

UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

WORK AND PROGRESS
of
The Agricultural Experiment Station
for the Year Ending
December 31
1929

BULLETIN 170

APRIL, 1930

Published by the UNIVERSITY OF IDAHO, Moscow, Idaho

UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

BOARD OF REGENTS

ASHER B. WILSON, President	Twin Falls
HUNTINGTON TAYLOR, Vice-President	Coeur d'Alene
MRS. J. G. H. GRAVELEY, Secretary	Boise
CLENCY ST. CLAIR	Idaho Falls
STANLY A. EASTON	Kellogg
W. D. VINCENT, Commissioner of Education	Boise

EXECUTIVE COMMITTEE

STANLY A. EASTON, Chairman	FREDERICK J. KELLY, Secretary	
HUNTINGTON TAYLOR	ASHER B. WILSON	CLENCY ST. CLAIR
COMMISSIONER W. D. VINCENT		

EXPERIMENT STATION STAFF

F. J. KELLY, Ph.D.	President
E. J. IDdings, M.S.	Director
C. W. HUNGERFORD, Ph.D.	Vice-Director
O. A. FITZGERALD, B.A.	Agricultural Editor

HOBERT BERESFORD, B.S. (Agr. Engr.)	Agricultural Engineer
JOHN SCHOLTEN, B.S. (Agr. Engr.)	Assistant Agricultural Engineer
H. W. HULBERT, M.S. (Agr.)	Agronomist
G. R. McDOLLE, M.A.	Soil Technologist
C. A. MICHELS, M.S. (Agr.)	Assistant Agronomist
F. L. BURKART	Field Superintendent
C. W. HICKMAN, M.S. (Agr.)	Animal Husbandman
E. F. RINEHART, B.S.	Associate Animal Husbandman
J. E. NORDBY, M.S. (Agr.)	Assistant Animal Husbandman
E. M. GILDOW, M.S., D.V.M.	Veterinarian
R. F. JOHNSON, B.S. (Agr.)	Assistant in Feeding Investigation
W. V. HALVERSON, Ph.D.	Bacteriologist
V. A. CHERRINGTON, B.S.	Assistant Bacteriologist
G. S. SCHILLING, M.S.	Assistant Bacteriologist
R. S. SNYDER, M.S. (Agr.)	Associate Chemist
H. P. MAGNUSON, M.S.	Acting Chemist
P. J. ISAAK, B.S. (Chem.)	Assistant Chemist
D. W. BOLIN, M.S.	Analyst
F. W. ATKESON, M.S. (Agr.)	Dairy Husbandman
D. R. THEOPHILUS, M.S.	Assistant Dairy Husbandman
H. C. HANSEN, M.S.	Assistant Dairy Husbandman
CLAUDE WAKELAND, M.S.	Entomologist
R. W. HAEGELE, A.B.	Assistant Entomologist
W. E. SHULL, M.S.	Assistant Entomologist
A. M. SOWDER, M.S. (For.)	Forester
ELLA WOODS, Ph.D.	Home Economist
P. A. EKE, Ph.D.	Economist
T. L. GASTON, M.S. (Agr. Adm.)	Assistant Economist
C. O. YOUNGSTROM, M.S.	Assistant Economist
C. C. VINCENT, Ph.D.	Horticulturist
LIEF VERNER, M.S.	Assistant Horticulturist
T. R. ASHLEE	Florist
C. W. HUNGERFORD, Ph. D.	Plant Pathologist
*J. M. RAEDER, M.S.	Associate Plant Pathologist
W. H. PIERCE, M.S. (Agr.)	Assistant Plant Pathologist
C. E. LAMPMAN, B.S. (Agr.)	Poultry Husbandmen
F. E. MOORE, B.S. (Agr.)	Assistant Poultry Husbandman
R. S. BRISTOL, B.S. (Agr.)	State Seed Commissioner
JESSIE C. AYRES	Seed Analyst
*A. E. McClymonds, B.S. (Agr.)	Superintendent Aberdeen Substation
D. A. STUBBLEFIELD	Superintendent Caldwell Substation
W. A. MOSS, B.S. (Agr.)	Superintendent High-Altitude Substation
J. H. CHRIST, M.S. (Agr.)	Superintendent Sandpoint Substation

*In co-operation with U. S. Department of Agriculture.

Report of the Director

As has been the custom in former years, a brief report for the agricultural experiment station is prepared in alternate years. This report, therefore, deals briefly with the various research undertakings of the station and a more extensive report will be issued for 1930.

The more important developments of experiment station policy during the year have been concerned with the enlargement of the Purnell Fund research undertakings, further extension of research projects to meet pressing regional situations, further progress in co-ordinating substation farm programs with central station projects, and closer collaboration between agriculture and home economics extension and research in those fields.

Few resignations have been submitted and the experiment station is benefiting from continuity of service. The state is large and agricultural conditions widely diversified. An initial period of experience in Idaho is necessary for the research worker to permit him to be most effective in adjusting experimental projects to the important needs of the state. Even greater length of tenure could be assured by an increased salary scale as compared to the one now prevailing.

Co-operation with the United States Department of Agriculture has been satisfactory and especially close collaboration has been had with the various divisions of the State Department of Agriculture.

The College of Agriculture NEWS LETTER has been used largely as the medium for disseminating new findings of the agricultural experiment station. The circulation of this paper has been maintained at approximately 15,000 and inquiry in various parts of the state indicates that it is generally read by the farmers. The style of the NEWS LETTER has been charged to conform with approved newspaper practice. The more popular method of presentation evidently has been effective in increasing the interest on the part of readers.

Publications

The bulletins and circulars published during the past two years have been written in popular style and have been in much demand by the farmers. Investigations of a more fundamental nature have been reported in technical papers and published in various scientific journals. The list of publications follows:

Bulletins.

163. Dairy Herd Improvement Through the Use of Proved Bulls.—F. W. Atkeson, H. A. Mathieson, and D. L. Fourn.
164. Work and Progress of the Agricultural Experiment Station for the Year Ended December 31, 1928.—E. J. Iddings.
165. Food Consumption and Food Expenditure With Relation to Standards of Requirement and Family Income.—Mildred W. Talbott.
166. Factors Related to the Price of Idaho Potatoes.—Richard B. Heflebower.

167. Progress Report on Prune Storage and Maturity Investigations—C. C. Vincent, E. C. Blodgett, and Leif Verner.

Circulars.

53. Factory Tests for Dairy Products.—D. R. Theophilus.
 54. Publications Available for Free Distribution.
 55. Wheat and Wheat By-Products in Swine Production.—J. E. Nordby.
 56. Alfalfa Hay and Alfalfa Leaves as Supplements in Dry Lot Rations for Finishing Fall Pigs.—J. E. Nordby.
 57. Wheat Supplemented With Tankage in Limited and Full Grain Rations on Alfalfa Forage.—J. E. Nordby.

Technical Papers.

57. New Developments in Combine Harvesting in Idaho.—Journal of Agricultural Engineering. Vol. X., No. 2, February, 1929.—Hobart Beresford and E. N. Humphrey.
 58. A Fronto-Parietal Skeleton Defect.—Journal of Heredity. Vol. XX., No. 5, May, 1929. J. E. Nordby.
 59. Sterility in Herd Boar and Reduced Size of Litters.—Journal of the American Veterinary Medical Association. Vol. LXXIV., N. S. 27, No. 6, May, 1929. J. E. Nordby.
 60. Congenital Skin, Ear and Skull Defects in a Pig.—Anatomical Record. Vol. XLIII., No. 3, May, 1929. J. E. Nordby.
 61. The Use of Dyes in the Isolation of a Nitrite Oxidizing Organism.—Chas. C. Prouty.
 62. The Use of Bacteriostatic in the Isolation of Rhizobium Leguminosarum Frank.—Journal of Agricultural Research. Ivan A. Anderson.
 63. Improved Hydrogen Electrode Cell for pH Determination.—Journal of Agricultural and Engineering Chemistry. W. B. Bollen.
 64. Controlling Perennial Weeds With Chlorates.—Journal Am. Soc. Agron. H. W. Hulbert, J. D. Remsberg, and H. L. Spence.
 65. Temporary Impotency in a Boar.—J. E. Nordby and W. B. Bollen.

Mailing List.

State of Idaho.....	14,147
States Other Than Idaho.....	4,144
Foreign	207
Total	18,498

Active Projects

A list of active Experiment Station projects follows. All investigations carried on at the several stations are in co-operation with the various departments of the home station.

Agricultural Chemistry

Coniferous timber soils investigation No. 2. Biological Activities of Helmer Silt Loam. (In co-operation with Bacteriology.)

The effect of time of irrigation on the yield, sugar content and sugar production of beets. (In co-operation with Agricultural Engineering.)

Rotation and fertility investigations at Moscow and Sandpoint. (In co-operation with Agronomy and Sandpoint Substation.)

Chemical studies of soil survey samples. (In co-operation with Agronomy.)

A study of certain types of chlorosis as found in Idaho on trees, shrubs, and herbaceous plants. (In co-operation with Agronomy and Plant Pathology.)

The protein content and yield of wheat, nitrogen content of the soil, when cropped continuously to wheat and when cropped under a definite rotation system.

Tolerance of crops and soils for alkali.

Slack spot investigations. (In co-operation with Agronomy.)

Blood studies, as an index to nutrition, health, and body functions of the laying hen. (In co-operation with Poultry and Bacteriology.)

Arsenical Spray Residue Removal. To develop efficient removal methods under a variety of conditions. (In co-operation with Horticulture.)

Drainage and reclamation of water-logged alkali and overflow lands. (In co-operation with Agronomy, Agricultural Engineering, and U.S.D.A. Bureau of Public Roads.)

Factors determining the storage of Idaho prunes. (In co-operation with Horticulture.)

A study of the influence of irrigation on soil fertility. (In co-operation with Agricultural Engineering.)

Spray residue control. (In co-operation with the State Department of Agriculture.)

Agricultural Economics

Changes of production of beef cattle, and reasons.

Agricultural economic study of irrigated farming in selected areas in southern Idaho.

A study of farm organization and management in the Palouse area of Idaho and Washington.

A study of the prices, marketing, and markets of the Dairy Products of Idaho. (In co-operation with Dairy Husbandry.)

A cost study of sacking wheat versus bulk handling of wheat in combine harvesting in the Palouse wheat area.

Agricultural Engineering

Factors underlying the economic use of water in irrigation, Sec. III. Drainage and reclamation of water-logged, alkali and over-flow lands.

A sub-project "Conditions governing the application of irrigation water" under Sec. I. "Soil and Irrigation relationships" of the general project, "Factors underlying the economic use of water in irrigation."

A study of "Plant and irrigation relationships" under general project "Factors underlying economic use of water in irrigation."

"A study of the influence of irrigation upon soil fertility," a sub-project under the general project "Soil and irrigation relationships." (In co-operation with Department of Agricultural Chemistry.)

A study of methods, equipment, crew organization, and cost of harvesting grain with combines in northern Idaho.

A study of methods, equipment, organization and cost of seed bed preparation on University farms.

A study of the methods, equipment, crew organization and cost of harvesting and stacking hay in southern Idaho.

The relation of electricity to agriculture.

A study of the cost, effectiveness, and methods of pumping for drainage and supplemental irrigation. (In co-operation with Idaho Committee on Relation of Electricity to Agriculture.)

The development of a method for structurally testing farm buildings.

A study of building requirements for poultry production in Idaho. (In co-operation with the Department of Poultry Husbandry, the Department of Extension, field poultryman, and the poultrymen of Idaho.)

Agronomy

Small grain improvement. (a) Wheat; (b) oats; (c) barley; (d) rye, emmer, flax, and miscellaneous grains. (In co-operation with the substations.)

Forage investigations: (a) Grasses and legumes for hay, seed, and potatoes; (b) cultural tests with alfalfa; (c) introduction and testing of miscellaneous forage crops; (d) seed production; (e) alfalfa improvement—(1) breeding, (2) hard seed study, (3) identification studies with seedlings.

Field and garden pea investigations: (a) classification studies; (b) cultural experiments; (c) breeding and improvement.

Corn breeding and improvement: (a) cultural experiments; (b) breeding improvement.

Weed eradication investigations.

Silage crop investigations: (a) cultural tests of corn for silage production.

Tests with commercial fertilizers.

Soil amendments: Use of sulphur, lime, gypsum, and leguminous crop. (In co-operation with Agricultural Chemistry.)

Rotation and fertility investigation.

Peat soils of Idaho. (In co-operation with Agricultural Chemistry.)

Soil survey: (a) A detailed survey of a designated area each season as funds permit. (In co-operation with the United States Department of Agriculture.)

Alfalfa seed production.

Animal Husbandry

Studies in the growth of wool.

Physiological effect of feeding rations restricted to Canadian field peas on growth and reproduction of swine.

The effect of field pea rations on the skeleton development in swine.

Hogging off field crops.

Protein supplements with barley and wheat for growing and finishing swine.

Steer feeding investigations. (In co-operation with Caldwell substation.)

Lamb feeding investigations. (In co-operation with Caldwell and Aberdeen Substations.)

Range livestock investigations.

Inheritance of skull defects in swine.

Whorls in the hair in swine.

Congenital epithelial defects in swine.

White spotting in Duroc Jerseys.

Black spotting in Ramboulllets.

Overshot (prognathism), and undershot (brachygnathism) jaw in sheep.

Turned-in eye-lids (entropion) in lambs.

Congenital ear defects in swine.

Bacteriology

Study of the blood as an index of the health and body functions of the laying hen. (In co-operation with Agricultural Chemistry Department and the Department of Poultry Husbandry.)

Study of scours in dairy calves. (Inactive.)

Legume culture preparation.

Sterility in the bovine male. (Inactive.)

Survey of prevalence of infectious abortion and its economic importance. (In co-operation with Dairy Husbandry.)

Bacillary white diarrhoea.

Study of udder infection in dairy cattle. (In co-operation with Dairy Husbandry.)

Coniferous timber soil investigations. Biological activities of Helm silt loam soil. (In co-operation with the Department of Agricultural Chemistry.)

Dairy Husbandry

A study of the normal growth of dairy cattle.

Survey of prevalence of infectious abortion and its economic importance. (In co-operation with Bacteriology.)

Weight of dairy cattle as influenced by pregnancy, age and methods.

The best winter ration for young dairy stock in Idaho. (In co-operation with Agricultural Chemistry.)

A study of the best methods of feeding calves while receiving milk.

The comparative value of various silages for milk production. (In co-operation with Agricultural Chemistry.)

Dairy farm management: (a) To encourage the introduction of dairying as a type of farming for this area of the state; (b) To determine the crops to be grown for a dairy herd; (c) To determine the proper number of animals to be maintained on an 80-acre unit of land and their management.

Official testing of dairy cows for advanced registry.

Continuous use of proved sires to breed dairy cattle that will be pure in their inheritance for high milk and butterfat producing capacities. (In co-operation with the Bureau of Dairy Industry, United States Department of Agriculture.)

Influence of kind of crops used and system of management on the value of pastures for dairy cattle. (In co-operation with the Caldwell Substation.)

Investigation of the use of dairy sires from ancestry of known production in co-operative bull associations.

Relation of physical characteristics of cow's mammary system to production. (In co-operation with Washington State College.)

Relation of feeding and management to production. (In co-operation with Washington State College.)

Cost and efficiency of raising heifers on different planes of nutrition. (In co-operation with Caldwell Substation.)

Factors affecting efficiency of cream collection by the route method in Boise Valley as measured by quality of cream and cost of collection.

Study of breeding efficiency in dairy herds.

Field study of efficiency of cream separators on Idaho farms.

The effect of standardizing milk with skim milk powder for cheddar cheese making.

Farm sterilizers.

A study of udder infections with special reference to the causal organisms, serum reaction of infected animals and methods of specified treatment.

Entomology

Aphids, control on fruit trees and garden plants.

Codling moth: Control investigations.

Eleodes beetles: Collecting and classifying all species in the state.

Investigation of sugar beet leafhopper. (In co-operation with Federal Bureau of Entomology and Utah Station.)

Oil sprays: Investigations in preparation and use of oil sprays in the control of orchard insects and their effects upon the trees. (In co-operation with Montana, Washington, California, Oregon, and with the Bureau of Entomology, United States Department of Agriculture.)

Onion thrips investigations.

Leaf hoppers of Idaho: A systematic study and collection of species. Control on fruit trees.

Mineola scitulella: Life history study and control experiments.

Wireworms: Experiments in control. (In co-operation with the Bureau of Entomology, United States Department of Agriculture.)

Pea weevil: Ecological study and control investigations.

Forestry

A forest survey of Benewah County, including a study of restocking on cut-over and burned-over lands.

A study of forest and shade tree windbreaks.

Experimental forest and shade tree planting on alkali soils.

Forest and shade tree planting in the higher elevations of Idaho.

Home Economics

Food expenditures of farm families.

A study of the methods of vegetable storage now in use.

A study of the conditions determining successful storage of potatoes.

The effect of storage upon the Vitamin C content of the Russet Burbank potato of Idaho.

Horticulture

Potato production experiments.

Experiments in the control of western yellow tomato blight by breeding and selection. (In co-operation with Plant Pathology.)

Varietal study and cultural tests in producing head lettuce.

Pruning investigations.

Orchard fertilization tests.

Variety testing of fruit trees, small fruits and vegetables.

Factors determining storage of Idaho prunes.

Apple breeding.

Factors influencing the cracking of sweet cherries.

Plant Pathology

Selections for resistance to curly top in tomatoes. (Western Yellow tomato blight.)

Studies of various virus diseases of potatoes.

A comparison of various methods of potato seed treatment.

Comparison of various treating agents for grain smut control.

A study of a sclerotium disease of wheat.

Clover mildew investigations.

A study of stripe rust of grains and grasses. (In co-operation with the Office of Cereal Investigations, United States Department of Agriculture.)

A study of mosaic and dry root rot of beans.

Poultry Husbandry

A study of the blood as an index of the health and body functions of the laying hen. (In co-operation with the Department of Agricultural Chemistry and Bacteriology.)

A study of the influence of the various levels and forms of alfalfa intake upon the interior quality of eggs laid.

The relation of humidity to the hatchability of hens' eggs.

A study of the inheritance of fecundity and egg characteristics in single comb white leghorns.

The inheritance of fecundity and plumage color in S. C. Rhode Island Reds and Barred Plymouth Rocks.

A study of the extent to which al-

falfa foliage, in combination with wheat or barley, may be used to replace yellow corn in a ration for growing chickens; and its ultimate effect on the rate of growth, health, productive ability and reproduction.

The effect of brooding and rearing in confinement on the reproductive ability of White Leghorn chickens.

Studies in the artificial hatching and rearing of turkeys.

The effect of insulating small poultry houses in Northern Idaho on room temperature, egg production and health of the birds. (In co-operation with the Department of Agricultural Engineering.)

Aberdeen Substation

(In co-operation with the United States Department of Agriculture.)

Small grain investigations: (a) Varietal experiments with wheat, oats, barley; (b) cereal breeding and selection in nursery.

Investigations in field and garden peas and beans: (a) Varietal experiments; (b) The value of the various pea varieties as nurse crop for alfalfa; (c) Seed-Bean investigations.

Breeding and selection of corn for eastern Idaho.

Potato seed cutting, and seed treating experiment.

Study of trees with respect to environment.

Duty of water for selected crops.

Seed production: (a) Potatoes; (b) Red clover and alfalfa seed.

To determine the adaptability of various ornamental trees and shrubs to higher elevations of eastern Idaho for the improvement of the homestead.

Soil fertility investigations: (a) To determine the effect of ammonium sulphate on yields of sugar beets; (b) To determine the value of manure in crop rotation, under crop rotations; (c) To compare the value of the different legumes in maintaining soil fertility in crop rotations.

Pure seed distribution: (a) Increase the distribution of pure seed of various crops which have been improved.

"The effect of time of irrigation on yield of potatoes," a sub-project of the general subject, "Plant and Irrigation Relationships." (In co-operation with the Department of Agricultural Engineering.)

"Effect of time of irrigation on yield, sugar content, and sugar production of beets." A sub-project under the general project, "Plant and Irrigation Relationships." The effect of heavy and light applications of water on different stages of growth of red clover plant in regard to red clover seed production. (In co-operation with the Department of Agricultural Engineering, Department of Agricultural Chemistry.)

A study of the alkali resistance of certain varieties of barley and strawberry clover.

A study of the grasses and grass pasture mixtures in relation to amount of forage production and palatability.

Variety tests of different strains of alfalfas.

A study of the winter hardiness of certain winter barleys.

Seed clover investigation selections for winter hardiness, mildew resistance and seed and forage.

Cereal smut investigations.

Lamb feeding investigations. (In co-operation with the Department of Animal Husbandry.)

Caldwell Substation

Steer and lamb feeding investigations. (In co-operation with the Department of Animal Husbandry.)

Pasture investigations.

Electricity in relation to agriculture. (In co-operation with the Department of Agricultural Engineering.)

Dairy farm management: (a) to encourage the introduction of dairying as a type of farming for this area of the state; (b) To determine the best combination of crops to be grown for a dairy herd; (c) To determine the proper number of animals to be main-

tained on an 80-acre unit of land and their proper management.

Farm management: (a) To place the remainder of the farm in condition to produce crops for feed or sale; (b) To determine the cost of certain crops from the standpoint of man and horse labor expended.

Corn investigations: (a) To determine the yielding capacity of introduced varieties as compared with those locally grown for the production of silage; (b) Later, a system of corn breeding will be established to produce an improved variety for this section of the state.

High-Altitude Substation

Small grain investigations: (a) Variety tests with wheat, oats, barley, and miscellaneous grains under high-altitude conditions; (b) Rate of planting oats.

Forage and miscellaneous crop investigations: (a) To determine the best variety of grasses and legumes for the production of forage and the most successful cultural practice; (b) The introduction and testing of such crops as flax, buckwheat, sunflowers, corn, etc., for the production of grain or forage; (c) Effect of sweet clover upon crop yields.

Horticultural investigations: (a) The planting of ornamental trees and shrubs for the improvement of the homestead.

Rotation experiments, primarily to discover the value of sweet clover in soil improvement.

Rotation experiments with peas and wheat.

Field and garden pea investigations: (a) To determine the varieties best adapted to dry lands.

Sandpoint Substation

Grain and field pea investigations: (a) Variety tests of winter wheat and barley, spring wheat, barley, oats, corn and field peas; (b) Rates of planting winter wheat; (c) Rate and date of planting field peas; (d) Effect of date of seeding corn and number of plants per hill upon yield; (e) Effect of spacing on yield of wheat.

Root crop investigations: (a) Potato variety test; (b) Potato seed treatments; (c) Date of planting potatoes; (d) Spacing of potatoes; (e) Maturity of seed potatoes and effect on yield.

Sheep management: (a) Cost of production.

Forage crop investigations: (a) Legume variety test; (b) Grass variety test; (c) Annual hay crop; (d) Clover and alfalfa seed production; (e) Pasture experiments; (f) Alfalfa variety test; (g) Experiments with reed canary grass; (h) Re-seeding of burned-over land.

Soil investigations: (a) Rotation experiment; (b) Sweet clover and manure rotations with winter wheat; (c) Sulphur fertilizers on alfalfa; (d) Cultipacking and harrowing experiments with grain; (e) Cultivation of alfalfa; (f) Experiments with gypsum.

Progress of Investigational Work

Detailed reports of the various departments and branch stations are prepared each year by heads of departments and substation superintendents. Brief abstracts of these reports will be found in succeeding pages.

Agricultural Chemistry

New Project.

Material progress has been made on the major projects under way. The preliminary work on a new project, the relation of irrigation to fertility losses, shows wide differences in nitrate content from different areas. Limited areas will be studied in detail next year.

Chlorosis Studies.

Soils from the Decatur orchard at Filer show high calcium carbonate ranging from 5 to 30 per cent but with little correlation with chlorosis. Small amounts of Fe and Mn are present. In soils treated with Fe SO_4 the water soluble Ca and SO_4 were greatly increased. The pH value is about 8.5 but shows no correlation with chlorosis. The orchard was scored three times the past season. It shows an improvement in condition over the past year, but not definitely correlated with the special treatments.

Detailed studies of the leaves are in progress, including determination of inorganic constituents and pectin in chlorotic and normal plants from Twin Falls and from Moscow. During the summer, studies of the saps were made in the field and laboratory. pH determinations do not show positive correlation but the conductivity is consistently higher for the chlorotic trees.

Slick Spot Investigations.

The slick spot studies in the field gave a good crop of corn making accurate mapping possible. Replaceable calcium is present in large amounts in both slick and normal, and sodium in small amounts. Total replaceable content is greater in the slick than in the normal soils. The upper horizon is low in replaceable bases, the second very high and then decreasing with depth. This agrees with the normal soils.

Spray Residue.

Arsenic determinations have been made on apples cleaned by different washing methods. The use of heat with HCl seems most efficient. In co-operation with the states of the Northwest, studies have been made on the relation of oils in the sprays to removal. In general oil increases the difficulty of removal, especially with the heavier oils.

Alkali Reclamation.

The alkali reclamation work has progressed satisfactorily, but the highly deflocculated soils high in CO_3 continue to be barren. An 18-inch well 30 feet deep has been installed. This is lowering the general water table, and slightly affecting the perched water table. A complete report of progress on this project usually is prepared each spring.

Helmer Soil Studies.

Studies on biological activities in Helmer soils have been carried through one more series of crops. The return of crops, especially legumes to the soil, slowly is increasing the nitrification in the virgin soils. The CO_2 production does not seem to be proportionate to crop production, nor to the return of plant materials to the soil.

Blood of Laying Hens.

The study of the blood as an index to health and body functions of the

laying hen has been carried through four periods. Analyses have been made on pooled samples of each pen, and on three representative individuals from each pen. This is establishing useful metabolism curves but the work has not progressed far enough to warrant conclusions.

Agricultural Economics

The research of the department has been directed to the problems of helping the farmer adjust his farm business in such a manner as to enable him to realize the highest net return for his labor and the use of his land and capital.

Emphasize Outlook Material.

Part of the research effort has been directed toward making the price and production outlook material which is being issued by the United States Department of Agriculture more useful to the farmers of the state. The basis for making potato outlook reports especially has been broadened and made more reliable by a bulletin entitled "Factors Relating to the Price of Idaho Potatoes." The trend of potato prices in Idaho this season so far confirms the accuracy of the method employed in the bulletin.

Study Beef Business.

A similar price analysis study has been completed for beef cattle. It is hoped that this analysis may be used to good advantage in giving the long-time outlook for beef cattle in the Pacific Northwest.

Southeastern Idaho Investigations.

To determine to what extent and how a farmer may adjust his business to prospective changes in prices and changes in other conditions, detailed farm records have been taken in Franklin, Jefferson, and Twin Falls counties. These records have been summarized and analyzed and will be used as a background for helping committees of farmers from these counties in recommending plans for successful farm organization and management.

Boise Valley Study.

An economic study of the Boise Valley has given a good background for work similar to that mentioned above for Franklin, Jefferson, and Twin Falls counties.

Marketing of Dairy Products.

As another step toward the profitable operation of farms, a study of the marketing of dairy products of the state can go a long way in promoting more efficient handling of dairy products and thereby securing higher prices to the dairymen.

Farms in Palouse Region.

A study of farm organization and management of grain farms in the Palouse area has resulted in definite suggestions for profitable systems. Plans for four different systems for tractor-powered farms have been made available, and plans for seven systems in which horses are used will soon be available. The probable income and expenditures of both systems have been outlined in detail.

Agricultural Engineering

Research studies in the Department of Agricultural Engineering are confined chiefly to projects outlined on a co-operative basis with other departments of the Agricultural Experiment Station.

Loss of Fertility.

Among the new problems being studied are the loss of fertility due to excessive application of irrigation water and the pumping for both drainage and irrigation from the same wells. Due to the shortage of storage water, the supplemental irrigation water resulting from the pumping proved of special importance. Irrigation water was secured by means of pumping at approximately one-third of the cost of storage water delivered at the same point.

Reclamation of Alkali Lands.

In co-operation with the Department of Agricultural Chemistry, most of the work done on the reclamation of alkali lands has been an attempt to secure more effective drainage on the plots being studied at Caldwell. Working with the Aberdeen Substation, data has been secured on the effect of the time of irrigation on sugar beets and potatoes. Similar work with the irrigation of beans has been carried on at Twin Falls in co-operation with the Department of Plant Pathology. In this study the effect of irrigation on the control of plant disease is combined with the study of soil moisture and plant growth.

Power Farming.

The work in the field of farm power and machinery has consisted of field studies of the operation of the combine in north Idaho for harvesting wheat and peas. Detailed records were kept on the entire operation of six combines which covered a total of 3,102 acres during the season. Of this, 544 acres were peas which were combined direct by means of home-made attachments used on two of the machines. Other studies in this field consist of a search for new methods of tillage and improved methods for harvesting alfalfa hay under irrigated conditions.

Electricity on Farms.

In co-operation with the Idaho Committee on the Relation of Electricity to Agriculture, the study of the electrification of the Caldwell Substation farm has been continued. The electric motor has been used for general farm power for grinding feed, filling silo, and hoisting hay. The saving in time and improved distribution of labor obtained with the electric motor has been more important than the saving in energy costs.

Household and dairy refrigeration studies have been continued both at Caldwell and Moscow. The use of electricity in the farm home and laundry has shown the washing machine to be one of the greatest labor-saving devices operated by electric power.

Farm Buildings.

The first year's study of the problem of testing farm buildings structurally has consisted of a survey of the farm building requirements in the state. Preliminary work on scale models in the laboratory indicated that pressures below atmosphere are created under certain conditions and

that such pressures may be more destructive than the straight force of the wind.

Housing Requirements for Farm Flock.

Co-operating with the Department of Poultry Husbandry the housing requirements of the farm flock are being studied by comparing the insulated and uninsulated laying houses. Records show that the importance of insulation may be found in the time of occurrence rather than the control in the degrees of temperature; thus making it possible to follow lighting schedules, feeding practices, and other phases of farm flock management that fit into the most desirable periods of the day.

Agronomy

Weed Eradication.

Sodium Chlorate diluted at the rate of one pound of the chemical to a gallon of water has proved generally effective in the control of quack grass, morning glory, Canada thistle, Russian knapweed, and yellow toad flax. In the irrigated areas, three pounds of chlorate should be applied per square yard for best results. In the dry farm and non-irrigated areas, a sufficient quantity of the standard solution to thoroughly cover the weed growth should be used. White top, blue flowering lettuce, and perennial sow thistle have not been uniformly successfully controlled. Additional information from 1929 experiments will be available next spring.

Forage Crops.

Extensive strain tests of sweet clover, red clover, and alfalfa are being carried on at Moscow. In the alfalfa strain test, Ladak, a variety recently distributed by the United States Department of Agriculture, has given the highest yields. However, under Idaho conditions this variety does not produce a hay of as satisfactory quality as that of Grimm alfalfa. For the fifth consecutive year, satisfactory seed yields of Grimm alfalfa have been secured. The prerequisites of seed production in the Palouse area are a thin stand, not more than one plant to the square foot, and utilization of the first growth. Rate and date of seeding trials have shown that eight pounds of Grimm alfalfa seeded early without a nurse crop produces the maximum yields of hay. Common alfalfa seeded ten pounds of seed to the acre should be used. For the second consecutive year profitable seed yields of red clover have been secured by using a similar stand to that required for hay production.

New Pea Variety.

Idabell, a selection from Bluebell field peas, has been distributed to farmers in the Palouse area this season. This variety has been tested for a ten-year period and has proved to be the highest yielding variety for Palouse conditions. Other varieties which produce satisfactory yields for forage purposes are White Canada, Bluebell, and Kaiser.

Nek Sweet Clover Strain.

A new strain of sweet clover having purple seeds, a crown similar to alfalfa, and non-shattering of seeds, has been developed by the Idaho station. Seed is not yet available for distribution.

Cereal Investigations.

Mosida and Triplet have proved to be the high yielding winter wheats over a period of years. Several selections for winter hardiness, made from a cross of Fortyfold and Federation, have shown considerable promise and are to be increased and included in the varietal trials. In addition, a number of crosses between Mosida and other promising varieties have been made. Co-operative winter wheat nurseries have shown that Mosida is the outstanding variety for the cut-over sections and Sherman for the dry farm areas of southeastern Idaho. Both of these varieties are now widely distributed among farmers of the respective sections.

Test Australian Wheat.

Binya, one of the spring wheat varieties introduced from Australia, was the high yielding variety in the spring variety test. Other varieties giving satisfactory yields were Jenkin, Federation, and Hard Federation.

Barley Varieties.

Trebi Barley is still the outstanding variety over a period of years. This season it was outyielded at Moscow by Ezond, a smooth awned variety developed by the Aberdeen substation. Other smooth awned varieties such as Velvet, Sparton, and Glabron have not given as satisfactory yields as the standard varieties.

Smut Resistant Oats.

Markton oats are the high yielding variety over a period of years. This variety is smut resistant and has become quite widely distributed throughout the farming districts. Victory and Idamine are two other varieties which are better adapted than most of the other varieties commonly grown.

Use of Gypsum.

Gypsum and sulphur have proven to be important soil amendments when legumes are to be grown in the cut-over areas. Both of these products have given profitable yields over the cost of application.

Deep Tillage.

A combination of deep tillage, the use of alfalfa and sweet clover as a cover crop, and more thorough irrigation have shown promising results in the improvement of the chloritic condition found in many Idaho orchards. Further work upon this problem is contemplated next season. A study of the distribution of acid soils in the state was started this season. Such a survey seems decidedly necessary since the use of lime as a soil amendment is being recommended by commercial companies in all sections of Idaho. There is also a need for considerable investigation work in regard to the effect of phosphorus upon the yield of crops in irrigated sections.

Dry Farm Tillage Practices.

Tillage work, using a chisel as a substitute for the plow in seed bed preparation, has been started in southern Idaho. It is believed that cultural practices in dry farm sections will change materially due to the development of new machinery in the next few years. Similar work has been begun in the drier areas of northern Idaho where wheat is the principal crop.

Soil Surveys.

The soil survey of Gooding county was completed this season. In addition, a new survey was started in Benewah county, the completion of which will require the greater part of the coming summer.

Animal Husbandry

One of the major investigational undertakings of the Department of Animal Husbandry is the utilization of Idaho-grown feeds in the finishing of steers and lambs for market conducted on the Caldwell and on the Aberdeen substations. Reference to the work for the past year will be found in the reports of the substations.

Swine Feeding Investigations.

In comparing wheat supplemented with tankage in limited and full grain rations on alfalfa forage it was found that 10 pigs with an average initial weight of 51 pounds on a limited ration of 15 parts wheat and 1 part tankage gained 1.28 pounds per day for 94 days, requiring 338 pounds of wheat (ground) and 22 pounds of tankage for each 100 pounds gain, while 10 similar pigs on a full ration of 13 parts of wheat and 1 part of tankage gained 1.45 pounds per day for 83 days, requiring 348 pounds of wheat and 27 pounds of tankage for each 100 pounds of gain.

The total feed required for each 100 pounds gain was less on the limited ration. However, the lot on a full ration reached the market 11 days earlier, on September 6, when the price was appreciably more than enough to offset the slight increase in cost of production. (Station Circular 57.)

A lot of 8 fall pigs with an average initial weight of 85 pounds gained 1.08 pounds daily for 98 days on a ration of 14 parts of ground barley and 6 parts of cracked Canadian field peas, requiring 330 pounds of barley and 142 pounds of peas for each 100 pounds of gain. A similar lot gained 1.2 pounds per day for 94 days when fed a ration of 14 parts barley, 6 parts peas and about 1 part ground alfalfa hay, requiring for each 100 pounds of gain 306 pounds of barley, 131 pounds of peas and 25 pounds of ground alfalfa hay. (Station Circular 56.)

Eight 80-pound fall pigs, fed ground barley alone for 84 days, gained .84 pounds daily and required 580 pounds of barley for each 100 pounds gain. Another similar lot gained 1.3 pounds daily on a ration of 13 parts barley and 1 part tankage. Each 100 pounds gain required 446 pounds of barley and 34 pounds of tankage. A third lot gained 1.45 pounds daily and required 430 pounds of barley, 28 pounds of tankage and 20 pounds of alfalfa leaves for each 100 pounds of gain on a ration composed of 15 parts barley, 1 part tankage and about 1 part alfalfa leaves. (Station Circular 56.)

"Overshot" and "Undershot" Defects in the Jaws of Sheep.

As a result of systematic matings specific information is being made available which indicates that this defect is definitely inherited.

Skeletal Defects in Swine.

A preliminary report of this defect has been published in the Journal of Heredity, Vol. XX, No. 5, May, 1929.

Whorls in the Hair of Swine.

The inheritance of this character has been studied for a number of years. It has been proved to be inherited and it appears that the type of inheritance is not simple.

Spotting in Duroc Jerseys.

White tends to spread in this breed. Specimens have been produced with a complete white belt, all four legs and the tip of the tail white.

Impotency in Boars.

Boars have been studied that showed pronounced inability to produce functional spermatozoa. One case has been reported in detail in the Journal of the American Veterinary Medical Association, Vol. LXXIV, N.S. 27, No. 6, May, 1929, pp. 911-914.

A paper covering a case of temporary impotency in a boar will appear in the Cornell Veterinarian July, 1930; Vol. XX, No. 3. Studies are being made with a view of determining what specific affects environment or the plain of nutrition may have on this problem.

Defective Ears in Swine.

This defect is in the form of a dwarfed external ear, with the absence of an ear opening. It has been proved heritable and progress is being made in an effort to analyze the type of inheritance involved.

Oestrus Ovis in Sheep.

A study of the correlation of nasal discharge and infestation with Oestrus ovis grub in sheep as well as the extent of injury to infested sheep has been carried on.

Rambouillets showed a lower percentage of muco purulent nasal discharge (7+%) than Panamas (25%), Hampshires (28+%), Suffolks (21+%), Lincolns (18+%), or Southdowns (24+%). A total of 258 head were examined.

Autopsy data on eight sheep that died or were killed show the prevalence of grubs and the type of lesions produced. The number of grubs varied from two to fourteen per sheep. The lesions found consisted largely of an accumulation of purulent material in the sinuses affected as well as in the nasal passage proper. Inspissated pus and calcified material were found in long standing cases.

Elimination of Infectious Abortion.

Following three consecutive monthly tests, the last one conducted January 22, 1929, six positive reacting animals were removed of 87 pure-bred Holstein and Jersey cattle making up the herd. Since the removal of these reactors three abortions have occurred and three additional tests have been made. In no instance have such tests detected additional reactors nor did any of the aborting animals react or exhibit evidence of infection with the organism responsible for Bangs disease (contagious abortion).

Four tests at 90-day intervals have been made on the beef herd. The first test, conducted December 6, 1928, revealed 19 suspicious or positive reactors of 76 beef animals tested. The last test, conducted September, 1929, revealed 14 reactors, two of which were new cases that had de-

veloped. Several reactors had been sold in the intervals between tests. This work is to be continued.

Bacteriology

Microbiological studies have been in progress for several years for the purpose of finding an explanation and remedy for the slow rate of decomposition of organic residues and the low crop-producing powers of newly cleared forest soils. Two representative soils have been studied, one a virgin forest soil and the other a similar soil which has been under cultivation for the past 15 years.

Forest Soils.

Laboratory and greenhouse studies indicate that the depressing factor present in raw cleared forest soils is not toxic to the ammonifying organisms appears to be inimical to the growth of the organisms responsible for the formation of nitrates in the soil. The value of fertilizer amendments is more apparent in the virgin than in the cropped soil. The influence of lime in promoting microbial activity applied either with or without gypsum is not only evidenced by the gain in nitrates and increased numbers of bacteria present but also by the amount of Coproduced by the decay processes active in the soil. Data concerning this phase of the problem are being submitted by the agricultural chemistry department.

Salmonella Pullorum Infection of Fowls.

The relative merits of the test tube microscopic agglutination test as compared with the rapid plate test have been studied by running them simultaneously on 2200 samples of sera. Four and six-tenths per cent of the fowls tested reacted positively to the tube method and 5.6 per cent by the rapid plate method. These tests seem to indicate a higher degree of reliability in the test tube method.

Supplementary Poultry Disease Studies.

(a) The chemical nature of the constituent in fowl serum responsible for non-specific precipitations in serological antigens.

Qualitative and quantitative studies indicate that precipitating sera contain a significantly higher lipoidal content than do non-precipitating sera. Significant differences in their protein content do not occur. These data indicate that the constituents in fowl sera responsible for the non-specific precipitations are lipo-proteins and neutral fats.

(b) Routine diagnostic tests for *Salmonella pullorum* infection.

In the 1929 season, 75 flocks comprising 24,500 birds were tested by means of the agglutination test for *Salmonella pullorum* infection. Twelve or 16 per cent of the flocks were found free from infection. In the remaining 63 flocks, 1,043 reactors were found, which is 4 per cent of the total number of birds tested.

(c) Use of ipecac in the treatment of infectious entero-hepatitis.

Blackhead in turkeys has commonly been treated by giving powdered ipecac mixed with the feed or drinking water, administering the drug in the fluid extract form directly into the ceca. Both oral and rectal injections in chickens indicate that a dose of 0.025 gms. of the ether soluble alkaloids per kilogram of body weight to be non-toxic. Further tests,

using 0.0165 gms. as the dosage, were found to be innocuous and in the limited number of cases where it was employed in a natural infection arrested the progress of the disease. It was noted that turkeys exhibit individual idiosyncrasies toward this drug.

(d) Brucellosis in Fowls.

In order to check on the frequency of such infection in Idaho samples of sera submitted for diagnosis of *Sal. pullorum* infection were simultaneously tested against *Brucella abortus* antigen. Of eleven flocks with a total of 2,200 birds four contained reactors to the test. The highest percentage of infection found was ten.

Studies in Udder Infection.

Serological and cultural studies have been made in which known streptococci and unidentified strains from diseased udders have been used, with the view of establishing a better basis of classification. In the light of experiments conducted it seems that agglutination is not a desirable means of identifying or arranging streptococci into serological groups.

Studies concerning the bacterial flora of normal and diseased udders have shown that the occurrence of mastitis in cows was associated with an abnormally high bacterial count as determined by the plate method when lactose agar is used. The kinds and numbers of bacteria present indicate that a fairly complex microflora may be present during the course of the disease.

Study of the Blood of the Laying Hen.

This initial report purports data collected on pens of hens fed on variable protein rations. Animal proteins were used to make up high protein, medium high, and normal protein rations whereas a check pen received no animal protein. Analyses of pooled samples of blood from each pen have been made and individual birds have been selected for total analyses and for pathological study at periodic intervals. From the pathological standpoint the data indicate that any of the rations are compatible with health. If the gain in body weight and maintained high production level are taken as criteria of optimum nutrition, then rations containing the higher animal protein levels are superior.

Infectious Abortion and Its Economic Importance.

This work has been extended and organized so as to secure several sets of data on the cattle represented by three dairy herd improvement associations located in widely separated areas. Of 1500 cows tested representing 76 herds, 58 herds were found to harbor infected animals. A total of 195 cows reacted positively, which is equal to 14 per cent of all tested.

Routine tests made on 1155 miscellaneous samples indicate an infection incidence of 21.5 per cent. This figure is much higher than was reported above because the sera was generally from selected cases where practitioners or dairymen wish to confirm their convictions as to the presence of the disease.

Miscellaneous Services.

Cultures of root nodule bacteria sufficient to inoculate more than 12,000 acres of legumes were distributed during the year.

Many samples of milk and water have been tested and pathological

material is frequently sent to the laboratory by physicians for examination.

It seems highly desirable to promote the use of the laboratory by physicians, public health workers, and the public in general with the view of aiding in the dissemination of information and in improving the general health conditions of northern Idaho.

Dairy Husbandry

The Dairy Herd.

The average production of the dairy herd during the past year was 14,136.9 pounds of milk and 496.17 pounds of butterfat per cow. The monthly average number of cows in milk was 34.50. Twenty-seven official production records were made, of which 23 were long-time records of ten months or a year. Three of the records were over 700 pounds of butterfat and eight state records were broken.

Breeding Studies.

A co-operative project in the Holstein herd with the Bureau of Dairy Industry, United States Department of Agriculture, is on the continuous use of proven sires to breed dairy cattle pure in their inheritance for high milk and butterfat production. To date 96 females have been used in this experiment, 14 of which were foundation animals. Of the 82 offspring, the number of each generation obtained is 26 F¹, 26 F², 19 F³ and 11 F⁴. Fifty-three of these are still in the herd and 48 of the 82 have completed yearly records. Eight bulls have been used, four of which have been proven and three others will be proven in another year. This project will continue.

Bull Association Studies.

The project on co-operative dairy bull associations was in co-operation with the Bureau of Dairy Industry, United States Department of Agriculture, until July 1, 1929. Since then it has been carried as a state project. Four and one-half years' work has been completed and a report published on the first three years' results.

Normal Growth Studies.

Normal growth studies on the Holstein and Jersey breeds have been in progress for about twelve years. This project will continue.

Breeding Efficiency.

A field study of breeding efficiency in dairy herds has been in progress one year. Data are being gathered on about fifty herds. Such factors as calf crop, abortion tests, production records, feeding methods and management are being studied.

Calf Feeding Investigations.

Seven calves were fed skim milk, hay and grain, the skim milk being limited to 12 pounds per day for the entire six months period. The calves all made more growth than normal and appeared thrifty. The results will be checked against the same total amount of skim milk, but fed in larger daily quantities over a shorter period of time.

Standardization of Milk for Cheese Making.

Milk having a ratio of fat to serum solids of 1:2.4 was standardized by the addition of skim milk powder to a ratio of 1:2.8. The yield of cheese was increased 11.6 per cent and the cost of raw products per pound of cheese was reduced 0.9 of a cent. The cheese was of satisfactory quality as measured by flavor and body and texture score and chemical analysis.

A Study of Udder Infections.

In co-operation with the Department of Bacteriology, bacterial counts were taken on the first milking, the middle milking and the strippings from each quarter of the udders of 12 cows. Not only did the cows vary greatly in the bacterial content of their milk, but the individual quarters varied considerably in some cases. The fore milk was highest in bacterial count with the middle milk the best measure of the number in most cases. Cows with garget tendencies were very high in count. An unsuccessful attempt was made to identify or arrange streptococci into serological groups by agglutination tests.

Systems of Cream Collection.

The systems studied consisted of cream stations and contract hauling by trucks. Results indicate that cheaper collection would be possible if the creamery owned the trucks and had a better organization of routes. The average cost under the two methods studied was in both cases about three cents per pound of butterfat.

Official Testing.

During the past year representatives spent 286.5 days in the field on official testing work. Twelve or more breeders were served each month.

Babcock Glassware Calibration.

During the past year 139 packages containing 8,651 pieces of glassware were checked and etched with "S. G. I." if found accurate. Of this number 21 pieces were broken and 142 were found to be inaccurate.

Entomology

Alfalfa Weevil.

No general survey was made in 1929. It is known the insect is present, but not causing loss, in several southern Idaho counties.

Beet Leaf Hopper.

Co-operative work was continued with the Bureau of Entomology, United States Department of Agriculture. Station phases comprise a study of desert plant associations, determination of population areas, ascertaining seasonal host importance, collecting data on biology, parasitism, climate, etc. Selected strains of sugar beets continue to show less curly top disease and marked increase of yield over commercial beets, and retention of desirable qualities. Life cycle observations indicate three generations in southwestern Idaho.

Destructive Prune Worm.

Biology and control studies of *Mineola scitulella* were continued. Approximately 10 per cent of larvae are parasitized by six different species

of hymenoptera. Control was negative with dormant or delayed dormant sprays. Nicotine sulfate (1-800) combined with dilute oil emulsion, was effective in killing larvae soon after emergence from hibernacula but it became increasingly less effective as the season advanced.

Western Oil Spray Co-Operative Project.

Idaho, co-operating with other states of the Northwest, and British Columbia, continued investigations in the use of oil sprays for insect control. Comparing lead arsenate alone and in combination with oil, the combination produced 15 per cent more sound apples as a two-year average. Oil alone has proved ineffective in codling moth control. An oil-nicotine combination following early cover sprays of lead arsenate produces a high degree of control with low residue.

Apple trees sprayed with 6 per cent oil in mid-winter showed no injury. Those sprayed after growth started were injured.

Experiments indicate oil of 50 to 70 sulfonation test can be safely used for dormant spraying. Oils for summer spraying should have a sulfonation test of not less than 85 with a viscosity of 65-75.

Wireworms.

Five thousand dollars were appropriated by the last session of Congress for wireworm investigations by the Bureau of Entomology, United States Department of Agriculture, in co-operation with the Idaho Experiment Station, and this new project was initiated in August, 1929.

Farm Forestry

Windbreaks.

The experimental project in farm forestry has dealt primarily with windbreaks. In addition, there has been some attention given to shelter belts and to the planting of trees to determine their adaptability to various concentrations of alkali.

Data have been assembled on the windbreak studies and this project was completed during the past summer. Many of the trees on the alkali land experimental plots died during the season of 1928 and were replaced in 1929. Data were taken on the survival of the trees at Caldwell and also on the survival of trees in Caribou county at a high-altitude location. The objective in Caribou county is to determine the adaptation of forest and shade trees to higher elevations.

Experimental Plantings.

The trees on the alkali experimental forest and shade tree planting near Caldwell, which died the season of 1928, were replaced the spring of 1929 in order to obtain a larger numerical basis and thus make the data more reliable.

Data were taken on the survival of the trees at Conda (Caribou county), the location of the high-altitude experimental forest and shade tree planting. Progress reports of the foregoing two experimental plantings are now available.

Home Economics

In home economics the investigation into the effect of storage on the vitamin C content of the Idaho Burbank potato has been carried through one crop and a second season's product is now being studied. Before any definite conclusion can be made in regard to changes in vitamin content it is essential that the results of feeding with a comparatively large number of animals should be available. With the limited number of results now available, however, it would seem that the young growing tubers when cooked have greater anti-scorbutic value than do cooked mature tubers either before or after storage.

Data accumulated in connection with the study of the food requirements of the farm family have been published as Experiment Station Bulletin No. 165, "Food Consumption and Food Expenditures in Relation to Standards of Requirements and Family Income."

Horticulture

During the past year attention has been directed toward various research problems which have been mentioned in previous reports. There has been no essential change in the character of the projects during the year. The progress made in most of these lines of investigation has been satisfactory although unfavorable climatic conditions have interfered some with the work in progress. The season was on the whole extremely dry, and horticultural crops at the station suffered considerably from the drought. This report is intended to give only a brief outline of some of the work accomplished for the year 1929.

Apple Breeding.

Compilation of data which have accumulated on the apple breeding project seems to show inheritance in certain characters in apples. For example, from the material at hand the genetic constitution of some of the parents involved may be ascertained. Evidently Ben Davis is more prepotent than Esopus in transmitting tree shape; carries factors for medium to early bearing; tends to be dominant over Jonathan, Wagener, Esopus, and Rome in form of fruit, and carries factors for oblong and oblate fruits; is more prepotent than Jonathan, Esopus, Wagener, and Rome in the transmission of color of skin; does not carry yellow, but carries factors for solid red and striping; carries determiners for small and large fruits; carries factors for inferior and desirable flesh texture; is more prepotent than Jonathan and Wagener in transmitting thick skin; tends to be dominant over Jonathan in color of flesh, and carries factors for wide range of colors; carries sweetness as a recessive; and carries determiners for good as well as poor quality.

A study of inheritance of leaf characters was also begun late in the season of 1929. The following characters were observed in 29 seedlings of Wagener and Ben Davis parentage; size, shape, texture and serrations of the blade; type of petiole; tendency of blade towards flatness, folding, or waviness; and angle of growth from the stem, *i.e.*, upright, spreading or drooping.

Cracking of Sweet Cherries.

Results of a study of factors influencing the cracking of sweet cherries in the Lewiston district substantiate the conclusions of last year in showing no direct relationship between soil moisture contents, above the wilting point, and this type of injury. A new phase of the problem developed this year has shown a significant, temporary influence of fruit turgor on severity of cracking.

Storage of Prunes.

The prune storage and maturity experiment conducted in the Boise Valley for the past two years was continued in 1929 with but minor changes in the plan of procedure. In the main, the results secured this year support the conclusions drawn from the preceding two seasons' work. A progress report covering the first two years of this experiment, with temporary recommendations, has been published as Station Bulletin No. 167.

Orchard Fertilization.

The fertilizer experiment on prune trees in the Boise Valley has again shown a significant increase in tree growth and yields from the application of one-pound, two-pound, four-pound, and six-pound treatments, per tree, of ammonium sulphate. The six-pound treatment did not show a significant increase in yield over the two-pound and four-pound treatments and caused excessive vegetative growth.

Plant Pathology

Marked progress has been made in a number of investigations carried on by the Department of Plant Pathology. As space will not permit a complete review of all of the projects under way, only a few of the outstanding results will be cited.

Bean Diseases.

Careful roguing of isolated fields and greenhouse indexing of certified seed lots of Great Northern beans has been effective in controlling bean mosaic in southern Idaho. Isolation is an important factor and the thinly settled portions of the bean growing section are more favorable for seed growing. Selection for resistance to mosaic in the Great Northern variety has shown marked promise. Several selections have been made which have remained practically free from mosaic and have outyielded the commercial strains for the last two years. Selection and breeding for resistance to mosaic in several garden varieties as well as in the Great Northern variety is being conducted.

Control of Clover Mildew.

The use of sulphur dust applied at the rate of twenty-five pounds per acre was effective in controlling clover mildew and materially increased the yield of clover seed.

Seed Treatment.

In a comparative test of various methods of seed treatment for the control of cereal smuts, although some of the organic mercury compounds

gave satisfactory control of covered smut of oats, none of them was more satisfactory from the standpoint of control, cost, and ease of application than the Idaho modification of the concentrated formalin spray method, using one part of formalin to ten parts of water. Copper carbonate dust again proved most satisfactory for stinking smut control.

Bacterial Wilt of Alfalfa.

A survey conducted in southern Idaho this year revealed the fact that the bacterial wilt of alfalfa is widespread in that region. All the older stands of alfalfa have been destroyed in some sections. Selection for resistance and a study of cultural practices will be undertaken in an effort to combat the disease.

The following reports of progress are in manuscript form and will be published in the near future: (a) A new and serious sclerotium disease of wheat in Idaho; (b) A summary of ten years' tests of various fungicides for the control of grain smuts; (c) Studies of germination of spores of stripe rust caused by *Puccinia glumarum* (Schm) E. + H., in co-operation with the United States Department of Agriculture.

Poultry Husbandry

Relative Humidity in Relation to Hatchability of Eggs.

A horizontal dew-point determining instrument has been devised for accurately determining humidity in various types of incubators. The common precision hair-hygrometer has been found to be inaccurate in registering relative humidity in incubators until properly adjusted. When such adjustment is made by the use of this dew-point instrument, the hair-hygrometer will register the relative humidity sufficiently accurate to be relied upon. Field observations at hatcheries using hair-hygrometers as a means of measuring humidity have disclosed all instruments observed to be incorrect, some giving readings as much as 20 per cent from the true amount.

Relative humidity of forced draft incubators may be secured by the use of wet bulb hygrometers. To be accurate, however, the following conditions have been found essential: (1) A long thin mercury bulb on the thermometer; (2) A constantly moistened wick; (3) A water reservoir in such a position that the wick is on a gradual incline from the water to the thermometer; (4) Not over one inch of exposed wick between the reservoir and the end of the thermometer.

Data thus far secured seem to indicate that a relative humidity of from 65 to 80 per cent is needed at pipping and hatching time in order to get maximum hatches. A considerable range in relative humidity previous to the eighteenth day of incubation seems to be tolerated by the embryo without apparent serious effects. More work on this phase is necessary before definite reports or recommendations can be made.

Data taken thus far on artificial incubation of turkey eggs seem to indicate that better results are obtainable in still-air machines than is possible in forced-draft machines. More work will be given to this project during the coming season.

Influence of Alfalfa on Yolk Color.

Six pens of single comb White Leghorn pullets receiving a normal laying ration were fed alfalfa in varying amounts and in various forms. Eggs were candled and classified according to yolk color. Birds receiving free access to dry leaves of well cured alfalfa hay fed in hoppers and those receiving 5 per cent of alfalfa leaf meal in the mash laid the highest percentage of eggs with pale and medium yolk color. Birds receiving soaked alfalfa leaves fed in troughs and those receiving 10 per cent of alfalfa leaf meal in the mash produced fewer pale and medium colored yolks and a greater number of dark colored yolks. This work is being continued another year.

Yellow Corn and Wheat for Chicks Grown in Confinement.

This study was carried on with the object of developing a ration as low as possible in ground yellow corn that would produce normal gains in weight and a normal depth of yellow pigment in chicks grown in confinement. A ration containing 60 per cent ground yellow corn produced the best gains in weight and the greatest depth of pigmentation. A ration composed of 60 per cent of ground wheat and no yellow corn produced chicks that were very inferior from the standpoint of gain in weight and degree of pigmentation. Very satisfactory gains and a very good degree of pigmentation was observed in a group receiving 40 per cent ground yellow corn and 20 per cent ground wheat.

Correlation of Yolk Color and Yellow Pigment.

A very definite correlation was found to exist between the yolk color of the egg and the intensity of yellow pigment in the shanks of chicks hatched. Eggs with pale yolks produced a high percentage of chicks with pale shank color. The majority of such chicks were of a very inferior quality.

Protein Studies.

A study of the physiological effects of various protein levels in rations for laying hens is being carried on co-operatively with the departments of Agricultural Chemistry and Bacteriology. There are no definite results to report at this time.

Feeding Young Turkeys.

Excellent results have been secured at this station during the past season in feeding young poults our regular chick starting mash, supplemented with cut green feed. The mash was fed in self-feeders available at all times to the poults. Excellent gains were obtained and very little danger of over-feeding was experienced with this system. This procedure eliminates much of the tedious work that is prevalent in the feeding of young turkeys.

Pure Seed

The supervision of pure seed work and of the state seed laboratory is under the jurisdiction of the Agricultural Experiment Station. The laboratory contributes effectively to high standards in the seed producing industry and is an important factor in securing pure strains of seed for Idaho farm plantings.

Considerable increase in the number of samples received at the seed laboratory is reported; a total of 2,440 samples as compared with 2,084 in 1928. In addition to the purity analyses, 283 germination tests and 18 moisture tests were run by the Analyst.

Aberdeen Substation

The soils and crops investigations under irrigated conditions are conducted at the Aberdeen Substation. Much emphasis is laid upon cereal breeding studies in the program of this Substation. These investigations are conducted in co-operation with the Office of Cereal Crops and Diseases of the United States Department of Agriculture.

New Wheat Crosses Made.

Several crosses of Federation and Dicklow have been made in an attempt to breed and select a wheat with the stiffness of straw of the Federation and the flouring quality of the Dicklow. There is some promise of success in this undertaking.

New Barley.

A new barley, the Ezond, outyielded Trebi the past year. The new variety, a smooth awn barley, was obtained from a cross of Trebi and Lowden. The Ezond is now purified to practically a pure line barley with smooth awns.

Large Oat Nursery.

The oat classification nursery has been carried on in somewhat the same manner as in former years. The oats investigations have included a viability nursery carried on according to plans outlined by the Oats Specialist of the Office of Cereal Crops and Diseases. This nursery contains every variety that has been grown in the United States; in all, 1,819 varieties are included in this nursery.

Potato Studies.

A potato seed cutting and seed treating experiment has been initiated in co-operation with the department of plant pathology of the station with the purpose of determining the value of different seed treatments in controlling skin-born potato tuber diseases and the effect of different seed treatments in the preservation of seed pieces.

Irrigation Investigations.

Irrigation studies were continued on beets and potatoes with potatoes responding well to lack of frequent applications of water. Beets require uniform soil moisture after the plants have begun to shade the ground. An additional irrigation project is the irrigation of red clover to determine the amount of water and the time of application for optimum growth.

Legume Studies.

Both pasture yields and hay yields were taken from the grass plots. There has been found a wide variation between the various grasses in seasonal yields of forage. The rotation plots have been reorganized to test out the value of different legumes in keeping up the fertility for the soil.

Lamb Feeding Experiments.

The lamb feeding experiments were carried on as in former years. The particular objective in the past year was to test the value of one of the important by-products of the farm, namely, cull potatoes. The potatoes were fed both cooked and raw, and used as a supplement to barley and hay. The cooking of potatoes added to the cost, but did not increase the gains or improve the condition of the lambs. The raw cull potatoes proved to be an excellent supplemental feed. The cost of feed was reduced and profits increased. The substation fed lambs topped the San Francisco market when sold at the completion of the experiment.

Caldwell Substation

Excellent yields of most of the farm crops were obtained on the Caldwell Substation in 1929 with a somewhat limited supply of irrigation water. Some of the alfalfa fields seeded in 1928 came through in excellent shape and the first year after seeding produced good crops of hay of fine quality. In recent years, the manure from the feeding lots has been distributed over most of the substation. This has resulted in marked improvement in the productivity of the soil. The "slick" spots seem to be less dominant in the fields as compared with a few years ago and there is indication all over the farm of an increasing average yield. One of the alfalfa fields of 20.8 acres produced an average yield per acre of 5.33 tons. Other fields yielded from 2.14 to 3.7 tons. The hay produced on the substation this year was of high quality.

Station Improvements.

Further improvements have been added, consisting of increased shelter belt plantings, the construction of an additional shelter shed for dairy cattle, graveling of the road leading into the farm, and other additions and alterations.

Tractor Studies.

Records have been kept on the use of tractor power in the cultivation of fields, in the mowing of hay, the hoisting of hay to stacks, the grinding of feed, and in tillage of soils at below the plow depth by means of a chiselling tool. The farm power experiments are made possible by loans of equipment from machinery manufacturing concerns and all electrical investigations are in co-operation with the Idaho Committee on Relationship of Electricity to Agriculture.

Study Use of Electricity.

The dairy experimental program has been continued, involving studies of pasture treatment, feeding experiments with milking cows, and the testing of rations in the growing of young heifers. The aim of the experimental work with dairy cattle is to determine the most effective rations for the developing of young stock and for the maintenance of milking cows, utilizing, in so far as possible, feed stuffs produced upon the substation. Much interest has been manifested by farmers in southern Idaho in methods that show promise of increasing the carrying capacity of

pastures. Further seedings are contemplated in 1930 to broaden the scope of the pasture studies.

The animal feeding investigations have been continued, utilizing as in former years grains and hay crops generally grown in Idaho, prepared in various ways, and in combination with various by-products.

Lamb Feeding Experiments.

The lamb feeding investigations showed that chopping and grinding alfalfa hay reduces the amount of waste hay. The hay requirements were reduced with the preparation of the hay. There was no advantage of ground barley as compared with whole barley. Cull beans replaced 20 per cent of the barley in one lot. The gains were slightly less and the feed requirements were higher compared with barley and alfalfa hay. Cull beans are worth less than barley for fattening lambs even when fed in limited amounts. One lot was fed ground barley and ground beans. The grinding did not increase the gains or decrease the feed requirements.

Steer Feeding.

Steer feeding investigations showed that the chopping and grinding of alfalfa hay reduced the percentage of waste hay and the feed requirements for fattening two-year-old steers. Chopping and grinding alfalfa hay increased the gains and finish on the steers. Ground hay was somewhat more efficient than chopped hay. Fifteen pounds of cull potatoes added to the ration of long alfalfa hay and barley increased the gains and lowered the feed requirements. A larger allowance of potatoes tended to cause digestive disturbances. Corn silage added to the ration of long alfalfa hay and barley increased the gains and lowered the feed requirements. There was little difference between the steers in the lots receiving the corn silage and the cull potatoes except that the steers receiving the cull potatoes tended to scour. When cull beans replaced 16 per cent of the barley, the gains were fairly satisfactory and the hay and barley requirements were lowered but the steers did not seem to fatten. A limited allowance of cull beans caused the steers to be too laxative throughout the experiment.

High-Altitude Substation

The experimental undertakings of the High-Altitude Substation were affected by the unfavorable season of 1929. This resulted in low yields of winter wheat in the varietal, cultural, and rotation plots. The fall of 1928 was dry and germination was low in much of the winter wheat. Further losses were occasioned by winter kill, by smut, and by the growth of weeds in the thin stands.

The unfavorable season, and especially the prevalence of smut, resulted in calls upon the station for the varieties of wheats that seem to have best met the unusual seasonal conditions; especially was there demand for wheats showing resistance to smut.

Wheat Varietal Tests.

In the varietal plots of winter wheat, Kanred, Kharkof, and Triplet still lead in yield. Regal and Oro made excellent yields the past two seasons and show promise as winter wheats both from the point of view of yield

and of smut resistance. Marquis, Redbobs, Early Baart, Soft Federation, and Bluestem are the most desirable spring wheats from the standpoint of yield and milling qualities.

Oat Tests.

Victory again led the oat varieties by a yield of about two bushels per acre. Idamine, Markton, and Golden Rain compete closely with Victory and are well adapted to high-altitude conditions. It was found in the oat seeding trials that 32 quarts per acre give the best average yield. From 32 to 40 quarts seems to be the best rate of planting; taking into account the amount of seed used, time of ripening, and weed control.

Value of Summer Fallow.

The cultural work with wheat, continued for the past six years, has given definite results pointing to the value of good summer fallow in the growing of winter wheat. This experiment will be closed and the information made available to the public in bulletin form. It is hoped to initiate tests with weeders and deep soil tillage implements to determine the effect of soil cultivation at various depths upon the production of wheat.

Sweet Clover Results.

The sweet clover is showing pronounced effect in increasing the yield of wheat the second year after sweet clover. Data now available indicate a lessened yield in wheat grown on dry farms the first year following sweet clover except in seasons of plentiful rainfall. Land that has grown sweet clover should be summer fallowed for one year or used for a cultivated crop, such as potatoes, before it is again planted to grain.

Future Plans.

The plans for the immediate future contemplate the installation of a water plant to lift water from the Teton River to the dry farm. This water is needed on the dry farm primarily for drinking purposes. In addition, it is anticipated that a summer cottage and a machine shed will be constructed next year.

Sandpoint Substation

Fall seeding grains and alfalfa hay continue as the standard recommendations to meet all conditions of low winter temperature, lack of moisture in mid-summer, and early frost in the cut-over sections of Idaho.

Cereal Investigations.

In the cereal investigations much progress has been made in the development of certain high yielding hybrids, particularly with Fortyfold and Federation crosses and with certain Jenkin hybrids. Mosida, Triplet, and Hybrid 128 lead in the variety tests of the older varieties. The work with winter barley has shown rapid development and a number of varieties have been selected as worthy of plat trials. Particular emphasis is being placed on a selection known as 549; a development of this station. This barley has shown a high degree of winter hardiness, has high yielding ability, and is taller than any of the other varieties in the nursery. Spring grain yields throughout were low and with the exception of the

leading variety in the barley nursery, Union Beardless, did not exhibit a performance any better than average. Nursery work was started in the Blanchard valley this spring. This is the first investigation by this station in a region where frost is a limiting factor in the production of grain. The use of a cultipacker on spring grain seedings increased the yield 5.1 bushels per acre. The effect on fall wheat was not so striking.

Seeding Field Peas.

A conclusion of the work on date of seeding field peas shows a five-year average for early seeded peas of 19.5 bushels per acre, for mid-early 16.4 bushels; and for late seedings 10.9 bushels. In this case seedings were made at three-week intervals.

Alfalfa Production.

The production of alfalfa in legume trials and strain tests was outstanding in comparison to the yield of other legumes and grasses. After four years it was found that alfalfa still retained 80 per cent of the original stand and that most of the clover strains had been reduced below 20 per cent. Averages on the production of grain hay still show the highest yields for rye and vetch, with fall wheat and vetch a close second. Considering the season, reed canary grass made good yields under upland conditions. A number selections of this grass have been made and some show possibilities of less shattering.

Sweet Clover.

Sweet clover is showing to good effect on the seedings that have been made on burned-over areas. In all cases reseeding has been heavy and the stand has been increased. The futility of attempting to get a stand of grass where several years have intervened between the time of the fire and the time of seeding has been shown.

Sclerotinia trifoliorum has reduced the stands of one-year-old red clover plants 14.2 per cent, two-year-old plants 32.9 per cent, and three-year-old plants 53.8 per cent. Selections and inoculations have been made in an effort to find resistant plants.

More visitors were present at station activities this year than at any previous time. The field day was held June 28 with over 1,000 farmers and their families present. Delegations were also received from adjacent Montana counties and from a number of northern Idaho counties.

DISBURSEMENTS BY DEPARTMENTS

from

STATE APPROPRIATIONS

Jan. 1, 1929, to Dec. 31, 1929

HOME STATION

	Admin.	Agr. Chem.	Agr. Chem.	Agronomy	Bact.	Dairy	Entomology	Home Ec.	Hort.	Pl. Path.	Poultry	Soil Survey	Total
Salaries	\$466.50	\$ —	\$100.00	\$ 591.64	\$ —	\$ —	\$1466.66	\$ —	\$ —	\$ —	\$ 510.00	\$499.04	\$3633.84
Help	157.23	—	—	523.93	114.77	—	544.34	—	—	34.30	276.08	—	1650.65
Travel Expense	—	17.03	—	60.16	—	—	459.72	—	—	—	—	201.31	738.22
Communication	—	—	—	—	—	—	35.01	—	—	—	—	—	35.01
Freight and Express	—	—	—	.95	10.67	—	64.96	.60	.58	1.33	18.06	20.42	117.57
Printing and Advertising	144.75	—	—	2.55	—	—	4.62	—	—	.50	35.99	—	188.41
Office Supplies	110.72	—	—	1.20	—	—	22.20	—	—	.50	43.00	—	177.62
Laboratory Supplies	—	11.58	—	218.41	1.13	—	257.07	—	5.45	10.21	178.51	5.90	688.26
Repairs to Equipment	—	—	—	—	—	—	4.25	—	—	—	—	—	4.25
Feed Stuffs	—	—	—	—	—	201.35	—	—	—	—	381.00	—	582.35
Equipment	110.03	—	—	—	—	180.00	94.04	—	—	—	59.17	6.57	449.81
Light and Power	—	—	—	—	—	—	62.21	—	—	—	—	—	62.21
Totals	\$989.23	\$28.61	\$100.00	\$1398.84	\$126.57	\$381.35	\$3015.08	\$.60	\$6.03	\$46.84	\$1501.81	\$733.24	\$8328.20

SUBSTATION DISBURSEMENTS

Jan. 1, 1929, to Dec. 31, 1929

	Aberdeen	Caldwell	High-Altitude	Sandpoint	Total
Salaries	\$ 4,120.00	\$ 4,650.00	\$2,340.00	\$3,950.00	\$15,060.00
Help	996.85	2,135.55	77.50	614.08	3,823.98
Expense and Supplies	4,852.83	5,258.33	794.82	2,172.25	13,078.23
Equipment	5,473.32	2,080.49	540.30	612.54	8,706.65
Total	\$15,443.00	\$14,124.37	\$3,752.62	\$7,348.87	\$40,668.86

FINANCIAL STATEMENT

University of Idaho Agricultural Experiment Station

In Account With

Federal Appropriations

Dr.		Hatch	Adams	Purnell
To balance from appropriations for 1927-28		None	None	None
Receipts from Treasurer of the United States for the year ending June 30, 1929		\$15,000.00	\$15,000.00	\$50,000.00
Cr.		Abstract		
By Salaries	1	\$10,337.25	\$11,143.50	\$36,638.82
By Labor	2	3,220.37	1,643.67	3,013.07
By Stationery and Office Supplies	3	151.71	23.60	122.41
By Scientific Supplies, Consumable	4	202.72	803.60	1,207.64
By Feeding Stuffs	5	36.35	54.99	455.55
By Sundry Supplies	6	103.42	179.12	389.49
By Fertilizers	7	.....	.....	.....
By Communication Service	8	.....	.....	20.22
By Travel Expenses	9	470.57	495.88	5,522.46
By Transportation of Things	10	.....	.....	89.89
By Publications	11	359.16	.....	817.07
By Heat, Light, Water, and Power	12	.....	3.65	7.60
By Furniture, Furnishings, Fixtures	13	.....	22.85	424.35
By Library	14	.....	.....	37.57
By Scientific Equipment	15	.....	601.94	781.54
By Livestock	16	.....	23.00	27.00
By Tools, Machinery, and Appliances	17	114.25	.50	196.39
By Buildings and Land	18	.....	.....	242.03
By Contingent Expenses	19	4.20	3.70	6.90
Total		\$15,000.00	\$15,000.00	\$50,000.00