, resigned his position on the Station Staff September 1, 1925, to enter the commercial field.

Professor D. H. Nelson, Assistant Station Chemist, resigned from the Station Staff on September 1, 1925, to enter the teaching profession in one of the larger high schools of the state.

The following regular staff members, who had been granted sabbatical leave during the year 1924-25 for advanced study, returned to the Experiment Station:

- Dr. H. J. Frederick, Veterinarian.
- Dr. George Stewart, Agronomist.
- Dr. H. J. Pack, Associate Entomologist.
- Dr. (Dr. P. H.) E. G. Carter, Associate Bacteriologist.

In addition to those already mentioned, the following appointments were made during the year 1925-26:

- Charles J. Sorenson, Assistant Entomologist.
- Almeda P. Brown, Assistant in Home Economics.
- John W. Carlson, Superintendent of Uintah Basin Alfalfa-seed Experimental Farm.

**FARMS**

The Legislature of 1925 made a special appropriation for the establishing of experimental alfalfa-seed farms in the Uintah Basin and in San Juan County. These farms were located in the spring of 1925 and are now thoroughly established. The former is an irrigated farm and the latter is operated under dry-farm conditions. This makes a total of ten farms maintained and operated by the Utah Agricultural Experiment Station.
<table>
<thead>
<tr>
<th>Name of Farm</th>
<th>Postoffice</th>
<th>Location</th>
<th>No. of Acres</th>
<th>Remarks</th>
</tr>
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<tbody>
<tr>
<td>1. Central Station (Greenville)</td>
<td>Logan</td>
<td>2 Mi. north of campus</td>
<td>45</td>
<td>Irrigation, rotation, fertility, etc. Owned by the state. Established in 1901.</td>
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<tr>
<td>3. Davis Co. Exp. Farm</td>
<td>Farmington</td>
<td>Davis County</td>
<td>23.5</td>
<td>Truck-gardening. Bought by state in 1925.</td>
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<tr>
<td>4. Panguitch Livestock Farm</td>
<td>Panguitch</td>
<td>Garfield County</td>
<td>106</td>
<td>Livestock breeding (purebred). Owned by state.</td>
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<tr>
<td>5. Widtsoe (John’s Valley)</td>
<td>Widtsoe</td>
<td>Garfield County</td>
<td>40</td>
<td>Has been dry-farm; proposed to try irrigation. Given to state without cost as long as experimentation continues. Elevation, 7,800 feet.</td>
</tr>
<tr>
<td>6. Kanab</td>
<td>Kanab</td>
<td>Kane County</td>
<td>40</td>
<td>Dry-farm in extreme southern part of state. Given to state without cost as long as experimentation continues. Elevation, 5,800 feet.</td>
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<tr>
<td>8. Experimental Sheep Farm</td>
<td>Logan</td>
<td>1 Mi. north of campus</td>
<td>100.5</td>
<td>Leased from county for 10-year period (1924-34). Sheep and hogs. Also commercial fruit orchard of several acres included in farm.</td>
</tr>
<tr>
<td>10. San Juan Co. Farm</td>
<td>Monticello</td>
<td>San Juan County</td>
<td>40</td>
<td>Leased for 10-year period (1925-35). Dry-farm. Alfalfa-seed, forage, cereals, etc. Lease taken care of by San Juan County. Special appropriation from Legislature.</td>
</tr>
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</table>
PUBLICATIONS

The Utah Experiment Station publishes the results of its investigational and research work under three main headings: (1) Bulletins, (2) Circulars, and (3) Technical Articles, which appear in various scientific publications. In addition to these three general divisions, there are numerous popular articles written by the Station members throughout the year. During the past 18-month period a complete bibliography of bulletins, circulars, and technical articles by each Station Staff member has been compiled and printed.

The manner of distributing the three general divisions of Station publications was given in detail in the biennial report for 1923-24. (See Station Bulletin No. 192.)

In addition to the general distribution of each publication as issued, the Experiment Station maintains a classified mailing list of 9,272 names. This classification on June 30, 1926, was as follows:

I. Utah

<table>
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<th>Category</th>
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<tr>
<td>General</td>
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<td>Scientific</td>
<td>241</td>
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<td>Publishers and Editors</td>
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<td>Libraries</td>
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<tr>
<td>Miscellaneous</td>
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<td>Egg-laying Contest</td>
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<td><strong>Total for Utah</strong></td>
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II. States (Other than Utah)

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<tr>
<td>Scientific</td>
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<td>Publishers and Editors</td>
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<td><strong>Total for States (Other than Utah)</strong></td>
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III. Foreign

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IV. U. S. Department of Agriculture and State Experiment Station Workers

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<th>Names</th>
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</thead>
<tbody>
<tr>
<td>U. S. Department of Agriculture and State Experiment Station Workers</td>
<td>2935</td>
</tr>
<tr>
<td><strong>Grand Total of Names on Mailing List</strong></td>
<td><strong>9272</strong></td>
</tr>
</tbody>
</table>
During the past 18-month period special effort has been made to increase the number of names on the Utah General List. Lists of names by towns for each county were sent to the respective county agents with the request that this list be carefully checked and that all interested persons be added to the Station Mailing List. As a result, the Utah General List has been considerably augmented. Every effort is being made to serve the people of the state in the most efficient and expeditious manner.

In response to request made, more than 3500 lists of available publications have been mailed during the past 18-month period. In turn, the publications desired by the individuals making the request have been mailed from this office. In this way, many thousand bulletins and circulars have been distributed throughout Utah, the various states, and many foreign countries. Each year a count is made of the number of publications on hand on the general filing shelves.

Following is a summary of the bulletins and circulars issued by the Utah Experiment Station during the past eighteen months:

**Bulletin 192.—Biennial Report of Director, 1923-24, by William Peterson.**—About sixty different lines of investigation, ranging from experiments in sweet-cream butter-making to best methods of rotation and maintaining the fertility of the soil and including many other problems of major importance to the farmers of the state are reported in this publication. The bulletin reports the administrative, research, experimental, and other activities of the Station for the years 1923 and 1924. This is especially noteworthy since no such publication had been issued since 1906, when the last annual report (No.17) of the Experiment Station was published.

**Bulletin 193.—Cache County Water Conservation District No. 1, by William Peterson, George D. Clyde, D. S. Jennings, M. D. Thomas, and Karl Harris.* This bulletin reviews the possibilities and present status of the Cache County Water Conservation District No. 1, located in Cache County, Utah. In general, it is shown that (1) the area contains 7373.38 acres of land to which water is allotted; (2) the climate is well suited to the growing of such crops as alfalfa, grain,

*Graduate Student, Department of Agronomy.
sugar-beets, corn, beans, peas, and some truck crops; (3) the land has good surface drainage; (4) approximately 4200 acres of land in the tract can be irrigated with very little additional expense; (5) certain native plants growing in the district are an index to the presence of salt; and (6) the water supply of the district is ample.

Bulletin 194.—The Influence of Storage on the Composition of Flour, by J. E. Greaves and C. T. Hirst.—This publication reports the results of storing various grades of flour on which yearly analyses were made. The following results were noted: (1) Highly-milled flour made from sound wheat can be stored without deteriorating in dry rooms free from odors for at least four years. (2) Flours of poor grade and whole-wheat flours under the same conditions deteriorate during this period. (3) The moisture content of the flour as well as of wheat approaches a constant of 8 per cent. (4) The water-soluble phosphorus increases due to storage coming principally from the phospholipins of the flour. (5) The soluble carbohydrates increase, whereas the acidity decreased at first but later increased. (6) The rate and extent of increase varied with the flour; it was more rapid and greater in poor-grade flours than in high-grade flours. (7) The bread-making properties of flour increased for a time on keeping.

Bulletin 195.—Field Studies of Sugar-beet Nematode, by George Stewart and A. H. Bateman*.—Much of the data in this publication have been secured from the Amalgamated Sugar Company. A complete survey of the nematode in the sugar-beet growing districts has been given.

Bulletin 196.—Control of the Fruit Tree Leaf Roller by the Use of Oil Sprays, by I. M. Hawley.**—Complete descriptions and graphic illustrations of the insect in its different stages of development (egg, larva or caterpillar, pupa, and adult) are presented in this publication. The life history of the insect and a general discussion on methods of control of the fruit-tree leaf roller are also included.

Bulletin 197.—The Pear Leaf Blister Mite as an Apple Pest, by I. M. Hawley.—While the blister mite is of foreign origin, yet it has been prevalent in the United States for many years, occurring in Utah probably as early as 1898.

*Graduate Student, Department of Agronomy.
**Station Entomologist, July 1, 1921, to June 30, 1926.
During the last few years this pest has become abnormally abundant in some sections of Utah. At first this insect confined its activities to the pear only, but for the last twenty years it has also been found working on apple foliage. A very complete description of the blister mite, together with its life history, has been included in this publication.

Circular 54.—The More Important Insects Injurious to the Sugar-beet in Utah, by I. M. Hawley.—The insect pests of sugar-beets are considered under two main heads in this circular. In the first group are treated those insects that feed on the tops of foliage, while in the second group are placed those insects that feed on the roots of the beet. In the first group are included the sugar-beet leafhopper, sugar-beet webworm, sugar-beet armyworm, grasshoppers, beet leafminer, false chinch bug, flea-beetle, and blister-beetle. In the second group (those insects that feed on the roots of sugar-beets) are included the sugar-beet root aphid, sugar-beet root-maggot, white grub, and wireworm. Each insect is described in detail with a complete life history and methods of applying control measures.

Circular 55.—Rules and Regulations for Second Utah Intermountain Egg-laying Contest, by Byron Alder.—General information is given in regard to the second egg-laying contest held by the Poultry Department of the Utah Agricultural Experiment Station from November 1, 1925, up to and including October 30, 1926.

Circular 56.—Summary of Publications, by B. C. Pittman.—This circular of four pages includes a brief summary of the various publications issued by the Experiment Station between September, 1924, and September, 1925, inclusive.

Circular 57.—Economy in Harvesting Sugar-beets, by George Stewart.—This circular shows that great quantities of high-quality feed can be made as beet-top silage and also that heavy wastes during beet harvest may be avoided without great expenditure of labor or time.

Circular 58.—Potato Production in Utah, by George Stewart.—This circular is a revision of Utah Experiment Station Circular No. 40 published in 1919. This circular is of especial significance to potato growers of Utah. In addition to the general facts about potato culture, particular
attention has been given to the following problems: factors in production, preparation of the seedbed, varieties to plant, cultivation, irrigation, diseases and treatment, harvesting, grading, storage, and marketing.

Circular 59.—Control of Stinking Smut of Wheat with Copper Carbonate, by B. L. Richards and A. F. Bracken.—The importance of treating wheat before planting cannot be over-emphasized, and it was with this in mind that this circular has been written.

Circular 60.—Seed Potato Treatment, by B. L. Richards.—This publication includes treatment for the four common surface tuber-borne potato diseases—Rhizoctonia (stem canker), scab, blackleg, and dry-rot. The control measures include (1) corrosive sublimate treatment, (2) cold formaldehyde treatment, and (3) improved or hot formaldehyde treatment. The equipment for treating and precautions to be observed with corrosive sublimate are carefully considered. Both the advantages to be derived from and the precautions to be observed in the use of the hot formaldehyde method are given consideration.

Circular 61.—Rules and Regulations for the Third Utah Intermountain Egg-laying Contest, by Byron Alder.—This circular contains necessary information for entering the third egg-laying contest of the Utah Agricultural Experiment Station from November 1, 1926, up to and including October 30, 1927.
Specific data regarding number of each publication ordered as well as printing costs, etc., follow:

<table>
<thead>
<tr>
<th>No.</th>
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<th>No. Ord.</th>
<th>No. Pages</th>
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<tr>
<td>192</td>
<td>Biennial Report of Director, 1923-24</td>
<td>10,000</td>
<td>64 $</td>
<td>717.32</td>
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<tr>
<td>193</td>
<td>Cache County Water Conservation, District No. 1</td>
<td>5,000</td>
<td>48 329.50</td>
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<tr>
<td>194</td>
<td>The Influence of Storage on the Composition of Flour</td>
<td>4,500</td>
<td>22 162.68</td>
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<td>195</td>
<td>Field Studies of Sugar-beet Nematode</td>
<td>3,500</td>
<td>32 190.17</td>
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<td>196</td>
<td>The Fruit Tree Leaf Roller and Its Control by Oil Sprays</td>
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<td>The More Important Insects Injurious to Sugar-beets in Utah</td>
<td>10,000</td>
<td>48 $</td>
<td>549.41</td>
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<td>55</td>
<td>Rules and Regulations for Second Utah Intermountain Egg-laying Contest</td>
<td>2,500</td>
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<td>Summary of Publications</td>
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<td>Economy in Harvesting Sugar Beets</td>
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<td>58</td>
<td>Potato Production in Utah</td>
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<td>59</td>
<td>Control of Stinking Smut of Wheat with Copper Carbonate</td>
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<td><strong>The Influence of Manure and Irrigation Water on the Carbon, Phosphorus, Calcium and Magnesium of the Soil.</strong> By C. T. Hirst and J. E. Greaves. <em>In</em> SOIL SCIENCE, Vol. 19, No. 27, pp. 87-97.</td>
<td>400</td>
<td>11</td>
<td>$ 21.78</td>
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<td><strong>Effect of Dry Heat on Alfalfa Seed and Its Adulterants.</strong> By E. V. Staker. <em>In</em> JOUR. AMER. SOC. AGRON., Vol. 17, No. 1, pp. 32-40</td>
<td>100</td>
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<td>5.20</td>
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<td><strong>Land Policy for Public Domain.</strong> By George Stewart. <em>In</em> ECONOMIC GEOGRAPHY, Vol. 1, pp. 90-106.</td>
<td>150</td>
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<td><strong>Losses in Harvesting and Threshing.</strong> By A. F. Bracken. <em>In</em> JOUR. AMER. SOC. AGRON., Vol. 17, No. 8, pp. 508-514.</td>
<td>250</td>
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<td><strong>The Effect of Sulfur on the Microflora of the Soil.</strong> By J. M. Fife. <em>In</em> SOIL SCIENCE. Vol. 21, No. 4, pp. 245-252.</td>
<td>175</td>
<td>8</td>
<td>4.53</td>
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<tr>
<td><strong>Key to the Cultivated Wheat Varieties of France.</strong> By George Stewart. <em>In</em> JOUR. AMER. SOC. AGRON., Vol. 17, No. 11, pp. 741-747.</td>
<td>300</td>
<td>7</td>
<td>15.28</td>
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<td><strong>Moisture Equivalent of Soils.</strong> By M. D. Thomas and Karl Harris*. <em>In</em> SOIL SCIENCE, Vol. 21, No. 6 (June, 1926), pp. 411-424.</td>
<td>175</td>
<td>13</td>
<td>8.20</td>
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<td><em>Alfalfa-Growing in the United States and Canada.</em>** By George Stewart. Published by Macmillan Publishing Co. (New York), (March, 1925).</td>
<td>517</td>
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<td><strong>Bacteria in Relation to Soil Fertility.</strong> By J. E. Greaves and Ethelyn O. Greaves. Published by D. Van Nostrand Co. (New York), (1925).</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>2,750</strong></td>
<td><strong>883</strong></td>
<td><strong>$ 259.40</strong></td>
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*Graduate Student, Department of Agronomy.

(B. C. Pittman, In Charge Publications.)
LIBRARY

No. Bound Volumes ...................... 3702
Accessions during 18-month Period ........ 404
  Purchased ......................... 10
  Obtained by Gift or Exchange .... 66
  Bound by Station ............... 328
Volumes complete, ready for binding .... 155
Journals subscribed for .............. 26
Agricultural Papers Received .......... 225
  (Exchange for Bulletins.)

(B. C. Pittman, Librarian.)

LIST OF ACTIVE PROJECTS

The following list in tabular form indicates the active projects carried on during the past eighteen months together with the fund supporting each project as well as the department and the leader or leaders.

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Department</th>
<th>Leader or Leaders</th>
<th>Fund</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nephi Dry-farm Substation</td>
<td>Agronomy</td>
<td>Bracken</td>
<td>State</td>
</tr>
<tr>
<td></td>
<td>A. Cereal Breeding</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
|     | B. Plowing and C  
<p>|     |   tural Tests               |            |                   |      |
|     | C. Cropping Experiments      |            |                   |      |
|     | D. Fertility Tests           |            |                   |      |
|     | E. Varietal Tests            |            |                   |      |
|     | F. Forage Crop Tests         |            |                   |      |
|     | G. Miscellaneous Tests (7)   |            |                   |      |
| 2   | Other Dry-farm Stations      | Agronomy   | Stewart           | State|
|     | A. Widtsoe (7,800 feet)      |            |                   |      |
|     | B. Kanab                     |            |                   |      |
| 3   | Irrigation Practice          | Agronomy   | Pittman           | State|
| 4   | Tank Experiments on Soil Moisture | Agronomy  | Pittman           | State|
| 5   | Moisture, Soil, and Crop Relations | Agronomy  | Pittman           | State|
| 8   | Potato Breeding              | Agronomy   | Stewart           | State|
| 9   | Rotation and Fertility Tests | Agronomy   | Pittman           | State|
| 10  | Miscellaneous Field Studies  | Agronomy   | Stewart           | State|</p>
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
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<th>Fund</th>
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<tr>
<td>11</td>
<td>Action of Alkali</td>
<td>Soils</td>
<td>Thomas and Jennings</td>
<td>Adams</td>
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<tr>
<td>12</td>
<td>Soil Moisture Studies</td>
<td>Soils</td>
<td>Thomas and Jennings</td>
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<tr>
<td>15</td>
<td>Pumping for Irrigation</td>
<td>Irrigation and Drainage</td>
<td>Winsor</td>
<td>State</td>
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<tr>
<td>17</td>
<td>Fundamental Soil Moisture Constants</td>
<td>Physics and Irrigation</td>
<td>Gardner and Israelsen</td>
<td>Adams</td>
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<td>17e</td>
<td>Relative Elevations of the Water Table and</td>
<td>Irrigation and Physics</td>
<td>Israelsen and Gardner</td>
<td>Adams</td>
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<td></td>
<td>the Plane of Saturation in Fine-textured Soils</td>
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<tr>
<td>20</td>
<td>Hog Rations</td>
<td>Animal Husbandry</td>
<td>Carroll</td>
<td>Adams</td>
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<td>22</td>
<td>Factors Influencing Bacterial Activities of the Soil</td>
<td>Chemistry and Bacteriology</td>
<td>Greaves</td>
<td>Adams</td>
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<td>23</td>
<td>Permanent Fertility Studies</td>
<td>Chemistry and Bacteriology</td>
<td>Greaves</td>
<td>Adams</td>
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<td>25</td>
<td>Ground-water Development</td>
<td>Geology</td>
<td>Peterson</td>
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<td>31</td>
<td>Potato Diseases</td>
<td>Plant Pathology</td>
<td>Richards</td>
<td>Adams</td>
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<td>33</td>
<td>Canning Crop Diseases</td>
<td>Plant Pathology</td>
<td>Richards</td>
<td>Hatch</td>
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<td>Plant Disease Survey</td>
<td>Plant Pathology</td>
<td>Richards</td>
<td>Hatch</td>
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<td>Breeding for Egg Production</td>
<td>Poultry</td>
<td>Alder</td>
<td>Hatch</td>
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<td>Time of Hatching and Its Effect on Production</td>
<td>Poultry</td>
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<td>Canning Crops</td>
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<td>Abell</td>
<td>Hatch</td>
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<td>Grain Varieties</td>
<td>Agronomy</td>
<td>Stewart</td>
<td>State</td>
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<td>48</td>
<td>Range Survey</td>
<td>Range Mgt. Entomology</td>
<td>Becraft</td>
<td>Purnell</td>
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<td>51</td>
<td>Miscellaneous Insects</td>
<td>Human Nutrition</td>
<td>Hawley</td>
<td>Hatch</td>
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<td>52</td>
<td>Nutrition of Infants</td>
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<td>Alder</td>
<td>Hatch</td>
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<td>Poultry Feeding</td>
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<td>Wilson</td>
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<td>Range Reseeding</td>
<td>Range Mgt.</td>
<td>Becraft</td>
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<td>Cereal Breeding</td>
<td>Agronomy</td>
<td>Stewart</td>
<td>State</td>
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<td>Cultural Methods</td>
<td>Agronomy</td>
<td>Pittman</td>
<td>State</td>
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<td>65</td>
<td>Weed Control</td>
<td>Agronomy</td>
<td>Stewart</td>
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<td>Panguitch Livestock Farm</td>
<td>Animal Husbandry</td>
<td>Bateman (J. R.)</td>
<td>State</td>
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*In cooperation with U. S. D. A.*
<table>
<thead>
<tr>
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<td>67</td>
<td>Changes Occurring in Food During Storage</td>
<td>Chemistry and Bacteriology</td>
<td>Greaves and Hirst</td>
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<td>A. Flour</td>
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<td></td>
<td>B. Potatoes, Cabbage and Carrots</td>
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<td>72</td>
<td>Relationship of Stream Discharge to Precipitation with Special Reference to Forecasting the Supply of Water for Irrigation from Seasonal Surveys of Snow Cover on Mountain Sheds</td>
<td>Irrigation and Drainage</td>
<td>Clyde</td>
<td>Purnell</td>
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<td>Production Costs in Dairying</td>
<td>Dairying</td>
<td>Bateman (G. Q.)</td>
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<td>74</td>
<td>Egg-laying Contest</td>
<td>Poultry</td>
<td>Alder</td>
<td>State</td>
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<td>Alfalfa-seed Experiment Stations</td>
<td>Agronomy</td>
<td>Carlson</td>
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<td>A. Uintah Basin (irrigated)</td>
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<td>Bracken</td>
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<td></td>
<td>B. San Juan Co. (dry-farm)</td>
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<td>Investigations in Sheep and Wool Management</td>
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<td>Esplin</td>
<td>Purnell</td>
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<td>78</td>
<td>Injurious Effects of Sugar-beets and Their By-products as Feed</td>
<td>Veterinary Science and Chemistry and Bacteriology</td>
<td>Frederick and Greaves</td>
<td>Purnell</td>
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<td>Influence of Cropping Systems on Production Costs</td>
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<td>Chalads Fly in Alfalfa-seed</td>
<td>Entomology Home Economics</td>
<td>Sorenson</td>
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<td>81</td>
<td>Factors Affecting Penetration of Ultra Violet Rays of the Sun through Animal and Vegetable Fiber</td>
<td>Entomology Home Economics</td>
<td>Dozier</td>
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<td>Investigations of Sugar-beet Leaf-hopper</td>
<td>Entomology</td>
<td>Knowlton</td>
<td>Purnell</td>
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<td>83</td>
<td>Food Habits of Utah Farm Families</td>
<td>Home Economics</td>
<td>Brown</td>
<td>Purnell</td>
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<tr>
<td>86</td>
<td>Orchard Management A. Apple Thinning</td>
<td>Horticulture</td>
<td>Abell</td>
<td>Hatch</td>
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<td></td>
<td>B. Apple Harvesting Equipment</td>
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<td>87</td>
<td>Miscellaneous Investigations in Veterinary Science</td>
<td>Veterinary Science</td>
<td>Frederick</td>
<td>State</td>
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</table>

*In cooperation with U. S. D. A.

**In cooperation with U. S. D. A. and Idaho Agricultural Experiment Station.
PROJECTS STARTED SINCE JANUARY 1, 1925.

The following projects have been added to the list of active projects since January 1, 1925:

75. Alfalfa-seed Experimental Farms
   A. Uintah Basin (irrigated)
   B. San Juan County (dry-farm)

77. Investigations in Sheep and Wool Management

78. Injurious Effects of Sugar-beets and Their By-Products

79. Influence of Cropping Systems on Production Costs

80. Chalcis Fly in Alfalfa-seed

81. Factors Affecting Penetration of Ultra Violet Rays of the Sun through Animal and Vegetable Fiber

*82. Investigation of Sugar-beet Leafhopper.

83. Food Habits of Utah Farm Families

86. Orchard Management
   A. Apple Thinning
   B. Apple Harvesting Equipment

87. Miscellaneous Investigations in Veterinary Science
   A. Diseases among Animals
   B. Poisonous Plants on the Range

REPORTS OF PROJECTS BY DEPARTMENTS

A brief report of the progress of each active project carried during the past 18-month period is given herewith. Those directly in charge of the individual projects, in accord­ance with the usual custom, have submitted their own reports.

AGRONOMY

Project No. 1.—Nephi Dry-farm Substation.—This project, which is carried on at Nephi, is divided into the following divisions, each a complete project by itself:

(1) Cereal Breeding.—This project includes a study of pureline wheat selections and hybridized strains. Yield tests under plat conditions will be secured from crosses between Turkey and Kofod and Ghirka Winter and Kanred in 1926.

*In cooperation with U. S. Department of Agriculture and Idaho Agricultural Experiment Station.
Row tests of pureline Turkeys and Kofods, in 1925, showed a few outstanding high-yielding strains. (Stewart, G. and Bracken, A. F.)

(2) Plowing and Cultural Tests.—The 1925 yields of this test showed no difference between fall and early spring plowing. Later spring plowings, however, showed marked decreases in yield. The test also showed that in depth of plowing five inches is too shallow and ten inches a maximum. Seven to eight inches seems to be the depth at which the highest net returns are secured. (Bracken, A. F.)

(3) Cropping Systems Experiment.—The yields in 1925 from this test indicate that alternate fallow and crop is the safest and most efficient practice when compared with continuous cropping, two crops and one fallow, and one crop with two years of fallow. (Bracken, A. F.)

(4) Fertility Tests.—This experiment is divided into the following divisions:

A. Barnyard Manure Test.—The wheat yields from the 1925 harvest showed a gradual increase in yields as the amount of manure increased. In the alternate test, the 10-ton application gave an average yield of 49.6 bushels to an acre, while the check gave a yield of 31.6 bushels.

B. Green Manure.—In the green-manure test with wheat and peas plowed under at various stages of growth, each advanced stage of wheat showed decreases in the following yield of this cereal. With peas, the following yields of wheat showed slight increases up to the time when the peas were in the bloom stage.

C. Stubble Disposal.—In this test burning of all or part of the stubble showed small increase in yield of wheat when compared to plowing under similar amounts unburned. (Bracken, A. F. and Stewart, G.)

(5) Varietal Tests.—Of the spring wheats, Early Baart gave an average yield of 31 bushels which was the highest for wheats spring-sown. Sevier No. 59 was high for fall-sown wheats followed very closely by Kanred, Black Hull, and Turkey No. 26. Bulgarian winter barley ranked first of the barleys sown. (Bracken, A. F.)

(6) Miscellaneous Tests.—This main project is further subdivided into the following:
A. Rate and Date of Seeding Winter Wheat.—The rate and date of seeding Turkey wheat, extending from 2 to 8 pecks, inclusive, sown on August first and every 15 days thereafter until November first, indicated that in this territory no less than 5 pecks of grain should be sown not later than October. (Bracken, A. F. and Stewart, G.)

B. Cultivation of Growing Wheat.—In this test wheat was spaced 14, 21, 27, and 35 inches apart. Ordinary sowing with rows 7 inches apart was used for check. One series of replications was cultivated, the other left uncultivated. Ordinary drilling gave higher yields than land on which the rows were spaced farther apart, and in most cases cultivation decreased yields. (Bracken, A. F.)

C. Smut-Control Test.—In this test formalin, copper sulphate, and copper carbonate were used for treating smutted grain. In addition, a smutted sample untreated was sown for check. Formalin and copper sulphate were both slightly more efficient in controlling smut than copper carbonate. In the yield test in which no treatment, copper carbonate, copper sulphate, and formalin were compared no significant differences were shown since the wheat emerged soon after drilling. (Bracken, A. F.)

D. Nitrate and Moisture Studies.—Several plats in the tillage test, cropping experiment, barnyard manure tests, and green manure test are included. Samples are taken every six weeks over the spring, summer, and fall. Nitrate accumulation has been found to be directly correlated with moisture content of the soil. Any tillage which tends to conserve moisture, such as fall plowing or early spring plowing followed by normal tillage, stimulates nitrate accumulation. Wheat as a green manure depresses nitrate formation. Application of barnyard manure greatly stimulates nitrate accumulation. (Bracken, A. F.)

E. Delayed Harvesting as Affecting Quality of Hard Red Wheats.—Wheat was cut as soon as ripe and at intervals of ten days over a period of two months. The weight per bushel decreased from 61 to 57 pounds, but there was no change in the amount of gluten, loaf volume, and quality of bread from the delayed cuttings. (Bracken, A. F.)

Project No. 2.—Dry-farms Other than Nephi.—Various varieties of grain have been tested for yield on the dry-farm at Widtsoe. Colsess barley has done best of the barleys, and Turkey and Early Baart of the wheats. Counting year after year, rye is
among the most consistent yielders of the grains. Sweet clover is being grown in 1926 as well as the grains. Part of the farm is now being irrigated, and tests continued with grains partially watered. (Stewart, G.)

**Project No. 3.—Irrigation Practice.**—This project has been continued according to the revised plans of 1922. Previous work on this project has fairly well established the average optimum amount and distribution of irrigation water for the more common farm crops under the conditions of this experiment. They are as follows:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Optimum Amount in Water</th>
<th>Optimum Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Grains</td>
<td>15-20 inches</td>
<td>Early in season, beginning when plant has 5 leaves; frequent small irrigations more efficient.</td>
</tr>
<tr>
<td>Sugar-beets and Potatoes</td>
<td>20-25 inches</td>
<td>Uniform soil moisture throughout season; frequent small irrigations more efficient.</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Maximum</td>
<td>Distribution throughout growing season made little difference in yield.</td>
</tr>
</tbody>
</table>

In the reorganized experiment the crops are grown in rotation with sufficient manure to maintain a good normal fertility.

The results with alfalfa in this experiment are exceptional in that it is very difficult to apply enough water to reduce the yield. The 1925 yields on the excessive irrigation plats are as follows:

<table>
<thead>
<tr>
<th>Irrigation</th>
<th>Average Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 inch</td>
<td>6.47 tons an acre</td>
</tr>
<tr>
<td>25 inches</td>
<td>6.03 tons an acre</td>
</tr>
<tr>
<td>70 inches</td>
<td>6.88 tons an acre</td>
</tr>
<tr>
<td>105 inches</td>
<td>6.53 tons an acre</td>
</tr>
</tbody>
</table>

The rainy summer of 1925 seemed to make high irrigation unnecessary. A probable explanation of the failure of excessive irrigation to reduce yields in this experiment is the unusual depth and drainage of the soil. The water-table is permanent at 100 feet below the surface, and the material from 50 feet down to this depth is a very coarse gravel. With more than about 15 inches of irrigation, fertility seems to be more important in determining alfalfa yields than irrigation. Some of the plats that have been manured for 20 years previous to sowing to alfalfa have yielded annually 9 to 10 tons of hay
an acre with only three irrigations of about 5 inches each, and the first crop for 1926 has reached 5 tons an acre.

The yield of sugar-beets with different irrigations for 1925 was:

3 irrigations .................. 21.73 tons an acre
4 irrigations .................. 23.59 tons an acre
5 irrigations .................. 21.48 tons an acre
6 irrigations .................. 20.23 tons an acre
7 irrigations .................. 17.54 tons an acre

The yield of potatoes with different irrigation treatments was:

2 irrigations .................. 321 bushels an acre
3 irrigations .................. 330 bushels an acre
4 irrigations .................. 313 bushels an acre
5 irrigations .................. 286 bushels an acre
6 irrigations .................. 278 bushels an acre
7 irrigations .................. 141 bushels an acre

These maxima are in about the average position, though they vary considerably from year to year. The heavier irrigations not only reduce the yield but reduce the quality of the potatoes. The yield of beets and potatoes is more closely correlated to the size of the individual roots and tubers than to the number per acre or per hill. An attempt is being made (so far unsuccessful) to correlate the position of the maximum yield with some climatic or other factor.

The yield of Admiral peas in 1925 was:

Irrigated medium
early .................. 4039 lbs. (1st-grade) peas per acre
Irrigation withheld till nearly harvest ........ 5586 lbs. (1st-grade) peas per acre

The unusually heavy June precipitation may explain this result. With the Alaska peas used previously early irrigations gave best results.

Dicklow wheat with three irrigations in 1925 yielded 64.5 bushels an acre as compared with 62.3 bushels an acre for two irrigations, which is about the average increase. (Pittman, D. W. and Stewart, George.)

Project No. 4.—Tank Experiments on Soil Moisture.—A tank experiment on the growth of wheat in soil maintained
at different moisture contents at different periods of growth was conducted. The results are as follows:

<table>
<thead>
<tr>
<th>Soil</th>
<th>1st Period</th>
<th>2d Period</th>
<th>3d Period</th>
<th>Yield Grain</th>
<th>Yield Straw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>Dry Dry</td>
<td>Dry Wet</td>
<td>Dry Never</td>
<td>16</td>
<td>90</td>
</tr>
<tr>
<td>Soil</td>
<td>Wet Dry</td>
<td>Wet Dry</td>
<td>Wet Dry</td>
<td>20</td>
<td>99</td>
</tr>
<tr>
<td>Soil</td>
<td>Wet Wet</td>
<td>Wet Wet</td>
<td>Wet</td>
<td>27</td>
<td>85</td>
</tr>
<tr>
<td>Soil</td>
<td>Dry Wet</td>
<td>Wet Wet</td>
<td>Wet</td>
<td>24</td>
<td>125</td>
</tr>
<tr>
<td>Soil</td>
<td>Wet Wet</td>
<td>Wet Wet</td>
<td>Wet</td>
<td>25</td>
<td>122</td>
</tr>
</tbody>
</table>

These results show a serious retardation when the soil is maintained dry and then watered heavily when the grain is headed out. (Pittman, D. W.)

**Project No. 5.—Irrigation and Manuring Studies with Corn.**—This project has been continued as previously—growing corn continuously on plats with different amounts of manure. The results of 13 years' work were summarized in Utah Station Bulletin No. 188, showing a maximum yield with 20 inches of irrigation water and 15 tons of manure a year (the most used). They also show that manure will somewhat lessen the loss due to either insufficient or excessive irrigation and that optimum irrigation water is especially needed where manure is insufficient. Because of the number of years' data, the curves obtained for the yields were unusually smooth and conclusive. The results showing the yield of ear corn for 1925 are as follows:

<table>
<thead>
<tr>
<th>Irrigation Treatment</th>
<th>Manure Applied (Tons)</th>
<th>None</th>
<th>5</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 inch</td>
<td>54</td>
<td>57</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>5 inches</td>
<td>40</td>
<td>56</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>10 inches</td>
<td>55</td>
<td>57</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>20 inches</td>
<td>59</td>
<td>63</td>
<td>66</td>
<td></td>
</tr>
<tr>
<td>30 inches</td>
<td>59</td>
<td>67</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>40 inches</td>
<td>62</td>
<td>62</td>
<td>72</td>
<td></td>
</tr>
</tbody>
</table>

These figures will not noticeably affect the average of the last 14 years. (Pittman, D. W.)

**Project No. 8.—Potato Breeding.**—In 1925, the hill-selection work was continued. All evidence points strongly to the conclusion that in Cache Valley with Rural potatoes, mosaic and other diseases can be outrun by hill selection. Progeny rows
of selected hills were planted with check rows included at frequent intervals. All the checks for several years have had mosaic; nevertheless, the selected rows have maintained good high yields.

Altogether, there was about an acre of selected strains which averaged 563 bushels an acre, whereas the included checks yielded on the average 295.7 bushels an acre.

The selected strains were about 95 per cent marketable as compared with about 85 per cent for the unselected.

A few of the best strains yielded at the rate of more than a thousand bushels to the acre. Some were entirely infected and gave low yields.

In 1926, only a part of the experimental series is being continued, since it seems as if this phase of the problem is solved. (Stewart, G.)

Project No. 9.—Rotation and Fertility Tests.—This project is being continued according to the revised and enlarged plans of 1922, including several different systems to restore the fertility to a rather worn-out soil. It included six different rotations and a number of plats continuously cropped to each crop for comparison. The rotations represent four different types of soil-restoring crops, annual legumes, biennial legumes, perennial legumes and non-legumes. The results of the work previous to 1922 have been published in Station Bulletin No. 188, “Maintaining the Productivity of Irrigated Soils.” They show the great importance of manure for the cultivated crops and of rotation for the small grains.

The later results seem to be indicating that the annual or biennial legumes cannot compete with alfalfa as soil improves, that alfalfa responds marvelously well to manuring, and that green manure as used in these experiments may produce an immediate depressing effect on the yield of the subsequent crop with ultimate general soil improvement but much less notably than barnyard manure.

The 1925 beet yields were the largest yet secured. Some of the results are:
The effect of manure is outstanding, while rotation seems to be of little or no advantage to manured sugar-beets as long as there is no nematode present. In 1926 nematode was noticed for the first time on the plats. It is bad on the continuous beet plat receiving 10 tons of manure and tests show the plat receiving 30 tons of manure (one of those in continuous beets without manure) to be infected. The crop on these plats must be changed to eliminate this.

The results with other crops are:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Average Yield Unmanured</th>
<th>Average Yield, Manured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>6.35 tons</td>
<td>8.35 tons per acre</td>
</tr>
<tr>
<td>Potatoes</td>
<td>206 bushels</td>
<td>256 bushels per acre</td>
</tr>
<tr>
<td>Wheat continuous</td>
<td>14 bushels</td>
<td>24 bushels per acre</td>
</tr>
<tr>
<td>Oats continuous</td>
<td>37 bushels</td>
<td>92 bushels per acre</td>
</tr>
<tr>
<td>Oats in rotation</td>
<td>87 bushels</td>
<td>114 bushels per acre</td>
</tr>
<tr>
<td>Wheat in rotation</td>
<td>43 bushels</td>
<td>53 bushels per acre</td>
</tr>
</tbody>
</table>

Preliminary experiments in the greenhouse show a response to nitrogenous fertilizers but not to phosphorus nor potassium in this soil.

The plot of land set aside for future fertilizer experiments is still being tested for uniformity. The plats are far from uniform in crop-producing power but are maintaining their positions relative to each other quite consistently. The more infertile plats are more uniform among themselves than those showing fair fertility.

A preliminary test of the patent reagent for making manure out of straw has been unsuccessful so far. (Pittman, D. W.)
Project No. 10.—Miscellaneous Field Studies.—In 1925, ten strains of silage corn were grown at the Davis County Experimental Farm. The yields obtained confirm previous data, which indicated that by seeding two weeks earlier than for grain-corn, larger varieties could be used. The relative yields are given in the following table:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Acre-Yield</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Learning (check)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Boone County White</td>
<td>171</td>
<td>129</td>
</tr>
<tr>
<td>Pussey Cloud</td>
<td>132</td>
<td>122</td>
</tr>
<tr>
<td>U. S. D. A. No. 182</td>
<td>154</td>
<td>127</td>
</tr>
<tr>
<td>Lancaster</td>
<td>84</td>
<td>106</td>
</tr>
<tr>
<td>Red Cob</td>
<td>179</td>
<td>146 (soft)</td>
</tr>
<tr>
<td>Orange County Prolific</td>
<td>159</td>
<td>151</td>
</tr>
<tr>
<td>Improved Mastodon</td>
<td>129</td>
<td>98</td>
</tr>
<tr>
<td>Pride of North</td>
<td>98</td>
<td>96</td>
</tr>
<tr>
<td>U. S. D. A. No. 77</td>
<td>136</td>
<td>128</td>
</tr>
</tbody>
</table>

Several years' data indicate that Boone County White is the best variety, when both yield and maturity are considered.

In 1926, the highest-yielding strains seeded early are being grown. Learning was seeded on a series of dates and the effect of such seeding will be studied. (Stewart, G.)

Project No. 42.—Grain Varieties.—Plat yield tests of spring irrigated strains were conducted in 1925 of Dicklow, Federation, some pure lines of Dicklow, and some hybrid purelines from the cross Dicklow and Sevier. Lodging was extremely bad, and all strains lodged except Federation. Federation outyielded by 8 inches all other strains. This was exactly contrary to results of the previous season when only a normal amount of lodging took place. At that time ordinary Dicklow outyields Federation by about five bushels an acre and a pureline selection of Dicklow was about 5 bushels better than ordinary Dicklow.

In winter non-irrigated tests in rod-rows, four purelines of Sevier and about ten hybrids of the Dicklow and Sevier cross have far outyielded the best commercial strains, which are Kanred and Turkey. No plat tests of these have as yet been obtained.

In 1926 the variety tests are being continued with two additional pureline hybrids included. (Stewart, G.)

Project No. 62.—Cereal Breeding.—Hybridization studies of Sevier No. 60X Federation wheats were conducted in the
F-3 generation during 1925. The inheritance of awns and of spike density was studied in detail. Since most of this study was made in the eighteen months between January 1, 1925, and June 30, 1926, a summary of the experiment of the data and of the conclusions is given.

In 1926, F-3 progenies of F-2 plants are being grown of Sevier No. 59X Kanred, Sevier No. 59X Odessa, and Dicklow No. 3X Sevier No. 121. Genetic data will be taken on the progenies of these crosses.

F-3 and F-4 pure lines of the Sevier No. 60X Federation cross are being isolated for yield test on rod rows. (Stewart, G.)

Project No. 64.—Cultural Methods.—The successful parts of this project in 1925 were those dealing with the time of manuring and plowing and with catch crops.

The time-of-manuring and plowing test showed:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Corn Silage (bundles per plat)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manured fall; plowed fall</td>
<td>154</td>
</tr>
<tr>
<td>Plowed fall; manured winter</td>
<td>134</td>
</tr>
<tr>
<td>Manured winter; plowed spring</td>
<td>105</td>
</tr>
</tbody>
</table>

Corn (for fodder), Tepary beans and Colles' barley were successful catch crops planted after the middle of June. Soy beans did not mature and sugar-beets grew little but tops. (Pittman, D. W.)

Project No. 65.—Weed Control.—The only work done on this project this last year was to apply "K. M. G.," "arsenic chlorid," to a plat of small-leafed morning glory. The application was made in the evening with a fine sprayer, when the plants were beginning to bloom. The parts above ground were killed at once, but no apparent damage was done to the roots. (Stewart, G. and Pittman, D. W.)

Project No. 75.—Alfalfa-seed Experimental Farms.—Under this heading are included two major projects, as follows:

A. Alfalfa-seed Experimental Farm in Uintah Basin (irrigated)
B. Alfalfa-seed Experimental Farm in San Juan County (dry-land)

A. Alfalfa-seed Experimental Farm in the Uintah Basin.—This farm was established on May 30, 1925, one mile north of Fort Duchesne, in Uintah County. The location places the farm almost midway between the two extreme limits of the present alfalfa-seed-growing area of the Uintah Basin. The amount of accurate information on the proper methods of producing alfalfa-seed is very meager. It is, therefore, pro-
posed in the work of this farm to seek: (1) more reliable commercial methods of producing alfalfa-seed; (2) to study pollination and fertilization of the blooms of alfalfa as related to seed production; (3) to compare the seed-yielding qualities of known strains of alfalfa; (4) to search for or develop by breeding new superior strains of alfalfa for seed production.

In brief, the experiments will be conducted as follows:

1. Alfalfa-seed production as related to physical conditions of environment (with 8 subheads)

2. Technical studies of the alfalfa plant as related to its improvement for seed production and increased seed production.

Due to the lateness of the season at the time the farm was selected, no experimental work of significance was attempted during 1925. However, a building suitable for use as a laboratory, storeroom, and implement house was erected on the farm. In the fall of 1925 the work of plowing, leveling, and platting of the farm was done, and all possible plans made in preparation for the work to be continued in the spring of 1926. In the spring of 1926 different varieties of alfalfa, clover, corn, oats, and barley were planted as well as one variety of sugar-beets. Data will be compiled from these plantings at the close of the season.

In addition to the experimental work with crops, an evaporation tank for the measurement of the rate of evaporation of water from a free surface has been installed on the farm. Data on the rate of evaporation will be taken during the spring, summer, and fall months of each season. It is felt that these data will be useful in determining to an extent the water requirements of the plants in the Uintah Basin. (Carlson, J. W.)

B. Alfalfa-seed Experimental Farm in San Juan County.—This project, also begun in the summer of 1925, is divided into two main parts: (1) alfalfa-seed production and (2) miscellaneous tests with cereals and forages. The former includes study of tillage, time of cutting, spacing of rows and hills, and a study of varieties. The complete test was sown in August, 1925, and emerged to a good stand in early September. During the winter the ground was unprotected, and this together with alternate freezing and thawing killed the sowings almost to a plant. The test was resown in April, 1926, and again emerged to a good stand. It is very likely that the stand is now permanent.
The cereal tests include a study of rotations, such as wheat and fallow, wheat and corn, and wheat and potatoes. The wheat was sown in the fall of 1925. Due to winter-killing only about half a stand remained in the spring of 1926. A varietal study of cereals (winter and spring) is also being made. All winter oats and winter barley completely winter-killed, and only the hardy winter wheats (such as Kanred, Minhardi, and Odessa) came through the winter with normal stands. In the rate-of-seeding test with winter wheat (Kanred) with rates from one to six pecks to an acre, all stands from sowing from four pecks up to and including six pecks were normal; the lower rates were failures.

The forage test includes a test of both annual and perennial forages. Rye, both Rosen and common, sown in the fall of 1925, emerged through the winter with excellent stands. This crop, which had not been tried before in the San Juan District, gives promise of being a great help to the livestock problem. The forage test also includes several legumes, such as yellow and white-flowered sweet clover, red clover, sorghum, both sweet and grain, and sudan grass. Sweet clover sown in the fall of 1925 was just germinating in the spring of 1926; therefore, this legume was not resown. (Bracken, A. F.)

ANIMAL HUSBANDRY

Project No. 20.—Hog Rations.—Early in 1925 an experiment was begun to determine if possible a strain of hogs could be bred that would be more economic in feeding and developing to the marketing size. The project was started by choosing two uniform Duroc Sows. The project proposed selecting from the farrow of these sows the two best and the two poorest of each sex as breeders after the entire litter had been on full rations to the point of weighing 200 pounds. Because some of the sows of the second qualities in the experiment failed to breed it was concluded that the project was begun with too few animals, so the first attempt has been abandoned, planning to continue the study with a larger group of animals to assure definite conclusions in the breeding and feeding process. (Carroll, W. E.)

Project No. 66.—Panguitch Livestock Farm.—This project is one that has been devoted wholly to the beef cattle business, the main purpose of which has been to produce better bulls from the range herds.

Before establishing the herd, considerable thought was given to the particular breed that would best suit local conditions.
The section is high and limited in crop varieties, ranging cattle in summer and feeding during the winters, which are sometimes cold and long. Breeds of cattle already established were taken into consideration, so a herd of purebred Shorthorn heifers was placed on the farms, headed by an exceptionally good type of bull.

The get held from this bull have developed into excellent foundation dams. These dams have been used with a short, blocky bull, and excellent results are in evidence. The present total of herd is forty-five head.

The bulls from this herd have been placed in four different counties of the state.

The farm crops this spring are earlier than usual and water prospect is better than last year. Over a mile of net fence has been stretched and the pastures subdivided so that in the near future more intensive work can be carried on. Generally speaking, this project is in the best condition it has experienced since its beginning. (Bateman, J. R.)

**Project No. 77.—Investigations in Wool and Sheep Management.**—This project is too new to draw any definite conclusions. However, in brief, the purpose of the project is as follows:

1. To study the effect of winter feed and shelter vs. range on the quantity and quality of wool.
2. To carry on experiments in breeding for lamb production involving the making of various crosses.
3. To study the losses or shrinkage in scouring wool produced under different conditions, notably on different types of range.

The method of procedure has been as follows:

Messrs. H. L. Adams and L. N. Marsden of Parowan agreed to cooperate in the experiment.

These two men were selected as co-experimenters with the Experiment Station. Fifty ewes were chosen to represent each herd as nearly as possible. The ewes (25 from each of the two herds) were to be shifted to the Experiment Station in Logan, Utah. Twenty-five ewes were to be branded and left in the herd under desert conditions, while those moved to the Station were to have usual farm conditions.
In October, 1925, the herds were on the winter ranches on the Southwest desert of Utah, near the Union Pacific Railroad on the ranches of the owners.

The ewes on the desert experienced a favorable winter for climate and for feed.

The fifty ewes at the Station were pastured approximately 30 days with no supplemental feed. They were then pastured in fields and fed a light hay ration for another 39 days. For an additional 39 days they had hay only, and in late January were fed corn silage and alfalfa hay until green feed was provided in the spring. Sheds were provided when needed, but climatic conditions did not call for the use of sheds extensively.

The shearing schedule for the herds was given as the first week in May. The Station ewes were shorn the last week of April. The herd ewes were shorn early in May though the latter, on account of storm, was delayed to the first and second weeks of May.

The fleeces were weighed; samples were taken from seven parts of the fleece, usually neck, shoulder, side, thigh, rump, back, and belly. These samples were accurately measured for length or staple. A score card of the fleece was filled including character, color, soundness, purity and condition, and a blank provided to make diameter measurements to assist in grading the fleeces.

The fleeces from the herds bought by the Station were shipped for further study. The clean weight will be secured by scouring the samples and then by scouring the entire fleece. The ewes in the two herds were re-branded, at the shearing corral, for the continuation of the season for lambs and for another year on fleeces.

The Adams herd missed five ewes. The Marsden herd sustained only one loss. The Station sustained one loss by dogs up to shearing and one after shearing with alfalfa bloat. (Esplin, A. C.)

CHEMISTRY AND BACTERIOLOGY

Project No. 22.—Factors Influencing Bacterial Activities of the Soil.—The ash of grain has been found to be a foundation of the water applied to a soil. This is great enough at times to modify its nutritive value. This has been pointed out in an article:
"Irrigation as a Factor in Modifying the Composition of Grain," J. E. Greaves.


The accumulated results of the past ten years point to the conclusion that sulphur may at times be a limiting factor in crop production in some Utah soils. This phase of the subject is receiving consideration in conjunction with the influence of sulphur and the microflora of the soil.

Investigations extending over a period of four years demonstrate that the mere leaching of alkali salts from a soil is not always sufficient to restore its productivity. This may be partly accomplished by the use of barnyard manure or green manure and inoculation.

The results of the investigations are now ready for publication:

"The Productivity of Leached and Non-Leached Alkali Soil." J. E. Greaves.

(Greaves, J. E.)

Project No. 23.—Permanent Fertility Studies.—Under this project an extensive study is being made of the influence of straw on the microflora of the soil and the species of nitrogen fixers in some of the typical dry-farm soils. The work has not progressed far enough to warrant drawing any definite conclusions. (Greaves, J. E.)

Project No. 24.—Composition of the Irrigation Water of the Intermountain Region.—Lack of funds has prevented work on this project with the exception of the analysis of miscellaneous samples, which have been received. It is now eight years since the general survey, and if funds for the guidance of users of irrigation water could be made available for the repeating of this survey valuable information could be obtained. (Greaves, J. E.)

Project No. 67.—Changes Occurring in Food during Storage.—The project has recently been divided into the following main divisions:

A. Flour
B. Potatoes, Cabbage and Carrots
A. Flour.—It was found that highly-milled flours made from wheats can be stored in dry rooms free from odors without deterioration for at least four years. Under similar conditions poor-grade flours and whole-wheat flours deteriorate.

The moisture content decreases due to storage. This reaches a constant in both wheat and flour of approximately 8 per cent. The water-soluble phosphorus increases during storage, while the alcohol-soluble phosphorus decreases. The hydrogen-ion concentration first decreased and then increased, and it is suggested that the decrease is due to the continuation of the ripening process during the storage period. Later, as deterioration occurs, there is an increase in acidity. The soluble carbohydrates increased progressively during the storage period. The water-absorbing powers of the flours increased, as did all the flour and texture of highly-milled flours.

Results of this experimentation have been published as follows:


The practical value of the work has been pointed out in the article:

"Changes in Flour during Storage," (The American Miller, Vol. 54, (1926), No. 4, pp. 376-377).

The progress of all the work has been greatly hampered during the past biennium due to a lack of funds. Funds for paying a full-time assistant and more money for supplies and equipment would not only greatly help in the work, but make the funds received much more productive. (Greaves, J. E. and Hirst, C. T.)

B. Potatoes, Cabbage and Carrots.—During the past year the methods developed in a study of the storage of flour have been applied to a study of the changes occurring in potatoes, cabbage and carrots, according to the following outline:

Vegetables to be Studied.—
1. Carrots
2. Potatoes
3. Cabbage
Determinations to be Made.—

1. Hydrogen-ion Concentration
2. Carbohydrates
3. Water-soluble
4. Phosphorus
   (1) Lipin-carrying Phosphorus
   (2) Inorganic
   (3) Organic
5. Moisture

The work has not progressed far enough to warrant the drawing of any conclusions. (Hirst, C. T. and Greaves J. E.)

DAIRYING

*Project No. 73.—Production Costs in Dairying.—At the close of the year June 30, 1926, the herd of Holstein dairy cattle totals 57, as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purebred cows</td>
<td>20</td>
</tr>
<tr>
<td>Grade cows</td>
<td>9</td>
</tr>
<tr>
<td>Purebred heifers</td>
<td>3</td>
</tr>
<tr>
<td>Grade bred heifer</td>
<td>1</td>
</tr>
<tr>
<td>Purebred heifers open</td>
<td>4</td>
</tr>
<tr>
<td>Grade bred heifers open</td>
<td>2</td>
</tr>
<tr>
<td>Heifer calves</td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>57</td>
</tr>
</tbody>
</table>

During the year the following animals were disposed of:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purebred bull calves (sold as breeders)</td>
<td>3</td>
</tr>
<tr>
<td>Yearling Holstein-Jersey crossbred heifer (sold for beef)</td>
<td>1</td>
</tr>
<tr>
<td>2-year-old undesirable heifer (sold for beef)</td>
<td>1</td>
</tr>
<tr>
<td>Yearling steers (sold for beef)</td>
<td>2</td>
</tr>
<tr>
<td>Aged cows (14 and 15 years, respectively) sold as canners</td>
<td>2</td>
</tr>
</tbody>
</table>

*In cooperation with the Bureau of Dairying, U. S. Department of Agriculture.
5-year-old cow sold for beef (abortion and failed to breed) ........................................ 1

7-year-old grade cow (bloating while pasturing on alfalfa; died) .................................. 1

Purebred cow (A-16) failed to breed; considered barren) .................................................. 1

Total ................................................................. 12

During the year, Goliah of Hollywood 2d 411759 has been the herd sire. The bull, Korndyke Walker Pontiac Prince 243835 (owned by the U. S. Bureau of Dairying) was shipped to the Station from the Government Breeding Station at Huntley, Montana. This bull will be used in connection with Goliah of Hollywood 2d 411759.

Accurate production, feeding and breeding records are kept on each individual cow, from which cost of production will be derived. The feeds used during the past year have been alfalfa, corn silage, wet sugar-beet pulp, mangels, pasture, barley, oats and mill-run.

Starting January 1, 1926, two groups of eleven cows each were selected, the groups being made as uniform as possible according to age, production, weight and breeding. The object in selecting these groups was for a feed test to be made on corn silage and wet sugar-beet pulp. The experiment was begun February 11, 1926, and will run at least one year, and longer if thought necessary.

Each cow was weighed three days in succession at the beginning of the experiment and weighed every fifteen days thereafter or oftener if necessary.

The corn silage and wet sugar-beet pulp is fed upon a dry-matter basis, the amount fed depending on the body weight of the cow. Two and one-half pounds of corn silage is fed per hundred weight of cow to the silage group and enough wet sugar-beet pulp is fed to make up the same amount of dry matter in the wet beet pulp as is contained in the two and one-half pounds of corn silage. Moisture tests of both feeds are run every 15 days, or oftener if necessary. The moisture tests are being conducted by the Station Department of Bacteriology.

All cows are fed grain according to the amount of butterfat they produce. Three-fourths of a pound of grain per day are
fed for each pound of fat a cow produces a week, and cows producing 20 pounds of fat a month or less get no grain. The cows are fed all the good alfalfa hay they will clean up. Each and every milking is weighed and sampled, then every 10 days tested for percentage of butter fat.

A summary of this work has been made from February 11, to May 1, 1926. At this time silage and pulp were discontinued, both groups of cows going to pasture. The following gives the average amount of alfalfa consumed per hundred pounds weight of cow a day for both the corn silage group and the wet sugar-beet pulp group:

1. CORN SILAGE GROUP
   Avg. Amt. Alfalfa consumed per Cwt. of cow a day .......... 1.16 Lbs.
   Avg. Amt. Corn Silage consumed per Cwt. of cow a day ...... 2.43 Lbs.

2. WET SUGAR-BEET PULP GROUP
   Avg. Amt. Alfalfa consumed per Cwt. of cow a day .......... 1.20 Lbs.
   Avg. Amt. Wet Sugar-beet Pulp consumed per Cwt. of cow a day 6.40 Lbs.

No outstanding differences appear in checking over the body weights of the two groups of cows over this 79-day period. Neither do any outstanding differences appear in checking over the production of milk and fat of the two groups. The summary is made to show the progress of the work rather than to draw conclusion that the experiment has been under way too short a time. Professor George B. Caine of the Dairy Department is cooperating in this particular phase of the work.

A photographic record is being made of each individual calf born on the Dairy Experimental Farm. These photographs are being taken at 6-month intervals to be used in studies of conformation at different ages. A photographic record is also obtained which can be used in connection with any other calf-breeding or breeding work which may be under way. Professor P. V. Cardon of the Farm Economy Department has assisted in the photographic work.

The dairy experimental farm consists of 86 acres of land planted this year to the following crops:

   Alfalfa ......................... 33.5 acres
   Pasture ......................... 31.0 acres
   Barley .......................... 7.5 acres
   Oats ............................. 4.4 acres
   Sugar-beets ...................... 4.0 acres
   Corn Silage .....................  2.6 acres
The crops harvested during the fall of 1925 were as follows:

- Grain (barley and oats) .......... 949.0 bushels
- Green Corn Silage ............. 154.9 tons
- Alfalfa Hay .................. 135.0 tons
- Mangels .................... 30.0 tons
- Pasture—sufficient for ........ 52 head dairy cattle

The only feeds purchased were mill-run and wet sugar-beet pulp.

A study is also being made in cooperation with the U. S. Bureau of Dairying to determine the relationship of the conformation and anatomy of the dairy cow to her possible milk and butter-producing capacity. Careful measurements and tables are being compiled in connection with this phase of the project. (Bateman, G. Q.)

**ENTOMOLOGY**

**Project No. 51.—Miscellaneous Insects.**—This main project has been divided into several subdivisions and the work on each separate project is as follows:

**A. Fruit Tree Leaf Roller.**—The work on this project has been completed and has been published as Utah Experiment Station Bulletin No. 196 entitled "The Fruit Tree Leaf Roller and Its Control by Oil Sprays." (Hawley, I. M.)

**B. Pear Leaf Blister Mite.**—The work on this project has also been completed and has been published as Utah Experiment Station Bulletin No. 197 entitled "The Pear Leaf Blister Mite as an Apple Pest." (Hawley, I. M.)

**C. Sugar-beet Root Maggot.**—There are no new data regarding this pest. It is an insect which is periodic in its appearance and was very scarce last year. The project will be continued when the insects appear in sufficient numbers. (Hawley, I. M.)

**D. Insectivorous Reptiles.**—This work has consisted of a systematic study of the snakes and lizards of Utah as well as a study of their food habits. The systematic part of the problem is almost ready for publication. (Pack, H. J.)

**E. Ants.**—Different syrups and sugars were tested during the past year as attractants for several species of ants. The taste of the different ants has been found to vary considerably, and it was found that syrup that attracted some did not appeal to others. Calcium cyanide was very effective against the mound-building species. Some nests were destroyed by
placing a large ring of calcium cyanide around the nest and a small ring around each opening. Sodium fluoride was effective against household species when scattered freely beneath infested refrigerators. (Hawley, I. M.)

F. Squash Bug.—This pest has been known in Southern Utah for some time, but it has only recently been introduced into the northern part of the state. In 1922 it caused some damage near Ogden, and in 1925, squash in this region was almost a total loss. At present it may be found from Boxelder County to Salt Lake County. The parent bugs were treated with 10 per cent nicodust and calcium cyanide in the powdered form. This project will be continued in 1926 and several new materials will be tested. (Hawley, I. M.)

Project No. 80.—Chalcis Fly in Alfalfa-seed.—This project was outlined during the fall of 1925 for the purpose of investigating the chalcis-fly problem confronting alfalfa-seed growers of the state and to aid in its solution.

Dr. I. M. Hawley, Entomologist of the Utah Experiment Station, and Mr. V. L. Wildermuth of the U. S. Entomological Laboratory at Tempe, Arizona, made a preliminary investigation of the chalcis-fly situation in the Uintah Basin during July, 1925.

Special appointment to investigational work on this project was made November 1, 1925. It began with a brief survey in the Uintah Basin and in Millard County during the last days of October and in early November, 1925. Sixteen samples of unthreshed alfalfa-seed were taken from seed fields and stacks in the Fort Duchesne, Roosevelt, Ioka, and Myton districts. Many of the fields from which these samples were taken had received different treatments before and during the time of producing the seed crop. Seed analyses of these 16 samples showed the infestation of chalcis fly to range from 1 to 31 per cent, with an average of 12.06 per cent.

Analyses of 17 seed samples collected, in a similar way, in the Hinckley, Sutherland, and Abraham districts of Millard County showed an infestation ranging from 0.35 to 7.6 per cent, with an average of 12.06 per cent.

Laboratory studies have been made to determine the time of pupation of the chalcis fly and the length of its pupal period. Several individuals have been studied through the transformation period to the adult stage. This study at present is incomplete. It will be continued and repeated under field conditions.
Counts have been made of the chalcis-fly population for the purpose of ascertaining the relative proportion of sexes in a fly population, the species, and numbers present, and the comparative time at which the different sexes of flies and parasites emerge. The study thus far indicates that the males of both flies and parasites emerge first and that the maximum emergence of the parasites takes place several days later than that of the chalcis-flies. Of three or four probable species of parasites which have been found in the fly population, two species occur in greatly predominating numbers.

Experiments have been made in the laboratory in which infested alfalfa-seed has been planted in a series of three different soil types 4 inches deep. It was hoped that something might be learned concerning the ability of the flies to emerge through the soil and obtain a hint concerning the possibility of fly control by practical cultural methods. The data obtained thus far indicate some promise.

The work of this project will be continued. (Sorenson. C. J.)

Project No. 82.—Investigation of Sugar-beet Leafhopper.—Under a cooperative agreement between the U. S. D. A. and the Experiment Stations of Utah and Idaho a study of this pest is being undertaken. Technical methods of control are being studied by Mr. Walter Carter of the U. S. Bureau of Entomology and associates with headquarters at Twin Falls, Idaho. Mr. Carter is in direct charge of the work. Mr. George F. Knowlton of the Utah Station, under the direction of the Station Entomologist, is to give his full time to this problem.

The first work to be done is to make a survey of the possible native breeding areas in an effort to find the source of the migrations to beet fields. Many leafhoppers were collected from Russian thistle and saltbush around Cache Valley. During the summer of 1926 the survey work will be continued, and it is hoped that most of the state may be covered. (Hawley, I. M.)

FARM ECONOMY

Project No. 79.—Influence of Cropping Systems on Production Costs.—The immediate purpose of this project is to determine the cost of producing crops on both dry and irrigated farms in Utah. It also aims to determine what a given acreage of a known type of soil might be expected to return to its owner if devoted exclusively to any of several standard crops,
or to a rotation of these crops through a series of years, the cost factor being taken into consideration. Finally, it aims to determine possible application of the results obtained from this study to either established or recommended cropping systems.

This project was not begun until August 1, 1925, and was not formally approved until January, 1926. In this brief period, however, some substantial progress has been made.

The first work done was an economic survey for the celery situation in Utah. This was done cooperatively with the Station Department of Horticulture, and with a special celery commission of the Salt Lake Chamber of Commerce. The summary of this survey was published in Salt Lake City papers at the time the report was submitted in February, 1926. A specially requested article, based on this report appeared in the June issue of the "Market Growers' Journal," published at Louisville, Kentucky. The findings of the survey had a direct influence on the celery plantings in Utah for the season of 1926.

A study of the cost of producing dry-farm wheat in Cache, Boxelder, Tooele, and Juab Counties is now well advanced. Similar studies pertaining to field and orchard crops on irrigated land are being undertaken as rapidly as time and funds will permit. (Cardon, P. V.)

GEOLOGY

Project No. 25.—Ground-water Development.—The work on this project during this period has been confined mainly to the following problems:

1. Mapping those areas in the state where ground-water is available either as artesian water or surface wells for culinary use, watering stock, and for irrigation. The work has gone far enough to permit mapping at least in a reconnaissance way all areas where ground-water is available.

2. A careful study has been carried on to determine methods and obtain accurate data estimating the annual recharge to the valley in comparison with water which is now being taken from the ground. The method has consisted of a careful estimate of the drainage, assembling all possible data regarding rainfall, evaporation and runoff, and computing this against the water which flows from artesian wells and which is being pumped from the valley to determine whether or not the valley is open to further appropriation. The data
collected indicate that probably no precipitation between May and October (unless at least two inches) is in any way contributory to ground-water and that probably not more than one-sixth of the winter precipitation is available as annual recharge.

3. Measurements have been kept on artesian wells to determine whether or not the hydrostatic head is maintaining. It is difficult at this time to determine whether the loss in head is due to three consecutive dry seasons or whether the loss is due to exhaustion of the valley water-supply. This probably needs to be carried on for a longer period before definite conclusions can be made.

One feature is very important in the ground-water development of the state in that better legal protection be given to the farmers who are developing ground-water as a source of making a home. Definite information must be made acceptable to interpret when the ground-water of a valley is all appropriated with just the same emphasis as is now available indicating when a stream is entirely appropriated.

One of the most important needs of ground-water at present is a law which will protect the development and prohibit the underground reservoir being appropriated beyond its capacity. The problem will be continued and somewhat enlarged. (Peterson, W.)

HOME ECONOMICS

Project No. 81.—Factors Affecting Penetration of Ultra Violet Rays through Vegetable and Animal Fibers.—This project has barely been started and nothing definite can be reported. In attacking the problem the following methods have been applied:

1. To secure and review recent literature relating to this general subject.

2. To become familiar with the best technique of animal care and feeding and with the McCollum "line test" for rickets.

It is planned to continue the experiment during the coming year. (Dozier, C. C.)

Project No. 83.—Food Habits of Utah Farm Families.—The immediate objective of this project is to determine varieties and quantities of foods produced on Utah farms for farm home consumption. The method of procedure has been to secure a
number of representative farm families in selected communities 
(selected mainly for type of farming possible and for location 
with respect to markets) and to keep a record for the period 
of one year of home-produced foods consumed.

Twenty-eight communities with farms in neighborhood 
of two additional communities are represented in the survey 
at the present time. This includes thirteen counties with 
256 cooperators. (Brown, A. P.)

HORTICULTURE

Project No. 40.—Horticultural Survey.—This project has 
been divided into the following heads:

A. Ornamental Trees and Shrubs for Utah
B. Trials of New Fruit Varieties
C. General

A. Ornamental Trees and Shrubs for Utah.—As oppor-
tunity offers observations are made on the ornamentals planted 
on the Davis County Experimental Farm, on the campus at 
Logan, and on those privately owned. It is hoped that suffi-
cient material may be gathered to warrant the publication of 
a bulletin or circular in the fall of 1926.

B. Trials of New Fruit Varieties.—

1. Strawberries.—Records were kept on the yield and char-
acter of berries from the plats of strawberries on the Davis 
County Experimental Farm, the object being to find varieties 
suitable for shipment.

A new series of plats was planted in the spring of 1926, 
including about thirty of the best varieties from the old series 
and in addition twenty-three new varieties and five strains 
of Aroma. The first records will be secured in the spring of 
1927.

Field surveys in June, 1926, reaffirmed the desirability of 
Aroma as a shipping berry. The use of Marshall for jam, 
preserves, and fountain and ice-cream stock appears to be 
increasing.

Plot records indicate that Big Late, Bushel Basket, Chespe-
ake, Fremont William, John H. Cook, and Marvel have promise 
for shipping berries.

Common cellar storage tests in June, 1926, showed Big 
Late, Bun Special, Chesapeake, Cooper, Delicious, Fremont
William, Gandy, Gold Dollar, John H. Cook, Magic Gem, Marvel, Missionary, New Oregon, Nich Ohmer, Sample, Sionilli and Superb to be the best keepers.

In a cold storage test with ten late varieties Chesapeake and Gandy kept best, with Delicious, Fremont William, Lupton and William Belt second best.

Notes at blooming time show Big Late, Fendall, Haverland, Kellogg's Prize, Lucky Boy, Premier, Sample, Teddy Roosevelt, and William Belt to be more or less imperfect in bloom.

B. Bush and Vine Fruits.—Variety tests were also begun with other small fruits. In April and May (1926) the following varieties were planted on the Davis County Experimental Farm: Red, black, and purple raspberries; blackberry; dewberry; currant; gooseberry; and grape.

C. General.—In December, 1924, extremely low temperature injured many fruit trees. The following spring and summer a survey was begun to study the nature of the injury. Several factors active in favoring winter injury, especially to peach trees, were as follows:

1. Lack of irrigation water in late summer and fall
2. Insufficient soil fertility
3. Location of trees at low elevations or too far from mountains
4. Weakening of trees due to peach tree borer

Heavy heading-back of young trees the following spring (1925) appeared to reduce crotch injury, while in old trees heavy pruning by removing the live buds towards the ends of the branches caused their death. The greatest injury was to the cambium and new wood and was most pronounced on the trunk and large limbs from the snowline to high into the tree. (Abell, T. H.)

Project No. 41.—Breeding Horticultural Plants.—This project has been divided into the following divisions:

A. Tomato Breeding
B. Strawberry Breeding

A. Tomato Breeding.—The object of this phase of the project is to produce an earlier, dark, firm canning tomato with uniformly deep, smooth contour and high yield. The method of attack to date has been to collect various strains of Stone and Greater Baltimore as well as other varieties, test-
ing them on the Davis County Experimental Farm in triplicate 1-75-acre plats.

On account of ravages of the Western Yellow Blight in the summer of 1924, which made it impossible to secure yield data, this was the first time reliable measurements could be made of all selections of 1923 and as well as 1924.

Data were secured regarding earliness, yield, and fruit characters of each strain. Progress was made by selection of seed from desirable plants and strains. Records indicate the desirability of saving seed only from the best plants.

Because of the frequency of mixed types both in commercial strains and in those produced at the Station (probably due to cross-fertilization), it would be desirable to hold tomato seed over for a year before selling it so that it can be tested for purity of type.

There were outstanding differences between various strains of the same variety, in type, in yield, and in earliness. Differences in yield of 100 per cent and the fact of mixture of types is surely of highest importance to both grower and canner. The results to date encourage the belief that both parties can be benefited by securing superior strains of greater Baltimore and Stone.

B. Strawberry Breeding.—No crosses have yet been made. Plants brought to the greenhouses in Logan for winter hybridization were burned in the fire which destroyed the greenhouses in 1925. (Abell, T. H.)

Project No. 59.—Davis County Experimental Farm.—Researches on the Davis County Experimental Farm are divided into independent studies and cooperative studies with other members of the Station Staff. Those of the first type are grouped together and listed as Project 59, while those of the latter bear individual project numbers, or they may be units of larger projects. The following cooperative projects have been pursued during 1925-26, each of which is reported in detail by the departments cooperating:

1. Study of strawberry varieties
2. Selection studies and strain tests of canning tomatoes
3. Selection and varietal studies of celery
4. Varietal studies of bush fruits
   (a) Raspberries
   (b) Blackberries
   (c) Dewberries
   (d) Gooseberries
   (e) Currants

5. Insect control measures
   (a) Squash bug
   (b) Strawberry root weevil
   (c) Onion thrips

6. Silage corn variety studies

7. Tomato wilt studies—principally resistant strain

The independent efforts include:

1. Onion Studies
   (a) Comparison of various strains of Spanish onion, being sold as Sweet Spanish
   (b) Thinning of onions in relation to yield
   (c) Selection for type
   (d) Seed production

2. Varietal studies of early market tomatoes

3. Cost of producing strawberries

4. Irrigation of canning peas

5. Red beets
   (a) As a second crop following peas
   (b) Varietal studies for canning

6. Date of planting silage corn

7. String beans studies

8. Miscellaneous
   (a) Sweet potatoes
   (b) Carrot varieties
   (c) Sweet corn varieties
   (d) Varieties of garden peas
   (e) Cucumber varieties for late summer and fall fancy trade

1. Onion Studies.—

A. Strain Studies.—Because seed stocks of the Riverside Sweet Spanish have been far from adequate to accommodate the increased onion acreage since the introduction of their strain into Utah, growers have been compelled to purchase from a number of sources, most of which have proven inferior in some respects to the Riverside type. In view of this con-
dition and because of frequent statements made later by seedsmen and vegetable specialists that Sweet Spanish, Denia, Valencia, Giant Gibraltar and even Prizetaker are the same onion, as many strains of these varieties as could be obtained were planted in plats of 5 rows each, under comparable conditions. It was felt that such a comparison would be sufficient to evaluate the relative merits of the several varieties. The test includes nine lots sold as Prizetakers, four lots of Giant Gibraltar, two of Denia, and twelve lots of supposedly Sweet Spanish. The following results were obtained:

1. The Riverside Sweet Spanish type is more uniformly dark-colored, harder, and more nearly globe-shaped than any other strain of Spanish onion in the test.

2. The stocks imported directly from Spain, while producing high yields, do not compare with the Riverside type in desirability of shape, color, nor in keeping qualities.

3. Stocks of Prizetaker and probably of other Spanish varieties have been sold for Sweet Spanish, probably due to the more or less general opinion that all Spanish onions are alike. While Spanish growers recognize only two types of onions (the Yellow Grand and the earlier, lighter-colored Babose), it is evident from these studies that some selective agency has been operative with the Riverside Sweet Spanish to produce a strain with certain destructive characteristics. Moreover, these distinctive features have made the Riverside type (Utah Valencia) more desirable for Utah conditions than any other variety or strain of Spanish onion yet tried.

B. Thinning Onions.—This study aims to answer the question: “Does it pay to thin onions?” so frequently asked by the beginner in onion-growing. The work was done in a field of Riverside Sweet Spanish sown thicker than average plantings. Each type of thinning consisted of a plat five rows wide and 208 feet long. Each plat was adjacent to an un-thinned plat of the same size. It is quite evident that it is a loss of money to thin onions, when planted at the rate of 2.5 to 3.5 pounds of seed per acre.

C. Type Studies.—The object of this project, which has been under way since 1925, is to build up improved strains of Riverside Sweet Spanish through selection. The bulbs planted in 1923 are now in the first year of the third generation, that is, the second selection has been made and is being grown now (1926). It is of note that out of 110 bulbs planted in 1923 only five stocks have been retained.

Each mother onion is carefully described as to color, size, weight, and condition of neck—whether coarse or fine, full
or hollow. In addition caliper measurements are made in two dimensions and a ratio computed to give numerical indication as to shape.

D. Seed Production.—The Riverside Sweet Spanish onion is a low producer of seed. Various practices have been tried in an attempt to increase seed production. Fall versus spring planting has given a distinct advantage in favor of fall planting in yield per plant. However, fall planting resulted in only 50 per cent of a stand, whereas 90 per cent of spring-planted bulbs grew. Fall-planted bulbs yielded 0.607 ounce of seed per plant, while spring planting yielded only 0.18 ounce per plant. At this rate, 1000 bulbs planted in the fall would yield 303.5 ounces of seed, while the same number planted in spring (90 per cent stand) would yield only 162 ounces.

Attempts were made to influence yield of seed by cutting mother bulbs. This cut was made at right angles to direction of growth and about one-half way down the bulb. One lot was uncut, one lot cut only once, and one lot cut twice at right angles to each other and at right angles to direction of growth.

2. Varietal Studies of Early Market Tomatoes.—This work, which was started in 1926, aims to obtain good type strains of early tomatoes.

3. Cost of Producing Strawberries.—This work is being conducted along the same lines as previously reported. The 1924 planting became infected with strawberry root weevil and had to be abandoned. The 1925 planting has produced only one crop and is incomplete.

4. Irrigation of Canning Peas.—The object of this experiment is to determine the best time to commence the irrigation of the late varieties of canning peas. Three groups of plats were treated as follows: (1) First irrigation before the foliage turned dark; (2) first irrigation when color of the foliage indicated need of moisture; and (3) first irrigation after vines had suffered to extent of lower leaves being burned, but pod formation not injured.

5. Red Beets.—This project has a two-fold purpose: (1) to determine whether or not red beets can be grown for canning purposes following a crop of canning peas; (2) to determine good strains of canning beets. Detroit Dark Red is the best variety for canning but varies widely in essential characteristics. Out of four strains of this variety, the Special Selection of the Joseph Harris Company proved to be the best for shape and for color. Selections were made from this
strain and the roots planted for seed; the beets were selected in the field for shape and for absence of taper-rooted small beets. At planting time each root beet was notched with a knife, and those showing white rings were discarded. The market, of course, will always be limited for canned beets, although it is slightly expanding.

7. String Beans.—The yield data on this work have been completed; descriptions are being checked.

8. Miscellaneous.—Studies are more or less preliminary in nature and involve very largely minor truck crops. (Wilson, A. L.)

Project No. 86.—Orchard Management.—This project, which has been begun during the past fiscal year, is divided into two main divisions:

A. Apple Thinning
B. Apple Harvesting

A. Apple Thinning.—The experiments on thinning apples have been conducted on one of the Experiment Station farms near Logan. The trees are on a north slope; the soil is clayey and very rocky with good drainage. The crop was only medium. The results indicate that thinning increased the large apples one-half bushel a tree and reduced the small apples more than two bushels a tree. The apples were sorted over a Cutler Grader and wrapped and tier-packed. Records were kept of the number of boxes of each size of fruit and time required to pack each size. The cost of thinning was 12 cents a tree. This phase of the project will be continued during the coming year.

B. Apple Harvesting.—Jonathan growers have experienced considerable trouble with internal browning of the apples after storage. This, in some cases, seemed to be due to delayed harvesting. The object of this experiment, therefore, has been to determine whether or not delayed harvesting causes internal browning of the Jonathan. (Four plats of four trees each were chosen on one of the Experiment Station farms near Logan). About twenty apples from each plat were picked at weekly intervals beginning two weeks before commercial harvest and until three weeks after commercial harvest. The apples were stored in a common storage cellar with cement walls and dirt floor where apples keep in excellent condition until May first and later.

The first year's results indicate that internal browning is more abundant in Jonathan apples raised on very well-
drained bench soils and is practically non-existent in the richer, more retentive soils. Internal browning was clearly increased by leaving the fruit on the tree one week too long, and could have been avoided entirely by harvesting one week earlier without sacrificing much in red color. Water-core was serious in the extremely late pickings, but the amount was not so clearly correlated with time of earlier pickings. (Abell, T. H.)

HUMAN NUTRITION

Project No. 52.—Nutrition of Infants.—During the spring of 1926 an experiment was started to determine the effect of the heat treatment of milk from the curd character. These results show that upon bringing the milk to the boiling temperature the curd tension is decreased from 30 to 70 per cent, thus rendering the milk which has been boiled much softer-curded and therefore more easily digested than the raw milk. (Hill, R. L.)

IRRIGATION AND DRAINAGE

Project No. 15.—Pumping for Irrigation.—In cooperation with the U. S. Department of Agriculture two manuscripts covering the work under this project from 1914 have been submitted for approval. These reports cover the following:

- Types of wells and methods of development
- Necessity of sinking a test well
- Testing wells for water-supply
- Efficiency tests on typical pump installations
- Cost of pumping for irrigation.

An outline has been approved for extending this study to determine so far as practicable the economic limits of pumping for irrigation. (Winsor, L. M.)

Project No. 17-e.—Relative Elevation of the Water-table and the Plane of Saturation in Fine-textured Soils.—The work in the Department of Irrigation and Drainage during this period was concerned largely with two problems: (1) fundamental soil and water relations; (2) the correlation of quantities of water falling upon a given water-shed in the form of rain and snow with the discharge of streams from the water-shed.

1. Fundamental Soil and Water Relations.—This division of work has been conducted in the laboratory and in the field cooperatively between the Departments of Physics, and Irrigation and Drainage of the Utah Experiment Station to-
gether with the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture. The progress of the laboratory work is reported by Dr. Willard Gardner under Project 17. Reference is here made to the field aspects of the work.

Attention has recently been given primarily to a determination of the moisture distribution above the water-table in heavy soils. To accomplish this a thorough survey was made of the fine-textured soils of Cache Valley with a view to locating a field plat suitable for the experiment. In locating the plat for the field experiment an endeavor was made to find a tract, the surface elevation of which was sufficiently high above the surrounding drainage channels to permit excess water to drain away by gravity. After a very careful analysis of several possible locations, a tract was selected in Section 16, Township 12 North, Range 1 East, Salt Lake Meridian.

Two plats were selected, each 50 feet square, inside dimensions. Trenches were dug around these plats to a depth of approximately eight feet, and pipe placed to indicate and control the water underneath. A water-tight valve is used to regulate the water in the stand pipes around the two plats. Attention has been given to perfecting a means of detecting the elevation of the plane of saturation which it is believed may be a considerable distance above the water-table. Some preliminary results of these investigations will be available during the fall of 1926.

Considerable attention has been given during the 18-month period to the completion of a paper entitled "The Application of Hydro-dynamics to the Solution of Irrigation and Drainage Problems." This paper is now in process of publication. (IsraelSEN, O. W. and Gardner, W.)

**Project No. 72.—Snow Survey.**—The purpose of this project is to determine the relationship of stream discharge to precipitation with special reference to forecasting the supply of water for irrigation from seasonal surveys of snow cover on mountain watersheds. In addition to collecting and analyzing meteorological data on mountain watersheds, this experiment involves a study of stream flow and watershed characteristics. It also involves a study of the vegetation, geology, geographic location, and topography.

This project was begun in the fall of 1923. Detailed observations were made on the Logan River Drainage Area. Snow courses were established for measuring the winter precipitation, and standard rain gages were set up for measur-
ing the summer precipitation on the high watersheds. Similar observations were made on the Logan watershed during 1924 and 1925. The results of these observations correlated with the April-August runoff of the Logan River.

In the spring of 1925 this project was transferred from State to Purnell funds and its scope broadened. The work during the year 1925-26 has been confined to a detailed study of the following main factors affecting the relationship between the precipitation and runoff:

1. Collecting data on snow cover by seasonal snow surveys
2. Extension of area covered by snow surveys to collect data in the study of the distribution of precipitation on the high watersheds
3. Absorption studies in which small natural drainage basins are studied as to amount of precipitation which falls on and the amount which runs off
4. Evaporation studies
5. Studies to determine the correlation between precipitation
6. Spring studies
7. Collecting data on summer precipitation on high watersheds

A survey of the snow cover on the Logan drainage basin was made April 10-14, 1926. The snow cover this year is the least on record, it being only about 50 per cent normal. The temperature during April and May has been abnormally high, and as a result the water supply has come off early.

During the year seven snow courses have been established on the Sevier and Coal Creek watersheds. These courses are operated under a cooperative agreement between the irrigation interests and the Experiment Station.

Absorption studies were carried on in two small drainage basins. Due to light snow cover this year the stream courses out of these canyons have been dry all spring. On April 2, there were about 7000 acre-feet of water in Green Canyon, and on April 17, 1000 acre-feet in Card Canyon, none of which flowed out. The absorption and evaporation in these two canyons is therefore at least 8000 acre-feet and probably more.

Preliminary experiments were made to determine the evaporation from snow cover. The lack of snow prevented any conclusive results from being obtained. This work will be continued next year.
It is believed that there may be a close correlation between the precipitation during different periods and the April to August runoff. The correlation was worked out on the Logan and Provo Rivers. There seems to be a very close relationship between the December-April precipitations at Heber and the April-August runoff at Provo. There seems to be very little correlation between the precipitation at Logan and the April-August runoff at Logan. Using the short record available there is fair correlation between the snow cover in Spring Hollow and the discharge of the Logan River.

Ricks Spring is a tubular spring, having a flow which varies from 0 to 50 c. f. s. This spring seems to be very sensitive to precipitation on the surrounding watershed. A study of the discharge characteristics of this spring is being made to see if there is any correlation between the flow of this spring and the discharge of the Logan River.

Very few precipitation records on our high watersheds are available. In determining the relationship between precipitation and stream discharge, it is necessary to know the extent of the summer precipitation. To obtain this information standard rain gages have been established at the higher elevations. Two gages are above 9000 and two above 8000 feet elevation. The records at these stations during the summer of 1925 indicate the precipitation above 8000 feet elevation to from three to four times the precipitation in the valley. (Clyde, G. D.)

**Project No. 76.—Flood and Gravel Control.—**Investigations were conducted preliminary to undertaking detailed studies pertaining to the use of spring high-water and flood water in irrigation by direct application.

Before high water can be used on the farm direct from many mountain streams, the gravel and sand carried by streams must be removed. These investigations have been undertaken for the purpose of determining an economical method of removing heavy debris from streams.

Up to date fifteen control structures have been installed, each of which has accomplished the purpose for which it was built. Indications are that this method of control may be effectively and economically applied to a wide variation in stream flow conditions.

The actual construction cost and maintenance has been borne almost exclusively by those directly benefited. (Winsor, L. M.)
Project No. 17.—Fundamental Soil Moisture Constants.—
The work on this project during this period has been confined primarily to laboratory studies connected with the general field of agricultural physics with minor departures, as will be indicated hereafter.

The method of measuring the capillary potential (capillary pressure) has been improved. The porous cups are now made from clays obtainable in the valley. A very satisfactory instrument for this purpose has been secured.

Preliminary measurements have been made which show the variations in the rate of germination of seeds and their rate of growth with moisture available to them at capillary potentials ranging from zero to one atmosphere. This has necessitated the perfection of apparatus requiring some foundry work for the preparation of the cast aluminum forms, also the burning of the clay plates used. This work is being continued. It shows great promise of explaining many soil moisture problems which have formed the subject of investigation over the entire country.

It has been shown that if the angle of contact of the surface of contact of water and soil grains is zero, a soil kept in a dark chamber cannot be in equilibrium with saturated water vapor without becoming completely saturated with water. Although not completely verified, experimental evidence has been obtained indicating that the theory is correct. This leads to a new interpretation of the so-called hygroscopia coefficient, i.e., it becomes a measure of the moisture condition at equilibrium (dynamic equilibrium) between soil and water in the presence of light, but this moisture condition changes with the intensity of the light. A technical article is now in press giving the results of this investigation.

Some experimental evidence has been accumulated indicating that the angle of contact involves the curvature of the surface of separation of the liquid and solid phases, and this point is being given further attention at the present time. It is suspected that the surface tension heretofore regarded as a constant for a given liquid and given solid may itself vary over a slight range for varying curvature. This point may lead to new light in assisting to organize the present somewhat disorganized theory of colloidal physics. The results obtained may lead to some modification of the theory discussed in the previous paragraph but will not of course disturb the experimental data presented in the article mentioned.
In classical physics the angle of contact is usually regarded as equaling zero and the surface tension is regarded as constant for a given temperature, and it is upon the strength of this classical theory that the calculations were made.

Experiments are in progress measuring the capillary transmission function for saturated and also for unsaturated soils. These investigations when completed will lead to a better understanding of the operation of the soil mulch, the loss of moisture from soils by evaporation, and other such soil moisture phenomena.

Methods (not yet perfected) are being devised for measuring directly such properties as the tenacity or stickiness of soils as well as their friability. The results thus obtained will be correlated with the moisture equivalent and also with the mechanical analysis.

As a result of theoretical investigations, conclusions indicate that the heavy soils may be completely saturated at various levels above the water-table. The term water-table is defined as being the level at which the hydrostatic pressure in the soil is zero, this also being the arbitrary origin or zero of capillary potential. An instrument has been perfected for locating the position of this so-called super-water table, and in cooperation with the Irrigation Department an investigation is being conducted in the field for locating this for a particular soil type. (See Project 17-e.)

In cooperation also with members of the Irrigation Department wide variation has been shown from station to station in the annual rainfall over a small area such as Cache Valley. It has also been shown that the summer rainfall is very much higher in the mountains surrounding the valley than in the valley itself. Some meteorological measurements have been made in cooperation with the farmers at various points over the state, but to date with no essentially important conclusions. (Gardner, W. and Israelsen, O. W.)

**PLANT PATHOLOGY**

**Project No. 31.—Potato Diseases.—**

**B. Rhizoctonia Studies**

**C. Virus Disease Studies**

**B. Rhizoctonia Studies.**—Work on Rhizoctonia of the potato has been suspended during the past two years. Two publications, in addition to the three already published during 1921 and 1922, are pending and will demand some additional
data and checking which will be obtained during the year of 1926-27.

C. Virus Disease Studies.—During the past year mosaic, leaf-roll, and spindling tuber of the potato have been studied. Two phases of these diseases have been particularly stressed: (1) The symptoms as they normally are exhibited in the various potato varieties and as they occur in the field under different conditions and in the greenhouse; and (2) the testing of methods of control which might be effective in Utah.

By the use of insect cages, the greenhouse, and field plats the symptoms of mosaic and leaf-roll have been fairly well determined for each of the commercial potato varieties important in the state. The vine and tuber symptoms of the spindling tuber are much more obscure, and much in an experimental way remains to be done before effective diagnosis and control can be anticipated. This particular phase of the work will be pushed during the coming year, as spindling tuber is of vital importance in potato-seed deterioration in the state.

Control methods by rigid selection under isolation have been conducted for the past four years. During 1925 the greenhouse tuber-index method was first introduced into the experiments. Under this method the best stock was selected and eyes were cut out of each potato tuber and planted in the greenhouse, where each plant from these eyes was grown to maturity. Diseased tubers thus determined were then discarded and the disease-free tubers saved for seed. Seed thus indexed and selected in 1925 was planted under conditions of isolation in six different areas of the state as follows: Clarkston, Mantua, Eden, Morgan, Charleston, and Logan.

The 1925 crop was harvested and again indexed in the greenhouse in the winter of 1925-26. These tubers were planted in June, 1926. Results of this planting are not available at this time. This method rigidly employed has resulted in complete elimination of the rugose mosaic and leaf-roll and to very definite reduction in spindling tuber. It is becoming apparent that disease-free seedstock can be produced by this tuber-index method, and where employed can serve as a constant source of seedstock. (Richards, B. L.)

Project No. 33.—Canning Crop Diseases.—Work under this project has been confined to the three diseases of the tomato: Fusarium wilt, mosaic, and western yellow blight.

Fusarium Wilt.—Only three phases of this problem have received consideration: (1) Selection for disease-resistant
strains; (2) field tests for varietal resistance to Fusarium; and (3) survey.

Selection for disease-resistant strains has been conducted both in the field and in the greenhouse. As a result, four strains from the Stone variety have been selected which in 1925 indicated a high degree of resistance. These particular strains have been multiplied and are planted this year for testing in infected soil. Data will not be available until the end of the season of 1926. Selections from other strains will be continued during 1926.

Field tests for resistance were conducted during the year at Layton with ten tomato varieties. As in 1925, these groups include the three most important commercial varieties used at present in Utah and seven varieties of a somewhat known degree of resistance.

As in 1924, the Stone, Landreth, and Greater Baltimore, the most popular commercial varieties for the state, proved to be the most susceptible to the disease. The Livingston Stone for some unknown reason exhibited a much higher degree of resistance than in 1924; Norton, Norduke, Marvel, and Columbia again showed a high resistance. Of these the Norton variety without doubt appears the most promising both from standpoint for present substitution and for further improvement in disease resistance, quality, and yield.

Survey work shows Fusarium wilt to be a real problem in the state. In 1924, 68 per cent of the fields surveyed showed Fusarium wilt with a number of fields which exhibited a loss of from 25 to 75 per cent.

Work on the mosaic of the tomato has been mostly preliminary with the view of obtaining a clearer understanding of the symptomology of the disease and its occurrence in plants other than the tomato.

Mosaic.—Mosaic was cross-inoculated with success as follows: (1) from the potato to the tomato and to the Black Nightshade (Solanum nigrum); (2) from Physales to tomato and from the tomato to the Physales, Black Nightshade (Solanum nigrum) and yellow nightshade (Solanum villosum.)

What appeared to be four types of mosaic of varying degrees of severity were obtained on the Experimental Farm in Davis County. Three of these types continue true in symptomology and have been carried through three generations.

One of these three types has been successfully transferred to Physales and to the black and yellow nightshades. Careful experimental work is being planned in an effort to determine
the genetic relation and further expression of these three types of mosaic.

On the Davis County Experiment Farm a plot of ground was selected and counts were made to determine rate of spread of mosaic. Just previous to July 28, 1925, there was found to be an increase of 89.07 per cent in the number of diseased plants.

**Western Yellow Blight.**—Western yellow blight practically ruined the tomato crop in 1905 and again in 1924. In 1924 from 30 to 35 per cent of the crop was destroyed. The disease has again appeared on the 1926 crop. Already it has taken the major part of the crop in the St. George and Hurricane Districts. In Utah, Salt Lake, Davis and Boxelder Counties heavy inroads have already been made, and fields are common which as early as June 23 to 25 showed as much as 25 per cent crop destruction. The early appearance and the virulent condition of the disease indicated that very serious losses will result in the present crop. In many districts the crop will probably be a complete failure.

It is evident that in the three diseases—Fusarium wilt, mosaic and the western yellow blight—there is a condition that definitely threatens to become the limiting factor in tomato production. At present but little is known about the mosaic and western yellow blight, and annually they make their inroads uncontrolled or unlesssened by any attempted method of control. Intensive researches along this line are the paramount need of the industry. (Richards, B. L.)

**Project No. 34.—Plant Disease Survey.**—The object of this project has been to determine the presence, distribution, and economic importance of the various plant diseases in the state and also to discover the relationship of these diseases to cultural and irrigation practices. A further purpose of the survey is served in giving direction to our research. During the last year attention has been given especially to the occurrence and prevalence of the tomato diseases in connection with the research being conducted on these particular maladies. Other intensive surveys have been made also on the white spot and nematode of alfalfa.

**Fusarium Wilt of Tomato.**—The survey for Fusarium wilt showed 7.87 per cent of the tomato plants in the fields to be diseased. One field in Syracuse, Utah, was found to have as high as 80 per cent of the plants practically destroyed. This figure is significant when it is recalled that 68 per cent of the fields in the state in 1924, showed the disease present.
Fusarium was especially abundant in fields operated by farmers who had grown crops on the same ground for several consecutive years, thus showing the necessity of rotation.

The large percentage of disease present during so favorable a growing season for the tomato as the summer of 1925, is indicative of the importance of Fusarium as a factor in tomato production and especially during seasons of less favorable growing conditions.

**Tomato Mosaic.**—Mosaic was found to be present on from 0.5 to 100 per cent of the plants in every field entered, with an average of 32 per cent of the plants showing infection in the fields visited. An average of 10 per cent of the plants in the fields surveyed showed infection of such a nature as to seriously impair production and an average of 4 per cent of the plants was so seriously infected as to produce few, if any, marketable tomatoes.

Yield data accumulated to date indicate that such an infection of mosaic would result in a decrease of from 8 per cent in yield of the tomato crop.

The source of such a heavy and wide-spread infection presents an interesting problem in view of the relative scarcity of Solanaceous weeds and indicates that there may be some other host responsible for over-wintering and even increasing the reservoir of the mosaic virus. More survey and experimental work must be done on the weed problem.

The problem of insect transmission of mosaic is of equal importance and is in need of much careful experimental work.

What appeared to be different types of mosaic were picked up during the survey and used in inoculation experiments during the winter in the greenhouse.

**Western Yellow Blight.**—This disease has been found to occur this year in the 1926 crop in every tomato-growing district in Utah. In Washington County it has seriously damaged the crop, and in many instances has resulted in complete failure. As early as June 20-25, heavy percentages of diseased plants have formed in Utah, Salt Lake, Weber and Boxelder Counties. Even at this early date as high as 25 per cent of plants in certain fields are dead.

**White Spot of Alfalfa.**—This disease has also occurred extensively this year. During May a number of diseased fields were found in Utah and Salt Lake Counties. A more intensive
survey in Cache Valley located the trouble in 54 fields. In many cases serious damage resulted both in tonnage and in the quality of hay. The survey work has indicated clearly that this particular trouble is intimately connected with the application of irrigation water, especially after a period of drought.

**Alfalfa Disease Survey in Salt Lake County.**—In the autumn of 1925, 125 fields (comprising about 1900 acres) were surveyed for alfalfa diseases. Of the fields visited 49.6 per cent were infected with stem nematode (*Tylenchi dipsaci*). The degree of infection in the field was found to range from a trace to 95 per cent of the plants, with an average of about 40 per cent. The infected fields were confined to a strip of more or less water-logged soil in the neighborhoods of Hunter, Granger, Taylorsville, and Bennion between the South Jordan Canal and the Jordan River. Nematode was also found abundantly and operating effectively in well-drained fields in gravelly and sandy soils in the same locality.

Observations indicated that efforts to rid the fields of nematode by short-time rotation were futile and resulted disastrously to the young alfalfa after reseeding.

Root-knot nematode was found in four of the 125 alfalfa fields. These fields were confined to an area of small radius on Thirty-third Street near the Jordan River.

Crown wart (*Urophlyctis alfalfa*) was found in 16 per cent of the fields surveyed. These fields were grouped in the same area as the stem nematode.

Neither crown wart nor nematode was found in the great alfalfa-producing areas of southern and western Salt Lake County.

Dry-rotting and crown disintegration was extensive in 70 per cent of the fields and present to some extent in practically all of the fields. The exact importance of this crown injury as a factor in alfalfa culture is not known.

Heavy infestations of leaf spot (*Pseudopeziza medicaginis*) occurred in 32 per cent of the fields entered. So serious was the infection in some fields as to decrease the yield to 60 per cent by defoliating the alfalfa plants.

A study of the first-crop stubble and of the plants along ditch banks gave evidence indicative of a heavy infestation of bacterial stem blight (*Pseudomonas medicaginis*) on the first crops over the entire county.
No clear-cut evidence of bacterial root rot was found. In thirteen fields, however, abnormal yellow-zoning, somewhat characteristic of the disease, was found in the xylem of the roots of a few plants. In every case, however, the diseased yellow tissue was isolated from the cambium which was apparently healthy.

Downy mildew, gopher injury, and what appeared to be mosaic were seen during the survey. The damage caused by these agents, however, was insignificant.

Two diseases have been found to occur this year for the first time in Utah. The more important of these is that of the peach leaf curl caused by Exoascus deformans seen for the first time in the Fielding District. In this area it has practically destroyed the crop on one orchard. Should this disease become generally distributed it will undoubtedly become a limiting factor in peach production. The peach leaf curl may become very destructive in damp, cool seasons.

The second of these diseases, the yellow leaf blotch on alfalfa, has undoubtedly occurred in Utah for some time, but has for the first time appeared as an important factor in crop production. Further observations will be made during the summer. (Richards, B. L.)

Weed Survey.—The purpose of this survey was to determine the prevalence of weeds which might serve as agents in carrying over and in disseminating tomato mosaic in the state. Attention was directed particularly to the Solanaceous weeds, and was conducted along with the tomato-disease survey in Davis County, and with the alfalfa-disease survey in Salt Lake and Cache Counties.

The perennial ground cherry (Physalis) was found in 15.9 per cent of the fields visited in Davis County, 84 per cent of the fields in Salt Lake County, and 37 per cent of the fields visited in Cache County. Mosaic disease was observed on 80 per cent of the plants seen in Davis County, 85 per cent of the plants seen in Salt Lake County, and 63 per cent of the plants in Cache County.

Annual Solanaceous weeds, such as Solanum nigrum, S. villosum, and S. triflorum, were observed in 30 per cent of the fields visited in Davis County, 52.5 per cent in the fields in Salt Lake County, and 40 per cent of the fields surveyed in Cache County. Not a single plant of the annual Solanaceous weed was found infected with mosaic during the survey. (Nuffer, L. F.)

*Assistant Botanist, July 1, 1918, to June 30, 1926.*
Project No. 36.—Breeding for Egg Production.—This project was started in 1907, and the work of the past year and a half has been a continuation of the project as outlined. The aims have been (1) to develop a strain of fowls that would be heavy producers over a period of at least three years, and (2) to study inherent characteristics on this basis. There has been a gradual improvement in the flock from the start. During this period the birds in this project have made a better flock record than at any time before, and also the highest individual records. (Alder, B.)

Project No. 37.—A Study of Incubation Problems.—The work on this project has been a continuation of the study-of-time-of-hatching and its effect on egg production where the hens are held for three years.

The hens used were S. C. White Leghorns and were hatched each year about the first of March, April, May and June, respectively. The results to date indicate that for our conditions the April-hatched Leghorns give the best results during the 3-year period. Except for the first fall and early winter the March-hatched hens made lower records than any of the other groups. For some reason the late-hatched birds have made a better record during the second and third year than those hatched in March. (Alder, B.)

Project No. 57.—Poultry Feeding.—The feeding test was continued for the comparison of rations made of wheat, oats and barley or the home-grown grains and rations made largely of corn and ready-mixed feeds. The results during this period continue to show that rations made entirely of home-produced grains, properly supplemented and home-mixed, compare very favorably (from the standpoint of eggs produced and feed cost of one dozen eggs), with the ready-mixed rations and rations made largely of corn. These results indicate that the poultry raiser should consider more the comparative cost of the grains and let this determine to a considerable extent the amount of each grain that goes into the ration for laying hens.

Another phase of this project was to determine the comparative value of oyster-shell, limestone, oolite, and calcite as a grit and source of calcium carbonate for egg shell material and body maintenance. As a result of the information obtained on this phase of this project, most of the large poultry raisers are using crushed calcite instead of oyster-shell at a saving of from 50 to 75 cents per hundred. (Alder, B.)
Project No. 74.—Egg-laying Contest.—The first contest was run for 364 days with 22 entries of S. C. White Leghorns and one entry each of Barred Plymouth Rocks and White Wyandottes. Each entry contained ten competing hens and two alternates to replace losses by death. Thirteen of the entries were made by Utah poultry breeders, four by breeders in Washington, three by California breeders, three by Oregon breeders, and one by an Idaho breeder.

The competing hens made an average production for the year of 221.7 eggs. The winning pen made a record of 2488 eggs, or an average of 248.8 eggs for each hen; the winning hen made a record of 310 eggs. Every Leghorn hen entered made an average of over 200 eggs for each hen in the entry. (Alder, B.)

RANGE MANAGEMENT

Project No. 48.—Range Survey.—The purpose of this project has been to assemble data on Utah’s range resources and to ascertain relative importance of specific problems. It includes a general classification of range types and classes, their location, extent, seasonal readiness, adaptability to different classes of livestock, grazing capacity, present condition, and potential improvement.

Probably two seasons of concentrated effort will be required to complete the project if the specific data are obtained as planned. (Becraft, R. J.)

Project No. 61.—Range Reseeding.—There is ample evidence of potential increase in forage production on the ranges. Cultivated plants have been found in general not adapted to the severe conditions of drought or short-growing seasons. Nature has adapted the native flora to these range lands, and it appears promising that natural improvement may be speeded up by artificial aid in producing and planting seed.

The project was planned to cover:

1. Selection of valuable forage species
2. Collection of seed
3. Experimentation with seed production
4. Selection and planting of suitable test areas on the range

A survey has been made of the occurrence and distribution of all native plant species in Logan Canyon and adjacent areas to serve as a guide for future operations. Here also collections of seed have been made, and factors noted which affect the
production and maturing of a viable seed crop. Adverse weather and destructive pests limit the seed crop to a most surprising extent.

Plantings have been made two seasons at the Central Experiment Farm (Greenville). In 1925 the soil dried very rapidly and germination was very low. A half acre of _Bromus polyanthus_ developed a sparse stand, however, which has thickened up very well this year. Seed for this was provided by Director C. L. Forsling of the Great Basin Experiment Station of the U. S. Forest Service. This mountain brome grass has made excellent growth the second season and headed out beautifully about June 1st, the height being three to five feet. It was a most promising seed crop until smut began to show, and the total infestation is now estimated (June 16) at 30 to 40 per cent. Observation shows individual plants totally infested or totally free. Arrangements are being made for the Station Pathologist to investigate life history and control methods of this smut which occurs not uncommonly on native brome in the mountains. The relationship of the perennial habit of the grass presents an additional problem of interest.

This native brome grass, however, has exhibited remarkable vigor and has demonstrated fully its adaptability for seed production on valley lands. It is confidently expected that clean seed for future plantings can be obtained. (Becraft, R. J.)

**SOILS**

**Projects Nos. 11 and 12.—Action of Alkali and Soil Moisture Studies.**—The work under these two projects has been so closely associated that but one report for the projects is submitted at this time. The leaching experiment outlined in previous reports has been enlarged and continued. Eleven cylinders of soil from the Ballard series in Cache Valley and 30 cylinders from the soils west of Salt Lake City have been collected in an undisturbed condition and added to those reported at an earlier date. Attention has been centered on the use of calcium chloride and gypsum to increase the permeability of the soil. Calcium chloride has yielded some very promising results; gypsum acts similarly but much more slowly. The 30 cylinders of soil from the Salt Lake Area are being used to determine the minimum quantities of calcium chloride that may be used and yet affect reclamation in a short time.

It has been found that the addition of sodium salts has two important effects: (1) The concentration of the soil solution may be increased, producing a medium toxic to plants
and (2) the sodium enters the silicate complexes, replacing calcium magnesium and potassium, and yields a soil which is more or less impermeable to water and alkaline in reaction when the amount of soluble salt is low enough to be unotoxic. It is well-known that a given concentration of sodium sulphate or sodium carbonate is much more toxic to plants in solution culture than when added to the soil. An explanation of this discrepancy is afforded by vapor-pressure studies which show that the soil has the power of removing considerable quantities of these salts from solution but has little or no action on sodium chloride.

A number of heavy clay soils have been treated repeatedly with strong solutions of the salts of mono- and di-valent bases and subsequently washed free of soluble salt. The changes in the soil structure produced by these treatments and also by mechanical puddling and freezing have been studied by the vapor-pressure moisture equivalent and dispersion methods. It has been found that the mechanical treatments affect only the larger capillary spaces, whereas the chemical treatments produce more deep-seated changes. In wet soils, saturation with sodium causes a remarkable state of deflocculation which has a direct bearing on the reclamation possibilities of alkali land. This work is being continued to determine the activity of the bases in the soil in order to afford a complete explanation of the system. Two papers are being prepared covering these experiments. One paper has just been received from the press, which is as follows:


Solubility as a function of the size of particles is the problem attacked in this particular phase of the problem. Small drops of liquid have a greater vapor-pressure than large drops and small particles of a given mineral have a greater solubility in a given liquid than large particles of the same mineral. The quantitative relation between solubility and size is expressed by the Gibbs-Helmholtz Equation, and by measuring the solubility of different sizes of the mineral the surface-energy factor in the equation (which is the work required to separate one square centimeter of the solid-liquid interface) may be calculated. It is assumed that the solid-liquid surface energy is a constant. So far work has been done on a potassium-sodium feldspar and on apatite. The work on the feldspar has not been carried far enough to report. Two values, how-

*Graduate Student, Department of Agronomy.
ever, which agree well have been found for apatite. The aim of this phase of the problem has been to secure fundamental and accurate data on the work of separation of water and soil minerals. The solubility data for common soil minerals are needed in many directions, such as work on chlorosis and possible ionic concentration in the soil solution, and the surface-energy values calculated therefrom may be used to ascertain to what extent the solid-liquid surface energy of plow metal and other tools and equipment used in handling “sticky” soil must be modified in order to scour and thereby reduce the drag. (Thomas, M. D. and Jennings, D. S.)

**Project No. 49.—Soil Survey.**—The soil survey, as carried on at this Station, consists of two general types of work:

A. Field

B. Laboratory

**A. Field.**—The field work is conducted by a field party, making systematic observations on the character of the soil and subsoil in every 40-acre tract in a particular area. These observations have to do largely with soil color, texture, and origin of the soil material. On these bases the soils are temporarily mapped and classified. In the course of this work a large number of samples of soil is collected and sent to the laboratory.

**B. Laboratory.**—The analysis of these samples, both chemical and mechanical, constitutes the second phase of the work and may result in further division of the classification made by the field party.

Soil survey work began in this state as early as 1898, and by 1904 areas in Weber County, Sevier Valley, Salt Lake Valley, Utah Valley, and Bear River Valley were surveyed. These surveys, as was all of the work of that date because of its pioneer nature, were of a general reconnaissance character. No soil survey work was carried on between 1904 and 1913. Since 1913 detailed field work has been completed on the Cache Valley Area (1913), Delta Area in Millard County (1919), Ashley Valley Area (1920), and Uintah River Valley Area (1921).

Laboratory studies are partly finished on all of these areas, but more analytical work must be done before reports on the physical and chemical properties can be published.

Utah Experiment Station Bulletin No. 193, pages 10-25, gives a complete description of the work done on the Cache County Conservation District under this project. This work was done during the latter part of 1924 and early in the spring of 1925.
During the year a request came to the Experiment Station from the U. S. Reclamation Bureau for an opinion concerning the agricultural value of that tract of land located in Townships 1 North and 1 South, Range 2 West. Although bordering Salt Lake City on the west, this area is at present largely a barren alkali waste. Obviously, such an opinion could be given only after detailed field and laboratory work had been carried out. An appropriation of $200 was made by the Utah Water Storage Commission for laboratory work. The U. S. Reclamation Service furnished a man and car for the collection of soil samples. A test for total soluble salts by the electric bridge was run on more than 150 samples; 49 mechanical analyses and 50 chemical analyses of soluble salts have been completed. The following is a summary of opinion formulated from a recent report of this work: (1) A portion of the area can be reclaimed by drainage alone (particularly those areas having coarse strata in the profile). (2) There are areas of fine-textured soil which are high in soluble salt content and carry significant quantities of normal soluble carbonate which can be reclaimed only by chemical treatment. (3) The areas of these classes can be ascertained only by further detailed field and laboratory work.

The Department also rendered aid to the U. S. Reclamation Service in the nature of chemical analysis of samples of alkali soil collected by the Utah Bay District in Utah County.

Urgent requests have been made for soil surveys in other areas. Davis and Washington Counties are particularly anxious that the farming areas of these counties be surveyed in the near future. Request has come from the U. S. Reclamation Service that new reclamation projects have the soil areas carefully classified previous to the time of settlement on the project. Most of the other states have gone further in their soil survey than has Utah, and it is urgently requested that provision be made for the soil survey work to go on continuously until the entire farming area has been covered. The data collected in the soil survey should be a definite guide in cropping programs and in irrigation projects. (Jennings, D. S.)

VETERINARY SCIENCE

Project No. 78.—Injurious Effects of Sugar-beets and Their By-Products when Used for Feeding Livestock.—This project was approved as a Purnell project in September, 1925. Since that time a bibliography of the work on the feeding of sugar-beet by-products has been assembled. In this connection information has been obtained and observations made on the
methods in vogue for the handling of sugar-beets and their by-products when used for feeding livestock. Large quantities of this material are used annually for feeding livestock, and many feeders claim bad results from its use. Many of the losses affecting livestock fed with sugar-beet by-products are attributed to the use of such feeds.

During the beet harvest of 1925 some beet tops put up for silage were observed. The tops were gathered shortly after topping the beets. As much dirt as was possible was shaken out of them. The tops were then piled and soon hauled to the silo where layers of tops were alternated with layers of coarse, sweet clover hay. A horse was used for tramping the material until a mass about eight feet deep was obtained. This material was then covered entirely with fresh beet pulp and allowed to ripen.

Feeding experiments were conducted on horses, sheep, hogs, and cattle with the following results.

A. Horses.—On March 1, 1926, this siloed material was opened up and samples were secured for feeding and for chemical analysis. Beginning March 3, three horses were fed some of this beet-top silage. The silage obtained seemed to be in excellent state of preservation and apparently good feed. The animals were fed ten days before they would eat any great quantity of it. The beet-top silage was mixed with alfalfa hay so that the animals would more readily eat it. From 20 to 40 pounds of alfalfa hay with from 150 to 250 pounds of silage were given to the animals in a feed rack each day. The aim was to give them all the beet-top silage they would clean up. However, some was wasted. Nothing of an unusual nature happened to these animals, though they were observed two and three times a day. They were allowed, during the time of the experiment, all the fresh drinking water they wished.

On March 27th the animal which had eaten the greatest quantity of this beet-top silage died. Careful observations were made during the time of feeding and a complete postmortem examination of the animal was made at the time of its death. Accurate records of symptoms, death, and postmortem examination have been filed. No ill effects were noted on the other two animals, which were fed until May 5th, on which date this phase of the project was discontinued.

B. Cattle.—Several hundred head of cattle which were being fed on beet pulp and beet syrup were under observation. These animals were fed from 75 to 150 pounds of pulp daily and from 2 to 5 pounds of syrup each for 2- and 3-month periods
with apparently no ill results. Some cattle which had been fed beet syrup from barrels (where they had all they wanted) were sickened and put off feed for a few days; however, where the syrup was fed on hay and in reasonable amounts there was no trouble. Observations were made on many dairy cows fed from 15 to 40 pounds of pulp a day. All apparently were doing well. This last season seemed to be an especially favorable one for feeding animals, and very few, if any, bad results have been reported. Other years many complaints have been received regarding beet by-products. Probably the factors which are more or less responsible for this fact were an exceptionally mild winter, even temperature, and good feeding weather. It is imperative that this work be continued over a number of years for reliable results to be obtained.

C. Sheep.—For thirty days four sheep were fed all the silage they could eat with apparently good results. Each animal was given from 4 to 12 pounds each and sometimes even more. It seems that this material does not affect sheep as far as observations have been made here and elsewhere.

D. Hogs.—Four hogs were also fed beet tops with no harmful results.

Sufficient data from this experiment seem to be obtained to conclude that beet-top silage is not recommended in any quantity for horses. However, indications would warrant the statement that beet-top silage is safe for feeding to cattle, sheep, and hogs. The experiment will be continued during the coming year. (Frederick, H. J.)

Project No. 87.—Miscellaneous Veterinary Science Investigations.—During the past 18-month period considerable time and effort have been given to the following phases of work:

(1) Diseases among Animals
   A. Dairy Cattle
   B. Sheep
   C. Poultry

(2) Poisonous Plants on the Range

(1) Diseases Among Animals.—There have been several problems which have been investigated under this general division of the work. These are as follows:

A. Dairy Cattle.—The work done on this phase of the project has had to do with skin lesions of tuberculosis affecting dairy cattle. Most of the dairy cows condemned during the tuberculosis testing in the state showed only on postmortem
examination to be skin lesions. It was felt that an investigation was necessary to definitely determine whether or not all of these reactions and condemnations were the results of tuberculosis. In conference with the Chief of the U. S. Bureau of Animal Industry a request was made that the matter be investigated. Accordingly, an expert pathologist from the Bureau was sent here. On September 25, 1925, the Experiment Station secured four calves and four pigs inoculated with some of the skin lesions of condemned cows. The material was first examined in the laboratory, and germs resembling tubercle germs were found. These animals under observation were then inoculated with a suspension of these skin lesions. The animals were carefully cared for and observed by the Experiment Station. They were closely watched and tested with tuberculin on two different occasions. No reaction was observed, the tests showing in every case negative results. On June 22 these animals were slaughtered at a local abattoir; on postmortem examination no definite lesions were found on any of them. The work should be continued to determine whether or not all skin lesions on animals in the state are an indication of tuberculosis.

B. Sheep.—An investigation was begun on a disease among sheep which resembles progressive pneumonia, commonly known among sheepmen as "lunger" disease. Four affected sheep were shipped to the Experiment Station for observation. A number of remedies was tried in an effort to overcome the trouble but without success. Unaffected sheep were placed with the diseased sheep to determine if possible whether or not this disease was transmitted. As far as could be determined, it was not transmissible. Several sheep in other herds were also observed. The general report is that animals thus affected usually die during the winter months. All of the affected sheep under observation at the Station died during the winter. A trip was made to the Montana Experiment Station where work on this disease is being conducted. In Montana this is claimed to be the most serious sheep problem at the present time. The condition in Utah is somewhat similar and undoubtedly it is the same disease. Further work along this line is absolutely necessary.

Another problem among sheep which has been observed is one in which ewes die shortly before lambing. This occurs for the most part among farm flocks of sheep and has been the source of considerable loss. The investigation along this line has not been completed.
C. Poultry.—A number of outbreaks of diseases among poultry was investigated, one of which affected the hens at the Utah Station which were in the Second Intermountain Egg-laying Contest. This trouble was attributed to cholera with broken yolks. The disease was cleaned up and no further losses were experienced. A number of disease outbreaks among chickens was investigated in Boxelder County. Proper sanitary measures were recommended as well as changes in their management. A number of treatments were outlined. The condition seemingly was overcome.

(2) Poisonous Plants on the Range.—A very important problem which has confronted the state for a number of years is poisonous plants on the range. Each year at the Experiment Station complaints are registered regarding animals which have died on Utah stock ranges. Usually by the time the investigations have been made it has been too late to definitely determine the cause of the trouble. A number of plants have been suspicioned, but nothing definite has indicated that they were the causative factors. However, this spring a report was received at the Station in sufficient time to make a thorough examination and determine quite conclusively that the loco weed in a certain locality had been the ultimate cause of death of some 100 ewes. Tests were made and records of the investigation are on file which will be of material aid in future work. An effort will be made to determine, if possible, the poisonous property of this plant and to determine a treatment or method of saving the animal after the plant has been taken into the system. Therefore, further work will be done on this phase of the project. (Frederick, H. J.)

(College Series No. 225.)