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UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION

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*On leave of absence.
**In cooperation with U.S. Department of Agriculture.

Report of the Director

THE actute phase of the economic depression began to be effective in Idaho early in 1931. The Experiment Station, therefore, during the past year, faced the most difficult situation in the memory of those who are now connected with it. Farmers were discouraged because of low price levels and the demand from the farming sections was for emergency measures, for information or suggestions that would permit them to place their operations on a paying basis.

It was fortunate that the economic section of the Experiment Station was organized to render help. The Experiment Station economists assisted in interpreting the outlook and either completed or undertook new studies dealing with possible steps in farm organization in order to meet the difficulties of an agricultural industry in a period of general inactivity.

It was of course impossible for the experiment Station staff to make recommendations that would bring immediate solution to problems so fundamental in their origin. Much help was extended, however, in the form of advice in farm planning, suggestions for economies, and information on various kinds of losses in plant and animal production and marketing. These helpful activities seemed to be much appreciated. Meetings concerned with Experiment Station problems were well attended and the requests for guidance and advice were more numerous than in the years of normal prosperity.

The publications were more numerous than in any year of the history of the Station. Several studies which have been under way for some time were brought to at least partial completion and the Purnell fund research undertook studies which resulted in new discoveries and conclusions being given publicity through bulletins, news stories, and in other ways during the year.

The soils of Idaho average high in fertility and in the past comparatively little attention has been given to the question of soil depletion. In recent years the alfalfa yields have been declining in the irrigated sections and increased erosion has been noted in the non-irrigated, rolling lands and general interest has been aroused to the need of preserving soil fertility.

This demand from the state and aroused interest on the part of the members of the Experiment Station staff have resulted in increased time devoted to soils research. Some of the conclusions drawn from field tests with fertilizers, from fundamental research with drainage problems, and from studies of pumping for the combined purpose of

drainage and of securing additional water supply for irrigation, have been made available to the farmers of the state and through the Extension Service are being put into practice.

Special interest was shown during 1931 in pumping to secure irrigation water. The normal attention of the public was accentuated by a year of drouth. Experimental measurements were made on test wells and much information resulted regarding the possibility of using wells for the double purpose of relieving pressure from underground water and adding to the available supply of water for irrigation.

As indicated in the report of the Department of Entomology, the year was marked by the discovery of the Colorado potato beetle in scattered portions of the potato growing area in southwestern Idaho. In cooperation with the State Department of Agriculture, an attempt was made to eradicate the beetle from all affected sections. Late in the season, however, it was found that the infestation was too widespread to permit success in this effort.

Wire worms are becoming an important controlling factor in crop production, especially in their relation to highly specialized field crops and garden crops. Cooperative research by the Bureau of Entomology and the Idaho Experiment Station has been initiated at Parma, with the major portion of the work in charge of two federal entomologists stationed at Parma for that purpose.

Animal Pathology, including disease and parasite problems associated with the dairy, sheep, chicken, and turkey industries, has been given a great deal of attention. The recommendations of the veterinarian of the Station are being followed by a considerable portion of the men engaged in these industries. Contagious abortion has rapidly assumed a place of major importance and the Station is cooperating with the Extension Service and with the State Department of Agriculture in an elaborate undertaking aimed first at dissemination of fundamental information and second at effective measures for control.

The potato industry is a major source of income in normal years and the disease problems of this product demand each year considerable attention from the staff, especially from the Department of Plant Pathology. Some reference to this line of work is found in the report of the Pathologist.

As the result of selections of resistant strains, new bean varieties have been developed and now are being distributed.

The above are only a few of the important lines of work that have received special emphasis during the year.

In general the projects of the Experiment Station are up to date and are very closely correlated with the various phases of the agricultural

industry in the state and with the needs and demands of the farmers for new information to assist them in securing greater efficiency and increased success in their farming operations.

Several improvements were made during the year in the way of minor buildings, purchases of equipment, and alterations and repairs.

A new calf barn constructed especially with sanitation and the admission of sunlight as major objectives, was erected on the university farm. An addition to the swine barn provides for storage of feed and improved facilities for weighing animals used in experimental work. A shed was constructed to shelter a portion of the university herd of beef cattle kept in the open during the winter. A new greenhouse provides excellent facilities for tuber indexing of potatoes. This project is carried on in close correlation with the Extension Service activities for the certification of seed potatoes. A Monjonnier tester was purchased during the summer for the Department of Dairy Husbandry, to obtain greater accuracy in tests of dairy products.

Some minor improvements were made on the substation farms, and insofar as budgets would permit, additional equipment was supplied to contribute to increased accuracy of experimental projects.

Publications

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

Bulletins.

176. LAMB FEEDING INVESTIGATIONS. R. F. Johnson, E. F. Rinehart, and C. W. Hickman.
177. CROPS TO REPLACE SPRING WHEAT IN NORTHERN IDAHO. H. W. Hulbert.
178. GRAINS FOR THE CUT-OVER LANDS OF NORTHERN IDAHO J. H. Christ.
179. WORK AND PROGRESS OF THE AGRICULTURAL EXPREIMENT STATION FOR THE YEAR ENDING DECEMBER 31, 1930. E. J. Iddings.
180. RURAL ELECTRIFICATION DEVELOPMENT IN IDAHO. Hobart Beresford.
181. RATE OF SEEDING FOR PEAS. H. W. Hulbert and F. L. Burkhart.
182. FIELD STUDIES OF THE BEET LEAF HOPPER. R. W. Haegele.
183. STERILIZING DAIRY UTENSILS ON THE FARM. D. R. Theophilus and F. W. Atkeson.
184. PHYSIOLOGICAL STUDIES OF THE CRACKING OF SWEET CHERRIES. Lief Verner and E. C. Blodgett.

185. CONTROLLING THE FIREBRAT IN BUILDINGS BY MEANS OF POISONED BAIT. Claude Wakeland and Harold Waters.
186. TILLAGE METHODS FOR HIGH ALTITUDE DRY FARMING. W. A. Moss.
187. THE REMOVAL OF ARSENICAL RESIDUES FROM APPLES. R. S. Snyder and H. P. Magnuson.

Research Bulletins.

9. BORDER EFFECT IN VARIETY TESTS OF SMALL GRAINS. H. W. Hulbert, C. A. Michels, and F. L. Burkhart.

Circulars.

63. REPORT OF THE SEED COMMISSIONER FOR THE BIENNIUM 1929-1930. R. S. Bristol.
64. METEROLOGICAL RECORDS, SANDPOINT, IDAHO, 1910-1930. Compiled by J. H. Christ.
65. PURE SEED LAW. R. S. Bristol and H. L. Spence, Jr.
66. IRRIGATION PUMPING PLANTS. Mark R. Kulp.
67. PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION.

Technical Papers.

74. SOME OBSERVATIONS OF TREES EXPERIMENTALLY PLANTED IN ALKALI SOIL. In Press. A. M. Sowder, H. P. Magnuson, Hobart Beresford, J C. Marr.
75. TREATMENT OF UNDULANT FEVER WITH AUTOGENOUS ANTIGEN. Journal of the American Medical Association, Vol. 96, pp. 1945-1948, June 6, 1931. G. S. Schilling, C. F. Magee, F. M. Leitch.
76. INHERITANCE OF HERNIA IN A FAMILY OF HOLSTEIN-FRIESIAN CATTLE. Journal of Heredity, Washington, D. C., Vol. 22, No. 11, November, 1931. T. R. Warren, F. W. Atkeson.
77. BOVINE MASTITIS CAUSED BY PSEUDOMONAS AERUGINOSA. Journal of American Veterinary Medical Association, Vol. 79, No. 6, pp. 803-808, December, 1931. V. A. Cherrington, E. M. Gildow.
78. CHEMICAL STUDY OF CASEIN MADE IN EIGHT IDAHO PLANTS BY THE NATURAL SOUR METHOD. Concentrated Milk Industries, Vol. 2, No. 3, November 1931. D. R. Theophilus, H. C. Hansen, R. S. Snyder.
79. ORCHARD VARIABILITY IN MATURING THE ITALIAN PRUNE. Proceedings of the American Society for Horticultural Science, Vol. 28, 1931. L. R. Tucker.
80. INHERITANCE OF WHORLS IN SWINE. In press. J. E. Nordby.

Mailing List.

State of Idaho	15,910
States Other Than Idaho	1,280
Foreign	230
Total	17,420

Active Projects

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

Agricultural Chemistry

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

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

Drainage and reclamation of waterlogged alkali and overflow lands. (In cooperation with Agronomy, Agricultural Engineering, and Bureau of Public Roads, U.S. Department of Agriculture.)

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

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

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

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

Tolerance of crops for alkali.

Casein studies: No. I — Chemical studies of casein by the natural sour milk method in eight Idaho plants. No. II—A study of technique and physical and chemical analysis of casein made by the natural sour and grain curd methods. (In cooperation with Dairy Husbandry.)

Influence of kind of crop used and systems of management on the value of pastures for dairy cattle. (In cooperation with Dairy Husbandry.)

Analysis of feed and fertilizer samples to comply with the State law.

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

Agricultural Economics

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

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

Types of farming areas in Minidoka, Cassia, Jerome, Twin Falls, and Gooding counties.

A potato enterprise cost and efficiency study.

A dairy enterprise cost and efficiency study.

Agricultural Engineering

Factors underlying the economic use of water in irrigation, Sec. III. Drainage and reclamation of water-logged, alkali and overflow 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 cooperation 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. (In cooperation with the Idaho Committee on the Relation of Electricity to Agriculture.)

A study of the cost, effectiveness, and methods of pumping for drainage and supplemental irrigation.

A study of the effects of radiant energy on horticultural plants. (In cooperation with Horticulture.)

A study of the ventilation and lighting of dairy barns. (In cooperation with Dairy Husbandry.)

A study of electric soil heating and floor heating for hotbeds and stable floors.

A study of the comparison or radiant energy with cod liver oil as a vitamine source for promoting growth of chickens. (In cooperation with Agricultural Chemistry and Poultry Husbandry.)

The development of a method for structurally testing farm buildings.

A study of building requirements for poultry production in Idaho. (In cooperation 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.

Tests with commercial fertilizers.

Soil amendments; Use of sulphur, lime, gypsum, and leguminous crop. (In cooperation with Agricultural Chemistry.)

Rotation and fertility investigation.

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

Soil survey: (a) detailed survey of a designated area each season as funds permit. (In cooperation 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) cooperative cereal nurseries. (In cooperation 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—breeding; (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 rotations 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 cooperation with Caldwell Substation.)

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

Farm flock 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.

Sex development in cryptorchid swine.

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

Foul Sheath in sheep cured with copper sulphate.

Treatment of subacute and chronic mastitis. (In cooperation with Dairy Husbandry and Bacteriology.)

Bovine mastitis caused by pseudomonas aeruginosa. (In cooperation with Bacteriology Department.)

A new treatment for Oestrus ovis (grub in the head) of sheep.

Bacteriology

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

Study of scours in dairy calves. (Inactive.)

Legume culture preparation.

Sterility in the bovine male. (Inactive.)

Bacillary white diarrhoea studies. (In cooperation with Extension Poultry Husbandry.)

Study of udder infection in dairy cattle. (In cooperation with Dairy Husbandry and Animal Husbandry.)

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

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

Eradication of Infectious Bovine abortion (Bang Disease) and accreditation of Bang-Abortion Disease-Free dairy herds in the State of Idaho. (In cooperation with State Department of Agriculture, Dairy Husbandry, Animal Husbandry, and Extension Division.)

Dairy Husbandry.

Official testing of dairy cows for advanced registry.

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

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

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 inheritance of umbilical hernia in cattle.

Study of breeding efficiency in dairy herds

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

Study of the vitamin A content of pasture grasses. (In cooperation with Caldwell Substation and Home Economics.)

Pea meal compared to linseed oil meal for milk production.

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

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

Study of water requirements of dairy calves.

Study of water requirements of dairy cows.

Study of udder infections. (In cooperation with Bacteriology and Animal Husbandry.)

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

Study of farm sterilizers.

Study of prices, marketing, and markets for dairy products in Idaho. (In cooperation with Agricultural Economics and Bureau of Dairying, State Department of Agriculture.) Purnell Fund.

Comparison of methods of standardizing milk for cheese making.

Casein investigations. (In cooperation with Agricultural Chemistry.)

Entomology

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

Codling moth. Control investigations.

Beet leaf-hopper investigations. (In cooperation 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 cooperation with the Experiment Stations of Montana, Washington, California and Oregon, and with the Bureau of Entomology, U.S. Department of Agriculture.)

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 cooperation with the Bureau of Entomology U.S. Department of Agriculture.)

Pea weevil. Ecological and biological study of the insect and a study of cultural practices bearing on control. (In cooperation with the Bureau of Entomology, U.S. Department of Agriculture.)

Tarnished plant bug. Investigations of injury to alfalfa affecting possible seed set.

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

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.

A study of the Vitamin G content of the Idaho Russett Burbank Potato.

Vitamin A content of pasture grasses. (In cooperation with Dairy Husbandry.)

Effect of storage in household refrigeration upon the Vitamin C of lettuce (In cooperation with Horticulture.)

Horticulture

Apple breeding.

Orchard fertilization. (In cooperation with Agronomy.)

Tomato experiments.

Potato production experiments.

Pruning investigations.

Varietal study and cultural tests in producing head lettuce.

Variety testing of fruit trees, small fruits and vegetables.

Factors determining storage of Idaho prunes.

Factors influencing the cracking of sweet cherries.

Factors influencing the keeping quality of sweet cherries.

A study of maturity and keeping quality of apples.

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 and the stem rot of alfalfa

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

Plant disease survey.

Poultry Husbandry

The relation of humidity in the artificial incubation of chicken and turkey eggs.

A study of the blood as an index of health and body functions. II Mineral supplements (a) comparative value of calcite and oyster shell in chick rations; (b) various levels of mineral supplements in chick rations. (In cooperation with Agricultural Chemistry and Bacteriology.)

Comparative value of calcite and oyster shell as a source of calcium carbonate for laying hens.

The effects of varying proportions of wheat and yellow corn in the scratch feed of laying hens.

The value of ultra-violet rays produced by the S-1 type sun lamp and the C-X globe in promoting normal growth in chicks grown indoors.

The efficiency of "lustraglass" (a new window glass) in transmitting utra-violet rays, as measured by the normal growth of chicks.

The efficiency of electric brooders in insulated and non-insulated portable brooder houses as compared with coal-burning brooders.

Aberdeen Substation

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

Various 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 investifations. (In cooperation 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 cooperation 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 or 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 cooperation 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 tests (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.

Caldwell Substation

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

Pasture investigations

Electricity in relation to agriculture. (In cooperation 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 cooperation with Agricultural Chemistry.)

Agricultural Chemistry

The Relation of Protein Content and Yield of Wheat to the Nitrogen Content of the Soil.

RESULTS at the present time seem to indicate that the addition of twenty tons of manure per acre every third year maintains the nitrogen content of the soil and increases the yield and protein content of the wheat. Legumes in the rotation increase the yield of wheat but permit a steady depletion of the soil nitrogen, though not as rapidly as in the non-legume rotations. The wheat, oats, pea rotation with manure every third year gives high yield and high protein content of wheat and steadily increases the nitrogen content of the soil. The wheat, oats, fallow rotation is still producing high yields and high protein wheat but the soil is being very rapidly depleted in soil nitrogen.

The Effect of Sulphur, Gypsum and Lime on Yield and Composition of Alfalfa.

Hydrogen ion determinations have been made on all samples of soil. At the present time analyses for total sulphur are being made upon all soil and alfalfa samples to which high applications of gypsum or sulphur were made. Acid soluble phosphorus determinations are being made upon the check samples and samples which received applications of phosphorus.

Slick Spot Investigations.

Greenhouse work has been completed upon corn grown in pots that have various mixtures of slick and normal soils. Analyses are being made upon these soil mixtures for hydrogen ion values and carbonates.

Fertility Studies.

About one hundred and fifty samples of soil were collected this summer for further study on the availability of plant nutrients and the response to fertilizers of Idaho soils. Phosphorus determinations have been completed on weak sulphuric acid extracts of eighty-three of these soils. Hydrogen ion determinations have been made on the extracts and also upon the soils.

The study of loss of fertility through excessive irrigation has been continued in cooperation with the Department of Agricultural Engineering and the Bureau of Agricultural Engineering, U.S. Department of Agriculture. Approximately 400 samples have been taken up to the present time. Of these, about 200 have been completed for carbonates, bicarbonates, sulfates, chlorides, nitrates, phosphates, calcium, magnesium, sodium, and potassium. The remainder are being analyzed as rapidly as possible.

In connection with this work rapid methods have been devised for the determinations of potassium, calcium, phosphorus, and sodium.

Chemical and physical treatments have been continued in the field on the project "The Drainage and Reclamation of Waterlogged, Alkali, and Overflow Lands." No further laboratory work has been done upon this project this year.

Chlorosis.

Considerable time has been spent on the chlorosis problem as found in Idaho upon trees, shrubs and herbaceous plants. The work in field, greenhouse, and laboratory, up to the present time, appears to bear out the following conclusions:

1. Chlorosis is caused by nutritional disturbances.
2. A high lime content together with a high Ph of the soil is responsible for the unfavorable medium for plant growth, by tying up some of the elements essential for plant development in an alkali medium.
3. Manure, ammonium sulfate, and iron sulfate seem to aid in eliminating some of the chlorotic conditions as shown by the work in the greenhouse on spinach.
4. Conductivity and Ph measurements on leaf extracts cannot be correlated with the chlorotic condition of the plants.

5. Complete chemical analysis does not reveal any deficiency of either iron or manganese in chlorotic plants.
6. Pectins are not precipitated in the chlorotic twigs, a condition which was thought due to the dark rings revealed in cytological studies.

Removal of Arsenical Residue from Apples.

A bulletin was published in November on this work in which a summary was given as to the effects of oils and waxes, cold and common storage, and various strengths and kinds of wash solutions, upon the removal of the arsenical residue from apples. Recommendations also were made as to the proper procedure to be followed by the grower in spraying, storing, and washing his apples to obtain the best arsenical removal.

Casein Studies.

A paper was published in November, in cooperation with the Department of Dairy Husbandry, on "*Chemical Studies of Casein as Manufactured in Eight Idaho Plants.*" It was found that, by the present methods of analysis, Idaho casein has a high degree of uniformity and high quality except for an excess of acid, which defect may be remedied by more thorough washing. Analyses compared favorably with analyses of a limited number of imported caseins.

Pasture Grass Values for Dairy Cattle.

One hundred and fifty-eight samples of pasture grass samples have been taken for the study of systems of management and relative values of pastures for dairy cattle. Analyses of these samples are being carried on as rapidly as possible in the laboratory.

Poultry Studies.

Further work has been done in cooperation with the Department of Poultry Husbandry on the study of the influence of calcites, oyster shell, and bone meal upon the blood and bones of growing chicks. Several hundred analyses of the blood and bones have been made for calcium and phosphorus. Ash was determined on the bones also.

Some study is being made on the effects of radiant energy of various wave lengths on growing chicks, in cooperation with the Departments of Agricultural Engineering, Poultry Husbandry, and Animal Husbandry. Comparisons have been made with a check pen and a cod liver oil pen. Analyses for ash, calcium, and phosphorus have been made upon the bones; and calcium and phosphorus upon the blood of

chicks from these pens. Progress reports will be made on these two chicken projects in the near future.

Miscellaneous.

About one hundred forty-eight analyses for moisture, ash, protein, crude fat, crude fiber, and nitrogen free extract have been made for various departments. Much miscellaneous work has also been done on samples of soil, cereals, fertilizers, minerals, and feeds.

Agricultural Economics

THE Department of Agricultural Econimics has continued its program of research with the same number of men and the same organization as for 1930.

Farm Organization and Management.

The general purpose of all research projects has been to assist the farmer in adjusting his farm to ever-changing conditions in such a way as to realize the highest labor income consistant with soil maintenance and a reasonable standard of living. For this reason, two of the eight active projects of the year have been concerned with prices of farm products and six projects have dealt with farm organization, farm management, and enterprise efficiencies. Four of these projects have reached the stage of manuscripts, and will be published within the next few months.

Extension.

Fortunately, two extension economists, who were first employed during the fall of 1930, have continued with the Extension Division, and with increasing experience, they have been in a position to make the research of this department available to the farmers of the state. Bulletins have been available for distribution, articles have been written for the News Letter and for other publications reaching Idaho farmers, and talks by the members of the Department have added to the extension of findings.

Two farm management conferences were held in cooperation with all extension specialists. Farmers took an active part in the work of these conferences and recommendations were published.

Plans for the Future.

All projects at present active are scheduled for completion within the next three years. The study of prices of farm products may be extended to include other staple farm crops. The 1930 census, which

will soon be completely available, suggests a number of studies. Chief among these is a mapping of the state with respect to types of farming areas. With the census of distribution available, the marketing of various crops can be accurately described. The relation of the price of feed to the prices received for livestock under different management methods, may be determined for several irrigated areas.

General Service Work.

Economic information has been made available to individuals and associations upon request. A file and library are being collected of the great mass of information made continuously available by the several experiment stations, the U.S. Department of Agriculture, and by other individuals and institutions. These data are both historical and current. Considerable inter-departmental exchange of information has taken place within the university. The "*Idaho Agricultural Situation,*" which gives outlook information monthly, is edited by the Department of Agricultural Economics.

Agricultural Engineering

Reclamation, Irrigation, and Drainage.

A new project, "The efficiency of irrigation and drainage plants," has contributed much valuable information regarding combined drainage an irrigation pumping from wells in the Boise Valley. Monthly readings of groundwater levels were taken during the irrigating season on about 250 observation wells radiating from 21 drainage wells, and on some wells during the non-irrigating season, to determine the drainage effect and movement of groundwater. The shortage of irrigation water during the season has increased the interest of water users in supplementary pumped supplies.

A study of the effect on yield of potatoes of diferent amounts of irrigation at various intervals was carried on at the Aberdeen Substation. The effect of time and amount of irrigation on the yield of beans was continued in cooperation with the Department of Plant Pathology at Twin Falls. A field newly broken from clover was used to eliminate the objectionable feature of land cropped for a number of years to beans. More water was applied there in previous years but the rate of yield per acre was approximately the same as last year, ranging from 39.3 to 51.5 bushels per acre, using C6 Great Northern seed both years.

The study of the loss of fertility through excessive irrigation was continued in cooperation with the Department of Agricultural Chemistry.

The reclamation of alkali land at Caldwell was studied in cooperation with the Department of Agricultural Chemistry and the Bureau of Agricultural Engineering. It has not been possible to drain a perched water table on part of the land by open drains, blasting, or by a pumped drainage well. Chemical and physical treatments were continued. Records of groundwater levels were kept in connection with the drainage well.

Farm Power and Machinery.

The direct harvesting of field peas with the combine has been included in the study of harvesting methods and equipment. During 1931 a detailed study of five machines equipped for the direct method of harvesting and field studies of the harvest losses were made in cooperation with the Department of Entomology and the Bureau of Entomology, U.S. Department of Agriculture.

The best record for the direct-combine method was on 170 acres which yielded 1,446 pounds of harvested peas per acre with a field loss of 132 pounds per acre. The average for 1,198 acres of peas harvested by the direct-combine method gave an average yield of 1,129.51 pounds of harvested peas per acre with an average harvest loss of 438.7 pounds per acre.

The investigation of tillage problems has included the study of new types of equipment and the use and management of the more promising tillage tools. The work has been made possible by the cooperation of farmers who have used "Servis Recorder" clocks on their tractors for obtaining the exact record of the operation of each implement. These "Servis Recorder" records are the basis for records of the duty of equipment and cost of operations obtained by the study. The effect of tillage practice on crop yields, moisture penetration, soil erosion, and cost of tillage has been continued. The use of the chisel seems to be favorable to moisture penetration and soil-erosion control as indicated by field observations.

Rural Electrification.

The value of warm water as compared with cold water for fattening livestock has been studied at the Caldwell Substation in connection with the experimental feeding work conducted by the Department of Animal Husbandry. Immersion-tpye electric stock tank heaters were used for warming the drinking water in the steer and lamb feeding pens and in the tank at the experimental dairy unit. Drinking water was heated for a total of 78 steers during a feeding period of 80 days. An average net gain of 23.19 pounds per head was attributed to the effects of the warmed water. The energy consumption of the water

heater averaged 24.3 kilowatt hours per steer for the period. In addition to the gain of weight made by the animals, the elimination of ice from the water troughs reduced the chore labor. This reduction of chore labor was the only benefit observed for the fattening lambs. During periods of more intense cold the benefit of warm drinking water may be more pronounced and for that reason the trials are being continued.

Cooperating with the Department of Poultry Husbandry, the housing requirements for and the management of electric brooders under northern Idaho conditions are being studied. Thus far the trials have shown that electric brooders compare favorably with coal brooders provided the brooder houses furnish adequate protection, or when supplemental heat is available for meeting low-temperature conditions. Under similar conditions 1 kilowatt hour of electrical energy used in the electric hover-type brooder equalled 2.39 pounds of coal used in the stove-type hover. For successful operation, the electric brooders require careful adjustment of their ventilating systems to meet any change in room temperature or humidity. Failure to make such adjustments results in excessive sweating and dampness which requires frequent changes of litter. A comparison of an insulated brooder house with an uninsulated house showed that a sufficient saving of fuel or electrical energy to justify the cost of insulation might be expected under northern Idaho conditions.

The use of artificial radiation for the promotion of chick growth and electrically heated hotbeds are being studied in cooperation with the other Departments of the Station. A newly developed soil heating wire will be applied to hotbeds and floor heating tests will be made for under-heat brooders and hospital stalls.

Farm Building and Equipment Plans.

Plans for farm buildings have been developed for other Departments and for the Substation Farms. Feed storage and animal shelters were planned and built at the University farm and the High Alttude Substation. In addition to the building plans developed especially for Idaho conditions, several negatives of plans were secured from the Bureau of Agricultural Engineering, U.S. Department of Agriculture. Blue print copies of these plans are available through the county agents or upon application direct to the department.

The testing of farm buildings structurally has been continued by a detailed study of framing joints. This work was made possible through the courtesy of the Department of Civil Engineering. Full-scale models of framing joints have been tested for distortion and failure as suggested by the behavior of scale models of trusses and fabricated building sections previously tested.

It is planned to continue this project using casein glue in connection with roof and wall construction. In certain types of frame buildings the present method of construction permits the distortion of nailed joints which cause the roofs to sag and the plastered walls to crack. Test of frame buildings structurally have shown that the common types of nailed joints must be improved upon if the failures noted are to be corrected.

The ventilation requirements for dairy barns and the management of modern ventilating equipment is being studied in cooperation with the department of Dairy Husbandry.

Agronomy

THE annual rainfall for the 1931 crop season ending August 31 was 17.09 inches, or 4.85 inches below the thirty-five year normal. A well distributed nearly normal June precipitation made possible very satisfactory crop yields and products of excellent quality, especially in fall sown crops.

Cereal Improvement.

The cooperative wheat improvement project with the U.S. Department of Agriculture has been under way for a little over a year. An important objective in the wheat improvement program is the production of superior soft white winter wheats. With this in mind more than 50 hybrids were made this season. Many of the present high yielding varieties are red wheats, such as Triplet and Mosida, and at present farmers are inclined to grow the somewhat lower yielding but more desirable white wheats. The Fortyfold Federation selections have been continued in the trials and show considerable promise. Next year the high yielding strain from these selections will be increased. If its milling quality is equally as good as Fortyfold it will be distributed in areas where this latter wheat is adapted. These selections are non-shattering, high in yield, with pink straw, brown glumes, and soft white kernels. Federation and Red Bobs are the high yielding spring wheats over a period of years. Federation, because of its white grain, is the recommended variety.

Trebi barley continued to lead the other spring barley varieties in yield. Spartan, a two row, smooth awned barley from Michigan, is producing good yields. All of the other smooth awned barleys are low in yield and not adapted to Idaho conditions. Markton, Victory, and Idamine oats are the better varieties. Markton, because of its smut resistance and slightly higher yield, is recommended.

A number of newly introduced pea varieties are showing considerable promise. Chang Dashaway, Alcross, Suprise, and Ashford outyielded White Canada, the check variety. Tall Gray Sugar and Early Washington, of the older introductions, are the high yielding varieties of the garden sorts. Idabell, S.P.I. 19709, Bluebell, and White Canada are the high yielding field varieties. Late varieties are of no value under Palouse conditions.

Soybeans Appear Valuable.

Soybeans grown experimentally on the H. L. Stafford ranch near Lenore show much promise for furnishing green pasture during the "summer drought" period. Thirty-five strains were included in the yield trials. Ito San, Minsoy, Manchu, and Mandarin were outstanding. The use of Idaho-grown seed, inoculation, thin stands, and a well prepared seed bed are essential for satisfactory results. The results from commercial fields indicate that about 500 pounds of seed per acre is a satisfactory yield. This crop furnishes an abundance of pasture during August and early September. If desired, soybeans could be used as a soiling crop to furnish feed for dairy cattle. None of the varieties seeded at Moscow matured before frost.

Weed Work Shows Progress.

The research work pertaining to the eradication of perennial weeds was materially increased. Extensive work on white top, covering an area of 10 acres, was started in the Boise valley. Six acres of this area is devoted to tillage experiments. Cultivation sufficient to keep down the top growth cost $23 per acre for the first season. Extensive treatments on leafy spurge, quack grass and morning glory were begun. Last season's treatments showed conclusively that sodium chlorate was more effective in weed killing than the other chlorates. Carbon bisulphide is efficient in the elimination of small patches in irrigated areas, where the soil can be thoroughly saturated with water previous to the chemical treatment. It is too expensive for extensive work.

Forage Crop Breeding.

The forage crop breeding program has been increased materially. Sweet clover, alfalfa, red clover, Ladino clover, sunflowers, and corn are the principal crops under investigation. The development of alfalfa with colored seed, mildew resistance in red clover, winter hardiness, and seed color in Ladino clover, sweet clover with colored seed, and the development of high yielding silage strains of sunflowers and corn are the objectives of the breeding investigations.

Soils Investigations.

The annual soil survey work was carried on in Bonner county. This county should be completed in another season. In addition, a supplemental soil survey of the Idaho Falls area was made to aid in the interpretation of economic data assembled in that county. This material will be published with the economic data.

A study of the effect of different rotations in the sixteen-year old rotation work on University Farm, Moscow, showed rather interesting results. Alfalfa drew moisture from a depth of 10 to 20 feet; sweet clover, 5 to 11 feet; sunflowers 5 to 11 feet; corn, wheat, oats, and barley, 4 to 7 feet; peas and potatoes, 3 to 5 feet.

Other projects pertaining to soils under investigation are the reclamation of alkali soil, management of orchard soils, deep tillage soil fertility studies, and soil moisture studies at the High Altitude Substation.

Animal Husbandry

THE investigational work in Animal Husbandry is conducted at Moscow and at the Substation Farms at Aberdeen and Caldwell. The experimental animal disease work is reported in Animal Husbandry. The following projects are being studied: Practical rations composed of Idaho grown feeds for fattening steers and lambs for market (see Substation Farm reports); Various combinations of feeds for growing and fattening swine; Animal breeding studies having to do with variations and abnormalties affecting swine; Control methods of parasites of sheep; Infectious abortion of cattle; Foul sheath in sheep; Subacute and chronic mastitis.

Winter Wheat as a Forage for Swine.

Twelve pigs weighing 46 pounds each were turned into a one-acre field of winter wheat May 20. This wheat was seeded in October of the previous year. They were fed a two per cent ration or about one-half as much grain as they would eat, and gained .81 pounds a day for 62 days requiring 257 pounds of wheat and 13 pounds of tankage (60 per cent) for each 100 pounds of gain. A similar lot for the same period on one acre of wheat gained 1.03 pounds per day on a full grain ration of wheat and tankage and required 358 pounds of wheat and 18.5 pounds of tankage for each 100 pounds gain.

Ear and Skull Defects.

Dwarfed or absence of ears in pigs at birth has been found quite common in one strain of Duroc Jerseys and in Poland Chinas. Records

are available from a number of herds and the defect has been traced to a common source in Durocs, 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 five skulls of affected specimens revealed a number of structural skull defects on the same side of the skull as the defective ear is found. 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.*

"Blind" Teats

When the end is telescoped back into the body of the teat of the sow it is spoken of as "blind" inasmuch as any manipulation of it has no influence on the sphincter muscle which controls the flow of milk. From results of a number of matings this defect appears to be inherited. Specimens with five "blind" teats have been produced.

Cryptorchidism.

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 scortum. 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 has also obtained without exception in the case of specimens in which both gonads have been retained.

White Spotting in Duroc Jerseys.

In 20 litters involving 194 pigs, 134 have been free from spotting and 57 have varied in their spotting from a small amount of white in proximity of one toe to pronounced markings on all feet and in one case a complete white belt.

Whorls in the Hair of Duroc Jerseys.

It appears from a study of 27 litters, some of which are full brother and sister matings that the inheritance of whorls involves two dominant complementary pairs of factors both of which must be present in the homozygous or heterzygous condition before the whorl appears.

Overshot and Undershot Jaws in Sheep.

This station has previously reported that the overshot and undershot jaw defects are inherited in sheep. (*Annual Report* 1928, '29, '30.) A discussion of these defects and the progress made in determining its

inheritance have been more fully discussed in an article published in the *National Wool Grower, Vol. XXI., No. 2, Feb.* 1931.

Elimination of Bang Abortion Disease.

Six herds are entered in this project, a cooperative one with the Departments of Bacteriology and Dairy Husbandry. Herd No. 1, now consisting of 105 animals, has been maintained free from abortion for three years. Herd No. 2, now consisting of 79 animals, contains 16 positive reacting animals. No new reactors have developed during the year. Herd No. 3 has been experiencing an abortion storm. It started with six reactors out of 36 animals tested at the first of the year and 15 reactors developed during the year. All of the reactors that developed were among the original animals tested. Herd No. 4 is in the midst of a storm, 13 reactors and five abortions having developed during the year. Herd No. 5 has reduced the number of reactors from 11 to seven by elimination of reactors, no new cases having developed during the year. Herd No. 6 has eliminated two reactors and two new reactors have developed, leaving seven reactors still in the herd. All herds excepting No 1 and No. 3 have been handled as a unit with but partial isolation of reacting animals practiced as a regular procedure.

A New Treatment for Oestrus Ovis Larvae in the Head of Sheep.

The article Jour. A.V.M.A., vol. LXXIX, N.S. 32, No. 2, Aug. 1931, pp. 210-216 gives specific information concerning the use of carbon disulphide and the position of the head of the sheep being dosed in the treatment for Oestrus ovis larvae. Additional data have been obtained indicating that a more dilute solution of carbon disulphide can be used which produces no loss of equilibrium even temporarily in the treated sheep.

"Bovine Mastitis Caused by Pesudomonas Aeruginosa."

The paper Jour. A.V.M.A., vol. LXXIX, N.S. vol. 32, No. 6, pp. 803-808, in cooperation with V. A. Cherrington of the Department of Bacteriology discusses a herd outbreak of mastitis caused by *Pseudomonas aeruginosa.* Agglutination tests of the blood and milk correlated with isolation of the organism from the milk of affected cows. It was concluded that the contamination of the water supply with milk from affected cows was the cause of the persistence of the outbreak.

Foul Sheath in Sheep.

This is a necrosis of the sheath of the union of the skin and mucus membrane on both bucks and wethers. It does not seem to be transmitted to ewes at service. It eventually interferes with copulation. Powdered copper sulphate, applied at three-day intervals for three to

six times, gives practically complete control in mild to moderate cases and if continued over a longer period of time will cure severe cases.

Treatment of Subacute and Chronic Mastitis.

An attempt was made to reduce the excessive high bacterial and leucocyte counts in milk from infected udders of seven lactating cows that were affected with subacute or chronic mastitis. The treatments tried were as follows: One ounce of formalin once daily for four days given as a drench in one quart of cold water; Fifty cubic centimeters of colloidal carbon injected intravenously on alternate days for three treatments. Subcutaneous injection of autogenous bacterins (standardized at three on the McFarlain nephelometer) on alternate days, using four, eight, and 12 cubic centimeters respectively; Use of ultra-violet light for 15 minutes twice daily for a five-day period, either before or after milking. For further detail Station report for 1931. In none of these treatments was the bacterial or leucocyte count regularly reduced either temporarily or permanently. This is a cooperative project with the Departments of Dairy Husbandry and Bacteriology.

Bacteriology

Bacillary White Diarrhea Studies.

CONTINUING the work of poultry accreditation which is carried on in cooperation with the Department of Poultry Husbandry, 22,848 samples of blood submitted from the flocks of 98 breeders have been tested for *Salmonella pullorum* infection during the current season. Seventeen flocks were found to harbor no infected fowls. Infection incidence ranged from 0.2 per cent to 47 per cent.

A rapid field method of serological diagnosis, in which a concentrated antigen containing methyl violet and sodium citrate were used, gave experimental results which were in close agreement with results obtained by the tube agglutination method. Extended studies of this method are contemplated with the hope that it might displace the latter in future routine testing.

Studies in Udder Infections.

The experimental work on this project has been confined to the university dairy herd and has been carried on in cooperation with the Dairy Husbandry and Animal Husbandry Departments. Three technical papers, embodying significant results obtained in these studies, are now being prepared for publication.

The first paper deals with "The Bacterial Count of Aseptically

Drawn Milk as an Indication of Udder Infections." This paper presents data showing that an excessively high count is a reliable indication of mastitis.

The second paper deals with "The Significance of Leucocytes in Milk." This paper indicates, essentially, that an exceedingly high leucocyte count is a reliable indication of udder infection. The relation of leucocyte count to udder infection is further substantiated by correlating it with decreasing H ion concentration and the presence of pyogenic cocci.

The third paper presents the subject "Irradiation of the Cow's Udder with Quartz Mercury Lamp as a Treatment for Mastitis." Data and observations are presented which show that the ultra-violet mercury-vapor-arc radiations are highly effective in relieving the physical symtoms of mastitis.

The Blood as an Index of the Health and Body Functions of the Laying Hen.

Anatomical studies of the skeletal structure of young birds held on varying mineral rations in which theoretically unbalanced calcium-phosphorous ratios were employed failed to confirm the view that an exact adjustment of the calcium-phosphate ratio is essential to normal bone development. This experiment, involving six pens of chickens, was repeated three successive times to eliminate any seasonal influence. Detailed histological studies were made on representatives of each pen.

A few cases of *arthritis deformans*, generally referred to as "slipped tendon" were encountered. The apparent cause of this deformity is not the dislocation of the gastrocnemius, but a relaxation of the ligaments of the tibio-metatarsal joint, or possibly an abnormal development in the fusion of the embryonic stage of the tarsal bones. The direction in which the joint is disarticulated, i.e., medially or laterally, is dependent upon whether the medial or latent ligaments relax. Such relaxation may be due either to deficient tenacity or is an accommodation to an enlarging tarsal bone. Very rarely is the gastrocnemius and the accompanying tendons displaced from the inter-condyloid groove. The condition can not be reproduced with any certainty by means of theoretically unbalanced mineral ratios. This work is being carried on in coopeation with the Departments of Poultry Husbandry and Agricultural Chemistry.

Eradication of Infectious Abortion.

The execution of this project is closely associated with the state program for the eradication of infectious abortion. Certificates of accreditation are granted by the Bureau of Animal Industry of the State De-

partment of Agriculture to dairy herds which pass three clean tests within a calendar year.

Up to and including December 15, 5,039 blood samples were tested. These were submitted in 423 consignments, some of which comprised complete herd tests, while others were individual or random samplings of herds. Of this number, 652, or 13.0 per cent reacted positively.:

Experimental work was continued on the relation of blood serological titre to milk serum titre and elimination of *Brucella abortus* in the milk or gynecological secretions.

The project is cooperative with the Departments of Dairy Husbandry, Animal Husbandry, Bacteriology, the Extension Dairy Husbandry Specialist, County Agents, and the State Department of Agriculture.

Availability of Plant Nutrients and the Response to Fertilizers of Idaho Soils.

This soil plaque method of testing soils to determine their need of phosphate fertilizers has been studied and a paper is now in the process of preparation which sets forth the new technique. This general project is being carried on in cooperation with the Departments of Agricultural Chemistry and Agronomy.

Legume Inoculation.

The demand for cultures of root nodule bacteria for legumes was much lower than in preceding years. This was due in part to the lack of ready cash among the pea growers as well as to the strong sales programs which are being carried on by several commercial concerns. In the absence of a state law regulating the sale of legume inoculants, it seems advisable to continue to prepare these cultures which serve to set a standard for competitors. Commercial concerns selling good quality cultures usually say that the sale of cultures by the State Agricultural Experiment Station is an aid to their business rather than a competitive hindrance.

Public Health Work.

This department continues to serve northern Idaho by doing a limited amount of public health work. No budget allowance is made for this service but the state laboratory at Boise is so remote that it is quite necessity to make the facilities of the university laboratories available to this work. Large numbers of water samples are tested to determine their potability and many tests are made on retail milk samples from several towns endeavoring to maintain a high sanitary standard of retail milk. It appears especially desirable that this type of work be extended.

Dairy Husbandry

The Dairy Herd.

AVERAGE production per cow during the past year was 14,187.9 pounds of milk and 494.6 pounds of butterfat. The monthly average number of cows in milk was 42.2. Twenty-six official production records of ten months or a year were completed, including five records over 800 pounds of butterfat. Inventory showed 55 Holstein females and 37 Jersey females, totaling 92 breeding females. The herd has been accredited as a Bang abortion free herd since May 3, 1930.

Bull Association Studies.

For four years, up to July 1, 1929 this was a cooperative project with the Bureau of Dairy Industry, U.S. Department of Agriculture. Since 1929 it has been continued as a state project. Two bulletins have been published on results from this project. At present, in Idaho, there are 20 cooperative bull associations, representing 465 members, 86 bulls, 336 purebred cows, and 3056 grade cows, making a total of 3392 breeding females. Five associations have operated for nine years, eight for eight years, and 14 for five or more 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 12 years in cooperation with the Bureau of Dairy Industry, U.S. Department of Agriculture. One hundred one female offspring have been obtained from the original 14 foundation cows. The number in each generation is 25 F_1, 31 F_2, 26 F_3, 17 F_4 and 2 F_5. Sixty-eight have completed yearly records and 60 of the 101 are still in the herd. Nine bulls have been used, five of which have been proven by dam and daughter comparisons in this herd.

Growth Studies.

Normal growth studies on both the Holstein and Jersey herds have been in progress for 13 years. Data on the effect of pregnancy on body weight have been collected for the same period of time.

Inheritance of Umbilical Hernia.

The defect seems to be sex-limited as only males were herniated. Hernia appears to be a dominant character. The results were published in the Journal of Heredity, Vol. 22, No. 11, November 1931.

Breeding Efficiency.

A field study is under way on about 50 dairy herds to determine the variations in breeding efficiency with respect to such factors 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 88 per cent, while the Jersey herd averaged 71 per cent. (Subject to correction.) This project is being carried in cooperation with the station veterinarian, the station bacteriologist, and with field agencies.

Pea Meal Compared with Linseed Oil Meal.

This year's results were in harmony with a similar trial the previous year. Two pounds of pea meal were substituted for one pound of linseed oil meal in the check ration which contained 25 per cent of linseed oil meal. The ration containing the pea meal seemed equally as efficient as the linseed meal ration when measured by milk and fat production and increase in body weight.

Calf Feeding Investigations.

Group I consisted of four Holstein calves. Skim milk powder was fed dry after the calves reached seven weeks of age. Group II also consisted of four Holstein calves. This group was fed similarly, but received dried buttermilk instead of dried skim milk. Both groups were thrifty and made normal growth. Cost of raising was approximately the same for both groups; namely, $14.50 per calf to four months of age and $21.50 to six months.

Water Requirements of Dairy Calves.

Data were obtained on 26 Holstein calves. The calves receiving liquid milk consumed free water as follows: 4 pounds at 6 weeks of age, 23 at 9 weeks, 46 at 12 weeks, 70 at 15 weeks 122 at 18 weeks, 175 at 21 weeks, and 240 at 26 weeks. Free water did not seem essential until the calves were about eight weeks old. Groups of calves fed dry milk in grain consumed enough more water to compensate for the absence of water in liquid milk. Water consumption showed a close relationship to body weight, to dry matter consumed, and to protein intake.

Water Consumption of Dairy Cows.

Individual records were obtained on seven Holstein cows under the following conditions: when not lactating, both with and without succulent feed; when at the peak of production, about two months in lactation; and when in low production, about ten months in lactation. Addition of succulence to the ration reduced the consumption of free water, but slightly more total water was consumed. More water was consumed as the work of production increased.

Studies of Udder Infections.

The detection and treatment of mastitis has received attention for two years. Three papers have been prepared for publication and will be found listed under the Departments of Bacteriology and Animal Husbandry.

Cream Buying Stations.

Of the butterfat used for commercial butter manufacture, about one-fourth in Idaho and one-half in the United States is collected by the creameries from the producers through the agency of a net-work of cream stations. The study of the efficiency of this agency has been completed and the report is on the press. This project is in cooperation with the Department of Agricultural Economics.

Standardization of Milk for Cheesemaking.

Previous work at this station proved that good quality cheese could be made from milk standardized with dried skim milk (spray process.) The results indicated a profitable outlet for milk powder and a more standardized cheese quality. Work in progress consists of a comparison of standardization with liquid skim milk, dried skim milk, roller process, vacuum process, and spray process. Standardization by removal of fat is being compared to addition of solids-not-fat.

Casein Investigations.

A chemical study was made of the casein manufactured by the natural sour method in eight Idaho plants. Results indicate the quality was very good, but there was a tendency toward too high ash content which could be corrected by more thorough washing. Results of the study were published in Vol. 2, No. 3 November 1931, *"Concentrated Milk Industries."*

Service.

Official testing of herds for production required a grand total of 344 days of supervisors' time, the same as in 1930. An average of 154.3 cows were tested each month and about 11.8 breeders were served each month. The glassware calibration laboratory received 10,098 pieces, of which 10,056 were found accurate and etched "S. G. I." (Standard Glassware Idaho), 27 were inaccurate, and 15 broken. Analyses of dairy products included 82 samples of milk and 5 of cream, tested for fat; 61 samples of butter, analyzed for fat, moisture, salt, and curd; and direct microscopic examination of 49 samples of butter.

Cooperative Projects with Caldwell Substation.

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

Entomology

Tarnished Plant Bug.

THE tarnished plant bug, *Lygus pratensis,* was found not to be present in the bean fields of southern Idaho and it was determined that two closely related species of Mirids, *L. elisus* and *L. elisus hesperus,* are involved in the puncture injury to beans.

Pea Weevil.

Study of the pea weevil in northern Idaho is continuing. The work was made cooperative with the Bureau of Entomology, U.S. Department of Agriculture, August 1, 1931, and an assistant entomologist of the Bureau was stationed at the Experiment Station.

Codling Moth.

Results of a three-year study of the codling moth life-history in southwestern Idaho, completed in 1928, were assembled in manuscript form and are being published as Research Bulletin No. 10.

Nineteen hundred thirty-one marks the sixth year of codling moth control experiments in southwestern Idaho; the chief improvements resulting in control practices are in better timing of spray applications and the addition of oil emulsions to lead arsenate spray which under certain conditions materially increases degree of control.

Leafhopper Study.

The systematic study of the leafhoppers of Idaho is continuing. Two species, *Empoasca maligna* and *Typhlocyba pomaria,* are common on apple in southwestern Idaho, and *T. pomaria* infests prunes also. *E. fabae* has not yet been collected in the state.

Beet Leafhopper.

Cooperating with the Bureau of Entomology, U.S. Department of Agriculture, detailed studies of the breeding areas, host plants, natural populations, etc., of the beet leafhopper in Idaho and work to develop curly-top-resistant sugar beets are continuing. A bulletin *Field Studies of the Beet Leafhopper,* was published during the year.

Wireworms.

The cooperative project on wireworms with the Bureau of Entomology, U.S. Department of Agriculture, is under way. Investigations in Idaho deal principally with cultural control possibilities such as the rotation of crops, use of fertilizers, irrigation water, etc.

Colorado Potato Beetle.

Cooperating with the State Department of Agriculture, an extensive and intensive attempt was made to eradicate the Colorado potato beetle from southwestern Idaho. The insect had become well established and widely spread before its presence was known. Information obtained this year leads to the belief that eradication is impracticable.

Idaho Insect Survey.

Further progress was made in the building up of the insect collection and in identifying the insects of Idaho.

Western Cooperative Oil Spray Project.

The Idaho station continued participation in the Western Cooperative Oil Spray Project. Injury to prune buds occurred when dormant-type oil emulsions were applied at a dilution of 4 per cent oil to buds green at the tips. Four per cent oil killed 38 per cent and 3 per cent oil killed 22 per cent of the blossoms when application was made when blossoms were nearly open. Four per cent dormant-type oil applied to prune trees December 24 killed some of the branches but 3 per cent oil caused no injury. Addition of summer-type oil emulsion to lead arsenate did not materially increase the degree of codling moth control. Complete kill of San Jose scale resulted at Lewiston from an application of either 3 per cent or 4 per cent dormant-type oil. The scale insects left alive following other treatments were as follows: Dry lime-sulphur, 12 pounds, 15 pounds, 20 pounds, and 33 pounds in 50 gallons water, 17.5 per cent, 13.9 per cent, 7.7 per cent, and 6.3 per cent respectively; Liquid lime-sulphur, brand "A", 4° and 5° B. test, 14.5 per cent and 13.5 per cent respectively; Liquid lime-sulphur, brand "B", 5° B. test, 5.8 per cent. Late summer examinations indicated that dry lime-sulphur 12 pounds, 15 pounds, and 20 pounds per 50 gallons water, had not produced satisfactory commercial control but that dry lime-sulphur, 33 pounds per 50 gallons water, and the liquid lime-sulphur at 4° and 5° test had.

Destructive Prune Worm.

The destructive prune worm, *Mineola scitulella*, increased its range and damage. Numerous experiments were made in control but results were negative or the degree of control very low.

Cattle Lice.

Experiments indicated that the little red cattle louse, *Bovicola bovis*, may be controlled by application of 60 grams sodium fluoride of 90 grams finely powdered diatomaceous earth per animal. This project is in cooperation with the Department of Dairy Husbandry.

Home Economics

DURING the year 1931 the Home Economics Department of the Station continued its investigation in the nutritive value of foods. The laboratory and office facilities provided in 1930 have aided greatly in the development of the work.

A stock colony of albino rats has been built up from which standard young animals are obtained for the feeding tests. A small colony of

guinea pigs also is maintained. The greater number of the guinea pigs are purchased. This year a grower has been found who can supply information concerning age and litter mates as well as weight. This information is a very great aid in the standardization of test animals.

Vitamin Investigations.

The investigation of the vitamin C content of Idaho Burbank (netted gem) potatoes has been continued.

Early in the year some tests were undertaken to determine whether or not the temperature of the water into which the potatoes were put for cooking made any difference in the biological analysis for vitamin C. The results from these tests would indicate that there is little if any difference between beginning the cooking process for potatoes in a small amount of water at room temperature or covering them with boiling water.

Another series of tests was carried out to determine how netted gem potatoes compared with other varieties after a storage period from November to April. Three other common varieties were compared with netted gems in these tests with 22 animals at four different levels. From the results obtained with this limited number of animals it would appear that netted gem potatoes compare very favorably with these common varieties as a source of vitamin C after storage of five to six months.

During the late summer and fall data were obtained upon the vitamin C content of mature netted gem potatoes from the Lewiston district when first put in storage. Potatoes from the same source are in storage and data will be taken for their content of this vitamin from feeding experiments conducted next spring.

Some preliminary work in the study of vitamin G in potatoes has been done this year. This work indicates that netted gem potatoes have significant amounts of this vitamin.

In cooperation with the Department of Dairy Husbandry a preliminary study was made on the vitamin A content of pasture grasses. The results of tests with white clover and blue grass show that fresh white clover is one of the richest plant sources of this vitamin and ranks with escarole, while blue grass is only about one-half as rich as the white clover. Further work with these grasses is in progress.

Horticulture

Prune Maturity and Storage.

A survey was made of maturity changes of prunes from various orchards in the Boise, Emmett, Payette, and Weiser districts. Fruit from the different orchards varied as much as four per cent in sugar

content when it reached the same definite firmness of 12 pounds. Firmness seemed to be a very good measure of the length of time the fruit would hold up under transportation and market conditions. At the same time, high sugar content seemed to be valuable as a further measure of flavor and quality. The sugar content of prunes from any orchard at a definite firmness seemed to be largely determined by some factor present before the first tests were made. From the investigations and observations made a study of factors causing the variation in sugar content seems advisable. The data on prune maturity and storage for the past five years are being compiled and will be published as a station bulletin in the near future.

Cracking of Sweet Cherries.

Station Bulletin No. 184, "*Physiological Studies of the Cracking of Sweet Cherries*", published this year, gives the causes of cracking. It was found that the type of cracking common to the Lewiston district was due to an osmotic absorption of water through the skin of the fruit. This type of cracking was directly affected by: (1) the osmotic concentration of the fruit juice; (2) turgor of the fruit; (3) temparature of the water; and (4) skin permeability. More recent studies have showed that cracking may be held in check to some extent by any method that will allow free circulation of air and sunlight, enabling the fruit to dry more rapidly after a rain. The different varieties in the Lewiston Orchards were studied also with reference to their structure and their tendency to crack.

Apple Maturity and Storage.

This work is being conducted in the Emmett, Payette, Caldwell, and Lewiston districts. Jonathan, Delicious, and Winesap are being studied. Ground color, red color, firmness, and sugar content were noted as measures of maturity. Orchards varied somewhat in these different measures and red color could not be dependably used as an index of maturity in all cases, even though there is a strong tendency to hold it as a standard. For example, fruit in some orchards color while still much firmer than in other orchards when maturity is measured by the pressure tester, ground color, and sugar content. While water-core this season was present in all varieties preceding picking in southern Idaho, it became more pronounced in each variety as the fruit matured.

Some of the late pickings in these tests showed every apple water-cored. With last year's crop, where the water-core was heavy, internal breakdown developed in storage. Apples of each variety were again stored at regular intervals this year and maturity changes in storage are being noted.

Apple Breeding.

Research Bulletin No. 8, "*Apple Breeding in Idaho,*" summarizes the results of the Apple Breeding Project.

Orchard Fertilization.

The work in orchard fertilization was enlarged to include additional plots in the Emmett, Payette, and Wilder districts. Preliminary data have been secured and the various fertilizer combinations will be applied during the winter.

Plant Pathology

Potato Virus Diseases.

INVESTIGATIONS extending over about ten years of various virus diseases of potatoes have resulted in the development of many facts of great importance to the Idaho potato industry. These investigations early brought to light the fact that certain parts of the state with comparatively high altitude are most favorable for the growing of seed potatoes. This apparently is due to the fact that certain insect vectors are more numerous in regions where temperatures are higher. These studies have also revealed the fact that the symptoms of certain virus diseases are more or less masked in the best seed growing sections so that even the best seed growers are not able to eliminate these diseases from their seed stock by the application of approved methods of control and the use of well-isolated seed plots. Tuber indexing in the greenhouse has been used to good advantage the past year. A small number of seed tubers were indexed for 45 growers and the results have been so satisfactory that all growers of certified potatoes have been offered this service for the coming year. This indexing has reduced to a minimum the amount of virus diseases present in each lot, thus eliminating the greatest factor in reducing yields. The Idaho Seed Potato Growers Association is cooperating in this work.

Bean Diseases.

One of the important projects of the Plant Pathology Department for a number of years has been a study of bean diseases in Idaho. The introduction of the mosaic resistant Robust variety of beans has solved the mosaic problem in the northern Idaho bean-growing sections. After a number of years of careful selecting and testing three selections of Great Northern beans were distributed to farmers in southern Idaho this year. These selections are so similar that they will be considered identical and will be referred to as U.I. Selection No. 1 of the Great Northern variety. In addition to being practically immune to the severe leaf curl type of mosaic, this selection this year outyielded other

strains of both common seed and certified Great Northern seed in several tests. Several other selections which appear promising will be given further tests. Further selections have been made, at the Aberdeen Substation, from several of the original strains with the idea of obtaining seed which might be adapted to that section.

Apparently resistance to curly top in beans cannot easily be secured by selection. Numerous crosses have therefore been made with both garden and field varieties. No pure line segregants possessing resistance have as yet been made. The procedure of securing this type of resistance is a complicated problem, in view of the fact that a number of factors are involved. In addition to possessing curly top resistance the segregant must also possess mosaic resistance and in the case of canning varieties, it must possess the ability to produce a product acceptable to the canning industry.

Grain Smut Control.

Further tests have proven the superiority of copper carbonate containing in excess of 50 per cent copper over other chemicals for the control of bunt in fall sown wheat. It should be applied to the wheat at the rate of three ounces per bushel of grain. This treatment will keep down infection to a mimimum. In spite of the availability of this information, the amount of wheat reaching terminal markets and classed as smutty, has increased alarmingly in the past few years. The reason for this is doubtful. There is good evidence however, that soil infestation is common with winter wheat in southern Idaho as well as in northern Idaho. To learn more regarding soil infestation, nurseries containing ten varieties of wheat possessing varying degrees of susceptibility to the disease, were seeded in various non-irrigated districts throughout the state. Seeding started August 15 and continued every ten days thereafter up to and including October 15. All seed was thoroughly treated with formalin previous to seeding. By this method it is hoped that the amount of soil infestation can be determined. Duplicate nurseries were seeded with the idea of determining the amount and type of "root rot" involved in reported decreased stands and yields in some of the non-irrigated sections.

Investigations to date indicate that there are at least four distinct physiologic forms of the organism causing stinking smut or bunt of wheat. Two of these are in the rough spored species and two in the smooth spored species of the organism.

Curly Top of Tomatoes.

Pure line selections and crosses of tomatoes for resistance to curly top or western yellow tomato blight were grown again this season. Because of the scarcity of leaf hoppers and therefore a corresponding

scarcity of curly top, the study of pure line segregants from the crosses showing resistance could not be accomplished to the best advantage. Further selections were therefore made for continuation next year.

Alfalfa Diseases.

Little disease appeared in the three alfalfa test plots located at Grandview, Hagerman, and Parma. Seven varieties of alfalfa were planted in these locations in 1930 to test their resistance to bacterial wilt. Yield data and disease notes were secured on these plantings. No conclusions can be drawn, however, as very little bacterial wilt was present this year. Field observations seem to indicate that bacterial wilt is more severe in old stands of alfalfa and in years following severe freezing when there is little snow cover which results in severe winter injury.

Sclerotium Disease of Wheat.

A sclerotium disease of wheat previously has been reported as occurring in Teton and Fremont counties. This disease caused severe injury to barley, wheat, and rye on the Sandpoint Substation early last spring. It also caused some injury to winter wheat near Hill City in Camas county. Several sclerotia forming fungi have been isolated from diseased grains and grasses from various sources. One of these isolated from infested wheat from Sandpoint, apparently is identical with a fungus secured from Heizi Tasugi in Japan and identified by him as *Typhula graminum Karst.*

Miscellaneous Projects.

Other projects under investigation include a study of life history and control of clover mildew, investigation of the black-leg disease of potatoes, and investigation of stripe rust of grains and grasses in cooperation with the Office of Cereal Crops and Diseases of the Department of Agriculture.

Poultry Husbandry

Humidity in Relation to Hatchability of Eggs.

WORK on this project during the past year has consisted of securing and compiling data on the loss of moisture due to evaporation for each of the six-day periods for both chicken and turkey eggs. In view of the difficulties previously encountered in controlling factors other than humidity which influence hatching results, an attempt was made this year to use the moisture conditions of eggs and chicks or poults during the pipping and hatching period as an index of correct evaporation. The data secured involved the use of approximately 3000 chicken eggs and 3500 turkey eggs. Data also were secured on the

loss of weight for each period of 317 individual turkey eggs which gave very valuable information as to the variability in the loss of weight of individual eggs.

Analysis of this data, in addition to that secured on the basis of tray weights, revealed a surprisingly wide range in the loss of weight due to evaporation of eggs from which good hatchability was secured.

A summary of averages obtained in two different cabinet type incubators for both chicken and turkey eggs is given in the table below.

Kind of Eggs	Incubator	Per Cent Loss by Periods			
		6 days	12 days	18 days	24 days
Chicken Eggs	Petersime	4.37	8.98	13.26	
	Buckeye	3.94	8.56	12.68	
Turkey Eggs	(1) Petersime	3.65	6.80	10.40	14.33
	(2) Petersime	3.56	7.53	11.08	14.66
	(1) Buckeye	3.39	6.38	9.77	13.72
	(2) Buckeye	2.95	6.70	10.39	13.79

(1) Data based upon the average weight of individual eggs.
(2) Data based upon the average secured from tray weights.

A very favorable moisture condition of eggs, chicks, and poults, as well as good hatchability, was secured with ranges in the loss of weight of from 12.0 to 14.0 per cent at 18 days in the case of chicken eggs and from 12.5 to 14.5 per cent at 24 days in the case of turkey eggs. Slightly greater losses were secured on the average in the Buckeye than in the Petersime. It is not feasible to recommend specifically the optimum condition of humidity because of difficulties in operation, especially air circulation and ventilation, of various machines. In general, for forced draft machines an average wet bulb reading ranging from 79° to 81° F. (40 to 45 per cent relative humidity) for the period prior to hatching and a reading ranging from 85° to 88° F. (54 to 63 per cent relative humidity) during the pipping and hatching stage should provide the proper evaporation for chicken eggs. For turkey eggs a wet bulb reading of approximately two degrees higher during the period prior to hatching and from four to six degrees higher during the pipping and hatching period should provide the proper evaporation. The increased humidity during the pipping and hatching stage is very essential, especially for turkey eggs.

Mineral Supplements.

Three phases of this project have been given attention during the past year, two of them in cooperation with the Departments of Agricultural Chemistry and Bacteriology.

A comparison of calcite and oyster shell as a mineral supplement of chick rations has been in progress. Three series of tests have demonstrated that from a standpoint of average weight and physical

condition of chicks at 12 and 16 weeks of age, the calcite products used proved equal to oyster shell. The analyses of bones and blood specimens from respective groups and studies in the calcifiication as indicated by the line test are being carried on. The calcite used analyzed approximately 95 per cent calcium carbonate and less than 2 per cent magnesium carbonate.

The effects of different levels of calcium and phosphorus in the ration for growing chicks are being studied. The favorable results in rate of growth and physical condition of birds receiving a low mineral supplement would indicate that less mineral is necessary than was previously advocated. Analytical data are being secured by the Department of Agricultural Chemistry and will be reported later.

In trials conducted during the past year calcite gave results equally as good as oyster shell as a source of calcium carbonate for laying hens. Comparisons were made on the basis of number of eggs produced, soundness of egg shell, and physical condition of the birds. The calcite was the same product used in the chick work as reported above. The trial is being repeated this year.

Effects of Different Types of Irradiation.

This project was initiated for the purpose of studying the effects of irradiation with the S-1 type sun lamp and the C-X bulb. It is conducted in cooperation with the Chemist, the Agricultural Engineer, and the Veterinarian of the Station. The trial was started in June and conducted through the summer months. The birds were confined in a well-lighted building but removed from contact with direct sunshine. The group of birds in the check pen made as good or better growth, to 16 weeks of age, as the irradiated groups or the group receiving cod liver oil. The good growth made by these birds and the absence of any symptoms of rickets may be attributed to the effects of ultra-violet rays available in diffused light or sky shine, also to the favorable calcium phosphorus balance of the basal ration. As measured by comparative rate of growth and physical condition of birds, irradiation proved of little benefit.

Pure Seed

IDAHO'S activities in the interest of the production and marketing of high quality seed are under the general supervision of a Seed Commissioner who is appointed by the Director of the Experiment Station. Pure seed work includes maintenance of a state laboratory in Boise, annual inspections of seed merchandising concerns and educational efforts in the direction of improved practices and high quality.

During the past season there was a large increase in the number of

samples received at the seed laboratory. A total of 2,950 samples were received this year as compared with 2,521 during the 1929-1930 season. Of this total, germination tests were run on 553 samples and moisture tests made on 68 samples. This represents an increase of approximately 16 per cent over the previous year.

The seed laboratory staff is composed of an experienced, permanently employed analyst and an assistant. At the beginning of this season a decrease of seed samples was anticipated on account of the drouth and grasshopper infestation but instead there was an increase. The unexpected increase was due to market conditions. Buyers were inactive and farmers who formerly sold their seed in the dirt decided to clean their seed this year in order to make it attractive to buyers. Many lots which never before have been represented in the laboratory have been analyzed this season.

The Seed Commissioner also supervised the inspection of seed houses throughout the state. As a result of this inspection, several lots of seed were condemned for failure to meet the state seed law requirements. It is felt that with the influence of the new labeling law enacted by the last legislature, and by an annual inspection of seed houses to insure proper labeling, practically all seed sold will conform to the seed law requirements.

Aberdeen Substation

THE 1931 growing season was very unfavorable for crop production. The irrigation water had to be used very sparingly to make it last through the growing season and the situation was made more acute by the frequent wind storms and the extremely hot weather the latter part of July. The last two weeks of July were the hottest two weeks ever experienced since records have been kept at the substation. The rainfall for 1931 was far below normal, total precipitation amounted to 6.61 inches. Nineteen thirty-one was one of the driest years on record. Some of the young seedlings in the rotation plots have a poor stand and it will be necessary to do some reseeding.

Cereal Investigations.

Barley breeding work again was carried on by Dr. H. V. Harlan, in charge of barley investigations. A total of approximately 2300 barley rows were grown, varying in length from five feet to rod rows. These were grown for selection, strain test, crossing, and for studying the composite cross method of breeding. Eighty-three English barleys, brought from England by Dr. G. D. H. Bell, were planted on eight different dates.

The oat nursery consisted of 1450 rows varying in length from five feet to a rod. Studies were made for testing of natural crossing, inheritance, and yield trials. The wheat nursery was devoted largely to yield tests of the Dicklow and Federation crosses.

Cereal Plots.

Grain yields in the plot tests all show a material decrease over past averages. Approximately a 20 per cent decrease in yields was found in barley, wheat, and oats. Field peas also produced a lower yield, with the exception of Alaska, an early garden variety. Hot weather did not damage Alaska as it did the later varieties.

Red Clover.

Yields of red clover seed were far below normal in both field and plot experiments. None of the three different methods generally practiced in red clover seed production resulted in yields that ordinarily are expected. This generally was the case in the Aberdeen section, with but a few exceptions.

The red clover plot irrigation experiments also were low in yield. Unfavorable weather and insects (grasshopper and chalcis fly) were the chief factors causing unfavorable yields. This experiment is carried out in cooperation with the Forage Office of the U.S. Department of Agriculture.

Potatoes.

The potato work included date of planting tests for both Rural and Russett potatoes and irrigation experiments with the Russett variety. Early planting of the Rurals gave higher yields of the U.S. No. 1 potatoes. The percentage of No. 1 Russett potatoes increased with later plantings but the yield did not vary so much.

Lamb Feeding Investigations.

The lambs were smooth quarter-blood Oregon lambs purchased at $4.50 per cwt. They arrived at Aberdeen on October 18 and were weighed the following morning, averaging 64.2 pounds per head. They were then put on pasture until November 13. At this time a heavy snow fell and further pasturing was impractical. The lambs were weighed and put on feed November 19.

Exceptional gains were made by all lots. The lot receiving 10 per cent cottonseed cake made an average gain of .37 pound per day. The lot receiving 20 per cent peas made the second highest gain, namely, .35 pound per day. The check lot came third with an average daily gain of .33 pound.

Lamb feeders' day was well attended and much interest was shown. A program of educational talks on topics related to sheep breeding and lamb feeding was presented in the afternoon.

Farm Flock Wintering Experiment.

The purpose of this experiment is to find out if alfalfa can be replaced by clover chaff without sacrifice in the production of wool and lambs. Results so far seem to indicate that about one-half of the hay can be replaced by clover chaff without decreasing lamb or wool production. Further work is necessary before definite conclusions can be reached.

Caldwell Substation

Season Unfavorable.

NINETEEN thirty-one was one of the dryest seasons in the history of the Boise valley. One and seven-tenths acre feet, per acre, were delivered under the ditch from the Deer Flat reservoir and one and six-tenths acre feet from the Arrowrock reservoir. It was apparent early in the season that water would be scarce and a part of the acreage available was not put into crop.

By this adjustment of area farmed to estimated water supply reasonably good yields were obtained of barley and first cutting alfalfa hay. The total production of the substation however was much less than in normal years.

Chopping Alfalfa from the Field.

In order to determine the feasibility of chopping hay direct from the field as compared with the usual policy of chopping from the stack at a later date, most of the alfalfa hay from the first cutting and all of the second was chopped as it was hauled in from the field. The hay was cut and shocked and after it was cured hauled to the cutter just as it would have been handled for stacking.

Using current prices for labor, team hire, and other items of expense, the alfalfa hay was hauled from the field and put through the cutter at a total cost of $2.33 per ton. A part of the crop was stacked direct from the field without chopping, at a cost of $1.31 per ton. The commercial charge at the time of the experiment for cutting hay from the stack was $1.75 per ton. Cutting the hay direct from fieldshocks therefore, as compared with stacking of long hay and cutting at a later date, was done at a saving of 73 cents per ton.

Vitamin A Content of Pasture Grasses.

A biological study was made of the vitamin A content of white clover and Kentucky blue grass. Rats were fed three different levels of the green feeds. Approximately 220 rat units were indicated for the white clover and half this amount for the blue grass. In comparison with published results for other green leaves, this work would rank these plants first and third as sources of vitamin A. These results are

of considerable interest in considering the vitamin A content of butterfat. Further work is planned, using other green grasses and the same grasses dried. This project was made possible through the leadership and cooperation of the Home Economics Section of the Agricultural Experiment Station.

Steer Feeding Tests.

Three lots of ten two-year old steers each were fed on the same ration consisting of chopped alfalfa hay, corn silage and ground barley. Lot I had access to warm water and Lot IV had access to warm water and an open shed. Lot IV made the largest and most econimical gains, requiring 22 pounds less barley, 41 pounds less corn silage and 81 pounds less alfalfa hay to produce 100 pounds gain.

Lot IX had access to cold water as compared with Lot 1 having access to warm water. Lot I having access to warm water made the larger gains and more economical gains, requiring 45 pounds less barley, 91 pounds less corn silage and 132 pounds less alfalfa hay to produce 100 pounds gain. There was little difference between the three lots in the shipping and killing data.

Six lots of ten yearling steers each were fed on various rations to determine the efficiency of these rations. All alfalfa hay was chopped and all barley, wheat and oats were ground.

Lot II was fed alfalfa hay and barley as compared with Lot III which received cottonseed meal in addition to the alfalfa hay and barley. Lot III made slightly larger and more economical gains: 39 pounds cottonseed meal and 17 pounds alfalfa hay replacing 81 pounds barley.

Lot V was fed alfalfa hay, corn silage and barley in comparison with Lot II which received alfalfa hay and barley. Lot V made larger and more economical gains; 704 pounds corn silage, replacing 482 pounds alfalfa hay and 114 pounds barley. The use of corn silage seemed to lessen the danger of digestive disturbances.

Lot V was fed in comparison with Lot VI receiving alfalfa hay, corn silage, barley and cottonseed meal. The gains and feed requirements were essentially the same for both lots consequently the gains were more costly for Lot VI receiving the cottonseed meal. Lot II was fed alfalfa hay and barley in comparison with Lot VII receiving alfalfa hay and wheat. Lot VII receiving the wheat made slightly larger and more economical gains, requiring 78 pounds less wheat and 28 pounds more alfalfa hay to produce 100 pounds gain.

Lot VII was fed in comparison with Lot VIII receiving alfalfa hay, wheat and oats. Oats were fed at the rate of 25 per cent of the grain allowance. Lot VIII made essentially the same gains but more eco-

nomical because 94 pounds oats replaced 76 pounds wheat and 215 pounds alfalfa hay. The substitution of oats for a portion of the wheat lowered the feed cost but did not eliminate digestive disturbances.

Lamb Feeding Trials.

Eight lots of sixty lambs each were fed on various rations to determine the efficiency of these rations. All alfalfa hay was chopped and all grain was fed whole. All lots except Lot V had access to warm water.

Lot I was fed alfalfa hay and wheat as compared with Lot II in which oats replaced 25 per cent of the wheat. Lot I receiving wheat made slightly larger gains and it required 100 pounds oats to replace 56 pounds wheat and 14 pounds alfalfa hay. The lambs in Lot II seemed to tend more toward growth rather than fattening.

Lot I was fed in comparison with Lot VI which received alfalfa hay and barley. Both lots made essentially the same gains and both lots have about the same feed requirements.

Lot VI was fed in comparison with Lot V which received alfalfa hay and barley and had access to cold water. The gains and feed requirements were only slightly in favor of Lot VI having access to warm water.

Lot VI was fed in comparison with Lot VII, both lots receiving the same ration, but Lot VII being lighted with electric lights to determine if lighting by extending the feeding period daily would increase the efficiency of the ration. Lighting did not so influence this lot. Lot VII made slightly less gains and required slightly more feed to produce 100 pounds of gain.

Lot VI was fed in comparison with Lot VIII, both lots receiving the same ration but Lot VIII having access to open shed. Lot VIII having access to open shed made slightly larger gains and on lower feed requirements than Lot VI in open lot.

Lot IV was fed alfalfa hay and wheat and made larger gains and required less feed to produce 100 pounds of gain than Lot II.

Lot III was made up of peewee lambs weighing 52 pounds as compared with lambs weighing 63 to 64 pounds in the other lots. This lot was fed alfalfa hay, shelled corn and cottonseed cake. They gained nearly as fast as the lambs in the other lots and made 100 pounds gain on the lowest feed requirements.

All lots of lambs except Lot VII were shorn March 2, 1931, 35 days previous to the close of the feeding trial. All sheared lots gained much more rapidly after shearing than before; also the seven lots sheared gained much more rapidly than Lot VII which was not shorn. Warm weather was possibly responsible for the shorn lambs gaining so rapid-

ly. Shearing also removed many ticks which would account for some increase in gains.

These lambs were shipped and sold on Sioux City, Iowa, market after the middle of April. The sheared lambs showed a much heavier shrinkage in shipment to market.

High Altitude Substation

Abnormal Weather.

THE season of 1931 was unfavorable for experimental work at the High Altitude Substation. The rainfall was much below normal, especially during the growing season, and there was an unusual amount of wind which dried the soil and whipped out the young spring grains. This, together with late spring frosts, cut the yields of spring grains very low in the variety plots.

The winter wheats yielded much better than the spring wheats since they were less affected by the unfavorable weather conditions during the early part of the 1931 growing period.

All varieties of barleys as well as some varieties of wheat in the variety plots were too short this season to cut with a binder and were mowed. Some of the spring wheats were just emerging when the high wind and frost hit them.

There was plenty of moisture in August and September to benefit potatoes. The first fall frost was delayed, allowing the potatoes to make a good growth and yield as much as they do in an average season. The quality of potatoes was only fair as the dry weather early in the season caused knotty and pointed tubers.

Deep Furrow Drilling.

Data from this year's deep furrow drilling shows but a slight increase in yield over the ordinary method of seeding winter wheat. This may be partly accounted for from the fact that the deep furrow plots had a much heavier stand and were well stooled and therefore burned more when the dry weather came. The deep furrow plots had all the appearance during the earlier part of the season of producing much more than the ordinary seeded plots but yielded only .4 bushel more per acre and the grain was shriveled more than from the ordinary seeded plots.

Chiseling.

The first year's data on the deep tillage experiment indicates a slight increase in yield on "the spring chiseled plots followed by a disk" as compared with the "spring plowed plots." When no disk was used

after the chisel the yield was not as good as on the plowed plots. There also was slight increase in yield on the fall chiseled plots that were spring disked, over the fall plowed plots. The yield also was less on the fall chiseled plots where they were not followed by spring disking.

The present indications are that the small increase in yield of wheat on deep chiseled land over ordinary plowed land will not pay for the extra cost of the operation. More data are needed however on this experiment. Potatoes which require a deep loose soil did not yield any more on fall chiseled summer fallow than they did on summer fallow alone.

Wheat Nursery.

A uniform winter and spring wheat nursery was started last year in cooperation with the U.S. Department of Agriculture. Several new promising wheats are included in this nursery. Owing to the fact that the Upper Snake river country is probably better adapted to grains than any other crop it is important that a cereal nursery be maintained at the High Altitude Substation.

Potato Experiments.

Some additional work was started with potatoes this year. The three year rotation showed the value of potatoes in any rotation. Every crop following potatoes made a higher yield than it did following any other crop. The strain test with potatoes was continued this year in cooperation with the Department of Plant Pathology. Several sacks of disease free tubers of the Netted Gem variety were raised this year which will be tuber indexed in the greenhouse at Moscow this winter and planted on the substation farm next spring. The increase from these potatoes will be put out to seed growers as foundation stock.

Variety Tests.

The leaders in the variety plots remain about the same as last year. The Oro variety of winter wheat may replace Kanred and Turkey Red on account of its freedom from certain forms of smut. Although Oro is not immune from smut it seems to be less susceptible than some other varieties.

Peas were almost a failure on account of the damage done by porcupines. Some varieties, especially the Bliss-Everbearing, were almost a total loss.

The new improvements for this year included a barn and machine shed on the dry farm.

Land has been purchased in Tetonia and the buildings on the irrigated farm will be moved to the new site which will become the headquarters for the Substation.

Sandpoint Substation

CLIMATIC and crop conditions for the year 1931 were without unusual factors. The winter season was mild and no losses occurred from winter injury. Rainfall for the year was slightly above normal but several summer months showed a wide departure from the normal expectancy. Dry windy weather in May and June forced premature development of a number of grain varieties but yields differed little from average expectations.

Wheat Variety Tests.

Leading in the winter wheat varieties were Mosida, Hybrid 128 and Triplet. In the winter wheat nurseries the high varieties were White Odessa, Albit, and Bluestem with the high averages going to Mosida, White Odessa, and Forty-Fold. A uniform winter and spring wheat nursery was established at Sandpoint and Bonners Ferry under the direction of the Cereal Office of the U.S. Department of Agriculture. High yielding selections were isolated from a group of Jenkin hybrids. Onas, Bluestem, and Dicklow led the spring wheats in plat comparisons and Jenkin, Bluestem, and Little Club outyielded other varieties in the spring wheat nurseries.

Barley Yields and Diseases.

Squarehead, Scottish Pearl, and C. I. 876 were heaviest yielders in winter barley plats, while in nursery work the three leaders were Han River, Scottish Pearl, and Squarehead. Severe losses were had in the winter barley plats with the disease "snow-blight." This disease also was of importance in an increase field of Mosida. Union, Ezond, and Hannchen led other barley varieties in plats, and in nursery trials Ace, Union and O.A.C. 71 were the leaders. Highest barley yields were obtained on land that had been cropped two years previously to alfalfa. The first year after legumes the highest yields were obtained on sweet clover plats. Barley smut resistance was greatest in Ottawa 7, Ace, Smyrna, Glabron, Flynn, O.A.C. 71, Oderbrucker, Baker and Velvet. Best controls for barley smut were with copper carbonate, copper sulphate, and Ceresan.

Oats and Miscellaneous Crops.

Victory, Abundance, and Banner led other oat varieties in plot work and in the nursery series the leading varieties were White Tartar, Silver, and Markton. Oat and barley combination seedings gave higher yields to those mixtures containing the greater percentage of barley. Kaiser, White Canada, and Bluebell were leading field pea varieties. Variety studies were conducted with winter and spring wheats, spring

barley, oats, peas, root crops, alfalfa, grass, and legumes on a drainage reclamation project in the Kootenai valley. Nursery work with winter wheats was conducted at Clarksfork and spring grains were tested in the Blanchard area.

Seven selections of reed canary grass were made which apparently shatter less than the group from which they were chosen. The work on reseeding burned-over land was summarized and the material was given wide distribution so that it was available to those who had met forage losses as a result of forest fires.

Root Crop Trials.

Leading potato varieties were Netted Gem, Bliss Triump, and Idaho Rural. Highest yields of potatoes were obtained from a May 15 planting. A start has been made on the indexing of the Northern Idaho Rural. Original stock showed a 92.9 per cent mosaic infection. Potatoes treated with ethylene gas gave a greater yield than untreated seed. Yellow Belgian, Coreless, and Yellow Giant outyielded other carrot varieties. A one-foot spacing produced greater acre yields of carrots than two or three-foot spacings. Two hundred pound per acre additions of gypsum and 100 pound additions of sulphur gave almost identical yields when applied to alfalfa.

Publications — Iris Garden.

Bulletin 178, "*Grains for the Cut-Over Lands of Northern Idaho,*" was published in January and Circular 64, "*Meteorological Records, Sandpoint, Idaho,* 1910-1930" was published in May. The iris display garden conducted in cooperation with the American Iris Society proved to be the means of attracting many people to visit the station. Field Day was held June 27 with a large crowd of farmers and others interested in agriculture in attendance.

FINANCIAL STATEMENT

UNIVERSITY OF IDAHO AGRICULTURAL EXPERIMENT STATION
In Account With
FEDERAL APPROPRIATIONS

Dr.		Hatch	Adams	Purnell
To balance from Appropriation 1930		None	None	None
Receipts from the Treasurer of the United States for the year ending June 30, 1931		$15,000.00	$15,000.00	$60,000.00
Cr.	**Abstract**			
By salaries	1	$ 9,096.55	$12,562.28	$40,917.56
Labor	2	3,063.39	1,098.72	4,175.27
Stationery and office supplies	3	179.67	21.33	206.71
Scientific supplies, consumable	4	2.65	396.88	2,389.49
Feeding stuffs	5	397.78	50.00	423.45
Sundry supplies	6	313.40	119.90	657.67
Fertilizers	7			
Communication service	8	34.00	1.60	54.31
Travel expenses	9	894.34	323.66	4,508.98
Transportation of things	10	26.93	34.32	332.85
Publications	11	731.18	.....	873.44
Heat, light, water, & power	12	19.95	.....	310.78
Furniture, furnishings, fixtures	13	49.80	.....	1,546.01
Library	14	.....	.....	93.28
Scientific equipment	15	.....	277.17	1,240.49
Livestock	16	.....	.....	232.50
Tools, machinery, & app.	17	157.45	109.29	1,503.32
Buildings and land	18	32.91	.....	508.32
Contingent expenses	19	.....	4.85	25.59
Total		$15,000.00	$15,000.00	$60,000.00

SUBSTATION DISBURSEMENTS

(For Jan. 1 to Dec. 31, 1931 Report)

	Aberdeen	Caldwell	High.Alt.	Sandpoint	Total
Salaries	$ 3,794.17	$ 5,088.57	$ 2,330.00	$ 3,660.00	$14,872.74
Help	1,164.60	1,110.20	328.12	1,074.92	3,677.84
Expenses & supplies	2,884.88	6,133.33	696.57	2,034.60	11,749.38
Equipment	219.70	1,085.16	766.40	397.99	2,451.25
Total	$ 8,063.35	$13,417.26	$ 4,121.09	$ 7,149.51	$32,751.21

DISBURSEMENTS BY DEPARTMENTS

FROM
STATE APPROPRIATIONS
Jan. 1, 1931, to Dec. 31, 1931 — Home Station

	Adminis.	Agr.Chem.	Agri.Econ.	Agr.Engr.	Agronomy	An.Husb.	Bacteriology	Dairy
Salaries	$ 117.58	$ 358.33	$	$	$1,200.00	$	$ 400.00	$ .....
Help	257.90	65.50	105.88	.....	287.08	.....	93.65	936.45
Travel	133.35	205.55	306.01	401.47	700.39	45.06	.....	110.85
Freight & Miscellaneous	232.70	2.53	.....	4.41	18.32	.....	8.64	44.00
Printing & Adv.	734.71	.....	.....	40.30	2.75	24.00	.....	25.61
Office Supplies	164.61	.53	71.97	9.34	6.56	.....	.....	21.05
Lab. Supplies	.....	23.82	.....	28.58	164.44	4.80	4.00	99.67
Feed Stuffs	.....	.....	.....	.....	.....	97.10	.....	1,581.52
Repairs to Equipment	31.43	.....	.....	.....	140.03	.....	.....	.....
Membership & Leases	.....	.....	.....	.....	.....	.....	.....	.....
Equipment	360.24	124.80	-60.00	.....	26.05	.....	.....	31.76
Total	$2,032.52	$ 781.06	$ 423.86	$ 484.10	$2,545.62	$ 170.96	$ 506.29	$2,850.91

	Entom.	Home Ec.	Hort.	Legume	Plant Path.	Poultry	Soil Survey	Total
Salaries	$	$	$ 50.00	$ 800.00	$ 358.34	$ 127.50	$	$3,411.75
Help	412.63	.....	95.65	91.40	.....	351.85	340.21	3,038.20
Travel	218.28	.....	74.37	.....	16.88	127.38	64.58	2,404.17
Freight & Miscellaneous	56.71	.....	2.80	42.85	8.24	.50	5.00	426.70
Printing & Adv.	2.36	.....	15.00	.....	10.01	24.67	.....	879.41
Office Supplies	14.55	.....	1.19	8.69	.....	.64	.....	299.13
Lab. Supplies	242.09	17.60	5.11	189.41	8.25	169.08	17.43	974.28
Feed Stuffs	.....	.....	.....	.....	.....	767.33	.....	2,445.95
Repairs to Equipment	19.84	.....	.....	11.52	.....	28.49	.....	231.31
Membership & Leases	.....	.....	.....	.....	.....	.....	.....	.....
Equipment	388.76	10.38	.....	121.33	.....	34.69	.....	1,038.01
Total	$1,355.22	$ 27.98	$ 244.12	$1,265.20	$ 401.72	$1,632.13	$ 427.22	$15,148.91