UNIVERSITY OF IDAHO
AGRICULTURAL EXPERIMENT STATION

WORK AND PROGRESS

of

The Agricultural Experiment Station

for the Year Ending
December 31
1930

BULLETIN 179 JUNE, 1931

Published by the UNIVERSITY OF IDAHO, *Moscow, Idaho*

UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

BOARD OF REGENTS

MRS. J. G. H. GRAVELEY, President	Boise
CLENCY ST. CLAIR, Vice-President	Idaho Falls
WILLIAM C. GEDDES, Secretary	Winchester
STANLY A. EASTON	Kellogg
ASHER B. WILSON	Twin Falls
W. D. VINCENT, Commissioner of Education	Boise

EXECUTIVE COMMITTEE

STANLY A. EASTON, Chairman — MERVIN G. NEALE, Secretary
MRS. J. G. H. GRAVELEY — ASHER B. WILSON — CLENCY ST. CLAIR
Commissioner W. D. VINCENT

EXPERIMENT STATION STAFF

MERVIN G. NEALE, Ph.D.	President
E. J. IDDINGS, M.S.	Director
C. W. HUNGERFORD, Ph.D.	Vice-Director
O. A. FITZGERALD, B.A.	Agricultural Editor
HOBART BERESFORD, B.S.(Agr. Engr.)	Agricultural Engineer
HARRY MILLER, M.S.	Assistant Agricultural Engineer
M. R. KULP, B.S.(C.& I.E.)	Irrigationist
H. W. HULBERT, M.S.(Agr.)	Agronomist
R. E. BELL, M.S.(Agr.)	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, MS., D.V.M.	Veterinarian
R. F. JOHNSON, B.S.(Agr.)	Assistant in Feeding Investigation
W. V. HALVERSEN, Ph.D.	Bacteriologist
V. A. CHERRINGTON, B.S.	Assistant Bacteriologist
G. S. SCHILLING, M.S.	Assistant Bacteriologist
H. P. MAGNUSON, M.S.	Acting Chemist
R. S. SNYDER, M.S.(Agr.)	Associate 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.	Associate Dairy Husbandman
D. L. FOURT, B.S.(Agr.)	Assistant Dairy Husbandman
T. R. WARREN, M.S.(Agr.)	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
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
L. R. TUCKER, M.S.	Assistant Horticulturist
T. R. ASHLEE	Florist
C. W. HUNGERFORD, Ph.D.	Plant Pathologist
*J. M. RAEDER, M.S.	Associate Plant Pathologist
RUTH REMSBERG, M.S.	Assistant Plant Pathologist
C. E. LAMPMAN, B.S.(Agr.)	Poultry Husbandman
J. K. WILLIAMS, B.S.	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 coöperation with U.S. Department of Agriculture.

Report of the Director

WITH the advent of the period of depression, the calls increased for services from the Agricultural Experiment Station. In a period of rapidly changing price levels and other shifting economic conditions affecting farming, there was demand for advice concerning various phases of the state's leading agricultural enterprises and for counsel in plans for shifting from less profitable enterprises to those that seemed more promising of net returns. The experiment station staff was sympathetic in meeting this demand for service and the station undoubtedly has exerted a helpful and stabilizing influence in a period characterized by an unsatisfactory farm situation.

Intimate relationship has been maintained with commodity groups. This has prevailed both with organizations mainly concerned with production and with those dealing in marketing. Cordial relationship and close coöperation have characterized the station's relationship with the State Department of Agriculture This correlation of activities has permitted greater service to be rendered at a lower total cost as compared with an individualistic attitude on the part of both the experiment station and the state's regulatory agencies. The results of the year therefore are highly satisfactory in those relationships that have offered in the past and promise to give in the future, many opportunities for rendering service to the farm population.

The Director finds it necessary to spend much time in the field, especially in visiting the substation farms and in contacting members of the staff who are either permanently or temporarily located at field stations. While on the field trips, advantage is taken of proffered opportunities to address farm groups and other meetings and to contact organizations having direct relationship with farm problems.

Considerable progress has been made during the year in investigational work dealing with the control of noxious weeds. Weeds have spread rapily within the state in recent years, especially in the irrigated sections where the irrigation canals and laterals serve as a means of carrying weed seeds from high levels to lower lands during the irrigation season. The Experiment Station and the Extension Service have worked in close coöperation in conducting field test plots aimed at determining agencies effective in destroying weeds.

Agriculture, in recent years, has been rapidly increasing in the complexity of the problems that it offers to those engaged in agricultural educational and research undertakings. It is most encouraging to the administrative officials of the Experiment Station and to all members of the staff to know that the Experiment Station seems to have the favor and confidence of the people of the state. A very large proportion of the problems under investigation have been initiated because of request for such service by farmers of the state.

Over 160 projects are under investigation in the various departments of the Experiment Station and on the substation farms. This list of projects is constantly changing as demands are made for the investigation of new problems. A very large proportion of the investigations under way are being worked upon by several of the different departments. Coöperation in a number of the more important projects has been secured with various divisions of the U.S. Department of Agriculture. Coöperation among members of the Experiment Station staff and those employed in the Extension Service has been encouraged.

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 enable him to be most effective in adjusting experimental projects to the important needs of the state.

During the past year, seven replacements have been made in the Agricultural Experiment Station staff. The Dairy Husbandry, Horticulture, Plant Pathology, Agricultural Engineering, Animal Husbandry, Entomology, and Agronomy Departments were confronted with problems of filling the vacancies caused by the resignation of men called to new positions or to pursue graduate work.

In the Dairy Department, T. R. Warren has been appointed to the position of assistant dairy husbandman of the Agricultural Experiment Station to succeed G. C. Anderson, who resigned to accept the position of district extension agent for the southwestern Idaho district. Mr. Warren was graduated from the University of Idaho in 1927 and took his masters degree at the Kansas State College in 1928.

Lowell R. Tucker has been appointed to the position of assistant horticulturist of the Experiment Station. Mr. Tucker took his B.S. degree in agriculture at the University of Illinois in 1927 and his M.S. at the University of New Hampshire in 1928. Since 1928 he has been assistant horticulturist at the University of Illinois for one year and instructor in the Department of Horticulture at the Kansas State College last year. Mr. Tucker fills the vacancy caused by the resignation of Leif Verner, who left to accept the position of assistant horticulturist at the University of West Virginia.

Ruth Remsburg, B.S University of Idaho 1928, M.S. University of Idaho, 1929, has been appointed assistant plant pathologist to fill the vacancy caused by the resignation of W. H. Pierce, who is now at the University of Wisconsin doing graduate work on bean mosaic. Previous to this appointment Miss Remsberg was part-time assisant in plant pathology and part-time instructor in the Department of Botany at the University of Idaho.

Harry Miller, B.S., Agricultural Engineering, University of Saskatchewan, 1926; M.S. University of Missouri 1927; has been appointed to the position of assistant agricultural engineer of the Agricultural Experiment Station. Mr. Miller has had two years of experience in teaching and research at the University of Saskatchewan and one year at Rutgers University. Mr. Miller's present position was previously filled by John Scholten.

Another change in the Agricultural Engineering Department was brought about by the resignation of Edgar H. Neal, irrigationist of the Station. Mark R. Kulp has been appointed irrigationist to succeed Mr. Neal. Mr. Kulp has had extensive experience in irrigation and hydroelectric engineering. He received his B.S. in Civil and Irrigation Engineering from the Colorado Agricultural College in 1908. Since that time he has spent two years in Barcelonia, Spain, several years in Mexico, and a number of years in Colorado and New Mexico working on engineering problems.

President Frederick J. Kelly of the university resigned in May, 1930, permanently severing his connection with the university on July 1st. The Director of the Station, who also is Dean of Agriculture, was given active charge of the university affairs on the campus upon the retirement of President Kelly, under the title of Executive Dean of the University, serving in that capacity until the induction into office of the newly-elected president at the opening of the first semester of the university year. Dr. Mervin G. Neale, Dean of the School of Education of the University of Missouri, was selected by the Board of Regents to become Dr. Kelly's successor. He has rapidly made himself acquainted with the details of the university administration and has indicated a very direct personal interest in the success of research work in agriculture and home economics.

During the interim of service in university administration by the Director, Dr. C. W. Hungerford, who is Vice Director of the Experiment Station, served as acting director, continuing in that capacity until De-

cember 1, 1930. Dr. Hungerford as acting director was given cordial and loyal support by all members of the station staff.

During the year a new service building and a laying house have been built for the Department of Poultry Husbandry, a new sheep barn for the Department of Animal Husbandry, and a new dairy barn and a more adequate milk room for the Department of Dairy Husbandry. A small laboratory has been constructed in the basement of Morrill Hall for use in research and teaching in veterinary science. Water mains have been laid so that adequate fire protection is now afforded all of the university farm buildings. These improvements were all badly needed and will assist materially in caring for herds and flocks used in research. For several years some of the university livestock has been housed in old sheds located on the old fair grounds adjacent to the campus. Recent construction makes it possible to care for all the livestock in well constructed buildings belonging to the university.

More space has been provided in Morrill Hall for agricultural economics, home economics, and veterinary science. A new greenhouse has been provided for tuber indexing of potatoes and much needed repair work has been done on some of the buildings. Improvements on the substation farms include a machine shed at Sandpoint; garages, shelter sheds, and much-needed fencing at Caldwell; a shelter shed for sheep and other minor improvements at Aberdeen; a new cottage and a water supply system for the High-Altitude Substation.

The major needs of the Agricultural Experiment Station and of the College of Agriculture are an agricultural building which will adequately house the various departments of the college and for a salary scale which is more on a par with neighboring and competing institutions and which recognizes a difference between employment upon a twelve and a ten months' basis.

At the present time the various departments of the college are scattered over the campus in various buildings. Offices, classrooms, and laboratories are crowded to beyond capacity. Both experimental station and teaching activities suffer for lack of space. All of the agricultural faculty are employed on a twelve months basis and general service work, such as correspondence, conferences, and similar activities require additional space. Coöperation among departments in both teaching and research and correlation of activities of the college and experiment station would be greatly facilitated if all the departments could be brought together in one modern building. Agriculture is Idaho's major industry and there should be constructed on the University campus at Moscow a building in keeping with the dignity and importance of that industry in the state.

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 scentific journals. The list of publications follows:

Bulletins.

168. Control of Fowl Pox in Poultry.—E. M. Gildow.

169. Alfalfa on the Cut-Over Lands of Northern Idaho.—J. H. Christ.

170. Work and Progress of the Agricultural Experiment Station for the Year Ending December 31, 1929.—E. J. Iddings.

171. The Cherry Industry in the Lewiston Orchards with Cultural Recommendations.—Earle Blodgett.

172. Steer Prices in Relation to Idaho Beef Producers' Problems.—R. B. Heflebower.

173. Farming Systems for Northern Idaho and Eastern Washington.—George Severance, Byron Hunter, Paul Eke.

174. Standardization of Milk and Skimmed Milk Powder for the Manufacture of Cheddar Cheese.—D. R. Theophilus.

175. Bulk Handling Grain from the Hillside Type Combine.—Hobart Beresford, F. N. Humphrey.

Circulars.

58. How to Treat Seed Potatoes.—C. W. Hungerford.

59. Treatment for Control of Grain Smuts.—C. W. Hungerford.

50. Puncture Vine—A New Pest in Idaho.—H. L. Spence Jr.

61. Operation and Care of the Cream Separator.—F. W. Atkeson, D. L. Fourt.

Technical Papers.

66. Quintuplet Lambs an Unusually Large Family.—Journal of Heredity (Organ of the American Genetic Assn.), Washington, D. C., Vol. XIX, No. 9, September, 1928.—J. E. Nordby.

67. A Manifold Dessicating Apparatus for Determining the Dry Weight of Small Samples of Wool.—Science, August 1, 1930, Vol. LXXII, No. 1857, pp. 120-122.—J. E. Nordby.

68. Congenital Ear and Skull Defects in Swine.—The Anatomical Record, Vol. 42, No. 3, May, 1929. J. E. Nordby.

69. Effect of Mech. Equipment on the Distribution of Labor in Dairy Production.—Agricultural Engineering. (In press.) H. E. Beresford.

70. A New Treatment for Oestous Ovis Sarvoc in the Head of Sheep.—Journal of American Veterinary Medical Association. (In press.)—E. M. Gildow, C. W. Hickman.

71. Overshot and Undershot Jaws in Sheep.—National Wool Grower, Vol. XXI, No. 2, February, 1931. J. E. Nordby.

72. The Effects of Russet and Sunburn on Quality and Culinary Properties of the Italian Prune.—Proceedings of the American Society of Horticultural Science, 1930. Lowell R. Tucker, Gladys Boehm Tucker.

73. Experiments with the New Type of Pressure Tester on Certain Stone Fruits.—Proceedings of the American Society of Horticultural Science, 1930. Leif Verner.

Mailing List.

State of Idaho	13,417
States Other Than Idaho	1,797
Foreign	122
Total	15.458

Active Projects

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

Agricultural Chemistry

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

Rotation and fertility investigations at Moscow and Sandpoint. (In coöperation with Agronomy and Sandpoint Substation.)

A study of certain types of chlorosis as found in Idaho on trees, shrubs, and herbaceous plants. (In coöperation 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.

Slick spot investigations. (In coöperation with Agronomy.

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

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

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

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

Spray residue control. (In coöperation with the State Department of Agriculture.)

A study of the availability of plant nutrients and the response of fertilizers in Idaho soils. (In coöperation with Agronomy and Bacteriology.)

The effect of sulphur, gypsum, and lime on yield and composition of alfalfa. (In coöperation with Agronomy.)

Feeding experiments with dairy cattle. (In coöperation with Dairy Husbandry.)

Studies on animal nutrition—Effect of field peas on skeleton of swine. Inactive. (In coöperation with Animal Husbandry.)

Cumarin control of sweet clover and its effect on milk production. Inactive (In coöperation with Dairy Husbandry.)

Service analysis of feed samples.

Agricultural Economics

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

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

A study of farm organization and management in Twin Falls Irrigation Project of Southern Idaho.

Types of farming in Idaho.

Poultry management and cost study.

A study of farm management in Bonneville and Bingham counties.

Statistics on production and prices of hogs in Idaho and the Pacific Northwest and the factors influencing the prices and profitableness of raising hogs in Idaoh.

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 coöperation with 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 coöperation 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 coöperation with Poultry Husbandry, Extension, field poultryman, and the poultrymen of Idaho.)

Agronomy

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 coöperation with Agricultural Chemistry.)

Rotation and fertility investigation.

Peat soils of Idaho. (In coöperation with Agricultural Chemistry.)

Soil survey: (a) A detailed survey of a designated area each season as funds permit. (In coöperation with the U. S. Department of Agriculture.)

Alfalfa seed production.

Small grain improvement. (a) Wheat; (b) oats; (c) barley; (d) rye, emmer, flax, and miscellaneous grains; (e) rate and date of seeding; (f) coöperative cereal nurseries. (In coöperation 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; (f) strain test alfalfa varieties; (g) clover breeding studies; (h) pasture investigations.

Animal Husbandry

Studies in the growth of wool.

Physiological effects 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 coöperation with Caldwell Substation.)

Lamb feeding investigations. (In coöperation with Caldwell and Aberdeen Substations.)

Farm flock investigations.

Range cattle investigations.

Range sheep investigations.

Farm and range lamb marketing studies.

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 rambouillets.

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

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

Congenital ear defects in swine.

Bang abortion disease control program. (In coöperation with Dairy Husbandry and Bacteriology.)

Oestrus Ovis—Grub in the head—of sheep, its prevalence, pathological importance and methods of control.

Bacteriology

Study of the blood as an index of the health and body functions of the laying hen. (In coöperation with Agricultural Chemistry and 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 coöperation with Dairy Husbandry.)

Bacillary white diarrhoea.

Study of udder infection in dairy cattle. (In coöperation with Dairy Husbandry.)

Coniferous timber soil investigations. Biological activities of Helm silt loam soil. (In coöperation with Agricultural Chemistry.)

A study of the availability of plant nutrients and the response to fertilizers of Idaho soils. (In coöperation with Agronomy and Agricultural Chesmistry.)

Dairy Husbandry

Official testing of dairy cows for advanced registry.

Continuous use of proved sires to breed dairy cattle that will be prepotent in their inheritance for high milk and butter fat producing capacities. (In coöperation with the Bureau of Dairy Industry, U.S. Department of Agriculture.)

Study of the normal growth of dairy cattle. (Also being conducted at the Caldwell Substation.)

Influence of pregnancy on weight of dairy cattle. (Also being conducted at the Caldwell Substation.)

Study of the best methods of feeding calves while receiving milk.

Winter rations for dairy heifers. (Also being conducted at the Caldwell Substation.)

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

Investigation of the use of dairy sires from ancestry of known production in coöperative bull associations. *Purnell Fund.*

Study of udder infections. (In coöperation with Bacteriology.)

*The influence of methods of milking on quality and quantity of milk production. (In coöperation with Washington State College.) *Purnell Fund.*

*Relation of physical characteristics of cow's mammary system to production. (In coöperation with Washington State College.) *Purnell Fund.*

*Relation of feeding and management to production. (In coöperation with Washington State College.)

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

Study of breeding efficiency in dairy herds.

Study of farm sterilizers.

Study of prices, marketing, and markets for dairy products in Idaho (In coöperation with Agricultural Economics.

Pea meal compared to linseed oil meal for milk production.

Eradication of Bang's abortion disease. (In coöperation with Bacteriology and Animal Husbandry.)

*Temporarily inactive.

Entomology

The insects of Idaho—Assembling data considering the species of insects occurring in the state, their distribution and their economic importance.

Codling moth. Control investigations.

Eleodes beetles: Collecting and classifying the species in Idaho.

Beet leaf-hopper investigations. (In coöperation with the Bureau of Entomology, U.S. Department of Agriculture.)

Oil sprays. Investigations in preparation and use of oil sprays in the control of orchard insects and their effects upon trees. (In coöperation with the Experiment Stations of Montana, Washington, California and Oregon, and with the Bureau of Entomology, U.S. Department of Agriculture.)

Onion thrips. Control investigations.

The leaf-hoppers of Idaho. Investigations in control of economic species and a systematic study of the leaf-hoppers of Idaho.

Mineola scitulella. Life history studies and an investigation in methods of control.

Wireworms. Experiments in control and study of economic species. (In coöperation with the Bureau of Entomology, U.S. Department of Agriculture.)

Pea weevil. Ecological study and investigations in control.

Silverfish. A study of the preferred food and of baits for destroying economic species.

Puncture injury to beans. A study of the insects that may cause it.

Biology and control of the little red cattle louse.

Comparative results from the use of oil emulsion, liquid lime-sulphur and dry lime sulphur sprays in San Jose Scale control.

Home Economics

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 weed-

ern yellow tomato blight by breeding and selection. (In coöperation 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.

The harvesting and handling of sweet cherries for market.

A study of the maturity of apples in relation to keeping qualities.

Plant Pathology

Study of virus diseases of potatoes.

A study of a sclerotium disease of small grains.

Control of western yellow tomato blight by breeding and selection.

Grain smut studies.

Bean disease investigations.

Clover mildew investigations.

Nature and control of bacterial wilt of alfalfa.

A study of stripe rust of grains and grasses. (In coöperation with the Office of Cereal Crops and Diseases, U. S. Department of Agriculture.)

Plant disease survey.

Poultry Husbandry

A study of the blood as an index of the health and body functions of the laying hen. (In coöperation with 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

A study of mineral supplements in rations for growing chicks and laying hens.

A study of the extent to which alfalfa 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.

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.

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 efficiency of electric brooders in insulated and uninsulated portable colony houses without supplementary heat.

The effect of different periods of starvation, prior to treatment, upon the efficiency of various tape worm remedies for poultry.

Caldwell Substation

Steer and lamb feeding investigations. (In coöperation with Animal Husbandry.)

Pasture investigations.

Electricity in relation to agriculture. (In coöperation with 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 maintained 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, tractors, and horse labor expended.

Slick spot soil investigations. (In coöperation with Agricultural Chemistry.)

Aberdeen Substation

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

Cereal smut investigations.

Lamb feeding investigations. (In coöperation with Animal Husbandry.)

Small grain investigations, variety tests with wheat, oats and barley; (b) Cereal breeding and selection of wheat, oats and barley in nurseries.

Variety tests of spring grains and winter wheat variety tests carried on in coöperation with the county agents in various parts of southern Idaho dry farm areas.

Viability nurseries of oats and barley grown for the Department of Agriculture.

Investigations in field and garden peas and beans; (a) Varietal experiments; (b) Selection of beans for early maturity, yield, and disease resistance.

Breeding and selection of an early maturing yellow dent corn for eastern Idaho.

Potato seed treating experiment, and date of planting experiment.

Study of the hardwood trees in respect to environment.

Studies in seed production of alfalfa and red clover. Experiments conducted to determine the value of clipping, pasturing and no treatment on red clover for seed production. Studies in the relationship of beneficial insects and injurious insects to seed production of legumes.

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

Soil fertility investigations: (a) To determine the effect of ammonium sulphate gypsum, sulphur, potash, and phosphorus on the yield of potatoes; (b) To determine the value of manure in crop rotations; (c) To determine the value of the different legumes in maintaining soil fertility.

Pure seed distribution: (a) To grow for increase and distribute to the farmers pure seed that has been developed and improved on the station.

High-Altitude Substation

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

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.

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

Cereal nursery deep tillage experiments, furrow drill experiments. (In coöperation with the U.S. Department of Agriculture.)

Sandpoint Substation

Grain and field pea investigations: (a) Variety tests of winter wheat and barley, spring wheat, barley, oats, field peas and miscellaneous cereals; (b) Effect of annual weeds on grain yields; (c) Effect on yield of oats and barley combinations; (d) Seed treatments for control of barley smut.

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; (f) Carrot variety test.

Sheep management: (a) Cost of production.

Forage crop investigations: (a) Legume variety test; (b) Grass variety test; (c) Annual hay crops; (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) Sulphur fertilizers on alfalfa; (c) Cultipacking and harrowing experiments with grain; (d) Cultivation of alfalfa; (e) Effect of various legumes on yield of grain.

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

Research in Agricultural Chemistry is concerned with chemical phases of all the important divisions of the agricultural industry. Attention has been given to the practical problems as they develop in the state as well as to the fundamental principles upon which they are dependent. In the interest of brevity, only the more important projects are referred to in this report.

Nutrition.

The studies of the blood of laying hens as an index to health and body functions have been carried through a two-year cycle. The use of a special pellet feed has resulted in controlled composition of feed intake. The results to date show that the level of animal protein, as well as production, body weight, and health, has marked influence on the amino acid content of the blood. A continued high level of animal protein in the ration has a decided influence on the blood composition and is detrimental to the health of the bird.

Studies of various constituents of the ration are under way with special reference to the use of local products in the mineral mixture as compared with standard products of commerce.

A report has been prepared as a master's thesis on some phases of this work, but due to the fact that some phases are incomplete, definite conclusions are omitted.

Plant Production.

Chlorosis has been given further treatment in the field the past year. The iron and manganese treatments in the tree stems do not seem to be permanently effective. Chlorosis was especially severe the past season and was accompanied by much visable nitrogen starvation during the spring. The analyses of chlorotic and normal apple leaves for inorganic constitutents and pectins have been continued. Greenhouse studies on spinach have been carried through two series with controlled PH and Ca content. The PH of the sap of the plants is not controlled by the soil PH.

Spray residues studies have been continued in connection with the Northwest Oil Spray Project. The removal of arsenic has been facilitated by addition of salt to HCL, and kerosene emulsion is being tried out. The peak spray with oil and lead is satisfactory as far as removal is concerned. A circular on washing apples is in course of preparation.

Irrigation and Drainage.

The alkali reclamation project has been continued with a special attempt to drain the tract by pumping. Lysimeter studies show that chemical treatments have little effect on the layer producing the perched water table. Percolation is increased by certain treatments, especially through the surface layers. At six feet the PH has changed from five to nine under slow percolation. By special arrangement with the Division of Agriculture Engineering, U.S. Department of Agriculture, less chemical data will be gathered this year, giving the pump a chance to show its influence on the drainage and reclamation of the land.

The drainage water has been analyzed from a large portion of the state. Samples show wide differences and many carry high quantities of phosphorous ranging from .1 to 1.6 parts per million, showing that irrigation is having an influence on the supply of plant nutrients in the soil. Phosphorus seems to be more soluble in soil water and more susceptible to leaching than had been supposed.

Soils and Fertility.

The use of fertilizers is becoming an important problem in Idaho. An extensive survey of the state was made, including the taking of soil samples, to determine the effect of phosphate fertilizers. These samples will be run for available phosphorous both by chemical methods and by bacteriological methods. Field response was determined last summer by the Department of Agronomy. Special attention was given to the growth of alfalfa in the field. This seems to be correlated with fertility of the land. In the Twin Falls section, the structure of the soil seems to be changing under the system of culture in use.

Samples have been taken on fertilizer trials in the Winchester section, with special attention to the influence of sulfur on nitrogen content of soil and on the amount of hay produced.

The Slick Spot tract on the Caldwell Substation has been given chemical treatments and a second crop of corn grown. This land will be put into alfalfa next year. The greenhouse studies are designed to show the influence that the constituents of these soils have on texture, in relation to crop growth.

Methods.

Technical pieces of work frequently require the development of special methods and technique to meet the conditions involved in analysis. The soap titration method for calcium has been improved, magnesium titration altered, colorometric determination of phosphorous adapted to various applications on micromethods in blood analysis extended to cover more minute differentiation. A hand washer for removal of spray residues from apples that closely approximates machine efficiency has been developed. Much time has been given to the separation of arsenic and phosphorous in the analysis of sprayed apple leaves.

Service Work.

Large numbers of service samples have been run for other departments in connection with their projects as well as for farmers of the state. Extensive study was made of special soil from R. E. Shepherd and Mesa Orchards company in connection with experiments conducted on their ranches.

Samples of feeding stuffs coming under the law enacted by the last legislature also have been taken care of by this department. The volume of miscellaneous work has taken time needed for important research projects.

Agricultural Economics

Research in agricultural economics has been greatly extended since the summer of 1929, when the investigational staff was increased to two men full time and one man half time. One man has been stationed at Boise, where he has been carrying on research and editing "The Idaho Agricultural Situation." This mimeographed outlook is issued monthly and is available free of charge to all citizens of the state.

Trend of Prices.

In order to more definitely forecast the trend of prices of some of the leading agricultural products of the state, two studies have been made and two bulletins published under the following numbers and titles: No. 166, "Factors Relating to the Price of Idaho Potatoes"; No. 172, "Steer Prices in Relation to Idaho Beef Producers' Problems". A study of hog prices is now in progress.

Dairy Prices and Markets.

A coöperative study with the dairy husbandry department carried on for more than a year, will be reported in a bulletin on "Prices, Marpoultry cost accounting in several counties in the state.

Farm Organization and Management.

A study of farm organization and management in the Palouse area of Washington and Idaho has been carried on coöperatively with the Washington Agricultural Experiment Station and the U.S. Department of Agriculture. This study is now available as Bulletin No. 173, "Farming Systems for Eastern Washington and Northern Idaho." A similar study is nearly completed for the Twin Falls South Side Project. In addition, research was conducted and extension conferences organized in Franklin and Jefferson counties which resulted in two circulars, one for each of these two counties on the subject of farm organization and management.

The field work has been completed on a coöperative study of bulk handling of grain from the combine harvester in the Palouse wheat areas of Idaho, Washington, and Oregon. The bulletin should be in print within a year.

A new step has been taken in the direction of cost accounting and enterprise efficiency studies by the inauguration of a coöperative study between the Department and the Extension Division, with respect to poultry cost accounting in several counties in the state.

Economic information has been made available by several articles and extension talks given by members of the staff. Special compilations of information requested by individuals and associations have been prepared and delivered. A file and library have been collected at the office to make available at all time economic information both historical and current.

Studies Proposed for the Future.

For the next two or three years several projects are being considered, which will be taken up as developments indicate the need for these studies and as men and funds are available.

A study of the factors influencing the price of hogs in Idaho seems especially appropriate at this time, and some work will be done on this subject during the winter of 1931. Enterprise cost and efficiency studies have been found helpful in other states and this line of work will be expanded as soon as feasible to include both crops and livestock.

Studies similar to the one which has resulted in Bulletin No. 173, "Farming Systems in Eastern Washington and Northern Idaho," are planned for each year until one such detailed study has been completed in each major agricultural area of the state.

The promotion of farm cost accounting calls for the compilation of a suitable farm accounting system and for aid to farmers in summarizing their records at the end of the year.

A study of the marketing of agricultural products can be undertaken as the need for these studies becomes evident. Available information concerning the organization of coöperative purchasing associations is not at all adequate and this subject should be given attention.

Agricultural Engineering

The research studies in the Department of Agricultural Engineering are confined chiefly to projects outlined on a coöperative basis with other departments of the Agricultural Experiment Station.

Reclamation, Irrigation, and Drainage.

Combined drainage and irrigation pumping from the same wells by

electric motor operated pumps in the Boise Valley is being studied in coöperation with the Idaho Commitee on the Relation of Electricity to Agriculture and the Pioneer Irrigation District. During the irrigation season monthly readings of the ground water level have been made in 150 observation wells which surround the nine pumping plants included in the study. Individual tests have been made on the plants and data have been secured on the yield of the wells, the power required for pumping, the total operating costs, the drainage effect, efficiency and cost of the plants, and the comparative economy of the various types of wells. The average cost for the wells studied was $2.00 per acre foot of water pumped. The best wells have been made to yield from four to six second feet of water and when they are operated for the entire irrigation season they are capable of supplying water for irrigating 200 to 300 acres of land and at the same time effectively draining 400 to 600 acres. The supplemental irrigation water developed by these plants has been of economic importance and effective drainage is promised for waterlogged areas which heretofore have been unaffected by the open ditch drains.

The irrigation of representative crops, includes the time, amount, method of application, and yield, and is being studied in coöperation with the Aberdeen Substation and on the experimental plots at Twin Falls in coöperation with the Department of Plant Pathology. At Aberdeen the sugar beet crop was destroyed by an infestation of the beet leaf hopper.

A study of the irrigation of potatoes includes the application of various amounts of irrigation water under varying intervals and methods. At Twin Falls similar studies were made on the effect of the time, amount, and method of irrigation of beans. Variation in soil fertility on the plots made it difficult to draw final conclusions but the results thus far indicate that greater yields may be secured from plots of beans irrigated in each row as compared with plots irrigated in alternate rows.

The study of the loss of fertility through excessive irrigation has been continued in coöperation with the Department of Agricultural Chemistry. This work has consisted in securing samples of irrigation and drainage water throughout the irrigated areas of the state. The chemical analyses of the samples involve a great deal of time on the part of the coöperating department.

The reclamation of alkali lands at Caldwell has been continued as a problem conducted in coöperation with the U.S. Department of Agriculture and with the Department of Agricultural Chemistry. The reclamation of parts of the experimental plots has been delayed by a perched water table that has existed in the plots for several years. The area is drained by open ditch drains and a pumped well. Various crops have been grown on the plots and their growth mapped to show the extent of reclamation secured. Observation wells have been installed and the well readings made during the irrigation season. Infiltration tanks have been installed on some of the plots, and various chemical treatments of the alkaline soils attempted. The studies thus far indicate that the prevention of alkaline soil conditions by means of effective drainage will be more satisfactory than the attempted reclamation of soils after they have become alkaline.

Power Machinery

The bulk handling of grain from the hillside combine has been studied throughout the northern Idaho area. The four methods studied include the direct haul by means of motor truck from combine to warehouse; the intermediate field bin method, where the grain is transferred from combine to an intermediate bin, whence it is transferred by motor truck to the warehouse; the combination direct haul

and temporary storage method, where the grain from the combine is stored temporarily during the day and transferred from the field storage bin to the warehouse by the same truck during the night; and the farm storage method, where the grain is handled in bulk and stored on the farm. It has been found that under similar conditions the direct haul method using two motor trucks compares favorably with the intermediate field bin or combination temporary storage and direct hand methods employing one motor truck and the necessary transfer and storage equipment. The cost of between three and four cents per bushel for delivering wheat an average distance of five miles from the combine to the warehouse has been obtained through the careful selection of equipment and good management on the part of the operator.

The use of the combine for the direct harvest of peas continues to be one of the important applications of this machine, both from the saving of peas due to the elimination of shatter which occurs under other methods, and the possible control of the pea weavil, which is aided by the early removal of the peas from the fields.

New methods of tillage by means of tools which stir the soil without turning it over, as in the case of the moldboard plow, are being studied in an attempt to find a means of conserving moisture, preventing erosion, increasing yields, and reducing power costs. Two years' study of the work has been made in coöperation with farmers, and during the past year tillage work has been initiated on the university farm at Moscow. The adaptation of this moldboard plow to the plowless type of tillage has been called the "Idaho Digger" and several of these implements are now in service.

Improved methods and equipment for harvesting alfalfa hay under irrigated conditions also are being studied. The rolling system of handling hay whereby the entire load of hay is handled in a single operation has given the lowest labor and equipment costs for field stacking.

Electricity on Farms.

The use of electricity, both in established practices and for uses upon which there is little definite information available, is being studied in coöperation with the Caldwell Substation and the Idaho Committee on the Relation of Electricity to Agriculture. In connection with the lamb feeding work, the pens are being lighted for the purpose of lengthening the daily feeding period. Electricity is being used for heating the stock and dairy drinking water, and comparisons are being made between pens of fattening animals receiving the warmed water and animals drinking cold water.

The application of the electric motor to farm equipment has been studied both at Caldwell and at Moscow. Experiments with single and multiple "V" belt drives have shown this type of belt to be well adapted to most farm power applications. Multiple "V" belts are being used on the feed grinding equipment at Caldwell and a combination of a "V" motor drive and flat driven pulley were used for silo filling work at Moscow. This type of drive gave the lowest energy consumption that has been secured during the past five years' use of the electric motor for silo filling power. The five horsepower motor furnished power for cutting and elevating sun flower silage at the average rate of 4.4 tons per hour at 0.765 kilowatt hours per ton.

In coöperation with the Department of Poultry Husbandry and the Idaho Committee on the Relation of Electricity to Agriculture, the use of ultra violet light is being compared with cod liver oil as a substitute for sunshine in the raising of baby chicks. The housing requirements for electric brooding and the operation and management of electric brooders also are being investigated.

Farm Buildings and Equipment.

During the past year farm buildings have been constructed on the Agricultural Experiment Station farms from plans developed coöpera-

tively by this Department and the Departments of Poultry Husbandry, Animal Husbandry, Dairy Husbandry, and the Caldwell, Aberdeen, and Felt Substations. In addition plans have been furnished to farmers through the County Agents and to individuals who apply directly to the department.

The testing of farm buildings structurally has been continued by the construction of 1/6 scale models of trusses and fabricated building sections. The findings in these studies have been utilized in making the plans for the farm buildings developed by the Department of Agricultural Engineering. In addition to the development of new building plans adapted to Idaho conditions the department has available a blue print service of plans furnished by the U. S. Department of Agriculture.

Housing requirements of the farm flock are being studied in coöperation with the Department of Poultry Husbandry. A comparison of the insulated and uninsulated brooding and laying houses has shown very little difference in the maximum and minimum temperatures reached. The rate of change of temperature, however, is much slower in the insulated house and for that reason tends to produce more desirable living conditions.

Agronomy

Drought, beginning in June and extending throughout the remainder of the growing season, seriously affected the yields of nearly all annual crops. Above normal late winter and early spring precipitation furnished an excessive moisture supply at seeding time. This produced excellent stands, excessive stooling, and a large growth of straw. With the advent of the dry season, there was insufficient moisture left for the production of well filled heads and plump kernels. Spring wheats outyielded the winter varieties, although both ripened within a ten-day interval. Warm weather crops produced very satisfactorily; forage crop yields were practically normal.

Alfalfa Investigations.

Alfalfa seed was successfully produced for the fifth consecutive year. It would seem therefore that satisfactory seed yields of this crop can be depended upon in the vicinity of Moscow. Success with seed in any season, depends upon thin stands—not more than one plant to a square foot—and utilization of the first growth. Under no consideration should one attempt to produce seed from stands thick enough for hay production.

Rate and date of seeding trials with both common and Grimm alfalfa indicate that the best results are secured from ten and eight pound early seedings. The crop should be seeded on fall plowed land, thoroughly prepared in the spring. Cereals do not make satisfactory nurse crops. Early varieties of peas, such as the Alaska variety, make a more desirable nurse crop than any of the small grains.

Soybeans in Warm Areas.

Four varieties of soybeans, Mandarin, Chestnut, Wisconsin Black, and Ogemau, matured seed on the university farm, Moscow. Usually this crop is of no value for seed production under Palouse conditions. In seasons like the past, one soybeans cannot compete with field peas as a commercial crop. Coöperative experiments on the H. L. Stafford farm located on the breaks of the Clearwater river near Lenore indicated that soybeans may be of value as a supplementary crop for "hogging off." Ito San, a mid-early variety, produced excellent yields under those conditions, but their extensive use for this purpose would necessitate a source of local grown seed.

Small Seed Breeding Studies

A new strain of biennial sweet clover having purple seeds has been isolated. Selections of the most promising types of this strain have been made this season. In general, the strain has fine stems, a crown similar to alfalfa, purple leaf axils, and yellow flowers.

The strain of pink flowered Ladino clover, isolated a few years ago on the Geo. R. Johnson farm, Filer, is being selected for uniformity of type and color of bloom. The most promising strain is about two weeks earlier in time of maturity than the original one.

Progress has been made with the selections of Grimm alfalfa having well defined seed color. Individual plant selections made from mother plants having definite seed color are still breaking up. Further selection work is necessary to isolate desirable types.

Satisfactory seed yields of Anthranose Resistant Red Clover were again secured this season. After four seasons of satisfactory seed yields it seems probable that this crop has a place in Palouse farming systems.

The pasture program started at Caldwell in 1927 is progressing satisfactorily. This year definite pasture mixtures were designed and have been seeded in two acre areas for actual pasturing. Data secured upon the growth habits of the more common grasses and legumes were used in designing these mixtures. Their actual carrying capacity and ability to withstand grazing will be determined through their use by dairy cattle.

Extensive experiments upon the effectiveness of chlorates for the eradication of serious perennial weeds have been continued in all parts of the state. White top, Canada thistle, perennial sow thistle, and morning glory are the principal species under investigation. A careful study of the rate and date of chlorate applications, together with the method of treatment is expected to furnish valuable information for the 1931 weed control program. The use of acid in spray solutions as a means of increasing their effectiveness has been made a special study. Studies of spraying methods will be made next season since this apparently is an important factor in securing satisfactory control. Carbon bisulphide, while an expensive chemical to use for weed control. is very effective in the irrigated sections in eradicating small infestations of all perennial weeds.

Rate of Seeding Important in Peas.

Drill calibration studies have shown that approximately four plants per square foot of soil produce maximum yields of peas. Such a stand can be attained by seeding about six seeds per square foot. To secure such stands a different drill set must be used for each variety. Using a Superior drill, Bluebells, properly graded should be seeded at nine pecks on the oat side of the drill. Such a rate of seeding will require approximately 140 pounds of seed per acre. Other varieties vary in proper rate of seeding, depending upon the size of seed.

Higher yields of peas can be secured by using only carefully cleaned and graded seed for planting purposes. Experiments with large, small, and medium sized seed have shown large seed to be superior when seeded with an equal number of seeds per unit area.

Semesan and other seed disinfectants have not increased the yield of peas under field conditions. Negative results have been secured from the use of ultra violet rays and various seed stimulants.

Idabell, White Canada, and Early Britain have been found to be the best yielding field varieties over a period of years. Early Washington, Allans Canner, Sunrise, Hawley's Improved, Green Admirals, and Tom Thumb are among the better yielding garden sorts, their yields comparing very favorably with field varieties when seeded at the proper rate of seeding.

Cereal Investigations.

The enlarged cereal program with the Sandpoint Substation, coöperative farmer nurseries, and a more aggressive program at the University Farm, Moscow, have furnished valuable information upon this phase of the experimental work.

A cross of Fortyfold upon Federation made at Moro, Oregon, has shown much promise. The original introduction has produced consistently with the high yielding varieties, Mosida and Triplet. Many selections from this cross have been made, several showing better yielding ability than either parent or the original stock. All of the new selections resemble the Fortyfold parent in all plant characters except that they are non-shattering and higher in yielding ability.

Albit, distributed by the Washington Station a few years ago, outyielded Hybrid 128 this season for the first time since 1927 when it was included in the varietal trials. Albit consistently produces a crop with a low weight per bushel, usually grading below number one on this account.

Federation came through the winter of 1929 with little winter killing, although this variety is not a desirable one to use for fall seeding in this section. Jenkin, a popular variety in this section, was the high yielding winter variety in the nursery trials. Federation, Jenkin, and Baart were the high yielding spring varieties this season. Jenkin, Federation, and Red Bobs are the high yielding varieties over a period of years

Late seeded spring wheats, planted a month after the normal date of seeding, scarcely produced enough to pay for harvesting. In the average season early seedings, made just as soon as the seedbed can be prepared, produce the highest yields.

Winter club barley is the high yielding winter variety. This variety has consistently outyielded all others over a fifteen-year period. Trebi has proven to be the high yielding spring sort over a nine-year period. Ezond, a cross made at the Aberdeen Station, having barbless awns, is showing much promise.

Markton, Richland, Nova, and Swedish select were the high yielding varieties of oats for the season. Markton and Victory are best adapted according to the nine-year average yields.

Soil Survey Important.

The annual soil survey conducted in Idaho in coöperation with the bureau of soils was carried on in Benewah County. This survey was completed and work started in Bonner County where the survey is to be conducted next season. Such surveys are important in the proper development of our agricultural lands.

Considerable experimental work with the use of the chisel as a substitute for the plow has been started in the dry farm areas. Definite data upon these investigations will be available next season.

Fertilizers Give Profitable Returns.

Additional work with the use of sulphur, gypsum and related products has been initiated at Winchester. Sulphur in some form is essential for maximum yields of legumes in the cut-over areas.

Fertilizer experiments on peat lands of Bonner and Boundary counties have shown phosphorous and potash to be the limiting factors in crop production. Gypsum is superior to other materials for maintaining crop yields on the St. Joe bottoms. Phosphates are proving of value in increasing crop production in the irrigated areas.

Animal Husbandry

Swine.

Experimental feeding trials with wheat as the basic ration have been under way for a number of years. Wheat supplemented with protein feeds such as tankage, alfalfa leaves or small quantities of alfalfa hay, skim milk, or other feeds high in protein gives results somewhat higher than corn gives when fed to swine in the feed lot.

Cryptorchidism appears to be an inherited defect in swine. This abnormality has been under observation for some time with a view of determining if secondary sexual characters develop in males when one or both of the gonads have failed to descend normally into the scrotum. Data are available at this station which seems significant, as without exception all specimens having one testicle retained in the body cavity have failed to develop further evidence of masculinity after the removal of the normally descended testicle. In fact, they have become as barrows with a total loss of sex interest. This condition also has obtained without exception in the case of specimens in which both gonads have been retained. A cytological study is under way with a view of determining to what extent the abnormal location of the gonads has arrested the development of sex and interstitial cell tissue.

Dwarfed or absence of ears in pigs at birth has been found quite common in one strain of Duroc Jerseys. Records are available from a number of herds and the defect has been traced to a common source, namely, to the earless dam of a famous show boar. The data available so far indicate conclusively that this defect is inherited, and observations made on the skull of affected specimens reveal a number of structural skull defects on the same side of the skull as the defective ear. An analysis is being made of the type of inheritance and the association of ear and skull defects. (Preliminary report—Journal of Heredity. Vol. XXI., No. 12, Dec. 1930.)

Whorls and spotting in the hair of Duroc Jerseys have been found to be inherited. For a number of years these have been under observation in systematic matings (see Annual Report, 1928). It appears that whorls are not inherited as a single Mendelian character but in all probability two factors are involved both of which must be present either in the homozygous or heterozygous form to produce the defect.

Parrot Mouth in Sheep.

This defect is becoming common in sheep and this Station has previously reported (Annual Report 1928) that it is inherited. Breeders of sheep should cull out of the breeding flock all specimens that have either an overshot (parrot mouth—prognathism) or undershot (brachygnathism) jaw as either condition interferes with the looks and usefulness of the affected specimen. (National Wool Grower, Vol. XXI., No. 2, Feb. 1931.)

Impotency in Boars

Impotency in boars has been given consideration by this station in papers published in the American Veterinary Medical Journal, Vol. LXXIV, N.S. 27, No. 7, May, 1929, pp. 911-914; and the Cornell Veterinarian, Vol. XX., No. 4, October, 1930, pp. 381-385. Further observations and studies will be made on this subject.

Bang Abortion Disease.

A coöperative project with the Departments of Bacteriology and Dairy Husbandry on the control and elimination of Bang abortion disease in herds showing infected animals is being carried on through quarterly tests and isolation or elimination of reacting animals. During 13 months since the last report on the beef herd, the number of reactors

have increased from 14 positive reactors and 4 suspicious animals to 23 positive and 6 suspicious out of a total of 56 animals of breeding age. No attempt has been made to keep separated the positive and negative cows that are in milk. Dry cows and heifers now, however, are divided into positive and negative groups and are yarded separately. All cows have calved in box stalls or isolation quarters.

The last semi-annual test on the dairy herd of 71 head of breeding animals November 22, 1930, shows this herd still free from Bang abortion disease. This herd has been maintained free since January 22, 1929, a period of 22 months.

One purchased privately owned Guernsey herd consisting of 62 animals of breeding age was tested first in November, 1929. Sixteen animals were positive and two negative to the test. No definite method of segregating these animals was attempted except in isolation of positive reactors two weeks before calving and for one month following calving. Four positive reactors and the two suspicious reactors were sold leaving 11 positive reactors in the herd in the last test in September, 1930. In three of these 11 cows the titer has been gradually decreasing until now they can be classed as suspicious only.

Initial tests in eight other herds on this project showed five of them to be free from this disease. The infected herds contained fourteen positive and five suspicious of 66 breeding animals in the first herd, three positive and three suspicious of 36 animals in the second herd and nine positive of 24 animals in the third.

Grub in the Head of Sheep.

A continuation of this study of the parasite of sheep indicates that the use of one c.c. of carbon disulphide or three c.c of a mixture of equal parts of carbon disulphide and mineral oil introduced into the nasal passage and sinuses on each side of the head of sheep is very effective in killing grubs present in the sinuses. It does not appear to have any detrimental effect on minute grubs as found in the nasal passage. A definite technique has been worked out for the introduction of such small amounts of liquid into the frontal and maxillary sinues.

Minute larvae measuring two m.m. in length apparently recently deposited have been found in the heads of sheep in this locality as early as May 4, and as late as December 13. The distribution of larvae found in 42 heads was: Nasal cavity (minute larvae) 183, frontal sinuses 77, maxillary sinuses 19, and dorsal turbinate sinuses 14. Larvae have not been found in other sinuses of the head.

Eighty-six per cent of the larvae were killed on the treated side of 14 heads dosed after slaughter. Only 37 per cent of the larvae were killed in 21 sheep treated before being slaughtered. Occlusion with mucus of the foramina leading to the sinuses was found to be responsible for the ineffectiveness of the treatment.

Chronic Mastitis.

A series of treatments for mastitis in the dairy cow have been conduced in a coöperative project with the Bacteriology and Dairy Departments. Ultra violet ray radiation applied directly to the quarter affected in 14 cows has proven to be an efficient means of eliminating clinical symptoms of chronic mastitis such as flakey milk, swelling, and fever. No apparent change in the bacterial flora of the quarter was noted following treatment. The ray was applied once or twice daily for 15 minutes held approximately 25 cm. from the affected quarter.

A Cooper Hewitt Uviarc poultry treater type R.T., Spec. 100, was used as the source of light. Further information in regard to the bacteriological phase, the effect on milk production and convenience of application, may be obtained by reference to the report of the Bacteriology and Dairy Departments.

Tape Worm Treatments.

Experimental treatments for tape worm were conducted in coöperation with poultry husbandry in an attempt to determine the efficiency of three methods when the fasting period prior to treatment was varied. Sixty approximately five months old white Leghorn pullets were used. Each bird was proven to be harboring tape worms before treatment by finding tape worm segments in the droppings. All birds were killed and the intestines examined for tape worms or tape worm heads five days or more after treatment.

Nineteen birds were treated with each of C-A worm capsules (Park-Davis). Iodine Vermicide (Merk), and one gram Kamala tablets (Jensen-Salsbery). Five birds in each group were fasted eight hours, four birds 15 hours and 10 birds 24 hours before treatment. It was found that Kamala removed all of the worms from 15 of the 19 birds treated, Iodine Vermicide from nine of the 19 birds treated and C-A capsules from three of the birds treated. The three check birds all had worms at autopsy.

More satisfactory removal of worms was experienced when the birds were fasted 15 to 24 hours. Three of the four birds in the Kamala treated group that still had tape worms after treatment were in the lot fasted but eight hours before treated. Further data concerning these trials may be obtained by referring to the report of the poultry husbandry department.

Coöperative Projects With Substations.

Reports on projects carried on in coöperation with the Aberdeen and with the Caldwell Substations will be found under the sections of this Report devoted to the annual reports of these substations.

Bacteriology

Bacillary White Diarrhoea.

During the current season, 27,585 blood samples submitted from the flocks of 117 coöperators have been tested for *Salmonella pullorum* infection. One hundred and twenty-one breeding flocks are represented in the above compilation since four of the coöperators maintain breeding flocks of two breeds. No infection was found in 35 flocks (27.5 per cent) containing 5,715 breeders or approximately 21 per cent of the total number of birds tested.

The infection incidence ranged from three positive reactors to the serological test, which were later proved positively infected by autopsy, in 2,009 birds, to 65 in a breeding flock of 164, or 40 per cent. The accuracy of the serological diagnosis was checked by two methods: (1) autopsies and cultures on representative reactor birds selected at random from 33 infected flocks; and (2) a repeated blood test on the reactors in four flocks.

Of 83 birds autopsied and cultured, of which two were diagnosed as doubtful reactors, the two doubtfuls were found free from infection, 79 were found infected by cultural and serological methods, while two were not confirmed as infected culturally, but again were positive serologically.

In four flocks containing a total of 1,762 birds, 242 were found positive on the first routine diagnostic test. A retest was obtained on 199 of the birds in this reactor group after intervals of from six to twelve weeks In these rechecks 178 birds continued to give positive serological reactions.

From an original flock of 254, in which 21 birds were positive to the

blood test, 221 negative birds were retested after an interval of three months. Three additional birds were found positive at this time. This work is carried on in coöperation with the Poultry Extension specialist.

Studies in Udder Infections.

The purpose of this study is to find a cure for mastitis. Attention has been centered on the value of ultra-violet ray radiations for treating this condition. The effectiveness of this method has been ascertained by observing the physical condition of the udder and of the milk produced, as well as by making bacteriological studies to determine the numbers of bacteria present and the particular organism responsible for the diseased condition.

In general, it may be said that ultra-violet ray radiation was effective in eliminating the physical symptoms of chronic mastitis in 14 cows. There was no apparent effect on the bacterial or leukocyte count of milk during the course of this treatment. The following organisms have been isolated from the cases of chronic mastitis studied: *Streptococcus subacidus* (Holman), 1 case; *Staphylococcus epidermidis* Bergey et al), 2 cases, *Micrococcus varians* (Migula), 1 case; and an unidentified species of streptococcus from three cases apparently identical in etiology. The departments of Dairy Husbandry and Veterinary medicine coöperated in this project.

Blood As An Index of the Health and Body Functions of the Laying Hen

The coöperative study of the effect of high levels of animal protein in the ration of chickens has thus far revealed no significant gross alterations of degenerative changes of the viscera which might be attributed to nutritional disturbances. From the pathological standpoint under the conditions of the experiment the indications are that any of the protein levels used are compatible with the maintenance of health, and that other standards must determine the most desirable ration. The analyses and examinations made indicate that a reliable and comprehensive series of normal blood constituents will be obtained. The departments of Poultry Husbandry and Agricultural Chemistry coöperated in this project.

Infectious Bovine Abortion.

In answer to the demand for the extension of the testing for bovine infectious abortion, which arose during the prosecution of the project on the study of the breeding efficiency of dairy herds, a coöperative project with the department of dairy husbandry, a new project was undertaken dealing with infectious bovine abortion. It is designed to accomplish two purposes: (1) Eradication of Bang abortion disease; and (2) Official recognition of Bang abortion disease-free herds by the granting of a certificate of accreditation by the State Department of Agriculture. During the past year 235 consignments containing a total of 3,689 blood samples were tested for infectious abortion. Among those 574 were found to be positive to the test.

Eighteen herds were granted accreditation certificates as Bang abortion disease-free. Fifteen of these herds passed four or more clean tests during the past eighteen months without at any time showing a positive reactor. Three herds contained one or more positive reactors at the inception of the testing work. These reactors were eliminated, following which the herds passed three additional clean tests distributed over a calendar year before they were accredited. The state department of Agriculture, Dairy Husbandry department, and Veterinary Science department coöperated on this project.

Soil Fertility Investigations.

The increased use of phosphatic fertilizers on the farms of Idaho has made it necessary to study this problem with the view of finding or developing a laboratory method adapted to determining the need for this fertilizer. The development of a reliable method would make it

possible to survey the state and recommend the soils likely to respond to these fertilizers.

Preliminary field studies have been made and soil samples have been taken over a wide territory of southern Idaho where phosphatic fertilizers are being used. These samples are being tested in the laboratory by chemical and bacteriological methods. Preliminary studies already have shown the necessity for some modifications in the Winogradsky methods. This project is carried on in coöperation with the departments of Agronomy and Agricultural Chemistry.

Legume Inoculation.

Cultures of root nodule bacteria for more than 12,000 acres were prepared and distributed to the farmers during the past year. The continued demand for these cultures serve as a testimonial of their value.

Public Health Work.

The state laboratory at Boise finds it difficult to give quick service to northern Idaho and it seems desirable for the Station laboratory to serve to a limited extent in the public health field. Many samples of water were tested to determine their potability. A large number of them were found to be contaminated with sewage. At this time it appears especially desirous that a survey should be made of the water supplies used by rural schools of northern Idaho. Occasional epidemiological studies have been made and physicians and public health workers have been encouraged to use the laboratory.

Dairy Husbandry

The Dairy Herd.

Average production per cow during the past year was 15,573.2 pounds of milk and 559.1 pounds of butterfat, which was the highest in the history of the herd. The montly average number of cows in milk was 36.1. Twenty-six official production records of ten months or a year were completed. These records included two milk records of 31,241 pounds and 30,695 pounds, both state records; one fat record of 948 pounds, another of 822 pounds, and a total of seven over 700 pounds. Inventory showed 51 Holstein females and 29 Jersey females, totaling 80 breeding females. The herd has been free from abortion for two years.

Continuous Use of Proved Sires.

The continuous use of proved sires, pure in their inheritance for high milk and butterfat production, is a project carried for the past twelve years in coöperation with the Bureau of Dairy Industry, U.S. Department of Agriculture. Eighty-eight female offspring have been obtained from the original 14 foundation cows. The numbers in each generation are 25 F^1, 27 F^2, 22 F^3, 13 F^4 and $1F^5$. Fifty-four of the 88 are still in the herd and 57 have completed yearly production records. Nine bulls have been used, five of which have been proven by dam and daughter comparisons in this herd.

Bull Association Studies.

For four years, up to July 1, 1929, this was a coöperative project with the Bureau of Dairy Industry, U.S. Department of Agriculture. Since 1929 it has been continued as a state project. Results of the first four years were published in 1928 as Agricultural Experiment Station bulletin No. 161, entitled "Study of Bull Associations in Idaho" by H. A. Mathiesen and F. W. Atkeson.

Results of a closely related study were published in 1929 as Agricultural Experiment Station bulletin No. 163, entitled "Dairy Herd Improvement Through the Use of Proved Bulls" by F. W. Atkeson, H. A. Mathiesen, and D. L. Fourt. At present, in Idaho, there are 21 coöperative bull associations representing 469 members, 92 bulls, 349 purebred cows, and 3325 grade cows; making a total of 3774 breeding females.

Six associations have operated for eight years, and 13 of the 21 have operated for five or more years.

Growth Studies.

Normal growth studies on both the Holstein and Jersey herds have been in progress for 12 years. Data on the effect of pregnancy on body weight have been collected for the same period of time.

Gestation Periods and Birth Weights.

The average gestation period of 366 calves of both sexes was 280 days, with males averaging 280.8 days and females 278.9 days. Fifty-one per cent of the gestations were within three days of the average, and 89 per cent were within seven days of the average of 280 days. Age of dam showed very slight influence on the gestation period. The birth weight of 206 Holsteins of both sexes averaged 98 pounds, with the males averaging 102.4 pounds and the females 93.6 pounds. The birth weight of 87 Jersey calves of both sexes averaged 56 pounds, with the males averaging 59.3 pounds and the females 55.9 pounds. Holstein calves proved to be not only heavier at birth than Jerseys, but also larger in proportion to weight of dams, as indicated by 76 Holstein calves averaging 97 pounds at birth were 6.9 per cent of 1407 pounds, the average weight of their dams, while 30 Jersey calves averaging 56 pounds were only 5.9 per cent of their dams that averaged 960 pounds. Weight of dam had a distinct influence on weight of calf and percentage weight of dam in both breeds. There seemed some indication that younger cows had smaller calves. Sires varied considerably in average weight of their calves. The same appeared true from more limited data on dams.

Breeding Efficiency.

A field study is under way on about 50 dairy herds to determine the variations in breeding efficiency and the factors affecting efficiency, such as calf crop, abortion tests, production records, feeding and management, etc. The local station herd is being studied in more detail by monthly veterinary examinations and careful daily records. During the past year the breeding efficiency of the Holstein herd was 89.7 per cent, while the Jersey herd averaged 80.6 per cent. This project is being carried in coöperation with the station veterinarian and bacteriologist, and with field agencies.

Conceptions in Right and Left Horn of Uterus

Of 146 pregnancies, determined by rectal examination and later proved positive by calf birth, 93, or 64 per cent, took place in the right horn of the uterus, and 53, or 36 per cent, in the left horn. In other words, 75 per cent more conceptions resulted from the functioning of the right ovary than from the left ovary. The ratio of sexes among the calves resulting from conceptions in either right or left horn was well balanced, showing no preponderance of either sex in either horn. The observations were taken over the past six years in coöperation with the station veterinarian.

Calf Losses in the University Herd.

Study was made of all normal, live, calf births and losses incurred up to six months of age. During nine years, 1921 to 1929 inclusive, there were 237 normal, live births, of which 19, or 8.0 per cent, died before six months of age. Of 156 Holstein calves born, 11, or 7.1 per cent, died; while of 81 Jersey calves, 8, or 9.9 per cent, did not live to six months of age. The number of calves lost from the various cases are: pneumonia, 6; scours, 5; navel infection, 2; accidental, 2; unknown, 2; peritonitis, 1; depraved appetite, 1; and impaction, 1.

These facts verify the prevailing opinion that Jersey calves are more

difficult to raise than Holstein calves under the same system of feeding and management. For the two breeds combined only one calf was lost during four of the nine years, while two losses and four losses represented two years each, and one year there were three losses. An 8 per cent loss emphasizes the possible leak in profits, especially in a purebred herd, when we consider these figures do not include abortions, premature, and abnormal births.

Inheritance of Umbilical Hernia.

An unusually large number of male calves with umbilical hernia appeared in two herds in which the same herd sire had been used, thereby indicating that the defect might be heritable. Since 19 herniated animals in three herds were descendants of one common ancestor and since no animals not descendants of the ancestor were found to be herniated, there is little doubt that the character is inherited. The defect seems to be sex-limited as only males were herniated. Hernia appears to be a dominant character. Although insufficient data are available to justify definite conclusions, nevertheless, hernia seems to be inherited in a simple Mendelian manner and may be due to one allelomorphic chromosome carrying a sex-limited dominant factor for hernia.

Elimination of Infectious Abortion.

Infectious abortion has been eliminated from the dairy herds of the University and the Caldwell Substation through a system of partial segregation and gradual elimination of reacting animals. Eleven other dairy herds in the state have been freed of this disease. A more detailed report will be found under the reports of the coöperating departments of bacteriology and animal husbandry.

Pea Meal Compared With Linseed Oil Meal.

Two pounds of pea meal were substituted for one pound of linseed oil meal in the check grain ration which contained 25 per cent linseed oil meal. Hay and silage were fed and the double reversal method of feeding was used on two groups of cows. Results indicate that two pounds of pea meal are equal to one pound of linseed oil meal as a protein supplement to the grain ration for milking cows. Palatability tests indicate that most cows readily eat grain containing as high as 50 per cent pea meal.

Dried Buttermilk and Liquid Skimmilk for Calves.

Group II, consisting of Holstein calves, was fed whole milk for two weeks; which was gradually changed to skimmilk the third week; and when from four weeks to 120 days of age, the group received a limit of 12 pounds of skim milk daily, two pounds of grain, and all the alfalfa hay the calves would consume. From four to six months of age they received alfalfa hay and grain without milk.

Group I, also Holstein calves, received whole milk the first two weeks; which was gradually changed to dried buttermilk solution the third week; received 12 pounds daily of buttermilk solution during fourth and fifth weeks. The group was gradually taken off buttermilk solution during the sixth week, and fed dry grain and hay up to 120 days of age. The grain was one-third dried buttermilk powder and was limited to three pounds daily. From four to six months of age the calves received hay and two pounds of grain without the milk powder.

Group II, receiving fresh liquid skimmilk, made 96.5 per cent normal gain in height and 115.6 per cent normal gain in weight up to four months of age; and 92.4 per cent normal gain in height and 113.1 per cent in weight up to six months; compared to Eckles' growth standard. Feed cost to six months of age was $15.89 per calf, and the calves were sleek and thrifty.

Group I, up to four months of age, made 83.6 per cent normal gain in height and 87.6 per cent in weight. Up to six months of age this group made 87.2 per cent normal gain in height and 89.8 per cent in weight. Feed cost to six months of age was $16.83 per calf. The calves did not appear as sleek and thrifty as those in Group I, but no digestive disturbances occurred.

Irradiation of the Mammary Gland as a Treatment for Mastitis.

Clinical observations on seven cows affected with mastitis showed symptomatic improvement as the result of irradiating the udder with rays from a mercury vapor arc lamp. Seven cows affected with mastitis were then treated under controlled experimental conditions with careful checks on the symptomatic, pathologic, and bacteriological results.

Symptomatic improvement similar to the preliminary trials was obtained, further indicating the therapeutic value of the irradiation treatment. The diseased cows generally produced milk containing excessive numbers of bacteria and leukocytes. No uniform reduction in either was obtained during treatment.

In three of the seven cows mastitis was due to an undescribed species of streptococci. *Staphylococcus epidermidis* (Bergey et al) proved to be the causative organism in two cases, while *Staphylococcus subacidus* (Holman), and *Micrococcus varians* (Migula) each proved to be the cause of mastitis in one cow. The departments of bacteriology and veterinary medicine coöperated on this project.

Farm Cream Separators.

Forty-five per cent of 298 separators checked on service days held in three counties were losing more than 0.05 of one per cent of fat in the skim milk. The annual loss in excess of 0.03 of one per cent, considering the average of 112 pounds of milk handled daily and fat valued at 45 cents per pound, was $18.74 per separator. An average yearly loss of $5.42 per faulty separator was found among dairymen belonging to dairy herd improvement associations. Approximately 30,000 separators are in use in Idaho. The results of this study were published in Agricultural Experiment Station circular No. 61, entitled "Operation and Care of the Cream Separator" by F. W. Atkeson and D. L. Fourt.

Standardization of Milk With Skimmilk Powder.

Milk was split into four batches consisting of a check batch and three batches with the ratio of fat to serum solids standardized to 1:2.6, 1:2.8, and 1:3.0 respectively. Good quality cheese was made from all four batches, but results of many such trials showed the ratio of 1:3.0 sometimes yielded cheese that could not meet legal requirements. Addition of skimmilk powder decreased fat losses and increased yield and proved just as efficient as a source of serum solids as those found in fresh milk. When cheese was valued at 20 cents per pound, the return per pound of skimmilk powder was 17.5 cents, and the return for powder increased one cent for each cent increase in value of cheese. These results have been published as Agricultural Experiment Station bulletin No. 174, entitled "Standardization of Milk with Skimmilk Powder for the Manufacture of Cheddar Cheese" by H. C. Hansen and D. R. Theophilus.

Cream Buying Stations.

Large quantities of cream are obtained by the manufacturers from the producers through the agency of a network of cream stations. Information has been assembled on practically all the cream stations in Idaho to study their efficiency compared to other types of cream collection. This project is in coöperation with the department of agricultural economics.

Farm Sterilizers.

Eight commercial farm sterilizer units have been studied, including three with electricity as the source of heat, two with gasoline, two with kerosene, and one with steam from a boiler. All eight machine proved better than 99 per cent efficient in sterilization. Electric sterilizers cost from two to four times as much as other types and cost more to operate, but required less time, were automatically controlled, and were cleaner. Sterilizers using kerosene as a source of heat were most inexpensive in original cost and in operation, but required too much time, were not as convenient, and were not as clean. Sterilizers heated by gasoline were almost the same in initial cost, but were more economically operated than those electrically heated, required less time than kerosene, and were cleaner.

Comparison of Salts for Buttermaking.

Idaho creamerymen quite generally prefer eastern salt to western salt for butter manufacture because of the belief that western salt is more bulky, less soluble, and contains more impurities than eastern salt. A large sample of salt was obtained from each of three eastern and two western manufacturers of the most widely advertised and extensively used salts. Complete physical and chemical analyses were made in duplicate of each sample. Results on these limited number of samples showed no great difference physically or chemically between eastern and western salts.

Farm Cream Coolers.

Comparison in cooling milk and cream was made of the following coolers: "Kelso," "Hurri-Kool," "Chilly King," "Sorensen," "Instant," and a tubular cooler. The first two were of the holding type while the others were continuous coolers. "Chilly King," "Kelso," and the tubular coolers proved most efficient in time and final temperature. "Hurri-Kool" ranked next, and "Sorensen" and "Instant" coolers were not efficient.

Cooling of Milk.

Milk was cooled in still air at 65°F. to 75°F., 50°F. and 34°F.; and in both still and running water at 52°F.; and still water at 34°F. The degrees of agitation of the milk were none, constant, and intermittent hand stirring. Water proved 18 to 20 times as efficient as air of the same temperature as a cooling medium. Agitation accelerated the cooling process, but at the end of three hours the unstirred milk was approximately as cold as the stirred milk.

Service.

Official testing of herds for production required a grand total of 344.0 days of supervisors' time compared to 286.5 days in 1929. An average of 116.4 cows were tested each month and about 12.8 breeders were served each month.

The glassware calibration laboratory received 8214 pieces, of which 8119 were found accurate and etched "S. G. I." (Standard Glassware Idaho), 81 were inaccurate, and 14 broken.

Cream improvement posters were prepared for creameries in Idaho. In six months 76,689 posters or envelope inserts were distributed to producers.

Coöperative Projects With Caldwell Substation.

Reports on projects carried on in coöperation with the Caldwell Substation will be found under the section in this report devoted to the annual report of the Substation.

Entomology

Western Oil Spray Coöperative Project.

The Idaho Station has continued its participation in the Western Oil Spray Coöperative Project. Experiments have shown that dormant oil sprays may be applied safely to apple trees in the spring only before bud scales begin to separate. Oil sprays did not injure trees which were completely dormant even when applied at or followed by freezing or sub-freezing temperatures. Oil of 50-70 sulfonation and of not less than 100 viscosity test may be safely used for dormant spraying. Oil in combination with lead arsenate materially increases the degree of codling moth control. Oils of not less than 85 sulfonation and 65-75 viscosity test have proved satisfactory for foilage sprays.

Alfalfa Weevil Distribution and Control.

Population studies of the alfalfa weevil are being continued. There was a marked increase of population in 1930 over that of any year since 1924, especially in eastern and southeastern Idaho. Some control work was necessary and if populations increase further in 1931, extensive spraying will be necessary. Experimental work with the shipment of the alfalfa weevil in agricultural products is being conducted in coöperation with the Bureau of Entomology, U.S. Department of Agriculture. *Bathyplectes curculionis*, the alfalfa weevil parasite, was noticeably less abundant than during many former years.

Larvae injuring sweet cherries in southern Idaho have been reared and definitely determined to be those of the oblique-banded leaf roller.

Definite progress has been made in building up the University insect collection and in the identification of Idaho insects.

Silverfish Control Successful.

A successful and economical bait was discovered for controlling the fire brat (silverfish), an insect which is very destructive to certain stored materials, documents, libraries, etc. The bait has been applied in the University buildings and heating tunnels to destroy a heavy infestation of the insects which were ruining valuable documents.

Outbreak of Colorado Potato Beetle.

Eradication work was conducted against another outbreak of Colorado potato beetle in southwestern Idaho. This type of work constitutes an emergency for which funds are not provided in the regular Experiment Station Budget and there should be legislative appropriations available for meeting such emergencies.

Control of Destructive Prune Worm Not Certain.

Nirotine sulfate has proven to be an effective insecticide for control of the destructive prune worm *Mineola scitulella* under certain conditions. The insect is rapidly increasing in the commercial prune-growing areas. Conditions determining the effectiveness of nicotine sulfate must be ascertained before it can be recommended for commercial control and experimental work needs to be continued with this insecticide and others.

Wireworm Most Important Idaho Insect.

A ten-year project, coöperative with the Bureau of Entomology, U.S. Department of Agriculture, on control of wireworms in irrigated land, was begun in 1930. The phase of the problem initiated in Idaho is a study of cultural control. The wireworm causes more damage to cultivated crops in Idaho than any other insect and there is no known practical means of control.

Pea Weevil Studies Initiated.

A study of the pea weevil in northern Idaho was begun in 1930. The study deals principally with the life cycle and hibernation habits of the insect and with cultural means of control and environmental factors influencing seasonal populations. Facts already determined are: (1) Adults emerge in large numbers before seed goes into storage and hibernate outside of peas stored for seed; (2) Most adults hibernate close to infested fields, many of them fly long distances and hibernate under the bark of coniferous trees, and some of them fly at high elevations; (3) The degree of infestation decreases in a field with the distance away from the edge varying in a single field from as much as 25 per cent at the edge to as little as 0.2 per cent 500 feet from the edge at harvest time; (4) It is possible to materially decrease the number of adults that escape and enter hibernation by practical changes in harvesting methods.

Tarnished Plant Bug Injures Beans.

"Puncture" injury to beans has increased during the past three years and the re-grade it necessitates caused severe loss to farmers in 1929. It was suspected to be of insect origin and a study of the insect populations of bean fields was begun in 1930. To date, the "puncture" injury has been produced only by the tarnished plant bug although a a number of insects suspected of causing the injury were tested in cage experiments.

Beet Leafhopper Work Continued.

Coöperating with the Bureau of Entomology, U.S. Department of Agriculture, the detailed study of breeding areas, natural populations, host plants, etc., of the beet leafhopper is being continued in southwestern Idaho. Work in the development of curly-top resistant sugar beets by mass selection is being continued.

A systematic study of the leaf hoppers of Idaho is in progress. The two species commonly occurring on apple and prune trees have been determined to be *Empoasca maligna* and *Typhlocyba pomaria* instead of *Empoasca mali* and *Typhlocyba rosae* as previously believed. Leafhopper taxonomy in coöperation with the Department of Entomology, Ohio State University.

Home Economics

The end of the year 1930 finds the home economics work at the Experiment Station housed in new and very comfortable quarters on the fourth floor of Morrill Hall.

New Laboratory Now Available.

The animal feeding laboratory is a room approximately 21x24 feet and contains double laundry tubs with drain for dish washing, a Freas constant temperature oven, a table with a torsion balance for weighing animals and mixing food, another table for cleaning animal cages, a locker for coats, food containers, and four metal units for holding animal cages. Cages are under construction to bring the total number up to 40 for guinea pigs and 25 for albino rats. There is ample room for six of the metal units, making a total capacity of about 150 animals.

The office-laboratory room is across the hall and contains a counter of drawers and cupboards with working surface, a small acid-proof sink, a general electric refrigerator, a bookcase, desk, chairs, and files for office work and records.

This increased space and equipment, unfortunately, was not available until late in the year 1930 and has not been of much help in securing data for the year.

Year's Work Based on Potato Feeding.

Last year Russet Burbank potatoes from the Aberdeen Substation were put in storage and fed during the winter and spring. This fall potatoes in storage include Russet Burbank from the Aberdeen Substation and from the University Farm. Some of each of these will be curing data for the year.

The method used for the study of Vitamin C in potatoes during the past year has been based upon the prophylactic one of Sherman. A modification of his recommended diet to include one per cent cod liver oil and a test period reduced to eight weeks have been the changes made in his procedure.

Processing the Feed.

The potatoes fed were prepared by cooking with the skin still on for 30 minutes in 200 c.c of distilled water. The skin was then removed and the potato put through a ricer, thoroughly mixed, and portions weighed out and fed promptly. These doses were fed six days each week.

Potatoes cannot be force-fed very easily and some guinea pigs have consistently refused to eat the doses and their records, therefore, are of no value in the summary of results. However, such data as have been accumulated indicate strongly that, when the Idaho Russet Burbank potato is cooked as above described, the young, immature but growing tuber has better antiscorbutic properties than does the mature tuber or the one which has been in storage during the winter months. The following table summarizes the facts upon which the conclusion is based:

SUMMARY TABLE

Season	Dose	Ave. of No. Animals	Ave. Gain	Ave. No. Days Before Scurvy Symptoms	Ave. Length of Life	Post-Mortem Scurvy Score	
Summer	4 gms.	10	171	53	K*	4.7†	
Winter	4 gms.	8	25	22	K*	16.7†	
Spring	4 gms.	1	—109	12	21	23.0†	
Summer	6 gms.	7	142	56	K*	3.8†	
Winter	6 gms.	4	118	38	K*	9.0†	
Spring	6 gms.	5	10	17	52	13.0†	
Summer	8 gms.	4	91	55	K*	3.3†	
Winter	8 gms.	3	184	—	K*	2.0†	
Spring	8 gms.	3	36	17	K*	8.7	
Summer	Basal diet only	8	— 98	14	23	17.1	Negative controls.
Winter	"	4	— 97	12	21	14.8	
Spring	"	4	—138	14	26	20.4	

K*—Chloroformed at end of test.
†—Possible score equals 24.

It will noted that all the animals having as much as 4 grams of cooked potato live throughout the experimental period except when the potatoes have been stored all winter. It should also be noted that those animals which have no supplementary food (negative controls) die in about three or four weeks and that this time does not vary very greatly with the season. Attention should be called to the fact that averages based upon less than 10 animals may change considerably when more data are available. A few tests carried on the past summer with potatoes cooked without the skin indicate that for the summer potatoes, at least, there is very little difference in antiscorbutic potency due to cooking without skin.

New Procedure Proposed.

Now that more laboratory space is available, plans are being made for the use of Höjer's method also. This method involves the histological study of the teeth of the guinea pig as a means of assaying food materials for Vitamin C. The increased facilities of the new laboratory probably will permit the study of other vitamins in potatoes during the coming year.

Horticulture

Apple Breeding.

One of the objects of the apple breeding project has been to originate new varieties of apples, superior to existing types, by combining the desirable characteristics of the two parental varieties. Work on this project indicates that large numbers of progeny are necessary in order to obtain the combination or combinations required. The practical results obtained thus far are as follows:

Ben Davis x Jonathan and reciprocal have produced seven seedlings which are very promising and all have been marked for further testing. Ben Davis x Esopus and reciprocal have produced one seedling which seems fairly promising.

Ben Davis x Wagener and reciprocal have produced nine seedlings which may have some economic value. This is true of one seedling in particular which resembles Wagener in shape, has a more attractive color, is of good size, comes in season earlier than the Wagener, and remains in season beyond the Ben Davis.

Ben Davis x Rome and reciprocal thus far have produced no desirable seedlings. It is evident from this cross that it is impossible to obtain superior seedlings by combining two mediocre varieties.

Jonathan x Wagener and reciprocal have produced six seedlings which are listed as promising. Jonathan x Esopus and reciprocal have produced one seedling which shows some promise. Jonathan x Yellow Newtown and reciprocal have produced no promising seedlings as yet. Rome x Wagener and reciprocal have produced one seedling which has been marked for further testing. Rome x Yellow Newtown and reciprocal have produced no desirable seedlings.

Prune Storage.

Prunes in the Boise Valley were about 30 per cent larger this year than last. They ripened more rapidly during the picking season than in the three previous years studied. As in former years the sugar content increased and acid decreased throughout the picking season, improving the flavor of the raw prune. Storage results were similar to those formerly reported. Canning tests made from time to time brought out some very valuable information. The growers postponed picking last year so that the prunes might develop more color. Some of the earliest picked fruit when immediately canned gave a light-colored product. This same fruit, however, after being stored under transportation and marketing conditions, produced a much darker and more normally colored canned product. Although the color of the raw fruit did not seem to increase in storage there was a change that caused it to be more readily liberated during the cooking process. This indicates that from the appearance standpoint, color development in the fruit is less important for shipping to eastern markets than for home canning. Fruit picked September 1, with 17.3 per cent sugar and 1.07 per cent acid had a decidedly different flavor than that picked September 25 with 21.9 per cent sugar and 0.56 per cent acid. When plenty of sugar was added at canning time one had as pleasant a flavor as the other.

Prunes in old orchards ripened as much as two weeks earlier than those in adjacent young orchards. There appeared to be less difference in sugar and acid content than in the softening of the fruit.

Cracking of Sweet Cherries

Studies of sweet cherries seem to show a rather close correlation existing between pressure readings and the severity of cracking. In the Lambert a high percentage of cracking was found to occur as soon as the pressure resistance had fallen below 6 pounds; in the Royal Ann a notable increase in cracking was observed after the pressure had fallen below 8 pounds; and in the Bing, below 9 pounds. In most cases there was little further change in pressure after this point had been reached in each variety, but cracking severity continued to increase in proportion to increase in sugar content. The records also show that when cherries lose their normal turgor there is a marked decrease in the amount of cracking.

Greenhouse Tomato Studies

In order to provide preliminary data for the study of the effect of temperature range on fruit size, a crop of about 100 plants, representing 11 standard greenhouse varieties, were grown during the summer The results indicate that further studies will be of economic value.

Greenhouse-Field Tomato Investigation.

In September, 1929, the best plants of 17 of the most desirable varieties were propagated by means of cutting. Each variety so raised was selfed and 22 cross-pollinations were made. A crop was raised in the garden from the seed of both series, and records were made of their genetic behaviour.

Taxonomic Record of Tomato Varieties.

Records and notes are taken of all the tomato varieties grown by the department, 74 in all, and are permanently recorded by written descriptions and longitudinal and transverse section drawings. This investigation will greatly help in the selection of varieties to be grown by the department in the future, the determination of the synonymy, permitting the elimination of the low-yielding strains of identical groups.

Orchard Fertilization.

These investigations have been conducted in the Coeur d'Alene, Boise, Wilder, and Moscow districts. As in previous years, the circumference, terminal growth and yield records of trees in the various plots have been secured. Additional tests will also be made in the Payette and Lewiston districts.

Miscellaneous.

Work in coöperation with the Department of Agronomy was carried out in the treatment of cucumbers with ethylene. Coöperative work was done with the Department of Agricultural Chemistry on the effect of various fertilizer treatments of tomatoes.

New Projects.

Preliminary work has been started on two projects during the year: (1) A study of the maturity of cherries in relation to keeping qualities; and, (2) A study of the maturity of apples in relation to keeping qualities.

Plant Pathology

Virus Diseases of Potatoes.

An attempt was made during the past season to determine the rate and direction of spread in the field, of mild mosaic. In planting, the potatoes were interspersed with beans in such a manner that the infection emanating at the center of the plot could spread in eight direc-

tions. The product of each hill at harvesting was kept separate and will be indexed in the greenhouse.

An understanding has been reached with other investigators in the Northwest and with the U.S. Department of Agriculture, whereby an interchange of material and ideas will be made. To further enhance this work and at the same time place the seed potato certification of the state on a still more substantial foundation, a new greenhouse recently has been completed, in which all products of certified seed potatoes in the state will have an opportunity to have a representative sample of their certified crop tuber-indexed. Upon the completion of this indexing the tubers which are free of virus infection will be returned to the respective growers. These tubers planted in an isolated plot and properly tuber united should be the source of a product free of virus troubles.

Sclerotium Disease of Wheat.

Two organisms have consistently been isolated from diseased wheat In pure culture both respond similarly in that both produce sclerotia. The size of the sclerotia in the respective cultures is different, however, in that those produced by one organism average .5-.75 m.m in diameter while those produced by the other organism average 1.5-2.0mm. in diameter. The organism producing the smaller sclerotia grows more profusely at a higher optimum temperature than that producing the larger sclerotia. The pathogenicity of these organisms has yet to be proved.

Grain Smut Control.

From the standpoint of cost, ease of application, and efficiency, the following methods of seed treatment for control of bunt of wheat, loose and covered smuts of oats, and covered smut of barley are still advocated. For fall sown wheat, copper carbonate dust of the 50 per cent copper content, at the rate of three ounces per bushel, is still most efficient in controlling bunt or stinking smut. Formalin spray (1-10) still is advocated as a method of controlling the oat smuts; while the formalin dip (1-40) proved most efficient in controlling covered smut of barley. The proprietary compound known as Ceresan has exhibited possibilities in controlling the above diseases when applied to the various grains at the rate of three ounces per bushel. In addition to the continuation of the grain seed treatments, investigations of the question of physiologic specialization of the organism causing stinking smut of wheat has been instituted. To date three distinct forms have been found.

Western Yellow Tomato Blight.

Although some progress has been made in selecting tomatoes resistant to this trouble, breeding for resistance is now being resorted to in order to gain the desired goal. Crosses have been made, using as one parent those selections which are desirable commercial varieties, and as the other parent varieties less desirable from the commercial standpoint but which exhibit resistance. No pure lines have as yet been obtained.

Mosaic and Curly Top of Beans.

It has been possible to select Great Northern beans resistant to mosaic. About 95 bushels, the yield of five resistant selections, were harvested at Twin Falls this year. These selections, though varying considerably in type, are all of excellent quality and high yielders. More recent selections than the above, exhibit a still more desirable type and give promise to produce still higher yields. Crossing has had to be relied upon to obtain resistance in beans, to "curly top." Since segregation is still taking place in these crosses, no homozygous segregants showing resistance to this virus trouble have been obtained.

Clover Mildew.

Investigation of this problem, with special reference to the selection and breeding of resistance, has been carried on by the Aberdeen Substation in coöperation with this department. A number of selections and crosses have been made exhibiting varying degrees of resistance. Comparative yield tests of seed have been made which show the value of sulphur as a dust. Dusted stands of clover consistently outyielded undusted fields.

Bacterial Wilt of Alfalfa.

As a result of the inroads of the organism causing bacterial wilt, several variety test plots have been established in those sections of the state in which the disease prevails, in an attempt to test the relative susceptibility of various varieties and selections of alfalfa. Because of the nature of the disease, its control and the re-establishment of alfalfa stands in the state depend upon the finding of varieties or strains which are resistant. Preliminary tests indicate that resistance can be secured by selection.

Stripe Rust Investigation.

Coöperative work with the U.S. Department of Agriculture in the investigations of stripe rust of grains and grasses has been continued. In an attempt to determine the presence or absence of physiologic specialization with the organism involved, 33 wheat varieties from Germany have been used as differential hosts. In addition to the above, the relative susceptibility to stripe rust of 390 wheat varieties and crosses were tested for the Kansas Agricultural Experiment Station.

Poultry Husbandry

The program of experimental work of the department of poultry husbandry has been interrupted to some extent during the past year, extra efforts being devoted to the development of a new poultry plant. Approximately 25 acres of land recently have been allotted to the department which insures more adequate facilities for the growing of young stock. Two new buildings have been constructed. A service building 36x48 provides two full floors of working space and a third floor for storage purposes. A new laying house 20x90 provides 12 pens for experimental feeding work. A number of the smaller laying houses and all the colony houses were moved from the old plant. Considerable fencing has been done during the past two summers to enclose the ranges for young stock and to provide yards for the breeding and laying stock.

Humidity in Relation to Hatchability of Eggs.

The past year this study has been continued with hen eggs and additional work initiated to include a study of the humidity problem in the artificial incubation of turkey eggs. In the preliminary study of this problem, difficulty was experienced in registering the condition of humidity in incubators. It was found that the ordinary commercial hair hygrometer, as adjusted when received from the factory, did not accurately record the per cent of relative humidity when subjected to incubation temperatures. As reported last year, a dew-point apparatus that gives accurate reading was devised and used as a checking instrument with which to adjust the hair hygrometers to record correctly at these temperatures. When checked periodically, this type of hygrometer could be relied upon to give readings sufficiently accurate for our purposes. The dew-point apparatus also was used to check the accuracy of the wet bulb type hygrometer. The latter instrument was found to be sufficiently accurate for practical purposes, providing the long slender bulb type thermometer was used and the wick changed

sufficiently often to be kept moist. This year the study has been confined to narrower ranges of humidity than the work of a year ago. Observations were secured on eight consecutive hatches set at weekly intervals. A cabinet type of incubator in which the air was kept in constant circulation was used. The better hatches were secured with the average relative humidity of from 46 to 48 per cent during the first 18 days of incubation, and an average of 52 to 53 per cent from the 18th day to the end of the hatching period. The average loss of weight of eggs due to evaporation for the first, second, and third 6-day periods was 3.75 per cent, 3.94 per cent, and 4.31 per cent respectively, The loss in weight from the start to the 6th day was 3.75 per cent; to the 12th day, 7.65 per cent; and to the 18th day, 11.8 per cent.

Although many requests have come from the field for specific information regarding the condition of humidity at which incubators should be operated, our observations indicate that such information by itself is not adequate. This is due to the variations in air circulation in different types of machines and even in different machines of the same type. It would appear that definite information on the correct per cent loss of weight of eggs at the different periods and the increase in the size of air cell would be more reliable as guides in the operation of incubators.

Further work this past season on the incubation of turkey eggs has resulted in hatches practically as good in the cabinet type incubator as in the sectional type. A better understanding of the operation of forced draft machines has resulted in improved hatches as compared with last year.

The better hatches were secured with a per cent loss of weight of eggs from the start to the various periods as indicated in the table below:

Incubation Period:	6 days	12 days	18 days	24 days
Per cent loss	3.6-4.3	5.6-7.5	9.0-11.0	12.0-14.5

Such data indicate that the per cent loss of weight due to evaporation for turkey eggs should be but little more at 24 days than for hen eggs at 18 days. Consequently, a condition of higher humidity is necessary which will result in a slower rate of evaporation.

Blood as An Index of Health and Body Functions of Laying Hens.

This project has been carried on coöperatively with the departments of Agricultural Chemistry and Bacteriology through two seasons in a study to determine the physiological effects of various levels of animal protein in the ration. The first year the ordinary mash and scratch method of feeding was used. The animal protein supplement varied from none to 15, 22.5 and 30 per cent of the mash mixture for groups I, II, III, and IV respectively. This system of feeding did not prove satisfactory for this type of study, due to the fact that individual hens will select different portions of the ration when it is in such a form that selection is possible. A pellet system of feeding therefore, was initiated this past year. The entire ration was ground as a mash and compressed into pellets. Group I received no animal protein; Group II, 7.5 per cent; Group III, 11.25 per cent; Group IV, 15 per cent. Egg production followed the expected tendency, increasing with the higher levels of animal protein. The average body weight of hens completing their first year's production was lower in Groups I and IV than in Groups II and III, both at the end of the year and on an average throughout the year. The general condition of thrift and health of birds was noticeably better in Groups II and III at the end of the season.

The average feed consumption per bird was greater in Groups III and IV than in Group I. A disturbing factor in this type of feeding is that of palatability. The feed consumption per bird was somewhat

below normal in all pens; consequently, even though this type of feeding is highly desirable from the standpoint of controlling the intake of feed, making it uniform for each individual, it offers several objections which need to be worked out in further study. The influence of various levels of protein upon the blood constituents will be found in the report of the Department of Agricultural Chemistry.

Sanitary Brooding Practices.

Wire bottomed sun yards again were used this season as a sanitary measure in the brooding of chicks with excellent results. Particular emphasis was given this past season to the feeding of fresh cut alfalfa. The group of chicks varied from four to nine weeks of age when they were taken from their brooding quarters to the range. No difficulty was experienced from feather picking or toe picking. Normal feathering of birds was obtained in the groups having access to sunshine in these wire-bottomed yards. It would appear that some factor is involved in producing normal feathering under such conditions supplied either by direct sunshine or green alfalfa. To date, we have not been able to obtain normal feathering of chicks grown indoors, even when fed cod liver oil.

This season, young turkeys were brooded on wire bottomed pens inside, until they reached an age at which they could be put on range without heat. Under such conditions an average weight of 1.4 pounds per bird was secured at six weeks. One small group of late hatched turkeys was grown on a wire bottomed yard in front of a colony house, during the entire growing season up to the Thanksgiving marketing period. Although these birds made consistent gains and appeared thrifty, they did not equal in average weight or finish of flesh at the end of the season the birds of the same age on range.

Turkey Management.

Simplified methods in the care of young turkeys have proven extremely satisfactory this past season. A ration quite similar to the Idaho chick ration number eight in our feeding pamphlet was fed as an all-mash ration in self-feeders until the poults were from four to five weeks of age, at which time a scratch mixture of equal parts of cracked corn and wheat was given. Chopped green alfalfa was fed liberally each day in open troughs. The mash mixture was placed before the birds at all times and the scratch fed twice daily until the fall season, when it too, was placed before the birds at all times. The following table gives the average weight per bird at the stated intervals:

Age in Weeks	4	8	12	16	20	24
Ave. bird's wt.	1.09 lb.	2.3 lb.	4.5 lb.	7.69 lb.	11.23 lb.	14.37 lb.
Ave. hen's wt.					9.86 "	11.45 "
Ave. tom's wt.					12.31 "	16.69 "

Influence of Alfalfa on Yolk Color.

Preliminary work last year on this project indicated a higher percentage of dark-yolked eggs resulting from the feeding of soaked alfalfa than from the feeding of dry alfalfa leaves or of 5 per cent of alfalfa meal in the laying mash. A continued study of the comparison of dry and soaked alfalfa leaves has resulted in very little difference in the percentage of dark-yolked eggs in either system.

Treatment for Tape Worm Eradication.

This trial was conducted in coöperation with the Station Veterinarian in an attempt to determine the efficiency of three different tape worm treatments with varied periods of starvation previous to treatment. A summary of this work will be found in the report of the veterinarian.

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 as an important factor in securing pure strains of seed for Idaho farm plantings.

Inspection and Analysis.

Regulation of the sales of small seed within the confines of the state serve to maintain the high standards which are necessary in Idaho as a seed-producing state. The samples are taken by inspectors at intervals during the spring and submitted to the state feed laboratory for inspection and analysis. Most dealers, before offering these lots for sale, send to the laboratory samples of lots which they expect to sell.

State Laboratory at Boise.

The state seed laboratory at Boise is kept at a high standard of efficiency and is one of the twenty-three official seed laboratories in North America.

The work of this laboratory has become increasingly heavy every year, owing to the grading of all certified and registered alfalfa seed produced within the state. In 1930, 1457 samples of alfalfa were received, the bulk of which consisted of official samples of certified Grimm and Cossack alfalfa. This grading work and the field inspection of the registered fields is showing excellent results, as indicated by the increasing number of samples which are eligible for the blue and red tag grades. A branch seed laboratory has been maintained at the University of Idaho College of Agriculture at Moscow, under the supervision of H. W. Hulbert, head of the Department of Agronomy. This laboratory has been handling the analytical work and germinaion tests for dealers and farmers in the northern part of the state.

A total of 2521 samples were received at the state laboratory during the year 1930, of which 2175 were for purity analysis. This is a considerable increase over the number received in 1929 and has shown a steady increase since 1925.

Improvement Efforts Are Educational.

The pure seed work is conducted in close coöperation with the seed dealers and farmers of the state, the enforcement of the seed law being handled largely as an educational matter and not especially from the standpoint of law enforcement. The State Seed Commissioner is secretary of the Idaho State Show. The work of this educational organization is closely coördinated with the pure seed activities and proves of material advantage in improving the quality of Idaho seed.

Aberdeen Substation

The 1930 season was very favorable for high crop yields. A heavy rain on May 8 brought early planted cereals and forage crops along to the jointing stage without an irrigation. During July the nights were cool and excellent weather occurred for the setting of alfalfa seed. August was very rainy, causing threshing to be delayed and grains badly discolored and damaged. Frost did not occur until September 24, allowing potatoes to develop unusually well.

Cereal Experiments.

Trebi was the high yielding barley of the 11 varieties grown, followed by Ezond and Beldi. Abundance, Markton, and Victory were the

high yielding oat varieties ranking in the order named. Irwin Dicklow outyielded all of the other spring wheat varieties, but lead Federation and Onas by only .5 of a bushel.

The cereal nursery included 3250 rows of barley, 2000 rows of oats, and 500 rows of wheat in addition to the varieties grown for yield data. Studies and selections were made on large numbers of barley, oat, and wheat crosses in an attempt to secure higher yielding varieties of better quality.

Ninety-nine strains of barley, including imported strains and selections, were grown for yield trials. Twenty-eight of these strains produced 11 per cent more than the average of the entire group. The highest yielding barley of the six-rowed type was from Rhodesia and was known as C. I. 3339. This variety has a good strength of straw, probably slightly better than Trebi.

The wheat-breeding nursery consisted mostly of Federation, Dicklow, Federation Bobs, Bobs Dicklow, and Hard Federation Dicklow crosses. These crosses are being pure lined rapidly and some of them show excelent color of grain and stiffness of straw. Many of the more promising have been sent to Washington for milling and baking tests.

Garden Peas, Red Clover and Grasses.

The garden pea variety test was cut down to three varieties. The Everbearing was the high yielding variety again, giving an average yield of 63 bushels per acre. Lincoln average 56 bushels per acre and Alaska 49.2 bushels. The field pea varieties made much better than average yield. Six varieties were included in this test. Kaiser yielded the highest, with 52.8 bushels per acre. The 18-year average of this variety is 44.2 bushels per acre.

The red clover irrigation experiment was started this year. The object of the experiment is to determine the proper time and amount of water to apply for best seed production. One-fortieth acre plots were used and dykes were built up between each plot so that no water could go from one plot to another. The first year's data seem to indicate that the highest seed yields are obtained from plants that never suffer from water. This brings out the bloom to its fullest extent and more seed was set where the most heads were produced.

The red clover pasture plot experiments were continued. The plots pastured with sheep again outyielded all other plots. This has occurred during two out of the three years of this experiment. One year the plots that were let grow normally out-yielded the other two methods. Clipping proved to be a better method this year than letting the plants grow normally.

The red clover plant selection nursery was continued. Most of the plants survived the winter and records were kept of winter killing of all selections. Plants 1, 23, and 158 are the most promising of the original selections. Plant selections were again made this year. Considerable selfing was resorted to with some of the best individual plants in the nursery. Opening the flowers about 10 o'clock in the morning and dusting the pollen with a camel's hair brush was found to be an efficient method of pollination. Some very superior plants as to forage and seed yielding qualities were selected. These will be planted in a new nursery next year.

The grasses and grass mixture plots were continued. Careful data were taken on time ready for pasture in spring, time growth started, and upon yields. The new mixtures called Idaho No. 1 and Idaho No. 2 were planted in this nursery. These are made up of the grasses that have given the best results during the past three years.

Potato Experiments.

The potato irrigation plots were continued this year. The more frequent and light applications gave much better quality potatoes. The

longer irrigations in some instances gave more tonnage but practically all the yields were No. 2 and cull potatoes.

The potato seed-treatment experiment were continued this year. Three dates of planting were used, May 20, May 27, and June 3, and applications of sulphur, lime, and dipdust to the cut seed pieces were compared with treatment of the seed by the hot formalin method. The dipdust treated plots were two days later in emerging than any of the others and the yields of the dipdust plots and sulphur plots were somewhat depressed. The other three treatments yielded approximately the same as the check. There was not the usual amount of seed piece rotting in the ground this year as there as been in some previous years and no other marked differences were recorded in yields. The appearance of the hot formalin treated plots compared favorably with the others at all times during the summer.

A date of planting test was started this year to determine the best time to plant potatoes. As the two standard varities, Idaho Rurals and Netted Gems were selected and plantings were made from April 15 to June 27. The yields for this year were low, with the early planting attaining a peak about May 20 to June 3 and dropping off rapidly on a downward curve to June 27.

Lamb Feeding Investigation.

The lamb-feeding investigations at this station show that clover or alfalfa chaff can replace part of the alfalfa hay when the basal ration is barley and alfalfa hay for fattenings lambs. Clover and alfalfa chaff were fed to fattening lambs, replacing one-third to one-half of the alfalfa hay in the ration without materially changing the grains and feed requirements. The gains on the lambs tended toward growth rather than fattening when the clover or alfalfa chaff replaced as much as one-half of the alfalfa hay. After the amount of chaff had been reduced to one-fourth, and no more than one-third of the alfalfa hay allowed, the lambs continued to make good gains comparable with the lot receiving alfalfa hay and barley, and the lambs receiving the clover or alfalfa chaff allowance took on finish quite comparable with the lot receiving the basal ration. The value of the clover or alfalfa chaff fed in this manner was approximately one-half the value of the alfalfa hay. Beet molasses added to the clover or alfalfa chaff did not change the gains or feed requirements. All lots sold for the same price, $11.00 per hundred, on the market at Los Angeles, California.

Caldwell Substation

There is now available for the growing of crops at the Caldwell substation a total of 267 acres, all irrigated in years of plentiful water supply. The entire area is now in a state of cultivation and of fertilization to produce excellent crops. The buildings are well adapted to the handling of an experimental farm and are especially convenient for investigational work with the problems of animal feeding, including beef cattle, sheep, and dairy cattle. The major experimental projects are feeding tests with steers and lambs, experiments in the raising of calves, and in the production of milk under irrigated farm conditions, investigation of soils problems peculiar to the region, and cultural tests involving treatment of the soil and utilization of various new types of farm machinery.

Irrigation Water Limited in 1930.

The season of 1930 was a period of limited supply of water for irrigation. Water delivery, however, was more effective than in 1929. The hay was kept growing constantly until the season's allotment was exhausted. The third cutting was the only one affected by the water

shortage. Bacterial wilt appeared in some of the older alfalfa fields and it was decided to save sufficient water to permit seeding of 27 acres, thus making it possible to plow up some of the old stands. A good stand of new alfalfa was secured. New pasture grass mixtures were seeded for experimental work with the dairy herd. In all, forty-five acres were seeded down during the season.

A portion of one of the fields was chiseled, using a commercial type of machine, to a depth of 11 inches after the second cutting of hay and was irrigated soon after the chiseling. The slick spots in the treated portion of the field stayed green a few days longer than in the portions not chiseled.

A good crop of corn was grown and cut for silage at the mature stage. Three men were used in tramping the silage in an endeavor to keep down the percentage of spoiled silage. In the use of silage to date the additional tramping seems to have been very effective in producing a good grade of silage material.

Animal Feeding Investigations.

It is interesting to note in the feeding investigations during the winter of 1929-30, that with both the lambs and the steers it required practically the same amount of feed to produce 100 pounds of gain in the sheds that it did in the open lot. Gains were almost identical. There were very few cold rains, and blustering days, the weather for the most part being cold and clear. However, this test is planned over a five-year period.

There is very little difference between corn, wheat, and barley when compared with the number of pounds required to produce 100 pounds of gain. However, the wheat lot did not have the finish of the corn and barley fed lot. The average gain per lamb was three pounds less for the wheat lot than either the corn or barley lots. It required six pounds of hay and 15 pounds of barley more to produce 100 pounds gain than when corn was used. When wheat was fed, five pounds of hay and seven pounds of wheat more were required in producing 100 pounds of gain than when barley was fed. From the standpoint of feed requirements for 100 pounds of gain, when barley is worth $1.40, then corn is worth $1.46 and wheat $1.37 per cwt, as feed for finishing lambs. However, considering the difference in the finish and the market value, the difference in favor of barley and corn was greater.

Cottonseed meal added to the check ration of barley and alfalfa hay increased the gain and finish on the lambs. The grain requirements were reduced but not enough to effect the increased cost of gains.

Corn silage added to the check ration of barley and alfalfa hay did not increase the gains nor did it decrease the grain and hay requirements sufficiently to lower the cost of gains. Cottonseed meal added to the ration of barley, alfalfa hay, and corn silage increased the gains, improved the finish, and lowered the feed requirements and costs of gains. Cull beans were added to a ration of barley and alfalfa hay replacing 20 per cent of the barley, with the result that the gains were slightly reduced and the feed requirements materially increased. Eighty-three pounds of beans replaced 37 pounds barley but increased the hay requirements 201 pounds in the production of 100 pounds of gain.

One lot of lambs was fed in open lot having access to an open shed in comparison with one fed in open lot without the shed. The two lots of lambs made identical gains and in all other respects were the same throughout the experiment.

Steer Feeding.

Alfalfa hay and barley were compared with alfalfa hay and corn silage for steer feeding. Five hundred thirty-four pounds of barley

replaced 251 pounds of alfalfa hay and 1515 pounds of corn silage in the production of 100 pounds of gain. The grain fed steers gained .19 pounds more per head daily and sold for 25 cents per hundred more on the market.

Steers fed alfalfa hay, barley, and corn silage gained more than those receiving alfalfa hay and barley or those receiving alfalfa hay and silage, and sold for 25 cents and 50 cents per hundred respectively higher on the market. The addition of cottonseed meal to the ration of alfalfa hay 16.69 pounds, corn silage 18.37 pounds, and barley 7.85 pounds, when fed to two-year-old steers, did not increase the gains or lower the feed requirements sufficiently to justify its use.

Hay Alone Compared to Hay and Grain for Calves.

The calves in Group I at the Caldwell Substation received whole milk for the first two weeks. This was gradually changed to skim milk during the third week, and the group received skim milk from the fourth week to 176 days of age. The calves received all the alfalfa hay they would consume. Group II received the same and in addition a limit of two pounds of ground barley daily per calf. Group I gained daily an average of 1.69 pounds per calf compared to 1.75 pounds for Group II. Feed cost for 17 days was $20.58 for Group I, and $22.80 for Group II. Whole and skim milk combined represented 67 per cent of the feed cost on Group I and 61 per cent on Group II.

Wintering Dairy Heifers.

Two groups of heifers at the Caldwell Substation were fed as follows: Group I, alfalfa hay alone; and Group II, alfalfa hay plus two pounds of ground barley daily. The groups were well balanced and both were above normal in weight and height at the beginning and end of the experiment, as compared to the Eckles' standard. Group I gained an average of 145 pounds in weight and 3.8 centimeters in height in 165 days; while Group II gained an average of 186 pounds and 3.6 centimeters. Feed cost for the 165 days was $19.22, or an average of $3.49 per month, per animal in Group I; and $20.13 for 165 days, or $4.89 per month, per animal in Group II.

Irrigated Pasture Management.

An attempt was made to increase the returns from old blue grass pasture (uniformly watered) by supplementary seeding in the early spring. The pasture season extended over a period of 184 days, and results were measured with milking cows. The average returns per acre for two check plots were 180 cow days and $91 over other feed costs, while the average returns per acre for the two plots reseeded were 206 cow days and $104 over other feed costs.

Another old blue grass pasture (uniformly irrigated) was divided into four plots and treated as follows: phosphate; phosphate plus manure; no treatment; and manure. This was the second year of these treatments on these plots. The check plots yielded 138 cow days and $69 over other feed costs per acre, while the plot receiving manure yielded 270 cow days and $133 over other feed costs per acre. The plot receiving phosphate yielded 148 cow days and $70 over other feed costs, while the plot receiving phosphate and manure returned 179 cow days and $85 over other feed costs per acre. This project is in coöperation with the Department of Dairy Husbandry.

Individual Grasses and Legumes for Pasture

Acre plots of the following crops were studied: Ladino clover, first year white blossom sweet clover, first year yellow blossom sweet clover, second year white blossom sweet clover, second year yellow blossom

sweet clover, sudan grass, and rye. Milking cows were used to measure the results. Over a total grazing period of 184 days the acre yield in cow days and returns over other feed costs were as follows: Ladino clover, 170 cow days and $103; second year white blossom sweet clover, 150 cow days and $91; second year yellow blossom sweet clover, 128 cow days and $80; first year white blossom sweet clover, 54 cow days and $40; first year yellow blosom sweet clover, 77 cow days and $51; sudan grass, 70 cow days and $46; and rye, 128 cows days and $75. This project is in coöperation with the Department of Dairy Husbandry and the Department of Agronomy of the Agricultural Experiment Station.

High-Altitude Substation

Comparisons of Wheat.

The High Altitude Substation farm has continued to serve the Upper Snake River valley region and to investigate problems of high altitude farming. In the variety test plots Kanred, Kharkof, Regal, and Oro have been the best winter wheats again this year when yield, smut resistence, and milling qualities are considered. Oro and Regal have yielded more and have been more smut resistant than Kanred each of the three years they have been tested. Spring wheat yielded better than winter wheat this year, due to the lack of rainfall during June and July. The yields of spring wheats were all about the average while the yields of the winter wheats were below the average. Marquis, Red Bobs, Soft Federation, and Early Baart are the most desirable varieties of spring wheat for the region adjacent to the substation. Other varieties may yield higher in favorable years but cannot always be depended upon to mature before frosts in the fall.

Oats, Barley, and Peas.

The yield of the various oat varieties was somewhat above the average this year. Although Victory and Idamine have given the highest average yield for all tests made, Crown was highest this year, with Huitling and Golden Rain tied for second place.

All the barleys were short of straw and difficult to harvest. Ezond gave the highest yield among the barleys.

An average of 19.6 bushels per acre was secured for the 11 varieties of peas grown in the plot tests this year. Peas grown on the farm have always been free from weevil.

Rotation Experiments.

The results in the rotation plots were influenced materially by the lack of rainfall during the growing season. Spring wheat following sweet clover made excellent growth early in the season but the prolonged dry weather injured this wheat more than the wheat in the plots planted to wheat continuously year after year. Wheat following potatoes has given higher yields than any other rotation tested.

Cultural Tests.

Two new projects started this year include a comprehensive test of a deep furrow drill in comparison with an ordinary drill for winter wheat in one-tenth acre plots, and on field basis; and a thorough test of a deep tillage chisel used in comparison with plowing for winter wheat. Results from these tests will be available next year.

Cereal Nursery.

A cereal nursery was grown this year in coöperation with the United States Department of Agriculture. This will be repeated and enlarged next year.

Study of Potato Strains.

A potato improvement project was also initiated. This will include the testing of a number of lots of potatoes which have been tuber-indexed in the greenhouses of the university at Moscow in order to develop disease-free sources of seed and to test various strains which have had the disease factor eliminated so far as possible.

Improvements on the Dry Farm.

During the year a water system has been installed to lift water from the Teton river to the substation dry farm, a new road was opened up connecting the farm with the main highway, and a new four-room cottage erected on the dry farm.

Sandpoint Substation

The 1930 season of the Sandpoint Substation closed with the completion of a number of long-time projects in forage, grain, and root crop production experiments.

The climatic conditions of the 1930 crop year had an important effect on several of the major crops. The fall of 1929 was dry. The crops went into winter condition with a good growth but light snowfall, low temperatures, high winds, and low soil moisture content resulted in heavy killing of winter grain, the clovers, and less hardy strains of alfalfa. The 1930 summer season climatic factors were much more normal and good production was obtained from spring grain seedings and root crops.

Cereal Variety Test.

Ridit led the winter wheat varieties in yield but in yearly averages Mosida still retains a substantial margin. While the winter wheat nursery was not harvested because of excessive losses, information was obtained which shows a very decided relation of the varieties under test to winter hardiness. In this, Martin, Albit, and Triplet 505 ranked highest. A complete elimination was made of the Forty-Fold x Federation selections wich had been under study for some time. A few of the Jenkin hybrids showed good winter hardiness. Highest yielding spring wheat varities were Bluestem, Marquis, and Supreme but in the yearly summaries the leading varieties are Jenkin, Bluestem, and Defiance.

Leading oat varieties for 1930 were Marketon, Nova, and Silvermine, with the average over a period of years going to Nova, Markton, and Idamine. The highest yielding barleys have been Charlottetown, Hannchen, and Colsess.

The spring cereal nursery included 28 varieties of wheat, 17 selection of Jenkin, 23 oat varieties, and 28 barley varieties. The leaders in the respective groups were Bluestem, Jenkin, Moro 10, Victory-Moscow, and O.A.C. 71.

Cultural Experiments.

Rolling spring wheat after seeding gave an increase of 3.8 bushels per acre and for the three-year period, an average increase of 16.1 per cent over that on non-rolled land. Barley on clean land outyielded that where annual weeds had the ascendancy, showing 11.7 bushels per acre increase, while wheat under similar conditions made an increase of 17.2 bushels. All winter barley plantings were lost as a result of winter conditions. Spring barley following various legumes made the highest yield after plantings of sweet clover. Those on alfalfa land were lowest. Only slight differences in total yield were obtained from seeding various proportions of oats and barley mixture.

Work in Kootenai Valley and at Blanchard

A rather extensive project was started on the reclaimed land of District 111, north of Bonners Ferry, with cereal and forage crops. For the current year the work in this district consisted of nursery investigation with grain crops and the establishment of forage seedings. Plantings again were made in the Blanchard valley to find grain varieties that would mature under conditions found there.

Tests With Miscellaneous Crops.

White Canada and Kaiser continue to be the leading pea varieties. Substantial increases in yield are obtained from various rates of pea seeding, using between 60 and 150 pounds per acre. Rye and vetch lead in production for annual hay crops, with the choice of usage probably going to winter wheat and vetch. For the spring crops oats and peas would be the logical choice. Almost a complete elimination was made of less hardy strains of alfalfa, Common, Peruvian, Chilean, and Lebeau, while the variegated varieties like Grimm, Canadian Variegated, and Ladak withstood winter injury perfectly. The highest yielding grasses have been tall meadow oat, meadow fescue, slender wheat, and reed canary. Pasture cuttings gave increased yields to the legumes over any of the grasses. A number of promising selections have been obtained from reed canary grass in non-shattering seed qualities, seed production, vegetative characters, and spreading habits. Sweet clover is the only crop that has increased its stand over the original planting in the reseeding experiments on burned over land.

Potatoes Given Attention.

The northern Idaho Rural led other potato varieties in yielding ability. May 1 and May 15 plantings of potatoes continued to give better production than plantings made before or after those dates. Highest yields have been obtained from potatoes with 18-inch spacings but a higher yield of market stock is obtained from plantings at 36-inch intervals. A tabulation of the work on potato seed treatment does not show a great difference between that treated with bichloride of mercury and that with hot formaldehyde. Potatoes given these treatments outyield the non-treated check plantings and yield slightly less than that treated with formaldehyde, with better disease control than the seed treated with formaldehyde. Highest potato yields are obtained from late planted, non-mature seed.

Iris Garden.

An Iris Display Garden was started in coöperation with the American Iris Society.

Bulletin 169 was published in March. The title is "Alfalfa on the Cut-Over Lands of Northern Idaho." The completion of the soil survey in Benewah county brings the survey party to Bonner county for 1930.

DISBURSEMENTS BY DEPARTMENTS

FROM

STATE APPROPRIATIONS

Jan. 1, 1930, to Dec. 31, 1930—Home Station

	Adminis.	Agr. Chem.	Agri.Econ.	Agr. Engr.	Agronomy	An Husb.	Bacteriology	Dairy
Salaries	$ 789.50	.....	$ 72.25	$1,600.00	$ 200.00	.....	$ 340.00	.....
Help	480.46	11.90	16.38	.....	62.96	.....	224.27	987.78
Travel	35.86	24.72	461.22	199.33	683.39	93.70	.....	49.25
Freight & Miscellaneous	.....	55.39	4.25	.....	25.40	.....	41.00	122.78
Printing & Adv.	877.66	1.85	.....	.....	1.85	.....	.....	2.45
Office Supplies	115.09	.....	.....	.....	.....	.....	14.28	4.07
Lab. Supplies	6.90	74.30	2.40	127.32	187.88	24.40	201.88	171.50
Feed Stuffs	.....	.....	.....	.....	.....	.....	.....	568.75
Repairs to Equipment	.....	.....	.....	.....	7.00	.....	.....	14.27
Memberships & Leases	30.00	.....	.....	.....	.....	.....	.....	.....
Equipment	928.22	.....	3.22	84.82	7.50	.....	869.93	67.90
Totals	$3,263.69	$168.16	$559.72	$2,011.47	$1,175.98	$118.10	$1,691.36	$1,988.75

	Entom.	Home Ec.	Hort.	Legume	Plant Path.	Poultry	Soil Survey	Total
Salaries	$1,495.82	.....	.....	$1,080.00	.....	$ 423.58	$ 437.50	$ 6,438.65
Help	539.20	.....	88.55	337.73	4.50	841.43	20.83	3,615.99
Travel	180.68	.....	367.58	.....	68.52	.....	261.82	2,426.07
Freight & Miscellaneous	36.26	7.48	5.84	166.57	13.12	.....	2.11	480.56
Printing & Adv.	3.18	.....	15.28	27.50	.50	.....	3.00	933.27
Office Supplies	41.17	.....	.....	.....	.....	5.60	8.13	188.34
Lab. Supplies	517.58	3.20	41.00	1,116.03	4.50	327.08	.....	2,805.98
Feed Stuffs	.....	.....	.....	.....	.....	888.46	.....	1,457.21
Repairs to Equipment	.....	.....	.....	.....	.....	.....	.....	21.27
Memberships & Leases	.....	.....	.....	.....	84.00	.....	.....	114.00
Equipment	653.79	34.10	249.22	100.30	5.00	71.27	484.80	3,560.07
Total	$3,467.69	$ 45.14	$767.47	$2,828.13	$180.14	$2,557.42	$1,218.19	$22,041.41

FINANCIAL STATEMENT

UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION
In Account With
FEDERAL APPROPRIATIONS

Dr.		Hatch	Adams	Purnell
To balance from Appropriation, 1929		None	None	None
Receipts from the Treasurer of the United States for the year ending June 30, 1930		$15,000.00	$15,000.00	$60,000.00
Cr.	**Abstract**			
By Salaries	1	$ 9,290.95	$12,686.74	$46,322.69
Labor	2	4,133.40	798.21	3,444.33
Stationery and Office Supplies	3	30.30	13.75	177.47
Scientific Supp., Consumable	4	28.95	744.95	1,224.94
Feed Stuffs	5	1.45	58.44	490.18
Sundry Supplies	6	170.90	136.51	535.34
Communication Services	8	1.00	.....	34.08
Travel Expense	9	732.84	325.48	4,878.58
Transportation of Things	10	15.79	2.43	244.54
Publications	11	415.06	.....	1,011.09
Heat, Gas, & Water	12	.....	.....	412.60
Furniture, Furnish. & Fixt.	13	46.65	11.25	438.95
Library	14	.....	.....	65.31
Scientific Equipment	15	.....	141.36	394.20
Livestock	16	.....	.....	37.00
Tools, Machinery, & App.	17	127.71	18.10	189.68
Buildings & Land	18	.....	54.98	86.10
Contingent Expense	19	5.00	7.80	12.92
Total		$15,000.00	$15,000.00	$60,000.00

SUBSTATION DISBURSEMENTS

	Aberdeen	Caldwell	High Alt.	Sandpoint	Total
Salaries	$3,900.00	$5,534.98	$2,750.00	$4,139.99	$16,324.97
Help	1,904.80	916.11	427.33	305.10	3,553.34
Expense & Supplies	3,570.12	5,110.12	721.16	1,787.06	11,188.46
Equipment	1,026.48	1,047.01	2,148.37	218.18	4,440.04
Total	10,401.41	12,508.22	6,046.86	6,450.33	35,506.81