Bulletin No. 225



# Forty-five Years of Service

to

# Idaho Agriculture

## The Annual Report

of the Agricultural Experiment Station
for the Year Ending December 31, 1937

UNIVERSITY OF IDAHO
*Agricultural Experiment Station*
MAY, 1938

*Published by the University of Idaho, Moscow, Idaho*

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# Foreword

C. W. Hungerford, *Vice Director*

## Forty-five Years in Review

SEVENTY-FIVE years ago, in 1862 during the Civil War, President Lincoln signed the act establishing the United States Department of Agriculture, and the same year he signed the First Morrill Act, making possible the Land-Grant colleges and universities. Fifty years ago Congress passed the Hatch Act establishing the state agricultural experiment stations. Five years later the Idaho Agricultural Experiment Station was organized by the Board of Regents of the University of Idaho on February 26, 1892, and the Station immediately qualified for $15,000 of Federal funds annually under the Hatch Act of 1887. It is appropriate that the progress made and the services rendered during these 45 years be reviewed.

Fig. 1.—Hiram T. French, Director of the Agricultural Experiment Station from 1902 until 1910.

It is very significant that the pioneers who organized the early work of the Station realized the need for agricultural research on a state-wide basis. Three branch stations were established at once. One was near Grangeville in Idaho County, one near Idaho Falls in Bingham County, and the third one near Nampa in Ada County. In the first bulletin of four pages, published in September, 1892, Director Robert Milliken, in discussing the organization and progress of the Station, states, "The authorities of the Station have one end only in view and that is the rendering of definite, practical assistance to the farmers of the State." This objective has been followed throughout the years.

Robert Milliken resigned as Director and was succeeded by Charles P. Fox in 1893. Mr. Fox was replaced in 1898 by President T. B. Gault, who acted as Director of the Agricultural Experiment Station, as well as President of the University, until he left the University in 1899. J. P. Blanton, who succeeded President Gault, became Director of the Agricultural Experiment Station, as well as President of the University. President Blanton, in turn, was succeeded in 1901 by James A. McLean, who

acted as Director of the Station, as well as President, until Hiram T. French was made Director in 1902. Mr. French served until 1910, when W. L. Carlyle was appointed Director. J. S. Jones replaced Mr. Carlyle in 1914 and served as Director until 1918, when he was succeeded by E. J. Iddings, who has served continuously since.

The fact that the Agricultural Experiment Station activities have been state-wide and the results of research have, through the years, been of service to the farmers in every part of Idaho is very evident as one reviews the history of the Station's progress. Although it became necessary to abandon the three branch stations, to which reference has been made, very soon after they were established, others soon took their place, and the Experiment Station program at Moscow has ever been augmented and closely coordinated with the work of substation farms located in various agricultural communities of the State. The Caldwell Substation was secured in 1906 and has served southwestern Idaho continuously since that time. A substation at Gooding was operated from 1909 to 1917. Clagstone demonstration farms near Clagstone in Bonner County were used from 1909 to 1913. The Aberdeen Substation, established in 1911, has rendered marked service to the southeastern irrigated farming areas until at present it is one of the outstandingly successful substations of the West. A substation farm for potato and truck crop research was operated at Jerome from 1912 until 1921. The Sandpoint Substation Farm, established in 1912, and still in operation, has contributed very materially in establishing successful farming in the cut-over timbered areas of northern Idaho. The High Altitude Substation near Tetonia in Teton County, obtained in 1919, has been used in investigations pertaining to farming in high altitude nonirrigated regions. Returns to farmers in the vicinity from following recommendations of the Substation have repaid manyfold all the costs of this station.

Fig. 2.—W. L. Carlyle, Director of the Agricultural Experiment Station from 1910 until 1914.

The early research program of the Station covered a variety of projects. In the early days, as well as through the years, the projects under investigation always have been planned to obtain answers to those questions which must be solved in order to make agriculture a profitable business in various parts of the State. Projects dealing with alkali soils, soil fertility,

steer, lamb, and swine feeding, field and vegetable crop variety tests, control of weeds, insects, and plant diseases were early incorporated into the program. Of especial interest, perhaps, is the fact that experiments with sugar beets were begun when the Station was first established. Bulletins No. 12 and No. 18, published in 1898 and in 1899, reported the results of studies of problems connected with the growing of sugar beets in Idaho. These early studies, conducted largely in southern Idaho, aided materially in establishing the industry in the State and in interesting sugar companies in locating factories in Idaho. Other important early projects will be reviewed in the reports of various departments.

Fig. 3.—J. S. Jones, Director of the Agricultural Experiment Station from 1914 until 1918.

The number of workers in the Experiment Station staff is a fair measure of the growth of the institution throughout the years. In 1892 work was started by two members; in 1902 there were nine; in 1912, sixteen; in 1922, thirty-two; in 1932, forty-four; and during the last year there have been employed fifty-three persons either full time or part time in the Experiment Station program. This list includes several Federal employees who are stationed on the campus of the University and engaged in cooperative research. The Station has been financed very largely by funds from the Federal research grants. Rapid increases in personnel following 1906 when the Adams fund became available, in 1925 when the Purnell fund was received, and in 1935 following the granting of the Bankhead-Jones fund, are at once apparent. One of the early reports from the Station states that in 1903, for the first time, $5,000 of State funds became available for agricultural research. Less than $20,000 of State funds are available during the present biennium in addition to funds for the substation farms. Agricultural research in Idaho is still financed very largely by Federal funds.

Of interest, also, is the history of the development of the physical plant of the College of Agriculture. When the University opened, but one building was available. In 1898 two barns and a farm house were erected on the newly acquired 100-acre farm adjacent to the campus. In the same year a horticultural building and greenhouse was erected east of the main building. This building is still standing on the same site and is used for offices for the Department of Music. It is, therefore, the oldest building on the campus. Morrill Hall was erected in 1906 and is used by the

College of Agriculture and the School of Forestry. A dairy building, greenhouses, and various other buildings have been added in more recent years. The Home Station farm has been increased from time to time until it now includes over 880 acres of land.

The various activities of the College of Agriculture are seriously handicapped because of crowded conditions and the fact that the various departments of the College are scattered in various buildings over the campus. In order to carry on effectively the teaching, research, and extension activities of the College in a properly coordinated manner, an Agricultural College building is needed. It is hoped that such a building can be provided in order that agriculture, the most important industry of the State, may be served more adequately.

Fig. 4.—Dean E. J. Iddings, Director of the Idaho Agricultural Experiment Station since 1918.

As we review the 45 years of active service to Idaho agriculture performed by the many devoted workers of the Idaho Agricultural Experiment Station, we cannot but feel a justifiable pride in work well done. The results of research are often difficult to measure accurately, but each year farmers in Idaho are turning more and more to the Experiment Station for the solution of pressing problems because they know that the successful farmer must make wise use of the results of agricultural research.

## Two Western Regional Laboratories Established

The Bankhead-Jones Act of 1935 provided that 20 per cent of the funds allowed for agricultural research under the Act be placed at the disposal of the Secretary of Agriculture for the establishments of research laboratories in major agricultural regions. In accordance with this provision of the Act, two research laboratories have been located in the western part of the United States. One located at Dubois, Idaho, was established in 1936 to engage in research for the improvement of sheep for western ranges through the application of breeding methods. The other laboratory will be located at Riverside, California, to engage in cooperative research on "the relationship of salinity of irrigation water and of soil condition to plant growth and related factors involved in permanently successful irrigated agriculture." The research at these stations will be closely coordinated with the work of the agricultural experiment stations located in the 11 western states and with that carried on by the various bureaus

of the U.S. Department of Agriculture. An advisory council composed of workers from each of the various experiment stations and from the U.S. Department of Agriculture will supervise the projects undertaken. So long as these regional research projects supplement and increase the efficiency of the program of experiment stations, they can perform a very important function in coordinating effort on a regional basis and assisting in helping to solve problems of regional significance. One of the most significant trends in agricultural research in recent years is the tendency toward more coordinated effort in solving farm problems. Cooperation between the state experiment station and the Federal Government, between the states themselves, and between state and private agencies is constantly increasing. The Idaho Agricultural Experiment Station has memoranda of agreement for cooperative research with the Federal Government involving almost every department of the Experiment Station. We have cooperative projects with a number of other state experiment stations and several agreements with private commercial concerns.

### Changes in Staff Have Been Few

Few changes in the staff of the Station have occurred during the past year. The efficiency of the research program of our organization depends largely upon the continuity of service of our research staff. Alexander Joss resigned as Assistant Economist July 1, 1937, and George Schaefer was appointed to fill the vacancy. W. H. Pierce, Associate Plant Pathologist, resigned June 1, 1937, to accept a research position with a commercial concern. Walter Virgin has been secured to fill this vacancy. He will report for duty February 1, 1938. Roger Reid, Assistant Bacteriologist, resigned October 1, 1937, to accept a position at Johns Hopkins University. Fred Maurer was appointed November 1, 1937, to fill this vacancy. W. M. Beeson resigned as Assistant Animal Husbandman September 10, 1937. This position has not yet been filled.

## Publications

THE results of investigations by the Station staff are published as bulletins, research bulletins, circulars, and mimeo-leaflets by the University and as research papers by various scientific journals. The list of publications for 1937 follows:

### Bulletins

221. *Science serves Idaho agriculture*: Annual report of the Experiment Station for the year ending December 31, 1936.
222. *Survey of farm tenancy in southern Idaho.*

### Circulars

77. *Publications available for free distribution.*

### Mimeo-Leaflets

8. *Mosaic resistant Great Northern beans for southern Idaho.*
9. *Suggestions for Idaho farm leases.*
10. *Suggestions for pea weevil control.*

11. *Control measures for a few of the more important vegetable crop insects in Idaho.*
12. *Population trends and a regional land program.*
13. *Preliminary report on the composition of range forage plants as related to animal nutrition.*
14. *Insect pests of the prune, peach, and apricot with suggestions for their control.*
15. *Insect pests of currant and gooseberry with suggestions for their control.*
16. *Control measures suggested for the more important insects attacking grape in Idaho.*
17. *Common provisions of farm leases.*
18. *A farm management survey of the bench area of Gem County, Idaho.*

### Research Papers

151. *Influence of stripe rust on growth, water economy, and yield of wheat and barley.* Wayne Bever. Jour. Agr. Res., Vol. 54, No. 5, pp. 375-385. March, 1937.
154. *Reliability of selected tests for the detection of mastitis.* A. O. Shaw, H. C. Hansen, and Richard Nutting. Jour. Dairy Sci., Vol. XX, No. 4, pp. 199-203. April, 1937.
155. *Paratyphoid in turkeys.* V. A. Cherrington, E. M. Gildow, and Pren Moore. Poultry Sci., Vol. XVI, No. 4, pp. 226-231. July, 1937.
156. *Some factors influencing the transmission of fowl paralysis.* J. K. Williams, E. M. Gildow, and C. E. Lampman. U. S. Egg and Poultry Magazine, Vol. 44, No. 1, pp. 24-27. Jan., 1938.
157. *Legume viruses in Idaho.* W. H. Pierce. Phytopath., Vol. 27, No. 8, pp. 835-843. August, 1937.
158. *Common mosaic of the garden pea, Pisum sativum.* Donald M. Murphy and W. H. Pierce. Phytopath., Vol. 27, No. 6, pp. 710-721. June, 1937.
161. *Electric heat for laying houses.* Hobart Beresford, Jefferson B. Rodgers, and C. E. Lampman. C.R.E.A. News Letter, No. 16, pp. 18-24. Nov., 1937.

## Progress of Investigational Work

FOLLOWING the practice of former years, a brief summary of the progress of research in the various departments and the substation farms is presented. Each summary includes, also, a brief historical discussion of the development of research in the department.

As pointed out in the introductory statement to this report, the investigational program under way at the branch experimental stations is closely correlated with the research of the main Station conducted on the farm, in the laboratories, and in the greenhouses at Moscow. Each year the superintendents of the substation farms are called into conference with subject matter departmental heads to discuss the results achieved during the past year and to plan the work for one or more years in advance. Through this method the combined results of agricultural research conducted on branch stations throughout the State and on the University farm at Moscow become the complete program of the Idaho Agricultural Experiment Station. Reference to this close correlation and cooperation will be found in the departmental reports that follow.

# Agricultural Chemistry

H. P. MAGNUSON *in charge*

## Chemical Research Contributes to Agricultural Development of Idaho

THE Chemistry Department, in 1893, was one of the first departments inaugurated by the University of Idaho, and two of the first problems undertaken for investigation by C. W. McCurdy, the first Chemist of the Experiment Station, consisted of determination of the composition and origin of the different soils in the State of Idaho and the salt content of waters from various sources of supply. The next major problem undertaken was the study of the sugar content of different varieties of beets grown on irrigated land in order to promote the sugar beet industry in the State. This work was undertaken prior to 1900. From 1900 to 1909 the study of soil composition and type was continued as a major problem, with attention given to the treatment of alkali soils. The milling qualities, breadmaking properties, and factors which affect the protein content of different varieties of Idaho wheat were extensively investigated.

From 1909 to the present, with the inauguration of more departments in the Experiment Station and enlargement of the Agricultural Chemistry Department in personnel, space, and equipment, the scope of investigation broadened, and many of the projects became cooperative with the newly organized departments.

During this period the Department of Agricultural Chemistry has continued the former work on Idaho soils, with more attention being paid to the physical and chemical properties of the different types of soils in relation to plant growth. The different phases of soil research continued in cooperation with the Agronomy Department and Agricultural Engineering Department are physical and chemical characteristics of slick spots; factors affecting soil drainage; soil fertility and development of methods for the determination of available plant nutrients for different types of soils; investigation of salt content of irrigation waters from various sources of supply in different areas of the State; and the study of the effect of the salt content in these irrigation waters upon soil drainage, fertility, and plant growth. Rotation plots were laid out in 1916 in cooperation with the Agronomy Department to determine the effects of the various systems of rotation over a long period of management upon the nitrogen content of the soils and the protein content of wheat.

In cooperation with the Departments of Plant Pathology, Horticulture, and Entomology, different chemical phases of studies of insecticides and fungicides and their removal from fruits after harvest have been developed. A study of the cause and remedy for lime-induced chlorosis of plants has yielded valuable results.

Considerable attention has been given to animal nutrition, and cooperative investigations have been made with the Departments of Dairy Husbandry, Animal Husbandry, and Poultry Husbandry. Some of the phases of these investigations include studies of the nutritive value of

feeds like sunflower silage, alfalfa, peas, and grazing forage which are commonly grown and consumed in Idaho.

Aside from the analyses essential in carrying out the above research projects, the department has, since its inauguration, carried the burden of miscellaneous analyses of feeds, soils, waters, fertilizers, and foods for the farmers of Idaho.

### Soil Studies Continued During 1937

The study of the fertilizer requirements of the various soils of the State and a comparison of various carriers of phosphorus have been continued. The crop response, as well as the increase in phosphorus content of alfalfa as a result of application of insoluble phosphorus, has continued to be negligible, and the need for a soluble form of phosphorus on the high lime soils of the State has been shown more conclusively. More frequent applications and larger amounts of phosphorus have been applied in an effort to determine their influence on yield and composition of plants grown.

Investigations of the influence of various systems of management on the nitrogen content of the soil and the protein content of wheat grown in the rotation continue to show that proper and sufficient maintenance of nitrogen in the soil requires the use of legumes in the rotation, as well as the return of some organic matter to the land. The application of manure has given satisfactory results.

Greenhouse studies of the sodium-saturated slick spot soils show that the improvement in physical condition of the soil by the replacement of sodium by calcium, and the subsequent removal of replaced sodium has also materially improved the crop production of the soil. The slick soils are appreciably lower in organic matter than the normal soils and contain more magnesium.

### Iron Salts Give Temporary Correction of Lime-Induced Chlorosis

Three-years' study of lime-induced chlorosis on apple trees in southern Idaho shows that iron citrates and phosphates injected into the trunks of the trees in 1935 had lost most of their effectiveness. A re-application made to the same trees in April, 1937, produced good results, indicating that the green color can be maintained by repeated applications for a period of years. A very outstanding treatment was iron citrate applied in 1937 following an injection of zinc sulphate in 1935, the restoration of green color being the most satisfactory of any treatment tried. New plots were also laid out in April, 1937, and the treatments applied in 1935 were repeated, but less striking response was observed this year. Observations will be continued next year. Iron citrate was injected into the trunks of a number of trees in June, 1937. These showed a marked color improvement during the season in spite of the lateness of the treatment. More summer applications will be made next year for comparison with applications made to dormant trees.

### Chemistry of Farm Waste Utilization Studied

In an effort to salvage cull potatoes and farm wastes, a study has been

made of the manufacture of alcohol from these products. During the past years, pronounced advancement has been made in methods of malting and in drying residues. A plant is being built in Idaho Falls, under the supervision of the Department of Agricultural Engineering, in which some of the findings are being incorporated.

### Carotene Studies Produce Valuable Data

Cooperative work with the Department of Poultry Husbandry has shown that an average of 17 milligrams of dehydrated alfalfa per 100 grams of feed, when fed to laying hens at .1 milligram level of carotene per bird per day, is inadequate for protection and egg production. When fed at carotene levels of .25 and .5 milligram per bird per day, adequate protection was given, although .5 milligram gave better results in egg production.

Concentrates, including ground oats, ground barley, ground corn, cottonseed meal, bran, linseed meal, meat meal, yeast, middlings, and milk powder, mixed with equal parts of dehydrated alfalfa and stored at 60° F. for a period of 10 months, lost on the average 60 per cent of its carotene content. Dehydrated alfalfa stored for 10 months at 5° F. lost 1 per cent; at 17° F., 17.5 per cent; at 39° F., 35 per cent; at 60° F., 54 per cent; and at 80° F., 98 per cent.

Chemical analyses of numerous samples of commercial dehydrated alfalfa have shown that the carotene content per 100 grams of alfalfa may vary from 2 to 35 milligrams. Common samples contained between 16 and 20 milligrams of carotene per 100 grams. The carotene content of sun-cured alfalfa varied from 2 to 10 milligrams per 100 grams. The majority of these samples contained 4 to 6 milligrams of carotene per 100 grams.

For the last three years grasses grown on irrigated plots under grazing conditions on the Caldwell Substation have been collected and analyzed for carotene and protein content when they had attained two to three weeks' growth. The average amount of carotene in milligrams per 100 grams and per cent protein, on an oven-dry basis, of the different varieties of grasses is as follows: brome grass, 38.6 milligrams carotene, 23.9 per cent protein; Orchard grass, 37.7 milligrams carotene, 20.45 per cent protein; meadow fescue grass, 35.00 milligrams carotene, 20.00 per cent protein; Kentucky bluegrass, 30.9 milligrams carotene, 20.33 per cent protein; and timothy grass, 29.6 milligrams carotene, 18.7 per cent protein.

Grasses stored green after being ground with dry ice in a Wiley mill and stored for one year at 5° F. retained their carotene content. Alfalfa stored under similar conditions lost 64 per cent of its carotene content. The carotene content of cock-cured alfalfa hay averaged 4.9 milligrams per 100 grams of hay, while alfalfa hay cured in the swath contained no carotene in the samples analyzed.

A photoelectric spectrophotometer has been installed for the determination of carotene, as well as other substances of this nature.

### Phosphorus Requirements of Livestock Investigated

Analyses for two years indicate that range forage plants collected from

the grazing areas of the State in the forepart of June contained a considerably higher percentage of phosphorus than those forages collected in the latter part of August. The calcium-phosphorus ratio is higher in the latter part of the grazing season.

The inorganic phosphorus level of the blood of growing and fattening steers dropped from 6.69 milligrams to 4.31 milligrams per 100 cc. of plasma when fed ad libitum a ration containing .12 per cent phosphorus. The inorganic phosphorus level of the blood remains normal when steers are fed rations containing .23 per cent phosphorus. Results of feeding feeds of different phosphorus levels indicate the phosphorus requirements of growing fattening beef calves to be about 2.2 grams daily per 100 pounds of live weight for the best gain in weight.

The inorganic phosphorus of the blood of lambs receiving the .102 per cent phosphorus ration dropped from 5.0 to 3.5 milligrams of phosphorus per 100 cc. of plasma. Although the inorganic phosphorus remained normal on .124, .164, .185, and .230 per cent phosphorus ration, better weight gained per pound of feed was made on rations containing .23 per cent phosphorus. The phosphorus requirement is indicated to be between 2.5 and 3 grams daily per 100 pounds. Feeding experiments are being repeated by the Animal Husbandry Department, and additional analyses will be made to check the above results.

# Agricultural Economics

P. A. EKE *in charge*

### Agricultural Economics Research Increased by Purnell Funds

FORMAL research was commenced in agricultural economics at this Station when Purnell funds were made available in 1925. In the Annual Report for 1925 the following statement is found under Agricultural Economics: "Prior to the new undertakings, the investigation along this line consisted principally of farm organization studies made in Twin Falls and Latah Counties from 1919 to 1922." Byron Hunter of the United States Department of Agriculture did most of this work. In 1925 one full-time worker, G. T. Sulerud, together with a portion of the time of H. C. Dale, Dean of the School of Business Administration, was assigned to agricultural economics projects. These men carried on without assistance through 1926. In 1927 R. H. Engle came to join Sulerud, while Dale had withdrawn from this field. Engle and Sulerud resigned in 1928, and in the fall R. B. Heflebower became Assistant Economist and carried out the work until May, 1929, when Paul A. Eke came as Head of the Department. C. O. Youngstrom came as Assistant Economist that same year. In 1930 Heflebower resigned. In 1930 T. L. Gaston was added to the staff, and after his resignation in 1933, H. A. Vogel took his place. Upon Vogel's resignation in 1936, O. L. Mimms came to the department as Assistant Economist. Mr. Youngstrom has been on leave of absence for the past two years, and Alexander Joss and George T. Schaefer have substituted consecutively for him in his absence.

In personnel this department has suffered the handicaps of a new de-

partment in a relatively new and small experiment station. Young men have been hired. Experimenting and lost motion have been necessary. As the young men have developed and proved their worth, they were led into positions elsewhere by larger salaries and the lack of a consistent policy of salary increases here. More than half of the men who have resigned have, within a year or two, obtained salaries considerably above that of the heads of the departments at the University of Idaho. This continuous loss of the best talent to other institutions does not auger well for maximum efficiency.

### Results of Research Made Available by Publications

The first research of the department was a statistical compilation and description of the agriculture of the State. This study resulted in four publications: Bul. 151, *The Farming Business in Idaho;* Bul. 152, *The Dairy Situation in Idaho;* Bul. 153, *The Potato Situation in Idaho;* and Bul. 154, *The Poultry Situation in Idaho.* These studies were statistical compilations and graphic presentations of basic facts on Idaho agriculture. For a new department in a virgin field this was necessary and desirable research, and extension work could be guided thereby.

A number of marketing and price studies were made from 1925 to 1930, including Bul. 162, *Statistics on the Prices and Destination of Idaho Apples;* Bul. 166, *Factors Relating to the Price of Idaho Potatoes;* and Bul. 172, *Steer Prices in Relation to Idaho Beef Producers' Problems.* New statistical technique was here applied to describe the market and price forces which operate in Idaho on these commodities. More than description was achieved in the latter two bulletins, and some quantitative measures of these forces were made. These studies have acted as foundation material for current price outlook information. To further supplement outlook extension, the following two publications were added after 1929: Bul. 210, *Index Numbers of Idaho Farm Prices,* and Cir. 62, *A Review of the Accuracy and Timeliness of Outlook Statements.* Index numbers of Idaho farm prices have been kept up-to-date by the Federal Agricultural Statistician at Boise since the Agricultural Experiment Station relinquished this work to him about three years ago.

Farm management studies, which were first started by Byron Hunter of the United States Department of Agriculture, have resulted in Bulletins 123, *Farm Organization in Twin Falls and Latah Counties;* 132, *Business Analysis of 181 General Crops—11 Dairy and 10 Fruit Farms, Twin Falls County, Idaho;* 173, *Farming Systems for Eastern Washington and Northern Idaho;* 188, *Planning the Farm Business for the Year Ahead;* 195, *A Method of Determining What to Produce;* 198, *Profitable Systems of Farming for the Idaho Falls Area;* and Mimeo-leaflet, *Farm Management Information for Minidoka Project.* Other studies of this nature have been mimeographed for immediate distribution and as permanent records for future reference.

### Farm Budgeting Featured

Beginning with Bulletin 173, farm budgeting as a principle and practice was carried forward. These bulletins pioneered in this approach to farm

management problems. Natural and economic conditions in Idaho made this approach more productive of results than the farm survey or farm cost accounting records which had been pretty well worked out and standardized in the older states of the Middle West and East. The basic reason for this approach is the great variety of alternatives open to irrigated agriculture within the State and the enormous fluctuations in price due, largely, to high freight rates. What to grow during a particular season is relatively more important with respect to net farm income than an increase in efficiency of production. The managerial superiority of the

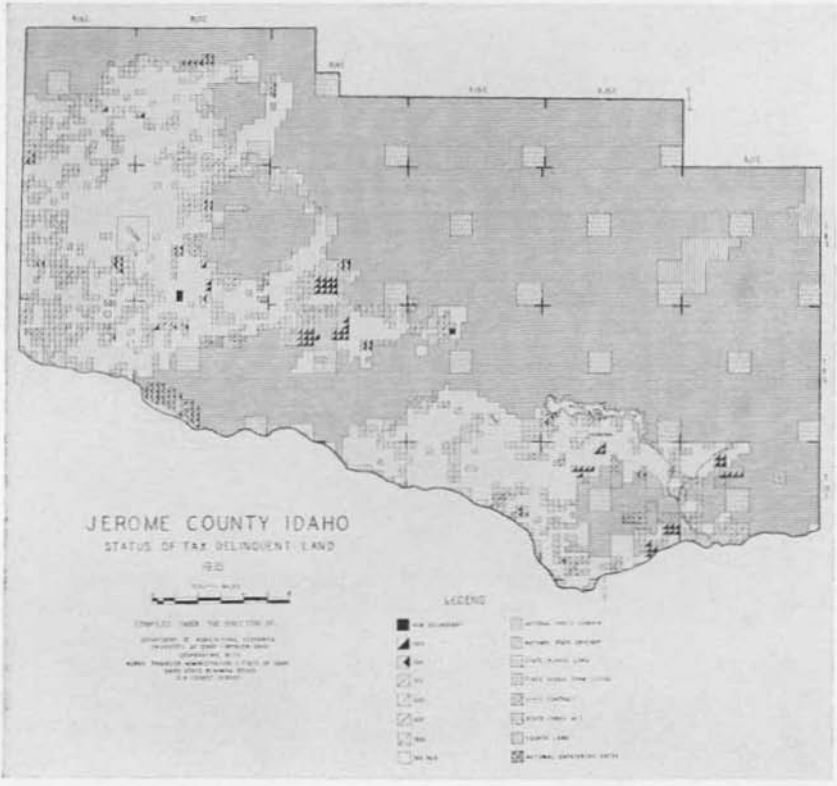



Fig. 5.—One of the maps showing data gathered in the land classification study.

farmer who plans his plantings and breedings on outlook information is very great in a state like Idaho.

## Land Classification a Continuing Study

The most outstanding work accomplished, and which has been most consistently carried forward, has been along the line of land classification. Commencing with Bulletin 151, *The Farming Business in Idaho*, by Sulerud and Wells, and an unpublished economic study of the Boise Valley by Sulerud, a great mass of data has been added since 1929. *Types of*

*Farming, Part I and Part II*, by Vogel and Johnson, was printed in 1934. *Farm Management Information of the Minidoka Irrigation Project* was mimeographed in 1933. Based upon data collected at that time, Bulletin 222, *Influence of Tenancy on Types of Farming*, was published in 1937. Similar basic data are available for Jerome County.

Since 1934, base maps and six land classification maps have been made for all except a few counties which now are being completed. These maps cover the following data: 1. Public and private service facilities; 2. Ownership of rural lands; 3. Proportion of agricultural land; 4. Average wheat yields; 5. Assessed valuation of agricultural lands; 6. Status of tax delinquent lands.

Plans now are completed for analyzing A.A.A. compliance forms by types of farming areas to obtain causal relationships for variations in farm organization. Cooperation and assistance was extended to the National Land Resources Board and the Farm Security Administration in Land Classification Studies. County Agricultural Planning work of the A.A.A. has been directed in large part by the department, and all reports are on file in the office. Future work is planned along this line.

Aid was given the Soil Conservation Service in planning the conservation and rehabilitation of the Squaw Creek Area in Gem County. Karl Hobson, Assistant Extension Economist, spent a short time in Gem County advising on the field work. The forms used were largely supplied by the Department of Agricultural Economics. One experienced farm management field man was loaned by the department for about six weeks, and his salary, except for the first month, was furnished while on this work. All analyses and publications by the Soil Conservation Service on the project have been reviewed and helpful suggestions made.

All farm management studies which have been made have a bearing on land classification and best land use. Tenancy studies are under way to relate tenancy to land use, net returns, and type of farming. As a by-product, improved lease contracts are being compiled for distribution.

Two educational bulletins, *Common Provisions of Farm Leases* and *Suggestions for Making Farm Leases*, have been mimeographed. These publications are helpful because of the immaturity of tenant-landlord relationships in Idaho, and because of needs arising from the Soil Conservation program in its broadest sense.

One tax study was completed in 1936 and mimeographed under the title of *The Sources and Uses of State and County Revenue in Idaho*.

# Agricultural Engineering

HOBART BERESFORD *in charge*

## Irrigation Studies Inaugurated When Station Established

THE division of Agricultural Engineering in the Agricultural Experiment Station was not recognized as such at the time of the organization of the Station. However, J. E. Ostrander, who was the first Professor of Civil Engineering, was a member of the original council and served the

Station as Irrigation Engineer. The need for engineering service in agriculture has grown with the expansion of the Experiment Station program.

In the 1894 Annual Report, the Irrigation Engineer proposed "practical experimental work in irrigation," and the 1895 Report states that "the Irrigation Engineer made progress in the mapping of the substations." Fred G. Frink served as Irrigation Engineer from 1898 until 1900, A. P. Adair was Acting Irrigation Engineer for one year, and C. N. Little served from 1902 until 1906. In 1907, the title of Irrigation Engineer was changed to Irrigationist, to which position Elias Nelson, a graduate of the University of Wyoming, was appointed and, in cooperation with the U.S. Department of Agriculture, inaugurated a number of irrigation experiments. Nelson served until 1909.

The only publications by an Irrigation Engineer (Professor of Civil Engineering) were Bulletins No. 45, *Trap Rocks of the Palouse Region as Road Material,* by C. N. Little and W. L. Zeigler in July, 1904, and *Part II,* published as Bulletin No. 50, By C. N. Little and W. G. Turley in September, 1905. These bulletins were also Nos. 1 and 2 of the Civil Engineering Department. The first investigations of the Irrigationist were concerned with duty of water experiments, pumping for irrigation, and plowing and sub-soiling for summer fallow and dry farming. Bulletin No. 58, *Irrigation Investigations,* by Elias Nelson, was published in May, 1907; No. 62, *Dry Farming in Idaho,* in March, 1908; and No. 66, *Alfalfa,* in May, 1909.

The Annual Report of 1908 shows investigations in duty of water, soil moisture, dry farming, evaporation from soils, and pumping. Soil evaporation measurements were made in tanks, which is the first mention made of laboratory equipment.

In the dry farming and summer fallow experiments, comparisons were made of different types of plows, subsoilers, and cultivators, indicating a broadening of the agricultural engineering field to include farm machinery.

### E. W. Hamilton Was Agricultural Engineer from 1912 until 1917

From 1909 until 1912, although some experimental work of an agricultural engineering nature had been carried on, no member of the Station staff was responsible for the program. In 1917 J. C. Wooley was appointed Agricultural Engineer and served until 1920. R. B. Gray served in a like capacity from 1921 until 1923, and M. R. Lewis, from 1924 until 1927. Hobart Beresford has held the position since 1928, and M. R. Kulp has held the title of Associate Agricultural Engineer and Irrigationist since 1930. With the addition of the irrigation laboratory, the field work could be checked and supplemented by laboratory investigations. In 1925 the cooperative work with the Committee on the Relation of Electricity to Agriculture added experimental work in rural electrification to the major projects which are being continued in land reclamation, power and machinery, farm structures and equipment, water supply and sanitation, and agricultural waste utilization.

### Land Reclamation and Power and Machinery Studies Produce Results

During 1937 tests of pumping plants showed one properly maintained

pumping plant operating with original discharge and efficiency after 10 years of service, while less carefully maintained plants showed deterioration.

New developments in field power and machinery are marked by the increased use of rubber tires on both power units and field machines. The Soil Conservation program has increased the interest in implements that produce a trashy fallow for the nonirrigated sections and the development of equipment for producing contour furrows in flood control areas. The Department of Agricultural Engineering cooperated with farmers in studying the problem of transferring crop cover from the untilled soil during the plowing operation in such a way as to produce a trashy fallow on the newly plowed ground.

Studies were made of operating costs for producing peas in the Palouse area with diesel-powered tractors. The following costs were obtained:

| | |
|---|---|
| Plowing: | $0.24 per acre using two 4-bottom 14-inch plows, plowing 24 hours per day, average 40 acres. |
| Disking: | $0.12 per acre using two 8-foot double blade disks, disking 24 hours per day, average 80 acres. |
| Drag Harrow: | $0.06 per acre using 50-foot harrow, operating 24 hours per day, average 200 acres. |
| Rod Weeding and Harrowing: | $0.13 per acre using three 8-foot sections of rod weeder and five sections of harrow, operating 24 hours per day, average 80 to 100 acres. |
| Seeding: | $0.12 per acre using two 11-foot drills, seeding 12 hours per day, two men used, average 70 to 80 acres per 12 hours. |
| Packing: | $0.09 per acre using two 16-foot rollers, operating 24 hours per day, average 120 to 150 acres per day. |
| Combining: | $0.21 per acre using 14-foot combine, operating 12 hours per day, average 25 acres. |

The cost of operating a 40-horsepower diesel-powered tractor on an average of 200 days per year was found to average $14.92 per day, including operating cost, labor, interest depreciation, and taxes.

A study of actual farm costs for power and machinery operation as compared with current custom costs was made for several farm and field operations. For a 40-acre unit of wheat, the farm cost was $0.92 per acre, and the custom cost was $1.25 per acre. For a 100-acre unit of peas, the farm cost was $1.10 per acre and the custom cost was $1.42 per acre. On an 800-acre farm, the investment in power and machinery averaged $10.56 per acre, with an estimated depreciation of $1.06 per acre.

A study of the cost of mowing and shocking hay by use of a seven-foot cut tractor mower and a side delivery rake, with a dump rake as a means of putting the hay into the shocks from the windrow, was conducted at the Caldwell Substation. The data indicate a cost of $0.77 per

acre for mowing, $0.42 per acre for raking with the side delivery rake, and $0.34 per acre for operating with the dump rake. This gives a total of $1.53 per acre for handling from the standing hay to the shock. The hay was hauled from the field, weighed, and fed into the grinder, which elevated it onto the stack by means of a wind stacker. Data indicate that the hay was handled at the rate of 3.056 tons per hour of paid time, requiring 4.50 man-hours per ton of hay, with a labor and machine cost of $2.37 per ton. The total cost for the hay harvested by this method was $3.90 per ton.

Methods of harvesting clover seed in southern Idaho were studied, where the clover is first mowed and windrowed in a single operation, after which it is picked up and thrashed with an especially equipped combine harvester.

A study of the change in volume of loose alfalfa hay as it comes from the field and is ground and blown into the stack indicated that a ton of loose hay, occupying 813.06 cubic feet, was reduced in volume to 153.84 cubic feet. This represents a loss of 81.08 per cent of the original volume.

A census taken in S.W. ¼ Township 4 N., R. 2, W.B.M., representing a typical southern Idaho irrigated district, indicated that the 63 hay growers in this area produced 6,042 tons of hay, with 60.3 per cent of them chopping or grinding 35.6 per cent of the hay.

Cost data and operating methods were secured for hay harvesting on a completely mechanized dairy farm near Caldwell, Idaho. The operator mechanized his haying operations to reduce the cost and crew size and to speed up the harvesting operations. The equipment consisted of a hay grinder with a temporary storage bin mounted on a revamped combine chassis, the grinder being powered by a 125-horsepower engine. The entire unit was pulled by a general purpose tractor. The crew consisted of a tractor operator, derrick man, truck driver, and a machine attendant. The operation consisted of picking up the hay from the windrow with a hay loader, which delivered it to the grinder where it was cut and reground. A blower then elevated the hay to the 1500-pound capacity storage bin. The ground hay was carried in box slings by truck to the stack yard or barn, where the slings were hoisted by a derrick. Data indicate that the hay was handled at the rate of 1.86 tons per hour of gross operating time, requiring 2.14 man-hours per ton, with labor and machine cost of $1.52 per ton.

Comparative data for the 1936 and 1937 models of small high-speed harvesters operating in the irrigated district just east of Bowmont, Idaho, indicate that fuel costs per acre are $0.24 and $0.21, repair costs per acre are $0.47 and $0.11 with a net working time of 68.22 per cent and 74.95 per cent, while harvesting 0.725 and 1.018 acres per hour, respectively.

### Rural Electrification Interest Increases

Interest in rural electrification has continued to increase during 1937, especially from the standpoint of new line construction sponsored and financed by government agencies. This activity is confined to the northern

part of Idaho and when completed will include more than 3,170 customers, requiring over 687.5 miles of distribution line. As of January 1, 1937, private utilities have completed rural electrification projects totaling 4,133 miles of line serving 24,307 rural customers. On a basis of the farms having homes valued at more than $500, Idaho now has more than 60 per cent of these farms electrified. On a basis of the total number of farms in the State with occupied dwellings, the electrification is 47.8 per cent.

For the past three winters the Agricultural Engineering Department, in cooperation with the Poultry Husbandry Department and the Idaho Committee on the Relation of Electricity to Agriculture, has been studying the problem of electrically heating laying houses. The trend in poultry house construction in recent years has been towards an insulated house which makes possible the economical use of heating systems.

Three years' study and observation on various types of heaters have resulted in the perfection of an electric heater which meets the requirements for heating an insulated house, having a floor area of 800 square feet and a volume of 5,000 cubic feet. Based on experimental results, the heater best adapted for this particular use is a circulation type of heater of 1,000- to 1,250-watts capacity with a fan capable of circulating from 200 to 225 cubic feet of air per minute. Such a heater, thermostatically controlled, will cost approximately $15.00. As each heater is a self-contained and controlled unit, one or more heaters may be installed in the larger houses.

The chief advantage of electric heating in laying houses is as a standby source of heat. Thermostats may be set to operate the heater when the temperature in the house reaches the predetermined minimum. This is an advantage if the temperature should drop suddenly, as it frequently does in the wintertime. Heating insulated houses electrically costs no more, and in many cases less, than heating by other means. The initial cost of an electrical heating system is low in comparison with other heating systems.

### Farm Buildings and Equipment Studied

In the field of farm buildings and equipment, a study was made of the use of models for the testing of building design. This method of testing affords an efficient, rapid, and accurate means of checking the structural design of a building. A new and efficient method of loading the models by a system of levers and of analyzing results with a sensitive dial gage has been developed. Scale models can be quickly constructed from brass wire of suitable gage by soldering the joints together. A model of a simple truss can be assembled and tested by the moment loading method in thirty minutes. Numerous tests on brass wire models gave such consistent results when compared with the results of tests on the model prototype as to justify a high degree of confidence in model testing.

Plans and specifications were prepared for a number of experiment station structures, including the new office building at the Aberdeen Substation, a judging pavilion, and poultry house at the Home Station, and a building for the new Agricultural Waste Products Laboratory at Idaho

Falls, Idaho. In addition to this, numerous plans were furnished county agents and private individuals throughout the State, and blueprint service was furnished the Rural Electrification Administration, the Soil Conservation Service, and the Agricultural Adjustment Administration.

### Waste Utilization Featured

Studies have been continued on the problems resulting from the investigation of the use of cull potatoes in the production of industrial alcohol. Plans were prepared for the erection of a laboratory and pilot plant, made possible by a special appropriation for this purpose. The plant is now under construction at Idaho Falls.

## Agronomy

K. H. W. KLAGES *in charge*

### Forty-five Years of Work in Crops and Soils Reviewed

PRIOR to 1904 research and teaching work in agronomy was supervised by the director of the Experiment Station. G. A. Crosthwait was the first Agronomist, serving from 1904 to 1907. He was followed by R. E. Hyslop, 1907 to 1909. L. F. Childers was appointed Agronomist in 1909 and was succeeded in 1911 by F. L. Kennard. In 1912 the department was broken up into the Departments of Field Crops and Soils, with F. L. Kennard in charge of Field Crops and P. P. Peterson as Head of the newly formed Department of Soils. This division of the department was maintained during the period that Dr. Peterson had charge of the soils work. In 1920 the research and teaching in crops and soils were again united into a Department of Agronomy. In that year G. R. McDole was appointed Soil Technologist. F. L. Kennard was succeeded by N. S. Robb, in charge of Field Crops, in 1914, and Robb by G. S. Ray in 1916. In 1918 R. K. Bonnett was appointed Agronomist and, with the recombining of the crops and soils work in 1920, as Head of the Department of Agronomy. H. W. Hulbert succeeded Professor Bonnett in 1924, serving until 1936, when the present head of the department, K. H. W. Klages, was appointed. G. R. McDole served as Soil Technologist until 1931, when he was succeeded by R. E. Bell. G. O. Baker, the present Soil Technologist, was appointed in 1935.

The early research work of the department was concerned largely with a study of crop adaptation. The rapidly developing agriculture of the State was provided with experimental data on the utilization of crops and varieties in the different agricultural areas. This period was followed by research along more definite lines dealing with methods of production and utilization of special crops, such as alfalfa and clover seed production, and extensive work on field peas. The breeding and testing of cereal crops for the various agricultural regions of the State were important tasks. In more recent years special attention has been given to the improvement and more extensive use of forage plants.

In spite of the not infrequently expressed ideas of early settlers that

our soils would never want in fertility, a set of fertility and rotation experiments were started in 1913. Work on this project has continued without interruption. A publication dealing with the results of these studies is being prepared at the present time. Additional crop rotation and fertility studies have been inaugurated following the acquisition of additional, much needed land by the department in 1936. Problems which have arisen during the rapidly changing status of agricultural production will be especially dealt with on these new rotation plats. Experiments on the utilization of phosphates and other commercial fertilizers were started in 1915. Work on this project is being continued and enlarged upon as changing conditions demand.

### Winter Wheat Hybrids Produce High Yields in 1937

Excellent stands and yields of winter wheat were obtained even though lack of moisture during the autumn months greatly delayed germination. The highest-yielding variety in the United States Department of Agriculture uniform yield nursery of 25 different varieties at Moscow was Fortyfold x Hybrid 128, C.I. No. 11735, which produced 68.5 bushels per acre.

The Idaho yield nursery consisted of 105 old and new varieties. Forty-seven strains are the results of hybrids between Mosida, Ridit, White Odessa, Martin, Fortyfold, Federation, and selections from Jenkin. The characteristics desired and worked for in the new hybrid varieties and selections in winter wheat are high-yielding capacity, resistance to bunt, early maturity, and short stiff straw. The Mosida, Ridit, White Odessa, and Martin hybrids are highly resistant to bunt, mature early, and have relatively short stiff straw. The most promising hybrid strains of this group were: Mosida x Federation, Idaho No. 24; Mosida x White Odessa, Idaho No. 10; Mosida x Ridit, Idaho No. 9; yielding 66.8, 63.1, and 56.3 bushels per acre, respectively. Three promising Jenkin selections outyielded the Mosida hybrids, selections No. 4, 3, and 6 yielding 72.8, 68.4, and 67.1 bushels per acre, respectively. These three selections are characterized by resistance to bunt and stiffness of straw. For the past five years they have been as winter hardy as standard winter varieties.

Three cooperative winter wheat yield nurseries, consisting of 16 old and new varieties, were conducted on farms in the vicinity of Cottonwood, Craigmont, and Nezperce for the purpose of studying adaptation to conditions prevailing in the respective local communities. Mosida x Federation, Idaho No. 30, gave the highest yield, 39.1 bushels per acre, followed by Golden with a yield of 38.0 bushels.

Nineteen varieties of winter wheat were grown in the larger yield plats during the past year. The comparative yields of four outstanding commercial varieties grown in field plats are given in Table I.

**TABLE I**

**Comparative Yields in Bushels per Acre of Four Standard Varieties of Winter Wheat in the Field Test Plats at the University Farm for the Years Indicated**

| Varieties | C.I. No. | 1935 | 1936 | 1937 | 3-yr. Av. | Av. per cent of Ridit |
|---|---|---|---|---|---|---|
| Golden | 10063 | 68.1 | 54.8 | 37.5 | 53.5 | 113.8 |
| Albit | 8275 | 54.4 | 51.5 | 42.0 | 49.3 | 104.9 |
| Rex | 10065 | 62.1 | 48.5 | 35.7 | 48.8 | 103.8 |
| Ridit | 6703 | 55.1 | 49.9 | 36.0 | 47.0 | 100.0 |

## Spring Wheat Breeding Results Encouraging

The spring wheat nurseries contained 48 varieties and strains. Twenty-five of these varieties were grown in the United States Department of Agriculture uniform nursery, made up of varieties developed by different State and Federal stations. The four high-yielding varieties in this group were: Baart x Hard Federation, C.I. No. 11615, 59.4 bushels; Federation x Bunyip, C.I. No. 11874, 57.4 bushels; Baart, C.I. No. 1697, 55.3 bushels; and Onas, C.I. No. 6331, 55.3 bushels per acre.

White Federation x Federation, Idaho No. 666, was the highest-yielding variety in the Idaho nursery with a yield of 55.1 bushels per acre. This variety has given consistently satisfactory yields during the past three years in both nursery and field plats. Under field conditions it produced this year a yield of 56.0 bushels per acre. It matures earlier than Federation, has short stiff straw, and a soft white kernel.

Twelve varieties of spring wheat were grown in field test plats. The season was favorable to late-maturing varieties. Jenkin gave the highest yield, 49.0 bushels. Idaed, a new variety developed by the Idaho Agricultural Experiment Station as a result of a cross between Sunset and Bodicea gave a yield of 35.0 bushels. This year a two-acre field of Idaed yielded 48.0 bushels per acre. Steps are being taken to increase this variety, and seed will be available for distribution next year. The comparative average yields of Idaed and four other standard varieties of spring wheat grown in variety test plats on the University farm are presented in Table II. Jenkin and Pacific Bluestem are recommended for the production of feed only.

**TABLE II**

**Comparative Yields in Bushels per Acre of Idaed and Four Standard Varieties of Spring Wheat in the Variety Test Plats on the University Farm for the Years Indicated**

| Varieties | C.I. No. | 1935 | 1936 | 1937 | 3-yr. Av. | Av. per cent of Federation |
|---|---|---|---|---|---|---|
| Jenkin | 5177 | 42.2 | 42.4 | 49.0 | 44.5 | 117.4 |
| Idaed | 11706 | 38.4 | 51.3 | 35.0 | 41.6 | 109.8 |
| Baart | 1697 | 37.9 | 43.3 | 40.0 | 40.4 | 106.6 |
| Federation | 4734 | 34.4 | 38.7 | 40.7 | 37.9 | 100.0 |
| Pacific Bluestem | 4067 | 35.3 | 35.1 | 42.0 | 37.5 | 98.9 |

## Markton Oats and Trebi Barley Outstanding

Extensive nursery and plat tests are in progress with these two feed crops. Markton outyielded all other varieties and hybrids in the nursery, and in the variety plats it was a close second in yield to Golden Rain.

In both the barley nursery and variety test plats, strains of Vaughn x Atlas hybrids outyielded standard varieties. Of the standard varieties, Trebi gave the highest yield. The above indicated hybrid strains are promising from the standpoints of yielding capacities and the ability to produce a stiff straw resistant to lodging.

## Alfalfa, Clover, Sweet Clover, and Grass Breeding Continued

Work is being continued on isolated strains of Grimm alfalfa, red clover, Ladino clover, sweet clover, crested wheat grass, and *Phalaris*

Fig. 6.—Plot of Mosida (winter wheat) x *Elymus condensatus* (giant rye grass) grown on the University farm in 1937. This shows some of the $F_2$ progenies. The man standing in the plot is six feet tall.

*tuberosa*. Among the promising materials developed are high-yielding strains of Grimm alfalfa, semi-dwarf and leafy strains of sweet clover, a purple blossomed and seeded type of Ladino clover, winter hardy under northern Idaho conditions, and a winter hardy, drought-resistant strain of canary grass. Several strains of crested wheat grass are under test. A new dwarf type showing early spring and persistent summer and fall

growth gives promise of being useful for pasture, lawn, and golf course purposes. This strain yielded 420 pounds of cleaned seed per acre.

## Inter-generic Crosses of Grasses Developed and Tested

Inter-generic hybrids were produced by crossing winter and spring wheats on *Elymus condensatus, Agropyron smithii, Phalaris tuberosa, Agropyron cristatum,* and a rye cross on *Elymus condensatus.* The Mosida (winter wheat) x *Elymus condensatus* cross is now in its third generation and is the only one of the inter-generic crosses far enough along at this time for determining its value for pasture and soil erosion purposes. Plants of the $F_2$ and $F_3$ generations show the perennial habit of growth of the Elymus (giant rye grass) parent; the leaves are wheat-like, and the seeds resemble those of common rye. The heads of the hybrid show characteristics of both parents. A yield of 20 bushels of seed per acre was obtained from the $F_2$ plants. This fall an acre of land was planted to this hybrid for the purpose of testing out its value as a pasture grass. Figure 6 shows the type of growth produced by the Mosida x Elymus cross.

## Seed Production of Forage Crops Tested

Tables III and IV give the hay and seed yields of various forage crops seeded in the spring of 1936. Table III gives the comparative performances of grasses and clovers in broadcast and in cultivated rows, the rows being 42 inches apart. Table IV gives the yields of indicated crops with varying rates of seeding. It will be observed that practically as high yields were obtained with the minimum as with the employment of the maximum rates. The seed yields of the smooth brome, crested wheat, meadow fescue, and slender wheat grasses were most promising. The yields of both red and alsike clovers were disappointingly low.

**TABLE III**

**Hay and Seed Yields of Broadcast and Row Planted Forage Crops Planted in the Spring of 1936**

| Crop | Yields of broadcast plats | | Yields of cultivated row plats | |
|---|---|---|---|---|
| | Hay in tons per acre | Seed in pounds per acre | Hay in tons per acre | Seed in pounds per acre |
| Smooth brome | 2.64 | 935 | 3.06 | 746 |
| Crested wheat | 2.24 | 789 | 2.61 | 622 |
| Tall meadow oat | 2.35 | 272 | 2.50 | 462 |
| Meadow fescue | 1.33 | 684 | 1.02 | 514 |
| Orchard grass | 0.80 | 67 | 1.04 | 137 |
| Red clover | 1.34 | 123 | 1.05 | 99 |
| Alsike clover | 1.02 | 45 | 0.97 | 28 |
| Slender wheat | 2.35 | 764 | | |
| Timothy | 1.67 | 403 | | |
| Ladak alfalfa | 3.27 | | | |
| White sweet clover | 3.68 | | | |

**TABLE IV**

**Hay and Seed Yields of Forage Crops with Varying Rates of Seeding, University Farm, 1937**

| Crop | Rates of seeding in lbs. per acre | | | | | | | | Av. of all rates |
|---|---|---|---|---|---|---|---|---|---|
| | 2 | 4 | 6 | 8 | 10 | 12 | 16 | 20 | |
| **Hay yields in tons per acre** | | | | | | | | | |
| Smooth brome | ..... | 2.77 | ..... | 2.75 | ..... | 3.30 | 3.26 | 3.35 | 3.09 |
| Crested wheat | ..... | 2.39 | 2.53 | 2.46 | 2.39 | 2.75 | ..... | ..... | 2.50 |
| Meadow fescue | ..... | ..... | 0.91 | 0.97 | 0.96 | 0.92 | 0.89 | ..... | 0.93 |
| Orchard grass | ..... | 0.72 | 0.75 | 0.80 | 0.87 | 0.75 | ..... | ..... | 0.78 |
| Red clover | ..... | 1.24 | 1.52 | 1.50 | 1.56 | 1.42 | ..... | ..... | 1.45 |
| Alsike clover | 1.01 | 1.30 | 1.35 | 1.38 | 1.45 | ..... | ..... | ..... | 1.30 |
| **Seed yields in pounds per acre** | | | | | | | | | |
| Smooth brome | ..... | 1063 | ..... | 1169 | ..... | 1008 | 1058 | 931 | 1046 |
| Crested wheat | ..... | 697 | 862 | 789 | 1100 | 898 | ..... | ..... | 869 |
| Meadow fescue | ..... | ..... | 514 | 582 | 583 | 546 | 532 | ..... | 550 |
| Orchard grass | ..... | 133 | 110 | 124 | 115 | 106 | ..... | ..... | 118 |
| Red clover | ..... | 104 | 161 | 150 | 142 | 123 | ..... | ..... | 136 |
| Alsike clover | 40 | 45 | 37 | 38 | 48 | ..... | ..... | ..... | 42 |

## Large Number of Pea Varieties Tested

This year's variety tests included 40 varieties. The highest-yielding varieties of the dry field group were: Potter Sel. B, 34.0 bushels; White Canada, 29.0 bushels; Ottawa, 29.0 bushels; Alaska Idaho No. 8578, 28.0 bushels; and Wisconsin Perfection Idaho No. 8677, 27.0 bushels per acre. Those ranking high in the market garden group were: Little Marvel Sels. Idaho No. 8659 and Idaho No. 8676 yielding 29.0 and 28.0 bushels, respectively; Telephone Sel. A, 28.0 bushels; and Gradus Sel. A, 26.0 bushels per acre.

The nursery tests consisted of 308 varieties and strains. The reason for such a large number of types is to provide materials for classification, foundation stock for hybridization, and to test adaptability for specific uses and disease resistance. A promising early market type was developed from a cross between American Wonder and an Idaho selection of Laxton Progress.

## Corn Breeding and Variety Testing Conducted at Caldwell

Experiments conducted at the Caldwell Substation indicate the value of hybrid field corns. Six of the highest-yielding open-pollinated local strains averaged 86 bushels of shelled corn as compared to an average of 116 bushels per acre of an equal number of hybrid strains.

Fifty crossbred types of sweet corn were tested at Caldwell. The yields of cut corn for the early group, in prime market condition in from 70 to 80 days, ranged from 5,276 to 6,195 pounds per acre. The yields of the mid-season group, reaching market condition in from 85-90 days from planting, ranged from 5,348 to 6,824 pounds of cut corn per acre. Golden Cross Bantam types appeared to be the best for canning purposes.

Fig. 7.—Strain tests of hybrid field corn conducted by the Department of Agronomy at the Caldwell Substation.

## Results of Cooperative Weed Investigations Reported

Extensive experiments dealing with cultural methods, competitive cropping, and chemical control of perennial weeds, especially bindweed, are in progress on the experiment station established in 1936 and conducted in cooperation with the Bureau of Plant Industry of the United States Department of Agriculture near Genesee.

At the end of the first season of cultivation the bindweed plants lost approximately 75 per cent of their root reserves. Plats under cultivation for one and one-half years had approximately 95 per cent of their reserves exhausted.

Good stands of forage crops were established on bindweed infested land. The application of 100 pounds of ammonium sulphate per acre to spring wheat on bindweed-infested land produced significant increases in yields. Ammonium sulphate applications on winter wheat did not increase yields.

Seven different chemicals were applied to 162 square rod and 12 one-twentieth-acre plats. Of the various chemical methods of application, dry sodium chlorate applied at the rate of two pounds per square rod in October was most efficient for eradication. Crested wheat grass, of numerous crops tested, showed most marked resistance to residual effects of sodium chlorate.

## Soils Investigations Produce Results

Progress is being made in the soil survey program carried on in cooperation with the Bureau of Chemistry and Soils of the United States Department of Agriculture. The survey of Bingham County was completed and work started in Bonneville County.

The study of fertilizer responses was expanded this year. Work was again carried on at the Aberdeen, Caldwell, and Sandpoint Substations. Approximately 90 experiments on 10 different crops were conducted in 35 counties of the State in cooperation with the Extension Service. Work on fertilization of orchards was also carried on in cooperation with the Horticultural Department. Preliminary results indicate that in addition to the recognized lack of available phosphorus in many of our soils, there appears also to be a deficiency of available nitrogen and, in a few cases, potassium for certain crops on certain soils.

Fourteen experiments to study the use of liquid ammonia as a source of nitrogen were conducted on four different crops—potatoes, onions, sugar beets, and beans—in six counties in cooperation with the Shell Chemical Company. Seventy-five pounds of liquid ammonia, containing the same amount of actual nitrogen as 300 pounds of ammonium sulphate, resulted in an average increase of approximately 14 per cent over the untreated plats.

The relative values of the various phosphate carriers, using alfalfa as an index crop, were studied in eight counties in the various irrigated sections of Idaho in cooperation with the Extension Service and at the Aberdeen Substation. The carriers studied were treble-superphosphate, raw rock phosphate regular grinding, raw rock phosphate fine grinding, bureau calcined, TVA meta, and TVA fused. Most economical increases in yields were obtained from treble-superphosphate. Raw rock, either finely ground or regular grinding, gave no material increases in yields. Rate and residual studies on treble-superphosphate were continued at Aberdeen.

The crop rotations established in 1914 on Field 1, at the main station, were continued, the yields following the trends shown in the summary of 22 years' results presented in last year's report. The effect of manure applications on soil and water losses are being studied in cooperation with the Soil Conservation Service on six of the plats. Preliminary data indicate that manure application to Palouse soils reduces soil and water losses.

Approximately eight acres of land were secured two years ago for additional work on crop rotation, management and fertilization studies, and to supplement the older rotations established in 1914. For the past two years the field was cropped uniformly to wheat to obtain an index of soil variability. The new rotations are: (1) wheat, peas; (2) wheat (plowing), fallow; (3) wheat (wheatland), fallow; (4) wheat (burning straw, plowing), fallow; (5) peas and sweet clover, sweet clover (plowed under), wheat, wheat; (6) wheat, wheat, peas (plowed under); (7) red clover, red clover (seed), wheat, wheat; (8) grass, grass, grass, grass, flax, wheat. The grass used is crested wheat grass. In all these rotations the wheat

straw will be returned to each plat to make conditions comparable to combine practices.

A second series of plats was established this year in order to obtain data on the influences of management and cultural practices to soil organic matter, soil nitrogen, water penetration, and erodibility. The following practices are included: (1) check, plowing; (2) check, wheatland; (3) straw burned; (4) two times the amount of straw produced burned; (5) ammonium sulphate added to make straw equal to 2 per cent of nitrogen; (6) manure, 15 tons every third year; (7) fall plow, leave rough, spring wheat; (8) stubble to stand, spring plow, spring wheat. These plats will be cropped to continuous wheat and all straw returned.

In addition to the above, deep tillage is to be studied on two plats and also the effect of returning twice as much straw as was produced.

Two series of plats, one wheat and the other alfalfa, have been established to study the effects of the various plant nutrients.

The crop rotation studies started at the High Altitude Substation in 1925 and at the Aberdeen Substation in 1929 have been continued. Plans have been formulated for the establishment of rotational studies at the Sandpoint Substation.

Investigations were started this year in cooperation with the Department of Plant Pathology on minor elements in their relation to plant growth.

### Pea and Bean Grading and Inspection

Between July 1 and December 1, 1937, thresher run certificates, representing 1,088,282 bags of peas, and thresher run bean certificates, representing 2,338 bags were issued. In addition, 376 certificates on processed peas and beans, representing approximately 250 cars, were issued.

## Animal Husbandry

C. W. HICKMAN *in charge*

### Livestock Improvement an Important Contribution

AN important contribution to the livestock industry of the State has been the improvement in the several classes and breeds of livestock at the Idaho Agricultural Experiment Station. This improvement is evidenced by the high place our livestock is accorded in the show ring and the excellent reception of our livestock at the State and national sales.

Experimental livestock feeding has occupied an important place in the general program since the establishment of the Agricultural Experiment Station. Much of the surplus feeder livestock, as well as surplus feed, are produced in southern Idaho. Consequently, it was but natural that much of the experimental feeding be done on the substation farms at Aberdeen and Caldwell. Experimental lamb feeding was started at the Caldwell Substation in the fall of 1910, and again in 1912. An experimental feeding plant was built at Caldwell in 1919 when steer fattening experiments

were started. The first ration used for fattening steers was alfalfa hay alone, which was the practice in southern Idaho in fattening mature steers at that time. Extensive experiments have been conducted on the preparation of alfalfa hay fed alone and in combination with other feeds, such as grains and corn silage. The chopping of alfalfa proved to be practical and economical and is generally used in southwestern Idaho. Chopping alfalfa hay for fattening steers increased the daily consumption, the rate of gain, decreased the feed requirements, and made the feeding of alfalfa more convenient. The feeding at the Caldwell Substation has showed the advantage of feeding grain and other supplements with alfalfa.

Experimental work has shown the advantages and disadvantages of feeding steers of different ages, i.e., two-year-olds, yearlings, and calves. The standard ration for fattening steers in Idaho is alfalfa and barley

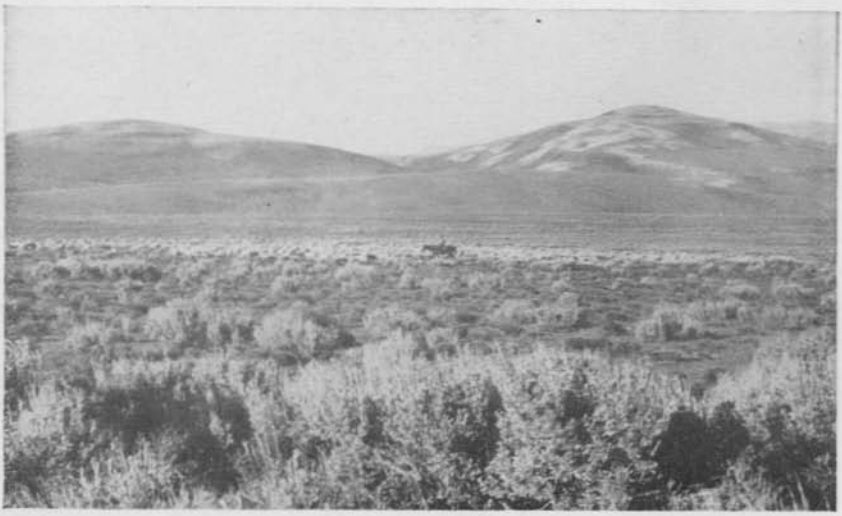


Fig. 8.—Sheep on the trail, Lemhi National Forest, Lemhi Valley, between Dubois and Salmon.

along with some succulent feed, either wet beet pulp or corn silage. When no succulent feed is available, it is a common practice to add some supplement to the barley such as oats, bran, cottonseed cake, etc.

The lamb feeding was revived at the Caldwell Substation in 1920 and was carried on at the Aberdeen Substation between 1924 and 1935. Although alfalfa is the basis for fattening lambs, some grain is required. The Substation first demonstrated that lambs fattened on alfalfa and barley were good enough to top the market at Chicago and Omaha. The standard ration for fattening lambs in Idaho is alfalfa and barley. Much work has been done in the utilization of various by-products for fattening both lambs and steers. Such by-products as alfalfa seed screenings, cull beans, cull peas, cull potatoes, and wet beet pulp have been used successfully. A flock of ewes has been maintained at the Aberdeen Substation for

a number of years to study ways of wintering ewes and the production of spring lambs. The flock was increased in 1935 to intensify the study of early lamb production.

Active projects in animal husbandry consist of studies of Idaho-grown feeds, including various by-products, for fattening steers and lambs for market; the influence of phosphorus in rations for fattening steers and lambs; composition of range forage plants as related to animal nutrition on the range; phosphorus requirements of sheep; protein value of field peas; wintering of ewes and the production of early lambs; experiments to increase the value of sweet clover pasture; experiments with various feed rations for growing and fattening swine; animal breeding studies having to do with variations and abnormalities affecting sheep and swine; artificial insemination in ewes with transported semen; and animal disease investigations—mastitis, paratyphoid in turkeys, foul sheath, *Oestrus ovus*, and fowl paralysis. Further discussion of animal diseases will be found under divisions concerned, i.e., Bacteriology, Dairy Husbandry, and Poultry Husbandry. The major portion of investigations of rations for fattening steers and lambs is carried on at the Caldwell Substation. Further discussion of lamb and steer feeding will be found in the section of this report devoted to the Caldwell Substation, and further discussion on wintering ewes and the production of early lambs will be found in the section of this report devoted to the Aberdeen Substation.

### The Influence of Phosphorus in Rations for Fattening Calves Studied

Five lots of steer calves, averaging about 450 pounds, with eight steers to a lot, were fed rations comparable as to protein, total digestible nutrients, vitamins, and calcium—the only significant variable being the level and source of phosphorus. The low phosphorus basal ration (.12 per cent phosphorus) was composed of dried beet pulp, 68.2 per cent; chopped alfalfa, 26 per cent; bloodmeal, 5.0 per cent; and limestone, .8 per cent. This mixture was fed ad libitum. Corn silage was fed to all lots at the rate of about 10 pounds per head daily. This is not a normal ration in Idaho but was used to learn the influence of varying amount of phosphorus. A phosphorus deficiency was produced by feeding a ration containing .12 per cent phosphorus with an average daily intake of 8.23 grams phosphorus per steer. The inorganic phosphorus level dropped from 6.71 milligrams to 4.40 milligrams per 100 cc. of plasma. The addition of .66 per cent bonemeal to the calves fed a basal ration low in phosphorus has increased the gains, decreased the feed requirements per pound of gain, and maintained a normal blood phosphorus. Bonemeal supplemented at one per cent level proved to be excessive, resulting in depression of the gains in comparison to the calves receiving .66 per cent bonemeal. These data indicate that a daily intake of 12.96 grams of phosphorus is sufficient for fattening calves. Cottonseed meal was not so effective a source of phosphorus as bonemeal when fed at the same phosphorus level. On the basis of this experiment, the phosphorus requirements of beef calves are about 2.2 grams of phosphorus daily per 100 pounds of live weight.

## The Influence of Phosphorus in Rations for Fattening Lambs Tested

Six lots of feeder lambs (65 pounds), with 25 lambs per lot, were fed for a period of 133 days on rations varying in source and level of phosphorus. The low phosphorus basal ration consisted of a mixture of dried beet pulp, 44.2 per cent; chopped alfalfa, 50 per cent; bloodmeal, 5.0 per cent; and limestone, .8 per cent. This mixture was fed ad libitum. Corn silage was fed at the rate of one pound per head daily in all lots. This is not a normal ration in Idaho but was used to learn the influence of varying amounts of phosphorus. All rations were approximately equal in protein, total digestible nutrients, vitamins, and calcium—the only variable being the level and source of phosphorus.

The addition of .7 per cent bonemeal to a ration containing .124 or .164 per cent phosphorus caused an increase in the average daily gain from .22 to .27 pound and reduced the feed requirements per 100 pounds gain by 23 per cent. These data indicate that the daily phosphorus requirement of lambs ranges between 2.00 and 2.79 grams, and that rations containing less than .23 per cent phosphorus are not optimum for the most rapid and efficient gains. An organic source of phosphorus as present in cottonseed meal was not as available to lambs as the inorganic phosphorus in bonemeal. There was no appreciable change in the blood inorganic phosphorus of the lambs fed on rations containing .124, .164, .185, and .230 per cent phosphorus. Lambs receiving .102 per cent phosphorus in the ration on a daily intake of 1.21 grams showed a decrease from 5.00 milligrams to 3.87 milligrams per 100 cc. of plasma. The above ration contained only 26 per cent alfalfa.

## Study of the Phosphorus Requirements for Growing and Fattening Lambs Continued

Twenty-four lambs were fed individually, in stanchion, on a phosphorus-deficient basal ration of dried beet pulp, 73 per cent; cane molasses, 10 per cent; alfalfa, 10 per cent; and bloodmeal, 7 per cent. Phosphorus was fed at five different levels in the form of di-sodium phosphate. Growth was retarded, and the blood phosphorus lowered to an abnormal level (2-3 mg./100 cc. plasma). When the lambs received from 1.0 to 1.5 grams of phosphorus daily per head, phosphorus deficiency was manifested by the eating of wood shavings, fence posts, feed boxes, and especially wool, and the lambs were emaciated, thin, and listless in appearance. Lambs ingesting 2.0 to 2.5 grams of phosphorus daily satisfied their daily phosphorus requirements as indicated by normal blood phosphorus, average gains, and healthy appearance. In general, these data corroborate the results obtained under commercial feed lot conditions, in that a fattening and growing lamb requires about 2.5 to 3.5 grams of phosphorus daily per 100 pounds of live weight.

## Composition of Range Forage Plants Investigated

Five hundred thirty species samples of range forage plants, including 30 major species grazed by sheep and cattle, have been collected from the ranges of Idaho. Plants were collected on the Boise, Minidoka, Cache,

Caribou, Targhee, and Sawtooth National Forests; the Fort Hall Indian Reservation; and several private and public ranges throughout Idaho. The plants were collected at two stages of maturity—the first in June when most of the plants were in the vegetative or bud stage; the second series during the latter part of August after the plants had matured. This project is designed to give a more accurate approach as to whether mineral supplements are needed by sheep and cattle under range conditions. Soil samples have been collected from the same areas. A summary of the composition of the plants collected in 1936 shows that the protein and phosphorus were higher and calcium, carbohydrates, and fats were lower in the early collection. The calcium phosphorus ratio is higher in the latter part of the grazing season.

### Animal Breeding Investigations Continued

A considerable number of problems in the inheritance of defects in farm livestock have been studied. In the study of inheritance in our farm animals it often is difficult to undertake involved genetic problems because adequate facilities are not available in the form of animals and equipment. The studies have been limited in general, therefore, to the more simple problems.

A number of defects that are harmful to the structure and functions of the animal body have been found in all classes of farm livestock. In general, these defects do not appear unless an animal is rather closely inbred. They are usually a source of trouble to the breeder who is attempting to concentrate the breeding in his herd or flock within desirable lines. It, therefore, is desirable to determine what the inherent defects are and to learn what their inheritance is so they can be eliminated.

A number of skeleton defects in swine and sheep have been studied. Some of these are so basic in their influence upon body functions that they render the animal useless. Among these are different types of skull defects that involve the brain inclosure and also the jaws. Other defects involve the muscles, skin, and softer tissues of the body, and vary somewhat in their destructive nature. Among these are the absence of functional nipples in swine and definitely circumscribed skinless spots in newborn pigs. Skin tumors are also among these inherited defects. Defective color markings in Duroc Jersey swine have been described.

Unbalanced rations and indifferent management have been found destructive to fertility in boars.

As preliminary steps in wool studies, a wool caliper and a dessicating apparatus for wool have been developed. A caliper, also, has been developed for measuring the inequalities in the length of jaws in sheep.

### Transmission of Fowl Paralysis (Lymphomatosis) Studied Cooperatively

Study of fowl paralysis in cooperation with the Department of Poultry Husbandry during the last four years, with over 2,500 birds, has given definite information on inherited resistance, superiority of hen progeny over pullet progeny, transmission by contact, ineffective use of confined

rearing, and age resistance in this disease. All of these points, except the last, are discussed in previous annual reports. During the past year it was found that day-old chicks were highly susceptible, with a mortality incident from paralysis of 41.8 as compared to 4 per cent mortality for pullets placed with affected stock at six weeks of age. More detailed information on this study is to be found in the report of the Poultry Husbandry Department.

### Artificial Insemination in Ewes with Transported Semen

In cooperation with the United States Bureau of Animal Industry, the 1936 Annual Report from this Station told of the successful insemination of three Lincoln ewes with semen obtained from the U.S. Sheep Experiment Station at Dubois, Idaho, through the cooperation of Dr. C. E. Terrill. These ewes subsequently produced a set of twins and two singles, all strong, healthy lambs.

During the fall of 1937, 24 Southdown ewes and 31 Hampshire ewes were inseminated with semen shipped by air mail and railway express from rams at the U.S. Department of Agriculture Experimental Farms at Beltsville, Maryland, of which two Southdown and three Hampshire ewes have apparently conceived, since they did not have further oestral periods. Considerable information has been accumulated on the proper method of packing semen for transportation.

### Sulphanilamide Tested in Treatment of Streptococcic Mastitis

In cooperation with the Departments of Bacteriology and Dairy Husbandry, it has been established that sulphanilamide can be detected in the blood, urine, and milk in appreciable quantities one hour after an initial dose. It has been found that the interval between doses can be as great as 8 or 12 hours without a drop in the blood concentration of the drug in dairy cows. After 12 hours following the final dose, the concentration of the drug in the blood, urine, and milk rapidly becomes lower until, between 24 and 48 hours, it is completely eliminated. Milking cows can tolerate as much as one gram sulphanilamide per 10 pounds of body weight daily over a seven-day period. Further data will be necessary before the effect of this drug on the course of streptococcic mastitis can be ascertained.

## Bacteriology

W. V. HALVERSEN *in charge*

### Research in Bacteriology Begun in 1908

THE lines of bacteriological work under investigation since the work started in 1908 have dealt directly or indirectly with soils, dairying, fruit preservation, and livestock diseases. In 1910 research in soil bacteriology was inaugurated under an Adams fund project entitled "Bacteriological Studies of North Idaho Soils." This project was based on the knowledge that soil fertility results directly from the mineralization of organic matter and the fixation of atmospheric nitrogen, and indirectly through the bringing of minerals into solution through the solvent action

of organic acids produced during the decay process. The factors influencing these organic transformations were given first attention. Some of the objectives of this project were: "(1) the determination of influences which operate under the biological agents that may be concerned in the production of available soil nitrogen; (2) the determination of the extent to which bacteriological deficiencies may account for low fertility in certain soil types and for differences between types and productive capacity; (3) the determination of practical methods of shifting the bacteriological equilibrium in the direction desired and of increasing the physiological efficiency of beneficial groups." These studies were soon extended to study the cause of the lack of fertility in recently logged-off forest soils. During the course of these investigations various woods, in the form of sawdust, were added to soil to determine their influence on biological activities. These woods, up to 5 per cent, were all found to reduce bacterial activity. One per cent of calcium carbonate overcame this detrimental effect.

In 1917 an Adams fund project on legumes, entitled "The Relation of Nitrates to Nodule Formation," was developed. It was discovered that the presence of nitrates prevented the normal formation of nodules on alfalfa and clover when grown in soft agar and solution cultures of the respective nodule bacteria. It was soon discovered that there were at least two factors to consider: (1) that in higher concentrations of nitrates the root nodule bacteria actually lost their infecting power; and (2) that nitrates caused the roots of plants to become more resistant to the attacks of the bacteria.

In 1920 research was resumed to learn the reason why timbered or cut-over soils which showed no marked deficiency from the chemical analyses failed to produce satisfactorily until cultivated for several years. Here, again, the toxic effects of forest tree products, needles, bark, sawdust, and also ferns, were shown to depress ammonification, nitrification, and non-symbiotic nitrogen fixation in these soils.

Animal disease work was inaugurated in 1920. Tuberculosis in poultry was found to be so prevalent that of 2,673 birds tested by the intradermal or wattle test during one month, 24 per cent gave positive reactions. The infection was confined to old birds, and in no case did the infection appear among young pullets running on the range.

Other bacteriological studies inaugurated as time went on were "Effect of Alkali Salts on Bacteriological Activities in Soil", "The Isolation and Study of Nitrifying Bacteria", "Surface Tension and Bacterial Growth", "Studies in Udder Infections", "Sterility in the Bovine Male", "Study of Scours in Dairy Calves", "Bacillary White Diarrhea", "Study of the Blood as an Index of the Health and Body Functions of the Laying Hen", "Survey of the Prevalence of Infectious Abortion and its Economic Importance", "Immunization Experiments Against Fowl Pox", "Availability of Plant Nutrients and the Response to Fertilizers of Idaho Soils", "A Study of the Cause and Methods of Control of Foul Sheath or Sheath Necrosis in Bucks", "Thermal Death Time Determinations for Spores of *Clostridium botulinum* at Temperatures Corresponding to the Boiling Point of Water at Elevations Commonly Found in Idaho and in the Steam Pressure

Cooker", "Paratyphoid in Turkeys", "Thermophilic Spoilage Bacteria in Sugar," and numerous other meritorious investigations. One of the remarkable things about these studies is the fine spirit of cooperation which always has existed between the various departments cooperating in these investigations. The Departments of Animal Husbandry, Poultry Husbandry, Dairy Husbandry, Agricultural Chemistry, and Bacteriology have worked in such unity that no departmental lines were in evidence.

L. F. Parsons was Bacteriologist of the Agricultural Experiment Station from 1908 until 1910. He was followed by J. F. Nicholson, 1910 to 1914; J. J. Putnam, 1914 to 1916; Paul Emerson, 1919; Wm. M. Gibbs, 1919 to 1926; G. L. A. Ruehle, 1926 to 1929; and W. V. Halversen from 1929 until the present time.

During the year 1937 the bacteriologists have concentrated their efforts with cooperators from other departments in the study of two main projects: (1) pullorum disease studies, and (2) studies on bovine mastitis. The effectiveness of the work was impaired due to the resignation of Dr. Roger D. Reid, who left to accept a position on the teaching staff of Johns Hopkins University.

## Control of Pullorum Disease Studied

A rapid whole blood (stained antigen) method of testing poultry for pullorum disease has been adopted extensively with the endorsement of the Bureau of Animal Husbandry, U.S. Department of Agriculture. This method is rapid and so simple to perform that poultry breeders very generally have conducted this work themselves. Serologists seriously objected to the adoption of this method because there was doubt concerning its accuracy even in the hands of skilled technicians. When this test was performed by the poultry breeder himself, there was doubt not only concerning the ethics of permitting the poultryman to make his own tests, but also concerning the accuracy of this test in the hands of an untrained technician. Because of the lack of trained technicians, it is very desirable to conduct a short-course school for the training of technicians, who could make tests in the field of sufficient accuracy to detect a high enough percentage of reacting birds so that the flock could legitimately be certified or accredited.

Large numbers of samples of poultry blood have been tested by the rapid whole blood (stained antigen), the serum plate, and the tube agglutination methods. These results indicate that the rapid whole blood method may, under proper conditions, be relied upon to detect most, if not all, of the carriers of *Salmonella pullorum* and be valuable in a control program. Schools have been conducted for the training of technicians who have been authorized to make rapid whole blood tests in the field. It is hoped that during the year blood tests on birds from representative flocks under supervision of the various authorized technicians will be tested in the laboratory to determine the efficiency of this method of control.

The testing of immature chicks in an attempt to eradicate pullorum disease before they reach maturity was continued during the year. Five hundred twenty chicks from a pullorum-free flock were inoculated in the conjunctiva with virulent cultures of *Salmonella pullorum* at one, five, and

twelve days of age. The mortality among the artificially infected chicks was approximately 30 per cent during the first three weeks of life. It was possible to recover the causative organism from the heart, blood, liver, and yolk sac in 90 per cent of the chicks which died during this period. Characteristic lesions were frequently observed; most commonly, the yolk sac was found to be unabsorbed, and the liver showed reddish-yellow areas.

Agglutination tests were performed on the blood of these chicks by the rapid whole blood method (Schaffer, McDonald, Hall, and Bunyea), and the macroscopic tube agglutination method at intervals of two weeks, beginning when the chicks were one month old. Reactors to the whole blood test were found on the first test. At six weeks of age, 38 per cent of the surviving chicks were found to react by one or both methods. Three per cent greater number reactors were found by the macroscopic tube method than by the rapid whole blood method. Reactors were autopsied and *Salmonella pullorum* was isolated from 14 per cent. No further reactors were found after the fourteenth week of the experiment. It was, therefore, concluded that reactors can be detected before the birds reach the production age.

The possibility of infected game birds released from game farms serving as a source of infection to domestic poultry flocks has also been studied. Through the cooperation of the Idaho Bureau of Animal Industry and the State Game Department, 2,000 game birds, mostly ring-necked pheasants, on the Lapwai and Jerome Game Farms were tested for pullorum disease by the rapid serum and tube agglutination methods. These birds were found to be free of pullorum infection.

### Sulfanilamide Tested for Control of Bovine Mastitis

In cooperation with the Departments of Dairy Husbandry and Animal Husbandry, continued studies have been made on the control of bovine mastitis. Previous studies reported have dealt with the treatment of cows with ultra-violet light, formalin, colloidal carbon, autogenous bacterins, and various germicidal dyes introduced intravenously and also into the udder. None of these methods has been entirely effective. During the present year seven cows have been treated with sulfanilamide (para-amino-benzene-sulfonamide) administered orally. Observations have been made concerning the effect of various rates of treatment upon the amount of the drug present in the blood, urine, and milk, and also concerning the effect of this medication upon the clinical symptoms of mastitis, as well as the numbers of leucocytes and the presence of streptococci in milk.

Sulfanilamide, which has been reported favorably for the control of acute streptococcic infections in man, was found to be tolerated by cows in doses twice the amount recommended for treating human beings—that is, one gram of sulfanilamide for each 10 pounds of body weight. In administering the drug to cows, the treatment was continued for six to seven days. Two doses daily were found adequate to maintain a high blood level. This is probably due to the rumen of the animal which presumably acts as a reservoir and supplies the material over a period of

several hours. Immediately after the drug appeared in the milk flow the streptococci disappeared, the leucocyte count remained approximately the same, and the appearance of the milk improved in cases where the udder was swollen and the milk had been abnormal. The drug is eliminated in both urine and milk. The greatest concentration of unconjugated sulfanilamide recorded was 8 milligrams per 100 cc. of blood, 8.5 milligrams per 100 cc. of milk, and 340 milligrams per 100 cc. of urine. At this time crystals of sulfanilamide were clearly visible in the urine. None of the cases treated were new infections; several were very severe, the udders being swollen and the milk abnormal in appearance. However, it is significant that within three or four days after sulfanilamide had disappeared from the milk the streptococci would reappear, thus indicating that the infection had not been eliminated.

## Etiology of Mastitis Studied

It is usually accepted that bovine mastitis is an infectious disease of the udder in which approximately 90 per cent of the cases are caused by *Streptococcus mastitidis* (*agalactiae*), the other cases having a wide variety of causal organisms. However, it has been suggested that mastitis, like hog cholera, common colds, etc., may have certain organisms present always, but that actually the etiological agent may be a filterable virus.

In order to determine whether a virus might be associated with bovine mastitis, milk samples were obtained from animals known to have the disease. The milk was coagulated with rennet, and the whey separated from the curd. This milk serum was then filtered through a Berkfeld filter and recovered in a sterile test tube. Two cc. of this material were injected aseptically into the teat canal of a cow known to be free from mastitis. As a control, 2 cc. of sterile saline were injected into another quarter of the same animal. Mild physiological forms of mastitis occurred in each of the two quarters. After a few days, however, both quarters returned to normal. Milk serum filtrate from three different cases of mastitis failed to produce a typical lasting case of the disease.

## Inoculum for 2,452 Acres of Legumes Prepared

Cultures of root nodule bacteria sufficient for the artificial inoculation of 2,452 acres of legumes have been manufactured and distributed during the year 1937. Approximately two-thirds of these cultures were for peas and approximately one-third for alfalfa and sweet clover. The practice of legume inoculation appears to be a permanent practice, as evidenced by the fact that there has been a continued demand for cultures for years since it was first inaugurated.

The root nodule bacteria cultures prepared for distribution are made by growing carefully selected strains on agar medium, similar to those used extensively throughout the country. Farmers frequently request black cultures or dry cultures. This preference is very likely due to an effective sales campaign by certain agencies which have this type of culture for sale. In an attempt to meet the demand for this type of culture, a new culture will be tried out this year on an experimental basis which we believe

possesses all the advantages of the pure culture now used and the black color which is frequently requested.

It is a common observation that some fields that formerly produced satisfactory yields of alfalfa now produce poor yields despite tillage or fertilizer treatment employed. Several foreign publications have reported results which indicate that degenerated or undesirable root nodule bacteria present in the soil may be at least partly responsible for the poor yield of alfalfa in these old fields. Preliminary studies are in progress at this time which should indicate if an analogous condition exists in Idaho. Under such a condition a more extensive use of cultures of root nodule bacteria would be warranted to replace the undesirable bacteria present.

## Dairy Husbandry

D. R. THEOPHILUS *in charge*

### Research Program in Dairy Husbandry Equally Divided Between Production and Manufacturing

RESEARCH work in the field of dairying, either along production or manufacturing lines, was inaugurated with the establishment of the Department of Dairy Husbandry and the employment of a Dairyman in September, 1907. Experimental work was undertaken immediately to determine the economy of butterfat production with various rations available in Idaho. Other projects started within the next few years were: a study of Idaho butter, a study of cottage cheese, and the use of milking machines. The first publication from the department was issued in June, 1908, and to date publications consist of 20 Experiment Station bulletins, 1 Experiment Station research bulletin, 6 Experiment Station circulars, and 21 research papers.

During the entire life of the department the research program has been rather evenly divided between the production and manufacturing phases of dairying. Some of the important production problems studied, the results of which have been published, are: utilization of by-products such as apple pomace, pea meal, potatoes, and alfalfa seed screenings as a feed for dairy cows; artificial insemination of dairy cattle; organization and operation of bull associations; use of proved bulls; factors influencing the solids-not-fat content of milk; inheritance of hernia and wrytail; control of mastitis and methods of diagnosis; vitamin A content of pasture plants; water requirements of dairy cattle; and management of pastures. The research in manufacturing has resulted in published work on: standardization of milk for the manufacture of casein; efficiency of cream stations; sterilizing dairy utensils; distribution and cost of steam, electrical power, and labor in creameries; influence of starters on the quality of cheddar cheese; influence of homogenization on the curd tension of milk; and tests for casein.

The project of longest standing and the one on which more time and effort have been expended is the continuous use of proved bulls. This project has been carried on practically exclusively with the Holstein-Friesian herd, although the Jersey herd has been included during the past

few years. The Holstein herd was started in 1911 with five females, and in 1921, when the herd contained fourteen cows, the program of using tried sires or sires with tested daughters available for inspection was adopted. This plan has been followed as closely as practical since its adoption in an effort to purify the inheritance for high production and acceptable type.

Daughters of nine bulls have completed records so that dam-daughter comparisons are possible. All comparisons have been made on the basis of first lactation records without selection, three-time-a-day milking, and adjusted to mature basis. Eight of the nine bulls increased production when records of daughters and their dams are compared. Progress in herd improvement is very clearly shown by the average production of successive generations from the original 14 producing cows in the Holstein herd when the project was inaugurated. The original cows averaged 17,787 pounds of milk and 541 pounds of butterfat, while the present herd of 24 tested progeny averaged 22,472 pounds of milk and 734 pounds of butterfat. The increase in butterfat by generations, through five successive generations, was 71, 31, 40, 15, and 34 pounds, respectively, or a total increase of 191 pounds of butterfat in five generations. Five cows have been in the herd which have produced more than 30,000 pounds of milk in a year, and, according to the latest available information, the herd ranks second among all Holstein herds in the United States in breeding and developing 30,000-pound milk cows.

Type has not been sacrificed or neglected, for the herd has been officially classified by the Holstein-Friesian Association of America three times and never has had a single individual rated either "Fair" or "Poor." The last classification showed an average of slightly higher than "Good Plus." The only three-generation group of "Excellent" cows of the Holstein breed, as well as one "All-American" three-year-old cow and one "Reserve All-American" two-year-old cow were bred and developed in the herd.

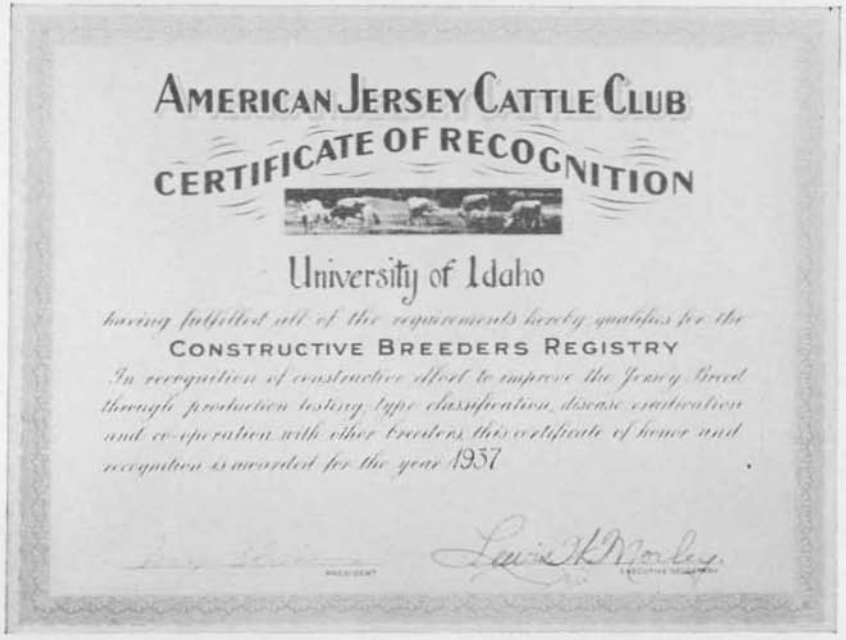
The Jersey herd has been included in the project in recent years and is making satisfactory progress, as indicated by recently being the recipient of the Constructive Breeder's Certificate from the American Jersey Cattle Club. Only one other college herd has received this honor, and it is the second award made in the Pacific Northwest. The Constructive Breeder's Certificate is awarded on the basis of production, type, number of animals bred by the owner, cooperation with breeders, and the observance of a satisfactory disease control program. The herd has to its credit 12 silver medal and one gold medal awards. The Silver Medal bull and the Gold Medal cow are the only animals in the State with this high distinction. The average score of the last official classification for type was just under "Very Good," which is much higher than the average of all Jersey herds which have been classified to date.

During 1937 the average herd production, including dry cows, was 464.5 pounds of butterfat. The Jersey herd of 22.4 cows produced an average of 384.5 pounds of butterfat, and the Holstein herd of 24.3 cows produced an average of 540 pounds of butterfat.

From the progress and high ranking of its Holstein-Friesian and Jersey herds for both production and type and the very favorable reception given its publications, it appears that the research program of the Department of Dairy Husbandry has made excellent progress in fulfilling its primary objective of serving the dairy industry of Idaho.

**Satisfactory Procedure Developed for the Artificial Insemination of Dairy Cattle**

Artificial insemination of dairy cattle with semen collected with the Cambridge rubber sperm collector resulted in 62.5 per cent pregnancies in a limited number of trials. Approximately 0.5 cc. of undiluted semen


AMERICAN JERSEY CATTLE CLUB

CERTIFICATE OF RECOGNITION

University of Idaho

having fulfilled all of the requirements hereby qualifies for the

CONSTRUCTIVE BREEDERS REGISTRY

In recognition of constructive effort to improve the Jersey Breed through production testing, type classification, disease eradication and co-operation with other breeders, this certificate of honor and recognition is awarded for the year 1937

Fig. 9.—Second certificate awarded to any experiment station herd in the United States and second to a herd in the Pacific Northwest.

was used for insemination. Insemination was simplified by the use of a glass speculum about 18 inches long and 1.5 inches in diameter instead of the standard cow speculum. A pencil flashlight was clamped inside the glass tube at the outer end, directing the light into the vagina and making the cervix visible. A standard 1 cc. pipette connected to a glass tube about 18 inches long with a rubber adapter was used to deliver the 0.5 cc. of undiluted semen into the cervix. Unsatisfactory results were obtained when using semen collected from the cow after service. All insemination took place within two hours after the semen was collected, although motility was observed in semen collected by means of the Cambridge rubber sperm collector after 11 days when semen samples were kept under refrigeration at a temperature of 35° F. Further work is being conducted in cooperation with the Department of Animal Husbandry.

## Preliminary Results Indicate that Sulfanilamide Does not Cure Mastitis

Administration of sulfanilamide to cows having chronic and acute streptococcic mastitis, with cases being of both long-time nature and of short duration, produced some very outstanding changes in the bacterial flora of the milk. With a limited number of cows, successful attempts were made to administer a sufficient amount of sulfanilamide so that at least a 6 milligram level of sulfanilamide per 100 cc. of blood was secured. Period of treatment varied from seven to 10 days. A fairly constant concentration of sulfanilamide in the blood stream was maintained when the interval between doses was eight to 12 hours. With milking cows, 1 gram of sulfanilamide per 10 pounds live weight was administered without toxic symptoms but with a slight decrease in milk flow. This dosage was on a basis of two times the amount recommended for human beings. When 1.5 grams per 100 cc. were administered, toxic symptoms were produced in one to three days, and a marked reduction in milk flow resulted. Within a period of one to three days after starting treatment, streptococci could not be found in the milk of some cows, and in the other cows the streptococci were present in greatly reduced numbers.

As long as the treatment continued, the milk from some cows continued to be free of streptococci, and in the milk from the other cows there were very few streptococci observed in samples examined after incubation. Within three days after discontinuing the treatment, however, streptococci were observed in the milk in all cases to date. Milk flow rapidly returned to normal after treatments were discontinued. Observation indicates that although the use of sulfanilamide does not destroy the streptococci it minimizes the physical symptoms of mastitis insofar as congestion and inflammation of the udder are concerned. Further work on the use of sulfanilamide is being carried on in cooperation with the Departments of Animal Husbandry and Bacteriology.

## Spread of Mastitis in Dairy Cows Can Be Reduced But Not Eliminated by Segregation

In January, 1937, nine cows, mostly first lactation heifers producing milk in which streptococci in incubated samples were not observed, were segregated from the remainder of the herd and kept segregated, but were milked in the same barn previous to the cows known to shed streptococci.

During the year 18 heifers freshened and were added to the segregated group after tests indicated that they were not shedding the organism in the milk. Tests indicated two heifers shed the organism when first fresh. These were never placed in the segregated group. Four other heifers were found to be shedding the organisms in milk after being in the segregated group one month, four months, six months, and ten months.

## Vitamin E Requirements of Males Apparently Higher than for Females

During the course of a study on the vitamin E content of pea germ meal, in which it was found that pea germ meal contains one-fourth as

much vitamin E as wheat germ meal, considerable data were collected which show rather conclusively that male rats require more vitamin E than female rats. Further work on the problem is contingent on the development of a technique to determine with accuracy the different stages of sterility in male rats. This study is in cooperation with the Department of Home Economics.

### Studies Made of Plant Practices and Policies Influencing the Quality of Milk

A summary of two summers' work on conditions influencing the quality of milk supplied 23 cheese and whole milk plants in eastern and southeastern Idaho very strikingly established the influence of some plant practices and policies on the quality of milk delivered, as judged by the methylene blue reduction test. Some conditions which were found to be conducive to a low quality milk supply were: competition for the milk supply, washing cans by milk route drivers, return of skim milk or whey in milk cans to the producer, low prices of finished products manufactured, methods of collection, and lack of a proper grading system. Sediment tests run in conjunction with the methylene blue reduction test showed no direct relationship between the two tests.

### Sole Alfalfa Hay Ration Influences Reichert-Meissl and Iodine Values of the Milk Fat of Holstein-Friesian and Jersey Breeds

Results of a study of two Holstein-Friesian and two Jersey cows receiving alternately rations consisting of only alfalfa hay and alfalfa hay, corn silage, and a grain mixture, show that a sole alfalfa hay diet definitely decreases the Reichert-Meissl value of the milk fat secreted by Holstein-Friesian and Jersey cows; that there is a definite tendency for the Reichert-Meissl value of the milk secreted by Holstein-Friesian cows to be higher than that secreted by Jersey cows; and that an alfalfa hay diet definitely increases the iodine value of the milk fat secreted by the Holstein-Friesian and Jersey cows. There is little difference in the iodine values of the milk fat secreted by the Holstein-Friesian and Jersey cows when on a sole alfalfa hay diet, but when on full feed the iodine value of the Holstein-Friesian milk fat is higher than that of the Jersey milk fat. Temperatures as low as -30° F. and as high as 60° F., and rapid changes in temperature between these two extremes, did not appear to influence the Reichert-Meissl or iodine values of milk fat of the representatives of either the Holstein-Friesian or Jersey breeds.

### Vitamin A Value of Idaho Butter Produced in the Irrigated Areas is High

Preliminary work on the vitamin A value (potency due to both carotene and vitamin A) of Idaho butter indicates that butter from the irrigated areas of Idaho has a much higher vitamin A value (approximately twice) than the average butter produced in the United States. Analyses were made biologically. Further work is being conducted in cooperation with the Departments of Home Economics and Agricultural Chemistry, using both spectrometrical and biological methods of analysis.

## Sticky Butter May Be Controlled

Work on modifications of the manufacturing procedure which might control the frequency of sticky butter indicates that under late fall and winter conditions the use of a cold wash water ranging around 40° F. results in butter which, when cut into prints, is not ragged, crumbly, or sticky, and has very good spreadability. Although the use of low temperature wash water will not absolutely prevent the occurrence of sticky butter, it does aid very materially in minimizing the frequency of its occurrence.

## Official Testing Service Work Increases

Two thousand three hundred two cows from 19 different herds were tested officially for production during the past year. The supervisors spent a total of 253.5 days conducting the tests.

The calibration laboratory received 6,000 pieces of glassware to be checked for accuracy and etched SGI (Standard Glassware of Idaho). Only 0.13 per cent of the glassware was found to be inaccurate.

During the past year 139 analyses of dairy products were made. The tests were divided as follows: 117 samples of milk for fat, sediment, bacterial content, and flavor and odor; six samples of milk for fat only; four samples of cream for fat; seven samples of skim milk for fat; three samples of ice cream for fat, total solids and bacterial content; and six samples of butter for moisture, fat, salt, and curd.

# Entomology

CLAUDE WAKELAND, *in charge*

## Insect Control Begun Early in History of Experiment Station

THE first entomologist employed by the Agricultural Experiment Station was J. M. Aldrich, who served from 1893 until 1905. His work was with insecticides, grasshoppers, the boxelder bug, Putnam's scale, San Jose scale, the codling moth, the elm louse, the pear leaf blister mite, and the apple aphid. He became recognized as an authority on the Diptera, but most of his collection was destroyed when the Administration Building burned in 1906. L. F. Henderson, who was Botanist and Plant Pathologist from 1893 to 1909, also served as Economic Entomologist from 1905 until 1908. He published on lime-sulphur sprays, insecticides, and codling moth.

Fig. 10.—J. M. Aldrich, Entomologist of the Agricultural Experiment Station from 1893 until 1905.

No work on entomology was reported between 1908 and 1913, when C. C. Vincent, Horticulturist, published on spray materials for the codling moth and on oyster-shell scale. A. C. Burrill was Entomologist from 1916 until 1918; R. H. Smith from 1918 to 1920, and Associate Entomologist from that date until 1922. He published on the clover aphid, the important orchard insects, the root maggot of radishes, spider mites affecting orchard and garden crops, aphids attacking stone fruits, and the eelworm disease of red clover. J. E. Wodsadalek was Zoologist and Entomologist from 1920 to 1922. Claude Wakeland has been Entomologist since 1922.

Members of the staff of the Department of Entomology have published since 1922 on the alfalfa weevil, the fruit tree leaf roller, false wireworms, the snowy tree cricket, control of household insects, the fire brat, the codling moth, the pea weevil, the Mormon cricket, and controls for numerous garden, ornamental, and fruit crop insects. Investigations have also been reported on the beet leafhopper, the Colorado potato beetle, the leafhoppers of Idaho, *Mineola scitulella,* the elm leaf beetle, grasshopper control, the cattle louse, Lygus species affecting beans and alfalfa, and physiological studies of insect blood.

## Cooperative Tests of Sprays for Control of Beet Leafhopper Continued in 1937

Beet and bean growers and sugar processors were interested in results obtained under the special appropriation by the 1935 session of the State Legislature. Approximately $40,000 of this appropriation was unexpended at the end of the biennium, and the growers secured an appropriation of $20,000 in the 1937 session for continuing investigations on the control of the beet leafhopper and the development of crops resistant to the curly top disease. At the direction of the Governor, investigations were made cooperatively by the Departments of Entomology and Plant Pathology of the Idaho Agricultural Experiment Station and the U.S. Department of Agriculture. Experiments were conducted in the laboratory during the autumn of 1936 and the winter and spring of 1937, and in field plots during the spring and summer of 1937.

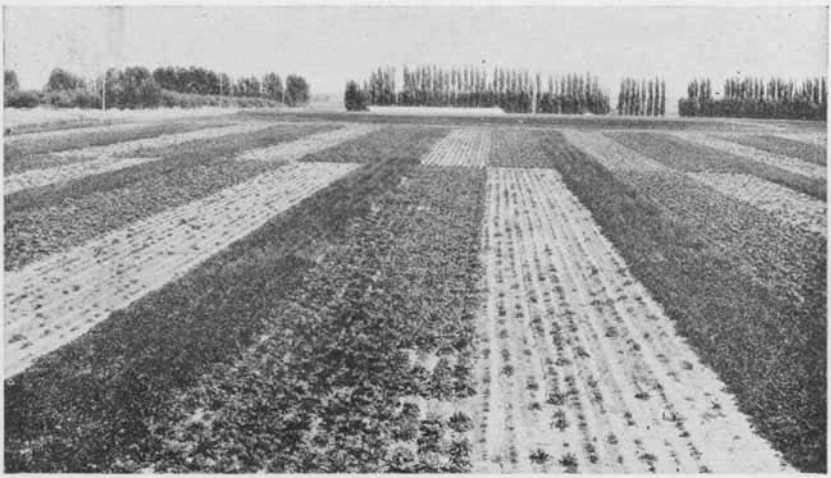


Fig. 11.—Field near Buhl, Idaho, where various insecticides were tested for the control of the sugar beet leafhopper.

High percentages of kills in the laboratory were obtained with Lethane-water-Aresket spray, atomized oil-kerosene and free nicotine, and with pyrethrum sprays and atomized oil-kerosene-pyrethrum, the degree of kill increasing, in general, as the percentage of pyrethrum was increased. Other materials tested were: atomized laurel rotenate in kerosene, nicotine sulphate sprays, derris sprays, derris extracts in sprays, atomized kerosene-oil-free nicotine, lime-sulphur sprays, naphthalene-carbon disulphide emulsion sprays, nicotine tannate spray, pyrethrum sprays, wettable sulphur and pyrethrum spray, nicotine peat spray, and several wetting and spreading agents. Experiments were replicated several times. The highest average efficiency with any material was 97.99 per cent and the lowest was 12.24 per cent.

Field-plot experiments were conducted on 13 acres of land rented near Buhl, Idaho. Plots were planted to a curly top-resistant strain and old German type beet seed. Insecticides tested in the field were: atomized kerosene-oil-free nicotine, derris-water-Aresket spray, atomized oil-kerosene-pyrethrum, and nicotine sulphate-oil emulsion-water spray. Migration of leafhoppers into the plots and movement between plots were so great that populations in the plots were not significantly reduced by the materials proved in the laboratory to affect a high degree of kill. None of the materials used caused injury to beet foliage. The total disease reached 100 per cent on old-type and 97.07 per cent on the resistant strain, and the obvious disease reached 99.64 per cent and 81.64 per cent, respectively. The average yield per acre was 12.691 tons for the resistant strain and 0.531 tons for old-type. Tomato and cucumber plants in plots succumbed almost completely to curly top, and no degree of prevention of the disease by insecticides was evident.

### Sprays and Dusts Tested for Lygus Insect Control

Many dusts and sprays were tested in the laboratory for their effectiveness in killing Lygus insects. The dusts used were: diatomaceous earth, several laboratory mixtures of pyrethrum liquid in dust, pyrethrum dust, commercially prepared pyrethrum dust and rotenone in dust. The sprays used were: atomized nicotine sulphate in kerosene, liquid pyrethrum in water, atomized pyrethrum in kerosene, derris extract in water, and several commercially prepared liquid insecticides containing pyrethrum, nicotine or rotenone. Dusts and sprays were used at different strengths of the toxic constituents. Excellent control was obtained in the laboratory by a number of mixtures, and it is planned to test the following materials further in the field next summer: activated "A" dust 60 per cent, sulphur 40 per cent, stabilized pyrethrum dust 1 part, diatomaceous earth 2 parts; pyrethrum dust containing 0.25 per cent pyrethrins; atomized kerosene-pyrethrum mixture containing 0.01 per cent pyrethrins with and without 1 per cent of 95 per cent free nicotine; and several proprietary insecticides.

### Promising Results Secured in Pea Weevil Control

The population of the pea weevil in southwestern Idaho was light. By following the suggestions of the Agricultural Experiment Station, a commercial cannery in that area succeeded in eliminating dangerously infested fields, thus preventing weevil-infested peas from reaching the cannery to cause possible rejections by the Federal Food and Drug Administration.

Cooperation was continued with the U.S. Department of Agriculture, under the direction of T. A. Brindley, in pea weevil investigations in northern Idaho. Border trap crops were helpful, although they were less successful in concentrating the weevils and preventing their spread to the main fields than formerly because weevils continued to fly to the fields after borders were destroyed. Rotenone-bearing dusts continued to give a high percentage of control of adults when applied when pods began to form and at intervals when the population was found to be increasing. It was determined that the number of weevils escaping from infested seed in the soil was inversely proportional to the fineness of the soil particles

and the thoroughness with which the vines were covered, the best results being obtained with a moldboard plow equipped with disc coulters. When weevil-infested peas were buried six inches deep or more, little emergence of weevils occurred. Examinations of samples of duff and soil indicated that weevils did not hibernate successfully in many localities where survival was expected, but recoveries were made in pine duff, in leaf mold beneath poplar trees, and in leaf mold beneath willows. Weevils hibernated successfully in field cages in every location where tested, the greatest percentage surviving in bunch grass.

### Codling Moth Population Light

The codling moth population was lighter than usual. Only the calyx and three cover sprays were applied against the first brood in plot experiments. The average amounts of clean fruit obtained with various insecticides per 100 gallons of spray were as follows: lead arsenate 3 pounds, No. 6 oil 0.5 per cent, Fluxit ¼ pound, 95.1 per cent; lead arsenate 3 pounds, No. 6 oil 0.5 per cent, triethanolamine-oleic acid emulsion, 95.4 per cent; calcium arsenate 4 pounds, No. 6 oil 0.5 per cent, 92.5 per cent; phenothiazine 3 pounds, 90.5 per cent; Kryocide 3 pounds, 89.3 per cent; calcium arsenate 3 pounds, Petrocide ½ gallon, 87.8 per cent; lead arsenate 3 pounds, Petrocide ½ gallon, 88.0 per cent; and lead arsenate 3 pounds, Spraylastic 1 quart, 91.4 per cent. Petrocide at 0.5 per cent killed 27.9 per cent of the codling moth eggs covered and at 1.0 per cent killed 46.4 per cent.

### Control of Insects by Parasites Tested

Additional liberations of the codling moth parasites *Ephialtes extensor*, *Aenoplex carpocapsae*, and the San Jose scale parasite *Prospaltella perniciosi* were made. *Ascogaster carpocapsae*, previously established, suffered heavy mortality due to its host larvae being killed by low temperatures. The parasite orchard has not been sprayed for five years. In 1936, 98.8 per cent of the apples were wormy, and the average percentage of clean fruit this year was: Jonathan, 46.7; Rome Beauty, 48.9; and Winesap, 66.4. Only 3 per cent of the codling moth examined in November, 1937, were parasitized; so the increase of clean fruit this year cannot be attributed entirely to the effect of parasites. Late in the summer San Jose scale spread over most of the experimental orchard, marking the sound fruit to the extent that it was not commercially marketable, in spite of the build-up of the parasite *Aphytis mytilaspidis* and the predator *Scymnillus aterrimus* in 1936. *Prospaltella perniciosi* is not yet known to be established.

No injury to apple foliage was observed where liquid lime-sulphur at 5° B. was applied April 3, followed by foliage sprays containing 0.5 per cent oil on June 3, 11, and 28.

### Miscellaneous Investigations Continued

Spider mites collected late in the summer were determined by E. A. McGregor as *Tetranychus pacificus*. The problem now is to determine whether the two-spotted mite also is involved. A high percentage of control of spider mites was obtained by powdered sulphur, Kolofog, summer

oil and a maximum of powdered sulphur, and liquid lime-sulphur. Vigorocide, at the strengths used, did not give satisfactory control.

Wireworm investigations were continued in cooperation with the U.S. Department of Agriculture under supervision of F. H. Shirck, in Idaho. Wireworm beetles congregated under small bunches of alfalfa or other such shelter, resulting in a concentration of eggs in such protected places. Ovipositing beetles appeared to penetrate somewhat deeper into the soil in bare plots than in moist, shaded situations. *Limonius californicus* deposited more than twice as many eggs in cages planted to red clover as planted to alfalfa. Soil treatments were made with carbon disulphide-naphthalene emulsion and with dichlorethylether. The wireworm population was little affected by dichlorethylether but was reduced from 52 per cent to 71 per cent by carbon disulphide-naphthalene emulsion, but the latter material caused severe damage to young beet plants. It was concluded that the increased amount of injury to potatoes left in the ground for two or three weeks after the date of maturity was not compensated for by the increased yield or the increased market price. Studies on the effect of crop rotations in relation to wireworm populations will be expanded in accordance with a new agreement.

## Home Economics

ELLA WOODS *in charge*

### Home Economic Research Initiated by Purnell Funds

RESEARCH in home economics in the Idaho Agricultural Experiment station was initiated in 1925 when the Purnell fund became available. The first project undertaken was one following the suggestion of the Purnell National Committee on rural home management studies and included a study of the use of time in the farm home. The results of the Idaho study were published in Experiment Station Bulletin No. 146, *The Use of Time by Farm Women,* by Ina Z. Crawford. The next project was one on food consumption in Idaho families. Experiment Station Bulletin No. 165, *Food Consumption and Food Expenditure with Relation to Standards of Requirements and Family Income,* by Mildred Waters Talbot, gives the details of this investigation. These first projects were carried out by investigators working only part time. Beginning September 1, 1927, Dr. Ella Woods was employed as Home Economist in charge of research in the field of food and nutrition, and a small biological laboratory was equipped in the spring of 1928.

One of the interesting facts noted by Mrs. Talbot in her study was the rather high consumption of potatoes by Idaho families even in the summer months when other vegetables are more plentiful. This fact, as well as other important considerations, made it seem desirable to use the Idaho potato in nutrition studies. The first investigation, therefore, in nutrition was the study of vitamin C in Idaho potatoes. The study started with new immature tubers and continued with mature ones and those which had been in common storage for different lengths of time. The Idaho Russet Burbank (Netted Gem) was the variety studied, and the results

are detailed in Station Bulletin 219, *The Vitamin C Content of the Russet Burbank Potato of Idaho*. The most outstanding result of this study was the evidence showing that the new immature potato contains about twice as much vitamin C as the mature potato.

In 1930 somewhat larger quarters became available, and the animal colony was expanded to include white rats so that problems other than vitamin C could be studied biologically.

### Vitamin Content of Grasses and Feeds Important

In cooperation with the Department of Dairy Husbandry work on the vitamin A value of pasture plants was undertaken. The papers which appeared in the *Journal of Dairy Science* from these departments were among the first to report the value of such plants fed under the conditions of pasturage.

The biological value in vitamin A of some of the grasses is still under investigation in the Home Economics laboratory, while parallel studies on the carotene content of the same grasses are made in the Agricultural Chemistry Department. Smooth brome grass contains a high amount of carotene and gives a biological response which is somewhat better than the theoretical and better than that of a solution of pure carotene fed to litter mates.

Also, in cooperation with the Department of Dairy Husbandry, studies in the vitamin E value of pea meal have been carried on. Evidence has been accumulated to indicate that pea meal contains vitamin E, and that the male rat requires a larger amount of the vitamin to prevent sterility than does the female to produce a normal litter.

In cooperation with the Department of Animal Husbandry, a study of the nutritive value of the protein of mature peas is under way. The problem of supplying the complete vitamin B-complex without the addition of protein has not yet been satisfactorily solved. Good growth has been obtained from a diet in which raw peas furnished both protein and the vitamin B-complex, but partial failure in growth has resulted when the peas were cooked. The indications are that cooking the peas destroyed some of the components of the B-complex so that they became the limiting factor in growth. This investigation has not been completed.

### Miscellaneous Studies Reported

Studies with the biological method for vitamin C indicated that the fresh Italian prune has some antiscorbutic value, but that it soon disappears in cold or frozen storage.

Several years ago an investigation was started to ascertain the value of potatoes to provide the relative heat stable, water-soluble factor which was then known as vitamin G. This investigation has been carried on with increasingly purified diets, and in each step potatoes or potato extract have shown definite value as a supplement to these diets.

With the separation of the vitamin G factor into more than one sub-

stance, with strong indication that what originally was meant by vitamin G is in reality a mixture of many substances, several of which may be essential, the potato study has included the fractionation of the extract and the feeding of the separate fractions as supplements to a starch-free diet. Through the courtesy of the Department of Chemistry of the University, several such fractions have been available for tests. Some of these indicate definite growth-promoting properties although evidence for the presence of the dermatitis-preventing factor is not so strongly indicated.

Plans are being made for taking part in a study of asorbic acid (vitamin C) metabolism of college students which has been initiated as a cooperative project among the home economics research departments of the northwest colleges.

# Horticulture

LEIF VERNER *in charge*

## Horticulture Through the Years

THE forty-five years since establishment of the Experiment Station in 1892 have covered almost the entire period of evolution of the important fruit and vegetable industries of Idaho. Throughout this period of development the horticultural work of the Experiment Station has played a prominent part, seeking solutions to perplexing problems which have beset these new industries and determining the most suitable methods of culture for the crops which have been grown. Problems of the apple industry early received attention, and investigations were under way and bulletins published prior to 1906 on such fundamental subjects as planting, pruning, picking, packing, and marketing of these fruits.

Fig. 12.—F. A. Huntley, Horticulturist of the Agricultural Experiment Station from 1897 until 1903.

One of the greatest needs for the future success of the Idaho apple industry seemed, in that early period, to be the development of new varieties which would have higher quality and greater adaptability to western conditions than the sorts then available. This demand gave rise to an ambitious program of apple breeding, initiated at the Experiment Station in 1909. In this experiment over 12,500 seedling apple trees of known parents, including Jonathan, Ben Davis, Rome Beauty, Spitzenberg, Wagener, Gravenstein, and many others, were produced over a period of six years. Nearly all of these seedlings have now borne fruit, and a period of 25 years of tedious, painstaking work has been required to single out the relatively few seedlings which show promise of proving superior to any of our present-day varieties. Each seedling has been examined critically in at least three of its fruiting seasons before final judgment has been passed. To date over 9,000 of these have definitely been discarded. Only 92 have been selected for further trial, while the remainder, over 3,000 in number, still are under preliminary observation. In the last two years 1,500 nursery trees have been grown from the seedlings chosen for further trial. These are being planted in different parts of the State, and the few which may finally prove their worth should be ready to release in the next five- to ten-year period.

The most promising of those now on trial include an apple nearly identical to Jonathan in form, color, and flavor, but of larger size and far superior keeping quality; another which closely resembles Wagener but is in season three months later; and a third variety similar to Stayman Winesap but excelling this variety in juiciness, tenderness of flesh, and skin texture. By far the greatest part of the immense task of producing, growing, testing, and evaluating these thousands of seedlings was carried on over a period of 25 years by the late C. C. Vincent, whose untimely death in 1934 deprived him of the satisfaction he might soon have enjoyed in the final introduction of some of his outstanding selections.

More recent fruit studies, covering the past decade, have been directed toward the solution of specific problems. Studies in the Boise Valley have

Fig. 13.—View of the Horticultural Building and Greenhouse built in 1898. Picture taken about 1903.

determined the best time to pick prunes for eastern shipment and have shown the possibilities and limitations of cold storage for this fruit. Cracking of cherry fruits, resulting in extensive losses in the Lewiston and other cherry districts, has been found to be due to causes beyond the control of the growers. Selection of resistant varieties, several of which have been discovered, offers the only practical solution to this problem. Fertilizer tests in many orchards in different parts of the State have shown negative results in a large majority of cases, and that expenditures for fertilizer by Idaho fruit growers seldom are necessary.

The vegetable and potato industries of the State have been promoted by many investigations and published reports dealing with cultural prob-

lems in these fields. Publications on onion production in the State appeared as early as 1900, laying the foundation for cultural practices which since have been generally adopted. Researches in vegetable seed production under Idaho conditions, completed in 1925, gave a definite impetus to an infant industry which, in the last 15 years, has grown from a few hundred acres to over 5,000 acres.

Among the more recent activities of the Experiment Station designed to serve the horticultural interests of the State was the acquisition two years ago of an 11-acre tract of land near Parma, where experiments with fruit and vegetable crops may be conducted under conditions representative of the areas in which these crops are produced in greatest quantity. Several important new projects already are under way at this new location.

### Progress in Apple Breeding in 1937

Definite progress was made in the apple breeding project in 1937 in establishment of final test plots for approximately 90 apple seedling selections, trees of which were planted under standard orchard conditions at both Parma and Moscow. Further selections were made, and 500 additional trees of previous selections were grown in the nursery at Moscow for future distribution.

### Orchard Soil Management Study Important

Orchard fertilizer studies were continued as in recent years. The scope of this project was enlarged by the establishment of a series of cover crop plots in a block of mature apple trees at the Parma Field Station. Nine different types of soil management were tested, including the use of seven different kinds or combinations of cover crops, clean cultivation, and straw mulch.

Sudan grass made an exceptionally fine growth as a cover crop under the shaded and somewhat crowded conditions in this orchard, while several of the other crops failed or made unsatisfactory growth.

### Potato Production Experiments Initiated

The use of straw mulch on main crop potatoes growing at Moscow resulted in distinctly greater damage to the vines from a frost on August 15 than was suffered by unmulched vines in an adjacent plot. This effect is thought to be due to failure of the soil under the straw to absorb as much warmth from the sun during the day as was absorbed by the directly exposed soil of the untreated plot. Thus, the mulched plot would have had less heat to radiate to the air around the vines during the night, and the straw might also have retarded radiation of the small amount of warmth that the soil had gathered. Differences in soil moisture in the two treatments were in favor of the mulched plot throughout the entire growing season, and the difference was especially great at about the critical time of tuber formation. It is felt that mulching may, on this account, have considerable value in this region on frost-free sites and in average growing seasons when such exceptionally early frosts are not experienced.

### Fruit and Vegetable Varieties Under Test at Parma

A total of 135 new varieties of stone fruits, grapes, brambles, and strawberries were planted at the Parma Field Station in April, 1937, and an almost equal number of varieties was planted at Moscow. One hundred sixty varieties of 26 different kinds of vegetables were tested both at Moscow and at Parma. Outstanding among those grown at Moscow were the Honey Rock muskmelon and the Pritchard and Moscow varieties of tomato. The best greenhouse tomato of those tested in 1937 was an unnamed selection from the Washington Experiment Station designated as W.S.C. 50.

### Deacon Cherry Resistant to Cracking

Previous observations indicating that the Deacon sweet cherry is highly resistant to cracking were substantiated by many orchard observations this year, when cracking again was a serious problem at Lewiston. A number of seedlings of Deacon x Bing were planted in the nursery at Moscow this year in the hope of finding a variety that combines the best qualities of these two parents.

### Crotch Angles in Fruit Trees Influenced by Treatment

Measurements of branch growth and crotch angles were made at intervals during the summer on 290 trees of Delicious apples planted in the spring at Moscow as one year nursery whips and subjected to various treatments designed to alter their branch angles. Similar studies were made on smaller numbers of other varieties of apple, and on young nursery trees forming lateral branches in their first year's growth. Useful preliminary data were secured showing the relationship of growth and of various treatments to angles formed by these lateral branches.

### Crops on Reclaimed Orchard Land Studied

Sixty Delicious apple trees were planted at Parma this year in continuation of a study of the effects of old orchard soils on young fruit trees. Thirty of these trees were planted in old tree holes, of which 10 were fertilized with barnyard manure, 10 with commercial fertilizer, and 10 were left untreated as checks. A duplicate series of 30 trees similarly treated were planted in the centers of squares formed by the trees of the original, mature apple orchard that recently had been removed. Final results of this experiment are not yet available.

# Plant Pathology

C. W. HUNGERFORD *in charge*

## Plant Disease Control Aids Idaho Agriculture

ALTHOUGH plant pathology is a comparatively new science, the Idaho Station very early in its history began to give serious attention to plant disease control. In the first Annual Report of the Experiment Station a discussion is given of a serious trouble of fruit trees noted at Paris, in Bear Lake County, by Director C. P. Fox. The disease was evidently lime-induced chlorosis which is still somewhat prevalent in southern Idaho. Thus, the first plant disease investigated in Idaho was located in the part of the state most remote from the University.

Fig. 14.—L. F. Henderson, Botanist and Plant Pathologist of the Agricultural Experiment Station from 1893 until 1909.

The early program of plant disease control was materially handicapped because of lack of funds and workers. The pioneer work of L. F. Henderson, however, who was Botanist and Plant Pathologist of the Station from 1893-1909, deserves especial mention. At a time when very few of the experiment stations had initiated work in this field, Henderson was a real pioneer in plant disease investigation. Numerous bulletins dealing with cereal smuts, cereal rusts, apple scab, orchard spraying, potato scab, etc., were prepared by him during his stay with the University of Idaho. This early work laid the basis for much needed research in later years. A separate Department of Plant Pathology was formed in 1919. Previous to this date the work was carried as a division of the Botany Department.

In any well-organized research program there are usually several projects which must be continued for a period of years before any final solution can be reached. Other projects, because of their nature, may be of shorter duration. One of the long-time projects in the Department of Plant Pathology has been concerned with the development of disease resistance in field and garden beans. All three means for securing resistance have been employed. The Robust bean was *introduced* about 20 years ago to meet the needs for a field bean in northern Idaho possessing mosaic

resistance. By *selection*, Great Northern U.I. 81, Great Northern U.I. 123, and Great Northern U.I. 59 have been produced and furnished the bean growers of southern Idaho and are rapidly replacing other strains. By *hybridization*, Idaho Refugee and Wisconsin Refugee mosaic-resistant garden beans were produced in cooperation with the Wisconsin Agricultural Experiment Station. More recently the Norida bean, a cross between the Robust and Great Northern, has met the needs of northern Idaho bean growers for an early bean possessing the excellent resistance to disease of the Robust parent.

For the curly top infested bean areas of southern Idaho, white beans of the Great Northern type possessing curly top resistance have been developed by crossing the Red Mexican, which is resistant to curly top, with Great Northern selections, thus bringing together resistance to both mosaic and curly top. Finally, small red beans of the Red Mexican type have been secured from hybrids between the Red Mexican and Great Northern selections. These new beans possess resistance to both curly top and mosaic and have characteristics desirable in a small red bean to be grown in certain sections in southern Idaho.

Other projects involving studies of diseases of grains, forage crops, potatoes, and fruits have yielded results to Idaho agriculture. Recommendations based upon these studies have been released through the Agricultural Extension Division to the farmers of the State.

### Progress Made in Breeding Bean Varieties Resistant to Disease

Research dealing with the development of bean varieties resistant to curly top and common bean mosaic was continued through the 1937 season. Common bean mosaic continued to be very severe on susceptible varieties during the season, and infestations of the beet leafhopper causing curly top in beans were very severe in areas near the breeding grounds of the insects.

Continued selections from hybrid material were made for curly top resistance in Great Northern beans. Many of these selections of Great Northern beans show complete resistance to curly top and bean mosaic and will be increased during the coming season. Mosaic resistant Great Northern beans U.I. 59, U.I. 81, and U.I. 123 continued to gain favor in commercial plantings and constitute nearly the entire crop of commercial Great Northern beans.

Two new varieties of mosaic and curly top resistant Red Mexican beans were released to selected Idaho growers through the cooperation of the county extension agents. The common Red Mexican variety is very susceptible to common bean mosaic, but the new varieties, Red Mexican U.I. 3 and Red Mexican U.I. 34, are entirely resistant to common bean mosaic, are superior in yielding ability, and possess a deeper red color than the Red Mexican variety.

Improvement of garden beans resistant to common bean mosaic has been continued. Several promising selections of Refugee type wax beans are now under test.

Further selections of various garden beans from hybrid material for

curly top resistance have been made. Backcrossing of these selections to desirable garden parents is in progress with the view in mind to increase the quality of those selections showing curly top resistance.

### Fruit Disease Investigations Continued

Field studies near Lewiston indicate that infection by the fungus causing Coryneum blight of stone fruits may occur any time during the year when moisture conditions are favorable. Vigorously growing young trees tend to outgrow the fungus invasion of twigs. Coryneum blight was extremely severe on unsprayed apricots near Moscow and caused considerable leaf spotting and fruit rot of sweet cherries in the Lewiston area.

The bramble fruit plantation at the Moscow station, now including about 150 varieties, did well this year, and preliminary notes were taken on the behavior of different varieties. Tender varieties survived under conditions that killed back varieties considered hardy.

Mottle leaf of cherry, of which specimens were collected as early as 1922, has been recognized recently, and preliminary tests show that it is transmissible readily by budding even though the buds may not grow. Surveys indicate that there is considerable injury by this disease in commercial areas.

Fireblight of pears and apples was less severe this year. Considerable loss of trees, however, was found in the fruit area southwest of Caldwell. Tests were made in the orchards of three cooperators with tree injections of a proprietary material for the control of fireblight. No conclusive results were secured.

Plans for certification of brambles and strawberries have finally been made, and next year one or more growers will set plants for the purpose of producing disease-free foundation stock. There is widespread interest in this problem.

The progress of studies on certain obscure diseases common in peach, prune, and apple orchards is not sufficient to justify conclusions. The work is to be continued.

A plot of ground was secured on the University Farm at Moscow for planting fruit trees and small fruits for studying certain diseases. This spring two trees each of 38 varieties of pears were planted to test their resistance to fireblight. Prunes, peaches, apricots, strawberries, brambles, and cherries were planted for experimental work.

Considerable time has been devoted to collection and preservation of herbarium and class room material and to taking photographs of fruit diseases. Field trips and contacts were made as time permitted.

### Promising Mosaic Resistant Potato Seedlings Developed

Further study of the reaction of potato seedlings to virus infection under field conditions was made during the summer. To date, 176 Katahdin seedlings and 25 Bliss Triumph x Katahdin seedlings have been tested. Many of these have been discarded because of virus infection.

In Table V will be found listed those seedlings which have responded

favorably and have yielded a pound and a half per hill for at least one year.

**TABLE V**

**Potato Seedlings Yielding 1.5 Lbs. or More per Hill in Either 1935, 1936, or 1937, When Grown at Moscow, Idaho**

| Seedling No. | Yield | | | Seedling No. | Yield | | |
|---|---|---|---|---|---|---|---|
| | 1935 | 1936 | 1937 | | 1935 | 1936 | 1937 |
| K 1 | 1.1 | 1.66 | 1.88 | K 89 | 1.7 | 1.57 | 1.19 |
| K 2 | 0.6 | 1.0 | 1.75 | K 109 | 1.5 | 1.26 | 0.97 |
| K 9 | 1.54 | 1.55 | 0.64 | K 127 | 1.3 | 1.2 | 1.5 |
| K 14 | 1.6 | 1.54 | Discard | K 131 | 1.3 | 1.67 | 1.5 |
| K 18 | 1.16 | 1.6 | 0.9 | K 137 | | 1.72 | Discard |
| K 21 | 1.7 | 1.6 | 0.83 | K 141 | | 1.55 | 1.64 |
| K 29 | 1.16 | 1.53 | 0.7 | K 143 | | 1.7 | 1.57 |
| K 33 | 1.0 | 1.55 | Discard | K 144 | | 1.0 | 1.91 |
| K 35 | 0.8 | 1.57 | 1.27 | K 145 | | 1.61 | 1.42 |
| K 49 | 1.5 | 0.96 | 0.77 | K 146 | | 1.95 | 2.02 |
| K 53 | 1.5 | 1.23 | 1.0 | K 152 | | 1.3 | 1.53 |
| K 62 | 1.4 | 1.63 | 1.05 | K 156 | | | 1.89 |
| K 67 | 1.5 | 1.3 | 0.67 | K 166 | | 0.9 | 1.96 |
| K 75 | 1.7 | 1.2 | 0.88 | K 171 | | 1.1 | 1.64 |
| K 77 | 2.3 | 1.36 | Discard | | | | |
| K 84 | 1.0 | 1.53 | 1.27 | | | | |

## Norida Beans Meet with Approval

Eight growers in Latah, Lewis, and Nez Perce Counties received seed of the new Norida bean in 1937. These growers grew this bean under conditions identical with their own crops. In every case the Norida was earlier maturing and completely free of common bean mosaic. The new bean is slightly larger than the Robust but not too large to be disqualified in the "small-white" class. Further distribution will be made in 1938.

## Pea Disease Investigations Feature Disease Resistance

Because of the resignation of Dr. W. H. Pierce in June, the investigations of pea diseases were temporarily retarded. Nevertheless, work started by him was continued. This work resolved itself into a further selection in the crosses which had been made by him for the production of resistance to near-wilt caused by *Fusarium oxysporum f. 8* Snyder.

Through the cooperation of Dr. W. C. Snyder of the California Agricultural Experiment Station, various segregants of the near-wilt crosses were tested on near-wilt infested soil in the vicinity of San Luis Obispo, California, during the winter of 1936-1937. In this manner, the relative resistance of the segregants was tested, and at the same time an additional generation of seed was obtained. The resistant progeny from California plots was returned to Moscow, increased during the summer, and further selected on the basis of agronomic character.

Additional selections were made in pea hybrids for resistance to pea mosaic. Indications are that near-wilt resistance and mosaic resistance can be found in a single segregant.

## Cereal Disease Investigations in Cooperation with the U.S. Department of Agriculture Reported

The cereal disease investigations in cooperation with the Office of Cereal Crops and Diseases of the U.S. Department of Agriculture, in charge of Wayne Bever, have been continued emphasizing three lines of investigations: stripe rust, wheat bunt, and a study of covered smut of barley.

Very little stripe rust has developed during the last two seasons; consequently, the work in this line of investigation has been limited. Although collections have been made and tested on the differential hosts, no new physiologic races have been observed. Physiologic race No. 19 is still predominant in its occurrence. Only the completely susceptible varieties in the standard rust nursery showed any infection with stripe rust this past season.

Of a total of 33 collections of bunt, 13 were caused by *Tilletia tritici,* and 20 by *T. levis.* When these were tested on the differential hosts, three definite races of *T. tritici* and three of *T. levis* were observed. One previously undescribed race was found and will be given further tests at the Idaho Station, as well as at other stations. Ridit C.I. 6703 and Oro C.I. 8220 proved to be more resistant than any of the other varieties.

The bunt soil infestation nurseries revealed that certain varieties, such as Ridit, Albit, and Martin, were susceptible to the so-called "short smut." These varieties previously were thought to be somewhat resistant to this smut. Relief C.I. 10082 appeared to be resistant in all locations.

The vacuum method of inoculating barley seed with chlamydospores of *Ustilago hordei* proved to be the most effective. Infections as high as 82 per cent were secured by the use of this method in comparison with 70 per cent by use of Tapke's method, which was next best. Higher infections were secured in every case at the Sandpoint Station than at the Moscow Station.

Of the 20 collections of *U. hordei* tested for physiologic specialization, five definite races were observed on the basis of Tapke's percentages. It is suggested that Tapke's percentages for race differentiation are not high enough for race identification from results secured at the Sandpoint Station.

Of the 100 varieties and crosses of barley tested against conglomerate inoculum of the 20 collections of *U. hordei,* O.A.C. No. 21, C.I. 3208-4, C.I. 3210-3, C.I. 3356, C.I. 3635, C.I. 3951-3, and three $F_{10}$ hybrids (Nos. 27, 33, 42) furnished by Professor C. A. Michels of the Agronomy Department proved to be free of any smut infection.

Inter- and intraspecific monosporidial crosses between *U. hordei* (Pers.) K. and S. and *U. nigra* n. sp. Tapke revealed that segregation for sex may take place either in first or second reduction division. The two species hybridize easily, producing echinulate chlamydospores in the $F_1$. Smutted heads resembling both parents were secured in the $F_2$ generation.

# Poultry Husbandry

C. E. LAMPMAN *in charge*

## Experimental Work in Poultry Husbandry Begun in 1913

THE Poultry Department was established in 1913 with Pren Moore, now Extension Poultryman, in charge and with an initial appropriation of approximately $1,500. Much of the initial equipment and stock was donated. Pren Moore joined the Experiment Station force in 1902, was in charge of the Poultry Department of the Experiment Station from 1913 to 1919, and from 1919 to the present time has served the University and the industry of the State as Extension Poultryman. The poultry industry of Idaho owes much to his pioneer work and untiring efforts in furthering its development. The philosophy underlying his work might best be stated in his own words: "Poultry in relation to agriculture is a part of diversified farming. Idaho, as an agricultural state, produces large quantities of feed, and the poultry enterprise may be profitable to the extent that its income represents the products of the farm." Among his major contributions to the poultry industry should be listed the development of feed formulas, poultry flock improvement and accreditation work, and valuable educational assistance in the formation of the Idaho Egg Cooperative Marketing Association as a means of disposing of the surplus poultry products of the State.

Fig. 15.—Pren Moore, associated with the Idaho College of Agriculture since 1902—Head of the Poultry Department, 1913-1919; Extension Poultryman since 1919.

The early research work consisted of feeding trials to determine the relative value of animal and vegetable proteins in laying rations. The results of three years' work (1913-1916) demonstrated the superiority of animal proteins by increasing egg production, size of eggs, and income over feed costs. Proteins supplied by meat scrap and skim milk proved more efficient than those supplied by the legumes, linseed meal, or the cereals. This early work demonstrated the efficiency of a combination of ground peas and liquid skim milk as protein supplements. It also served as a basis for further work along similar lines by R. T. Parkhurst and for work in recent years in which ground peas, especially those of the green-seeded varieties, proved to be

a valuable source of vitamin A in poultry rations. Early observations with respect to the vitamin A deficiency of poultry and poultry rations common in the State served as a basis for recent work at the Experiment Station on vitamin A requirements of laying hens and suitable supplementary feeds necessary for such requirements.

S. P. Smythe served as Poultry Husbandman from 1919 to 1921 and worked on the relative value of certain grains and cost of raising chicks.

R. T. Parkhurst, while serving as Poultry Husbandman from 1921 to 1927, further demonstrated the value of liquid skim milk and the combination of ground peas with skim milk as valuable protein supplements in increasing both the number and size of eggs produced. He also conducted feeding trials demonstrating the value of cod liver oil and alfalfa as supplementary vitamin feeds necessary for egg production and hatchability.

C. E. Lampman joined the Experiment Station staff as Poultry Husbandman in 1928. The major projects carried on in recent years include: the vitamin A requirements of laying hens, combined with the study of the value of alfalfa in relation to its carotene content (in cooperation with Agricultural Chemistry); mineral supplements for growing chicks and laying hens; further studies on protein supplements in combination with ground peas; protein and mineral requirements of growing turkeys; the value of the manganese content of orchard grass in preventing perosis; the problem of humidity in relation to the hatchability of eggs during incubation; factors underlying the prevention and control of poultry diseases; factors influencing the transmission of fowl paralysis; breeding for disease resistance and livability of progeny; and suitable housing conditions for stock during the winter season. The limited space permits the summarization of only the major and outstanding projects.

### Studies on Vitamin A Requirements of Laying Hens Continued

The investigation of the vitamin A requirements of laying hens, in cooperation with the Agricultural Chemistry Department, is now in the third year of work on this particular phase. The past year's work has confirmed the results previously reported in Experiment Station Bulletin No. 221. Carotene provided in dehydrated alfalfa and fed at levels of .25 milligrams per bird per day again proved sufficient to promote average egg production and to prevent any specific deficiency lesions. This level of carotene is approximately equivalent to 295 Sherman vitamin A rat units, and this is in fairly close agreement with the 240 units reported by Sherwood and Fraps of Texas when the vitamin A potency of the egg is not considered. One-tenth milligram of carotene per bird daily proved markedly inadequate. Five-tenths milligram resulted in slight, although statistically significant, increases in egg production and hatchability. This year, levels graduated from 2/10 to 5/10 milligram per bird daily are being used. This project has also provided data which proved the marked variation in the carotene content of commercially produced dehydrated alfalfa leaf meal, as well as sun-cured.

### Manganese in Orchard Grass Valuable in Preventing Perosis

Preliminary investigations just completed by the Departments of Agricultural Chemistry, Home Economics, and Poultry Husbandry have found

orchard grass to contain sufficient manganese to function as well as manganese salts in preventing perosis. Previous investigations by D. W. Bolin, Department of Agricultural Chemistry, reported in the *Journal of Agri-*

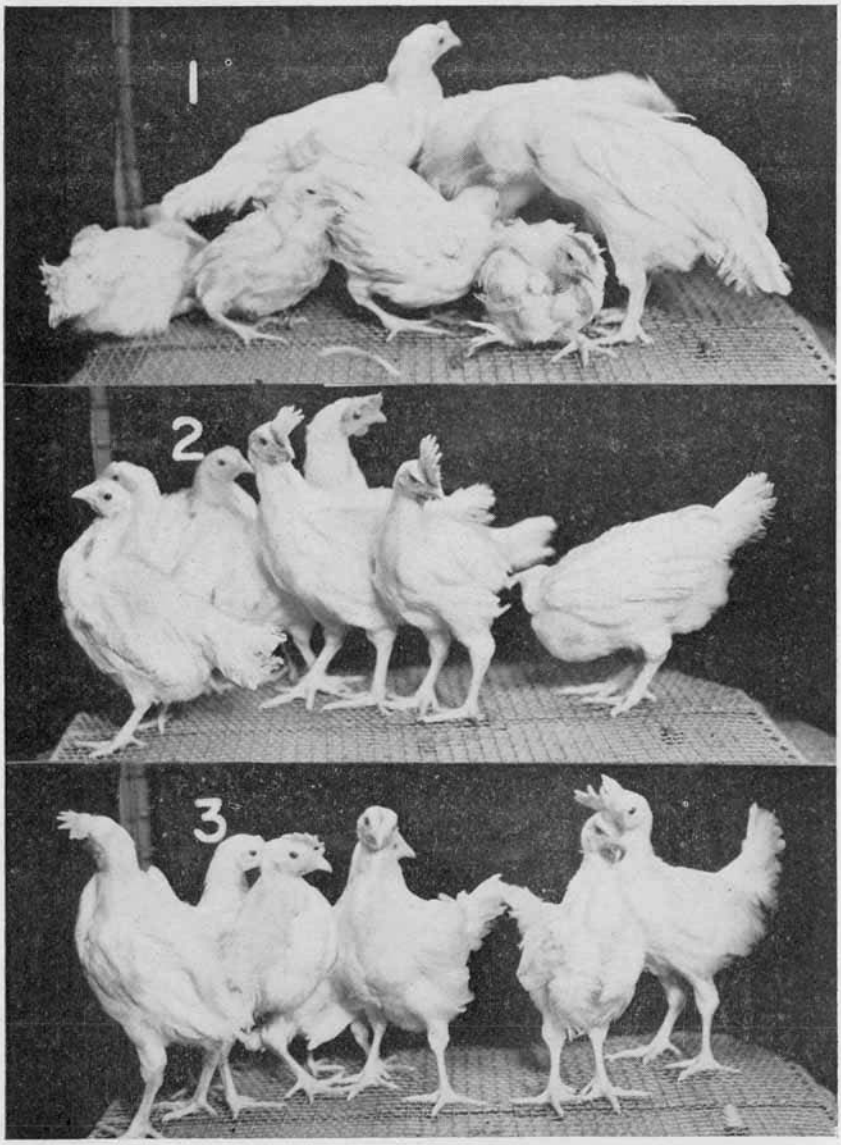



Fig. 16.—Group I, which received basal ration, exhibit perosis, "slipped tendons." Group II, basal ration plus manganese sulphate; and Group III, basal ration, except that orchard grass replaced alfalfa leaf meal at the rate of 5 per cent. All chicks in Lots II and III are normal. Previous work at this Station proved orchard grass high in manganese.

*cultural Research*, Vol. 48, No. 7, demonstrated orchard grass to have about four times as much manganese as alfalfa. In this preliminary trial the Cornell Perosis-Producing ration (except that meat scrap replaced fish meal) was used in Lot I. Manganese sulphate was added to the basal ration at the rate of one gram per kilo in Lot II; and orchard grass, used at 5 per cent of the ration in place of dehydrated alfalfa, in Lot III. The pictures in Figure 16 were taken when the chicks were seven weeks of age. The extreme cases of perosis are seen in the foreground of Lot I; however, only one chick of this group had normal hocks at this time. All chicks in Lots II and III were normal. Further work on the value of orchard grass and other grasses, as corrective agencies, will be reported later.

## Control of Humidity Important in Artificial Incubation

The project conducted several years ago on the relation of humidity to hatchability has proved particularly helpful in the artificial incubation of turkey eggs in demonstrating the desirability for control of humidity to promote the correct evaporation of moisture during a period prior to pipping and the necessity for a condition of high humidity during the final stages of hatching.

**TABLE VI**

**A Comparison by Per Cent of the Occurrence of Paralysis in Progeny from Paralysis-free and Paralysis-resistant Stock when Placed with the Paralysis-affected Station Stock**

| Trial | Affected Station Stock | Paralysis-free Stock* | Resistant Stock | Station Stock | | All Stock | |
|---|---|---|---|---|---|---|---|
| | | | | Hen Chicks | Pullet Chicks | Range | Confined |
| Series I 1933-34 | 31.1 | 43.3 | | 27.4 | 34.7 | 37.3 | 37.1 |
| Series II 1934-35 | 19.9 | 41.6 | | 17.0 | 24.6 | 25.0 | 26.3 |
| Series III 1935-36 | 6.9 | | 3.1 | | | | |
| Series IV 1936-37 | | Introduced at 1 da. 6 wk. 12 wk. | | | | | |
| | 7.6 | 41.8 4.0 8.0 | 5.5 | | | | |

*Paralysis-free stock for Series I and IV from same source.

## Specific Resistance a Factor in Control of Fowl Paralysis

The project on the factors influencing the transmission of fowl paralysis (in cooperation with the Station Veterinarian), involving four years' work, has now been completed. Two articles have appeared in poultry journals on this work, and it will soon be reported in detail in an experiment station bulletin. Table No. VI briefly summarizes the major results. It is to be noted that the progeny from stock never having had the disease is extremely susceptible, mortality of over 40 per cent occurring each year when introduced as day-old chicks; the mortality of such progeny is remarkably reduced when introduced as 6- or 12-week-old pullets. On the

other hand, a very low mortality was experienced in progeny from stock which previously had been affected but which had developed resistance. The mortality from the disease becomes less each year as the flock acquires resistance, and this reduction can be materially influenced by breeding and selection. Progeny from hen-breeding stock suffered less mortality in this project than from pullet-breeding stock.

### Disease Resistance Inherited

The general project in breeding for disease resistance and livability is still in the preliminary stages inasmuch as this type of investigation must extend over a number of years; however, thus far a marked difference has been found in the livability of the progeny from different sires, although this past season the difference was less than in previous years. This study shows a marked difference in the livability of progeny from different females. Further work will be necessary to determine how and to what extent this factor of livability is inherited.

### Protein and Mineral in Turkey Rations Important

The work on turkey rations this year has demonstrated a marked superiority of a ration analyzing 24 per cent protein, over an ordinary chick ration, from the standpoint of rate of growth, cost per pound gain during the first 10 weeks, superiority in plumage development, and in the final weight of birds at marketing period. Preliminary conditions of perosis developed in several cases on the chick ration, apparently due to its high phosphorus content, while none of this condition developed in the high protein ration in which no bone meal, as such, was added.

## Pure Seed

H. L. SPENCE *in charge*

### Pure Seed Program of Vital Importance to Seed Industry

THE pure seed program, which includes the enforcement of the State Seed Law and the maintenance of the State Seed Laboratory, although a part of the Experiment Station, is administered by the Extension Agronomist. This phase of work is vitally important to the success of both the seed industry in Idaho and the successful operation of the noxious weed program. The Idaho Pure Seed Law provides for its enforcement by the Director of the Experiment Station, who is authorized to appoint a State Seed Commissioner with offices at Boise to take charge of the work. Under the present policy this office is combined with that of Extension Agonomist, which carries out all phases, including seed house inspections and the supervision of the State Seed Laboratory.

It has been the policy of the department to carry out the provisions of the State Seed Law by straight educational means rather than policing. Dealers and growers alike have been cooperative and, in most cases, conscientious, in meeting the requirements of the law. More infractions of the law are committed by growers than by legitimate dealers, the largest source of low-quality seed not meeting the requirements of the law being peddled

from farmer to farmer. Much of this trade is carried on with no malice but rather due to lack of proper knowledge of the seed law requirements. At the same time, it is difficult to police such sales, and to overcome the practice means the broadening of the educational program. Seed schools have been conducted with marked success. A one- or two-day meeting in each county during the early spring months, before seeding time, where samples of various grades of seed are exhibited giving results from using each grade, have been very impressive. In addition, farmers are urged through preliminary advertising to bring in samples of seed they are planning on sowing. These samples are analyzed with the purchaser present, and he is shown the exact quality of his seed. In conjunction with these schools, weed mounts and identification material are made available with part of the meeting being devoted to this subject.

Seed enforcement work is very closely correlated with the seed improvement program in extension agronomy and makes it possible to maintain a closer relationship between the seed dealers and seed growers. Through the State Seed Law, it is possible to establish standards for the production of high-quality seed in Idaho by regulating the source of seed for planting within the State. The present seed law was placed upon the statutes over 20 years ago and does not fit present conditions existing within the State as fully as it should. Effort has been made to obtain its amendment but with no success to date. This is vitally necessary if Idaho retains its present reputation for high-quality seed. Likewise the recent extension of the seed production industry to vegetable and flower seed crops makes it more imperative that the seed law be brought up to date.

### Seed Laboratory Nationally Recognized

The mechanics of the State Seed Laboratory are carried out under the competent direction of Miss Jessie C. Ayres, who has been employed as State Seed Analyst for many years. Through Miss Ayres' efforts, the Idaho laboratory is recognized as an official laboratory by the Association of Official Seed Analysts of North America and has an excellent reputation among all seed dealers. In addition, Emery Chaffee is employed as Assistant Seed Analyst and assistant in handling the duties of the laboratory. During the summer months Mr. Chaffee acts as a field inspector in conjunction with both the pure seed and certification programs.

During 1937, one-third more samples were received at the seed laboratory for analysis than in 1936. It is gratifying to note that the number of farmers' samples more than doubled, which shows results of educational work toward encouraging farmers to plant only seed of known source. The largest increase was in germination tests, where the number of samples received was nearly three times as great as in 1936. With the increase in the production of garden seeds in Idaho, this demand likely will increase. It is vitally necessary that the Idaho Seed Laboratory maintain up-to-date equipment for handling this work. The laboratory, while one of the best-equipped seed laboratories in the West, is at present handling the maximum amount of work with available equipment and personnel.

Following is the statistical report of the State Seed Laboratory for 1936-1937:

| | |
|---|---|
| Total Number of Samples Received | 3,469 |
| Purity Tests | 2,302 |
| Germination Tests | 1,131 |
| Moisture Tests | 36 |

| Source of Samples | 1935-1936 | 1936-1937 |
|---|---|---|
| Dealers | 623 | 1,637 |
| Official | 1,214 | 1,377 |
| Farmers and Miscellaneous | 225 | 455 |
| Total | 2,062 | 3,469 |

# Aberdeen Substation

JOHN TOEVS *in charge*

## Aberdeen Experiment Station Established in 1911

THE present site for the Aberdeen Substation was selected in 1911. A long-term lease was negotiated, some buildings were erected, land was cleared from sagebrush the first year, and preliminary work was started in the spring of 1912. Meteorological records have been kept since January 1, 1912.

The early work at the Aberdeen Substation was largely of a pioneering nature. Farming by irrigation was an entirely new experience to the many farmers settling on irrigation projects started about that time. Many hardships and discouragements were encountered, as any new venture calls for experimentations, many of which are costly. This was especially true when information was not so easily obtainable as it is now.

L. C. Aicher was the first Superintendent and served from 1911 to 1921. A. E. McClymonds was Superintendent from 1921 until 1931, and John Toevs has been Superintendent since 1931. Considerable time was devoted to irrigation problems and introduction of new crops adapted to southern Idaho. The University of Idaho, through the Aberdeen Substation, has through the years aided materially in the development of the potato industry and in the production of Grimm alfalfa seed. The Idaho Grimm Alfalfa Seed Growers' Association, one of Idaho's strong cooperatives, has received considerable help and encouragement.

The Office of Cereal Crops and Diseases of the U.S. Department of Agriculture, cooperating with the Aberdeen Substation, was largely responsible for testing and developing new cereals which were later distributed by this Station. Dicklow wheat, Trebi barley, and Victory oats were among the first grains distributed. All of these varieties are still of primary importance in the irrigated sections of southern Idaho. Federation wheat was later tested and released and has replaced Dicklow where lodging is a factor.

Experimental lamb feeding was carried on from 1924 to 1934. Two

carloads of lambs were fed each year, except 1933. Aside from giving valuable information as to the value of feeds and their combination in rations for fattening lambs, this work has demonstrated the importance of livestock on the irrigated farm. Productivity not only has been maintained on the Substation farm but has been increased materially.

After the land had been farmed 15 to 20 years, alfalfa hay and red clover seed yields began to drop materially. On many farms yields dropped to less than half, and clover seed production became unprofitable. Many yields as low as two bushels per acre were reported. Fertilizer experiments in 1932 and 1933 clearly demonstrated that phosphate fertilizers increased the production of red clover seed and alfalfa hay. In all the tests conducted at the Substation, the best results were obtained by application

Fig. 17.—Uniform lot of range ewe lambs recently purchased for foundation stock in the study of production and feeding of spring lambs on the Aberdeen Substation.

of 200 pounds of treble-superphosphate per acre, which increased red clover seed yields from 80 to 110 per cent. Information from these experiments has hastened materially the use of acid phosphates on red clover and alfalfa, and the red clover acreage has again been increased. It has been estimated that at least 90 per cent of the red clover was phosphated in 1937, resulting in one of the highest average clover seed yields ever secured in Idaho.

In summarizing the work of the Substation, only a few of the most important projects have been mentioned from which direct benefit has resulted. Much of the work is in cooperation with other agencies. For instance, testing of new strains and varieties of red clover is in cooperation with the Office of Forage Crops and Diseases and the testing of new sugar beet selections is for the Office of Sugar Plant Investigations of the U.S. Department of Agriculture.

The 80 acres of land originally leased were later purchased. Since that time approximately 47 acres more land have been added to the farm. In the dry summer of 1934 a well was drilled for supplementary irrigation water. This has proved a great asset for experimental work. Seventy-five inches of water are available whenever ditch water is lacking or insufficient.

## Cooperative Fertilizer Tests of Liquid Ammonia Undertaken in 1937

Investigations of the use of liquid ammonia as a source of nitrogen fertilizer were undertaken in 1937 in cooperation with the Department of Agronomy and the Shell Chemical Company. The sugar beet experiments were established on farms that had a relatively high fertility, but the fields on which the sugar beet experiments were placed had not received any manure for the 1937 crop. The increase in yields for the liquid ammonia were barely sufficient to pay for the cost of application; yet when one considers that the yields of the check plots were 17½ and 22 tons per acre, an increase of a ton and a half to a ton and three-fourths from the plots receiving the liquid ammonia gives indications that when barnyard manure is not available, some nitrogen fertilizer might be profitably used on lands of lower nitrogen content.

The relative value of liquid ammonia and barnyard manure was tested in a potato experiment on the Substation farm. There was practically no difference between the plots receiving 10 tons of manure per acre and those receiving 75 pounds of ammonia. Both the manure and the liquid ammonia gave an increase of approximately 20 per cent over the check plots. The land on which this test was made was more or less depleted of nitrogen as it had produced a heavy potato crop in 1935 and a 100-bushel oat crop in 1936.

## Phosphate Fertilizer Experiments on Alfalfa Continued

The first year's results of the experiment dealing with the rate of application and the residual effects of treble-superphosphate applied at the rates of 75, 125, 200, and 300 pounds per acre indicate that the most economical returns were obtained from the 75-pound rate.

**TABLE VII**

**Influence of Rate of Application of Treble-superphosphate upon Yield of Alfalfa Hay on the Aberdeen Substation**

| Treatment | Rate pounds per acre | No. of Plats | 2d cutting 1936* (Tons) | Total yield 1937 3 cuttings (Tons) | Percentage of check | Corrected percentage of check based on 1936 yield |
|---|---|---|---|---|---|---|
| Check | | 8 | 1.69 | 4.29 | 100 | ..... |
| Treble-superphosphate | 75 | 3 | 1.70 | 5.49 | 128 | 127 |
| " " | 125 | 3 | 1.76 | 5.80 | 135 | 130 |
| " " | 200 | 3 | 1.61 | 5.58 | 130 | 137 |
| " " | 300 | 3 | 1.61 | 5.94 | 138 | 145 |

*Taken before treble-superphosphate was applied to check differences in stand and soil variations.

The various phosphate carriers included in this experiment were treble-superphosphate, raw rock (regular grinding), raw rock finely ground, bureau calcined, TVA meta, TVA fused, and TVA triple. The rate of application was determined on two bases, namely, equal amounts of available phosphoric acid and equal costs where figures were known. If unknown, the cost per unit of available phosphoric acid in treble-superphosphate was used in establishing the amounts. Preliminary indications are that the most economic returns were obtained from the treble-superphosphate and from the TVA triple superphosphate.

### Crop Rotations Influence Yield

The rotation experiments under the present plan were started in 1929. The three legumes—alfalfa, red clover, and peas—are grown for two years in a four-year rotation. Potatoes are grown the third year and wheat the fourth year in each rotation.

All plots in Series I received an application of sheep manure every fourth year in the spring before plowing the plots for potatoes. In other words, every plot in this series receives manure at the rate of 10 tons per acre. Series II contains the same rotations as Series I but does not receive any manure.

**TABLE VIII**

**Summary Yields of Crops in Different Rotations on the Aberdeen Substation**

| Crop | Rotation | Years | Series I with manure | Series II without manure | Increase favoring manure |
|---|---|---|---|---|---|
| Potatoes | Alfalfa | Av. 1929, 1930, and 1932* | 245 cwts. | 147 cwts. | 98 cwts. |
| | | 1933 to 1937 inclusive | 272 cwts. | 255 cwts. | 17 cwts. |
| Potatoes | Red Clover | Av. 1929, 1930, and 1932 | 208 cwts. | 126 cwts. | 82 cwts. |
| | | 1933 to 1937 inclusive | 270 cwts. | 238 cwts. | 32 cwts. |
| Potatoes | Peas | Av. 1929, 1930, and 1932 | 203 cwts. | 142 cwts. | 61 cwts. |
| | | 1933 to 1937 inclusive | 215 cwts. | 210 cwts. | 5 cwts. |
| Wheat | Alfalfa | Av. 1929, 1930, and 1932 | 59.4 Bu. | 40.6 Bu. | 18.8 Bu. |
| | | 1933 to 1937 inclusive | 73.1 Bu. | 70.6 Bu. | 2.5 Bu. |
| Wheat | Red Clover | Av. 1929, 1930, and 1932 | 57.8 Bu. | 36.1 Bu. | 21.7 Bu. |
| | | 1933 to 1937 inclusive | 71.7 Bu. | 58.1 Bu. | 13.6 Bu. |
| Wheat | Peas | Av. 1929, 1930, and 1932 | 50.7 Bu. | 42.1 Bu. | 8.6 Bu. |
| | | 1933 to 1937 inclusive | 66.5 Bu. | 61.1 Bu. | 5.4 Bu. |

*1931 yields were omitted. Yields suffered for lack of irrigation water.

In 1932 it was observed that red clover and alfalfa in both series made a very limited growth. The cause was attributed to phosphate deficiency. The true value of the various legumes in the different rotations could not be ascertained so long as this condition existed. It was, therefore, decided

to make phosphate applications to all plots in both series every two years. Applications were made in 1933, 1935, and 1937. Table VIII gives the comparative yields of potatoes and wheat in each rotation for three years prior to the use of phosphate and for the five years following the first application of phosphate. Yields for the year 1931 were omitted because the yields were entirely out of line due to the shortage of irrigation water.

### Feeds for Spring Lambs Tested

Feeding work at the Aberdeen Substation has been concerned with the production of spring lambs. A flock of approximately 120 ewes has been used for this purpose. After lambing, the ewes and lambs were divided into three lots. The ewes all received the same ration in 1936 and 1937. The lambs of Lot I received barley and alfalfa hay; those of Lot II received alfalfa hay only; and those in Lot III received creep feed and

Fig. 18.—New oat variety which will be distributed this year under the name of Bannock oat.

alfalfa hay. On May 7 each lot was divided equally on the basis of past performance in daily gains; one half of each lot was left in the feed lot; and the other half was put on red clover pasture until the experiment was closed on June 9. These lots were numbered IV, V, and VI.

For the first 17 days that the lambs were on pasture, Lots IV, V, and VI made an average daily gain of .342 pounds, as compared to .574 pounds daily gain for Lots I, II, and III remaining in feed lot. During the last 16 days of this pasturing experiment Lots IV, V, and VI made an average daily gain of .627, as compared to .336 for Lots I, II, and III remaining in their respective feed lots. Results definitely indicate that gains are unsatisfactory for the first two or three weeks on clover and alfalfa pasture. Lambs which will be ready for market two weeks after good pasture is available should be kept in the feed lot. Light and thin lambs which

## TABLE IX

**Results of Feeding Tests with Spring Lambs at Aberdeen Substation in 1937, Giving Average Daily Gains and Profit per Lamb**

| Lot Number: Ration: | Lot I Barley and Alfalfa Hay | | Lot II Alfalfa Hay | | Lot III Creep Feed and Alfalfa Hay | |
|---|---|---|---|---|---|---|
| Average daily gain to May 7 | .582 | | .534 | | .672 | |
| **Lots divided May 7. Numbered Ration:** | **Lot I Barley and Hay** | **Lot IV Red Clover Pasture** | **Lot II Hay** | **Lot V Red Clover Pasture** | **Lot III Creep Feed and Hay** | **Lot IV Red Clover Pasture** |
| Average daily gain May 7 to May 24 | .642 | .329 | .476 | .436 | .605 | .261 |
| Average daily gain May 24 to June 9 | .353 | .623 | .167 | .610 | .489 | .647 |
| Average daily gain May 7 to June 9 | .502 | .472 | .326 | .521 | .550 | .448 |
| Average value per lamb | $7.04 | $6.90 | $5.66 | $6.58 | $7.86 | $7.58 |
| Average feed cast per lamb Feb. 17 to June 9 | 4.22 | '2.90 | 3.47 | 2.78 | 5.63 | 3.49 |
| Average feed cost per lamb Date of lambing to Feb. 17 | .36 | .36 | .30 | .30 | .30 | .30 |
| Total feed cost ewes and lambs Date lambed to June 9 | 4.58 | 3.26 | 3.77 | 3.08 | 5.93 | 3.79 |
| Average profit per lamb | $2.46 | $3.64 | $1.89 | $3.50 | $1.93 | $3.79 |

require more time to finish should be put on pasture as soon as sufficient green feed is available. Table IX gives the results of the feeding tests.

## New Oat Ready for Distribution

The Bannock oat was increased in 1937 and is ready for distribution. This oat, a selection from a Markton-Victory cross made about 12 or 13 years ago, was developed at the Substation by the Office of Cereal Crops and Diseases of the U.S. Department of Agriculture. In all tests Bannock has been completely resistant to smut and has maintained a very satisfactory yield.

## Grasses Produce High Seed Yields

Table X gives the seed yields of the grass plots established in 1936. The grasses were seeded broadcast and in rows 36 inches apart and cultivated. Smooth brome and crested wheat gave materially higher yields in the row than in the broadcast seedings.

**TABLE X**

**Comparative Seed Yields of Grasses in Pounds per Acre Seeded Broadcast and in Rows in 1937 at Aberdeen**

| Grasses | Broadcast Seeding | Row Seeding |
|---|---|---|
| Meadow fescue | 1288 | 845 |
| Smooth brome | 671 | 1193 |
| Slender wheat | 663 | ..... |
| Crested wheat | 358 | 978 |
| Orchard grass | 220 | 200 |
| Tall meadow oat | 124 | 245 |

## Cereal Office Continues Extensive Program

The Office of Cereal Crops and Diseases, U.S. Department of Agriculture, continued a large breeding program. This program is for the purpose of developing new and better strains and for genetic studies. Considerable progress is being made with wheat, oats, and barley. Efforts are not so much centered around increasing yields as on improving quality and disease resistance. Reselection of the Federation-Dicklow cross, C.I. 11415, was necessary because of a variation in color of glumes.

## Forage Office Continues Tests of New Strains and Blends of Red Clover

A number of blends of red clover sent here from the corn-belt states are being tested for seed yield and winter hardiness. Most of these blends seem to be equally as good as the clover now being grown in Idaho. These new strains and blends have been developed to meet the conditions in eastern states. The growing of these adapted varieties or strains of red clover for seed production in Idaho is very desirable. It is very essential that the Idaho growers produce clover seed that is in demand in the consuming states.

# Caldwell Substation

R. J. JOHNSON *in charge*

## Caldwell Oldest Substation now Operated

THE Caldwell Substation is the oldest branch station operated at the present time. Established in 1906 and operated continuously through the years, the research at this Station has contributed much to the farmers and stockmen of southern Idaho. Elias Nelson was in charge of the Caldwell Substation for several years after it was established in 1906. L. C. Aicher then served as Superintendent for a brief period but was soon transferred to the Aberdeen Substation, becoming the first Superintendent of that Substation in 1911. C. P. Hampson was foreman of the Caldwell Substation for a period of years then C. M. Eklof became Superintendent. He was followed by D. A. Stubblefield in 1920, who served until 1932, when R. F. Johnson, the present Superintendent, was appointed.

A review of the steer and lamb feeding work of the Station will be found in the Animal Husbandry report.

Investigations in various phases of livestock feeding, pasture management, soil fertility, and crops at the Caldwell Substation have given to agriculture improvements in lamb and steer fattening rations and methods of fattening livestock, information on the productivity and value of grasses which are used in irrigated pasture mixtures, and improvement of pasture management. Studies are now in progress for the purpose of securing information upon problems of soil fertility, and tests are being made with varieties of field and sweet corn, through selection and breeding, to secure better quality and higher-producing strains adapted to irrigated sections.

## Steer and Lamb Feeding Experiments Continued

Steer and lamb feeding tests have been made to compare the relative quality of proteins in cottonseed meal, linseed oil meal, cull peas, and meat meal; to determine the amount of phosphorus and calcium which is necessary for fattening; and to study factors which influence the production of fat steers in a system which utilizes irrigated pastures. The results of the experiment to determine the amount of phosphorus and calcium which is essential for fattening lambs and steers are reported by the Department of Animal Husbandry.

Cottonseed meal, linseed meal, cull peas, and meat meal were fed with and checked against a ration of chopped alfalfa hay, corn silage, and ground barley to determine the quality of proteins needed for 750-pound yearling steers. These steers were fed in lots of 12 animals each. To provide sufficient and similar intake of proteins, the supplemental feeds were fed in the grain ration in the following proportions: cottonseed meal 6 per cent, linseed meal 8.5 per cent, cull peas 13 per cent, and meat meal 5 per cent. The results show that the quality of proteins provided by good quality alfalfa hay is sufficient to meet the need of fattening yearling steers. The rate of daily gains and the economy of gains were best in the lot fed the check ration. The palatability of the cottonseed meal, linseed

oil meal, and the cull peas appeared to be excellent. The steers did not relish the meat meal during the first 10 days, but later they consumed it readily. The quality of proteins also was tested with 65-pound range lambs using the same feeds in the same proportions as they were fed to the yearling steers, except that corn silage was omitted from the lamb rations. The results of this test indicated that the quality of proteins is more essential for a growing, fattening animal than for a mature, fattening animal. Without exception, the lots receiving the supplemental protein feeds made more rapid gains with a lower feed requirement than the lot fed chopped alfalfa hay and whole barley. Differences between cottonseed meal, linseed meal, and cull peas, which are of vegetable origin, and meat meal, which is of animal origin, were not significant, except that the feeds of vegetable origin were more palatable than the feed of animal origin.

Fifteen Hereford and 15 Angus range steers were used in a test which included a wintering period of 127 days, a pasturing period of 101 days, and a finishing period of 114 days in dry lot. This study of wintering calves is to determine the extent that irrigated pastures may be used for fattening steers and to study factors contributing to the most desirable method of finishing steers that have been summered on irrigated farm pastures. In previous trials steers that were pastured 150 days and finished in 50 or 60 days in dry lot produced carcasses having a "grassy" appearance, indicating too short a period in dry feed lot to produce the hardened finish desired in a good or choice carcass. During the wintering period 528-pound calves consumed 20.5 pounds of chopped alfalfa hay and gained 1.7 pounds per head daily. On Kentucky bluegrass and white clover pasture, and without additional feed, a gain of 1.4 pounds per head daily was made. The daily ration for the finishing period consisted of 14.7 pounds of chopped alfalfa hay, 11.5 pounds of ground barley and wheat bran with .5 pound of cottonseed meal added during the last 30 days. The average daily gain during the finishing period was 1.87 pounds. The feed costs of 100 pounds of gain for the three periods were as follows: wintering period, $4.97; pasturing period, $8.00; finishing period, $11.28; and the average for the entire period, $8.01. Feed prices were relatively higher during the finishing period than during the wintering period. When slaughtered, the steers dressed 60.2 per cent, eight of the carcasses graded choice, 11 graded good, nine graded medium good, and two graded fair, indicating that the steers had attained a good degree of finish.

### Pasture Mixtures Tested for Dairy Cattle

In 1930, eight 2-acre plots of irrigated pastures were seeded with from three to six grasses and legumes in varied rates of seeding. The grasses were orchard, meadow fescue, brome, Kentucky blue, tall oat, English rye, timothy, ladino clover, alsike clover, white clover, white and yellow blossom sweet clover. When pastured with eight 1,356-pound grade Holstein cows that had been in lactation for an average of 154 days and were producing .88 pounds of butterfat per head daily, seven 956-pound grade Holstein heifers, and four 718-pound Angus steers, the average carrying capacity per acre for all plots was 217 thousand pound animal unit days for the

season. This was equivalent to 1.42 thousand pound animals per acre for 153 days. Supplementary hay and grain were not fed to the cows or heifers and steers. The pastures were irrigated eight times during the summer at average intervals of 18 days; however, heavy rains during the early summer probably were equivalent to two irrigations. A pasture seeded with brome, orchard, meadow fescue, timothy, and yellow blossom sweet clover, at the rate of 50 pounds per acre, had a slightly lower carrying capacity than a pasture seeded with orchard, meadow fescue, and ladino clover at the rate of 12 pounds per acre. Kentucky bluegrass and white clover seeded at the rate of 15 pounds per acre produced 22 per cent less butterfat per acre than orchard, meadow fescue, and ladino clover seeded at the rate of 12 pounds per acre. Kentucky bluegrass is extensively used in irrigated pastures, but it has a tendency to become dormant during the hot summer months and thereby lowers its efficiency as a good pasture grass. The management of the pasture plots provided for removal and weighing of the cattle when the appearance of the pasture indicated that approximately 85 per cent of the forage had been grazed off. On a plot consisting of orchard, meadow fescue, Kentucky blue, tall oat, English rye, and white blossom sweet clover, the cows lost weight each of the five times they were pastured, indicating that the appearance of the forage was better than its actual condition.

### Commercial Fertilizers for Alfalfa

Sodium nitrate, treble-superphosphate, potassium chloride and gypsum, alone and in various combinations, were applied on .27-acre plots of 2-year-old alfalfa in the fall of 1936. The land had received an application of manure at seeding time and at about 3-year intervals for the preceding 12 years. No increases were obtained from the application of single materials, but in combinations slight increases were obtained. Yields for two or more years are necessary to show the residual effect which the fertilizer may have upon the crop and to provide data which may show the need for commercial fertilizers for alfalfa grown where liberal applications of manure are made at 3- or 4-year intervals.

## High Altitude Substation

W. A. Moss *in charge*

### High Altitude Substation Established Eighteen Years Ago

ONE hundred acres of nonirrigated land on the Teton River, four miles west of the town of Felt in Teton County, were leased from the State in 1919 for an experiment station to serve the farmers on nonirrigated land in regions of limited rainfall and at high altitudes.

Twenty acres of irrigated land were purchased near the town of Felt, and buildings were erected on this land, making a home for the farm superintendent. These buildings were moved in 1933 to a new site purchased in the town of Tetonia. A summer cottage and combined horse barn and machine shed were constructed on the dry farm in 1930.

The High Altitude Substation has been of great service to the agriculture of the region in the testing and distribution of crop varieties adapted

to the dry land areas of the Upper Snake River Valley. Of especial significance, perhaps, is the introduction of Oro, a variety of winter wheat. The value of this wheat to the nonirrigated agriculture of the Upper Snake River region is generally recognized.

W. A. Moss has been Superintendent of the High Altitude Substation since it was first established in 1919.

## Past Season Generally Favorable for Crops

The 1937 season was favorable for most crops, with a rainfall of 13.73 inches compared to 12.25 inches average precipitation. The rainfall from April to July, inclusive, was 6.92 inches compared to 2.93 for 1936 and 4.53 inches for the average year. There were also fewer drying winds during the growing season. These favorable growing conditions resulted in good yields for most crops. Poor stands of winter wheat, however, were secured, especially in the variety plots. This was due to especially dry weather during the fall of 1936. Some winterkilling also was indicated as stands of the less winter-hardy, beardless varieties were especially thin.

Very good yields were secured in the spring wheat nursery, some outstanding varieties yielding as much as 42.3 bushels per acre. The winter wheat nursery had a more uniform stand than the field plots of winter wheat but were not so good as the spring nursery. In the winter wheat nursery Hybrid 128 x Fortyfold, a soft white wheat, made an average of 42.0 bushels per acre. Table XI gives the average yield of both spring and winter wheat for two periods.

**TABLE XI**

**Average Yields of Both Winter and Spring Wheats on the High Altitude Substation for Two Periods: 1923-1937 and 1931-1937**

| | Average Yield in Bushels | |
|---|---|---|
| | 1923-1937 | 1931-1937 |
| Winter Wheats | | |
| Fortyfold | 17.8 | 13.6 |
| Triplet | 22.0 | 17.7 |
| Turkey Red | 22.1 | 17.2 |
| Oro | ..... | 19.0 |
| Spring Wheats | | |
| Soft Federation | 20.7 | 16.9 |
| Baart | 21.8 | 18.0 |
| Red Bobs | 20.6 | 16.5 |
| Marquis | 22.0 | 17.9 |
| Bunyip | .. | 15.9 |
| Onas | ..... | 16.6 |
| White Federation | ..... | 15.3 |

## Crested Wheat Good Dry-land Grass

The crested wheat grass in the larger plots was cut for seed again this year as there is a good demand for seed. One acre of crested wheat on the Substation yielded 400 pounds of clean seed this year. Crested wheat makes a favorable dry-farm pasture grass as it is ready to use as soon as the snow is off the ground in the spring. Sheepmen in the vicinity of

the Substation have been particularly interested in it. Selections of crested wheat have been made which should be especially adapted for pasture use.

### Results of Crop Rotation Studies Valuable

All of the winter wheat plots in the various rotations were reseeded to spring wheat last spring as some of the plots had a poor stand resulting from the dry condition of the soil when they were seeded in 1936. The heavy rainfall during the growing season of this year resulted in a very satisfactory yield on all the rotation plots. With plenty of moisture the wheat was able to take advantage of the extra nitrogen in the sweet clover plots. The average yield of wheat on the fallow plots following sweet clover was three bushels per acre more than on the two-year fallow wheat plots. The wheat-pea rotation also averaged higher than the fallow-wheat rotation.

Studies on the effect of crop rotations, under the condition of limited precipitation found at the High Altitude Substation, have been in progress since 1925. Table XII gives a summary of the results. Each rotation was duplicated each year.

The results indicate that, up to the present time, available precipitation during the growing season is more of a limiting factor on yields than soil fertility. In the future, under continued cropping, fertility and physical condition of the soil will, no doubt, become of increasing importance.

**TABLE XII**

**Summary of Results of Rotation Experiments, High Altitude Substation, 1925-1937, Inclusive; Each Rotation Duplicated**

| Rotation No. | Crop and Yield* | | | | | |
|---|---|---|---|---|---|---|
| 1 | Spring wheat 12.7 | Peas 7.2 | | | | |
| 2 | Winter wheat 14.2 | Fallow —— | | | | |
| 3 | Peas 9.0 | Spring wheat 12.8 | Fallow —— | | | |
| 4 | Sweet clover —— | Sweet clover 1.20 T. | Potatoes 41.2 | Spring wheat 17.5 | | |
| 5 | Sweet clover —— | Sweet clover 0.98 | Spring wheat 11.6 | Fallow —— | Winter wheat 15.8 | |
| 6** | Spring wheat + Sweet clover 7.9 | Sweet clover plow under and fallow —— | Winter wheat 15.2 | Fallow —— | Winter wheat 13.5 | |
| 7 | Sweet clover —— | Sweet clover 1.15 T. | Fallow —— | Winter wheat 15.2 | Fallow —— | Winter wheat 14.6 |

*Yields are expressed as follows: cereals—bushels; potatoes—hundredweight; sweet clover hay—tons.
**Average of eight years' results—1930-1937, inclusive.

### Ladak Alfalfa Yields Highest

Ladak alfalfa still holds the lead in yield, with Cossack a close second. Table XIII gives the four-year average yield of a number of alfalfa varieties. There was a difference of 1,400 pounds in the four-year average yield of Ladak over French, a non-hardy variety. This difference in yield of hay each year will more than pay the difference in price of the seed of the two varieties, yet some farmers plant the less hardy varieties because they can buy the seed cheaper. Last spring data on yields of the different varieties of alfalfa were sent to local dealers and several county agents. In most cases dealers advised their customers to plant the hardier varieties.

**TABLE XIII**

**Four-years' Average Yield of Certain Alfalfa Varieties, 1934-1937**

| Varieties | Tons |
|---|---|
| 1. Ladak | 2.03 |
| 2. Cossack | 1.93 |
| 3. Grimm | 1.88 |
| 4. Hardigan | 1.85 |
| 5. Baltic | 1.84 |
| 6. Kansas | 1.77 |
| 7. Canadian Variegated | 1.74 |
| 8. Idaho Grimm | 1.74 |
| 9. Utah Common | 1.70 |
| 10. North Dakota Grimm | 1.67 |

Other varieties tested (arranged in order of descending yields): Dakota Common, Hardiston, Turkestan, Argentine, French, Arizona Common.

### Needs for Future Development

Continuation of work under way and the development of other lines of research needed for the high altitude region necessitate the purchase of a small tractor and certain other farm equipment. Storage facilities for potatoes and root crops are inadequate, and a potato cellar on the property located at Tetonia should be constructed as soon as possible. Serious loss has been experienced nearly every year because of freezing of potatoes in storage.

## Sandpoint Substation

RALPH KNIGHT *in charge*

### Twenty-five Years of Service to Northern Idaho

THE Sandpoint Substation Farm was established in 1912. A deed to 170 acres adjacent to the City of Sandpoint was given in escrow to the University of Idaho so long as the farm is used for demonstration purposes.

William Heideman was the first Superintendent, and the preliminary work of clearing the land from timber and starting agricultural operations was under his direction. Heideman was followed by Frank La Frenz, and he was succeeded by Chase Raney, who in turn was followed by J.

H. Christ. Christ served as Superintendent from 1921 until 1935, and with increased funds, the farm developed rapidly under his direction. Ralph Knight has served as Superintendent since Christ resigned.

Contributions from the Sandpoint Substation to the agriculture of the cut-over farms of northern Idaho have been many and varied. Outstanding, perhaps, in direct value to this section has been the development of the forage resources of the region. Alfalfa, clovers, and grasses are of vital importance in the farming program, and their introduction and development in the region have been fostered by the Substation from an early date. The use of gypsum is essential for successful growing of alfalfa. This fact was demonstrated on the Substation farm. The work of the Substation always has been planned to meet the needs of the farmers on cut-over lands, and farmers of northern Idaho have made extensive use of this information.

Fig. 19.—Natural grove of Sandpoint Substation. Annual Field Day picnics are held in this grove.

## 1937 Season Favorable

The majority of farmers are of the opinion that the 1937 season was the most favorable ever experienced here, insofar as crop production is concerned. Good snow coverage prevailed from early December of 1936 until after mid-March of 1937, and the winter wheat and alfalfa emerged in the spring with practically no winter injury. During the summer months of June, July, and August there was a total of 6.30 inches rainfall, the highest ever recorded for that period. The rains were well distributed so that the soil was amply supplied with moisture during the entire growing season. Only .52 inches rain fell during May, setting a record low for that month. November precipitation soared to the other extreme with a record fall of 8.02 inches. The total for the first 11 months was 31.60 inches, 7.18 inches above the average for that period and 2.93 inches

above the normal for the entire year. Temperatures went to extremes in several instances. Sixteen days of zero or below were observed in January, with a minimum of -29 degrees on January 20. The mean minimum was minus 1.0 degree, making this the coldest month in history. Mean temperatures for October, on the other hand, were the highest on record for that month. There were only three days when the temperature was 90 or above, and the maximum for the year was 91 degrees. The period between killing frosts extended from June to September 22, a total of 110 days. This is one week shorter than the average frost-free period and 43 days shorter than the 1936 growing season.

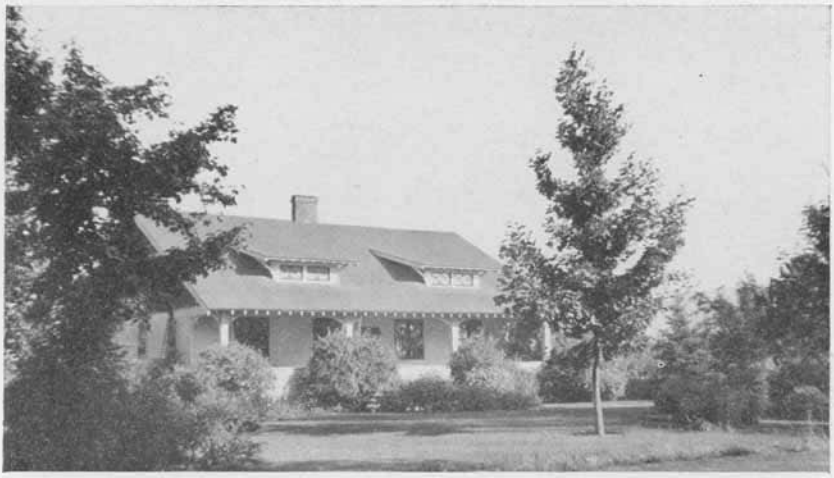


Fig. 20.—Superintendent's home on Sandpoint Substation Farm.

## Hybrid Wheats Yield High

Winter wheat varieties produced record yields this year. A good snow coverage afforded ample protection throughout the severe winter months, and observations in the spring revealed no injury either from snow scald or heaving. All varieties attained a height considerably above normal, but the per cent of lodging was negligible. While, as stated, yields as a whole were exceptional, the rank of some of the varieties, based on past performance, was almost, if not entirely, reversed this year. Kharkof, which has had the lowest average yield over a period of years, came to the front with a production of 56.7 bushels, while Albit, which has quite consistently maintained a top place rating, was third from the bottom with 42.4 bushels. Hybrid 128 was low with 38.1 bushels. Hymar, grown here for the first time this year, produced 47.4 bushels. Yields from Mosida, Triplet, 40-Fold, and Rosen rye were above 50 bushels in each case.

In the uniform winter wheat nursery C.I. 11695 and C.I. 11755 ranked high with yields of 59.1 bushels and 58.2 bushels, respectively. The first is a Triplet x Oro cross and the latter a 40-Fold x Hybrid 128 cross. C.I. 11692, a Hard Federation x Martin cross, was approximately 50 per cent

winterkilled and produced only 26.3 bushels. Jenkin was almost entirely winterkilled, and no yields were taken from this variety. In spite of the unusually long straw, there was no lodging of any consequence except in some of the Jenkin hybrids and a few other varieties, such as Rio, Relief, and Utah Kanred. Here the lodging ranged from 40 per cent to 100 per cent.

Onas ranked first in the spring wheat varieties with a yield of 38.8 bushels, almost double the six-year average. Red Bobs and Federation were second and third, respectively. Dicklow, which has been high during the 1931-1936 period, was low with 30.6 bushels. All spring wheat was heavily infected with stem rust, with the late-maturing varieties subject to the greatest injury. This fact undoubtedly accounts in some measure for the comparatively poor showing of Dicklow and Bluestem. Early varieties, such as Federation and White Federation, made record yields. Federation 47 was high in the spring nursery with 39 bushels, followed by Federation 15 and Bluestem.

Golden Rain, Banner, and Victory were the leaders in the oat variety test, the first making 76.7 bushels per acre. C.I. 2956, a Markton x Victory cross, led all other varieties in the nursery with 86.8 bushels. Hannchen maintained first place in the barley varieties with a yield of 39.5 bushels, followed by Union with 37.5 bushels. Beldi and Peruvian were high in the nursery.

### Eleven Potato Varieties Tested

The variety test consisted of 11 varieties. Some of the seed came from the Home Station at Moscow, some from local farmers, and some was carried over from the regular trials at the Sandpoint Substation. The Houma returned the best yield with 9,620 pounds per acre. This variety has yielded well consistently during the years that it has been grown here and has so far maintained remarkably free of any virus infection. The Red McClure, in its first trial year, was second high with 8,932 pounds. All of the Bliss Triumph and one plot of the Warba showed a heavy infection of mosaic. The Chippewa and Katahdin both made a poorer showing than usual.

### Sulphur Increases Yield of Alfalfa

Yields were taken this year from a series of fertilizer plots which were seeded in 1936. The fertilizers included sodium nitrate, ammonium sulphate, treble-superphosphate, muriate of potash, gypsum, manure, and various combinations of these materials. Ammonium sulphate, supplying both nitrogen and sulphur, outyielded the gypsum plot by a scant 40 pounds, and each of these produced approximately one and three-fourths tons more hay per acre than the check plots. It is interesting to note that manure produced the third highest yield of alfalfa hay. The plots fertilized with sodium nitrate, treble-superphosphate, and muriate of potash, singly and in combination, averaged only 829 pounds per acre higher than the unfertilized areas. These results substantiate those of previous years—namely, that sulphur is the limiting element, and the most economical method of

supplying the deficiency is in the form of gypsum. There have been numerous cases, however, in which new seedings of alfalfa have not been entirely satisfactory despite the fact that gypsum was used. In these instances the color was poor, and the plants lacked vigor. Preliminary trials indicate that an application of ammonium sulphate may correct this condition and return a profit in the form of an increased yield during the first crop year.

### Nurse Crop Retards Legumes

An experiment dealing with the effect of using a nurse crop with clover and alfalfa was started this year. The nurse crops included peas, oats, wheat, barley, and flax. No definite data will be available until a crop is harvested next year. Observations showed, however, that in spite of the extremely wet season, the growth of the legumes was greatly retarded by the nurse crop. The one exception was when peas were used, and here the growth of the alfalfa and clover compared favorably with that of the check plots. Growth of the legumes was poorest when flax was used as a nurse crop, none of the plants attaining a height of more than a few inches.

### Grains and Grasses Respond to Fertilizers

Significant results were obtained this year through the application of commercial fertilizers to cereal crops. Five plots to which were applied fertilizers containing some nitrogen yielded one-third more barley, grain, and straw than the six plots which were unfertilized. Treble-superphosphate and muriate of potash gave no significant benefit unless used in conjunction with a nitrogenous fertilizer. The plot receiving 10 tons of manure showed an increase of 22 per cent over the untreated plots.

Crested wheat grass grown for seed also showed response from fertilizer applications. The unfertilized plots yielded 466 pounds of seed per acre; 150 pounds of ammonium sulphate increased the yields 26 per cent; and 500 pounds of a complete fertilizer increased the seed yields 49 per cent.

### Comparison of Fall and Spring Application of Fertilizers

Fall and spring applications of ammonium sulphate, treble-superphosphate, and muriate of potash, alone and in various combinations, were made using potatoes as the index crop. Although these results are of a preliminary nature and are based on only one year's trials, the average of the fall applications showed an increase of approximately 8 per cent over the unfertilized, as compared to approximately 10 per cent increase for the spring applications.

### Grass Seed Production Good

Excellent yields were secured from grasses in a four-acre field which was seeded in 1935. These were all seeded in rows three feet apart, except in the tall oat grass the spacings varied from one to four feet. Considerable hand work was done the first year in removing weeds from the rows, but an occasional cultivation and hand roguing after the grasses headed has been the only necessary labor since that time. Yields of the past two years are given in Table XIV.

As previously indicated, part of the crested wheat acreage was devoted to fertilizer trials this year, and the yields varied from 456 pounds to 694 pounds per acre. The figures given represent the acre harvest from the entire area. The marked increase obtained through the use of fertilizers suggests that the interval between rows may be decreased if fertilizers are used, although it has been found easier to produce clean seed when the spacing is wide enough to permit the use of a cultivator. Yields of orchard grass are lower than ordinarily may be expected, due to the fact that alternate showers and drying weather during the curing process caused an unusual amount of shattering.

**TABLE XIV**

**Yields of Grass Varieties on Sandpoint Substation in 1937**

| | 1936 | | 1937 | |
|---|---|---|---|---|
| | Seed | Hay | Seed | Hay |
| Crested Wheat | 287 | 1353 | 532 | 2822 |
| Slender Wheat | 449 | 1960 | 610 | 2886 |
| Orchard Grass | —— | —— | 283 | 2877 |
| Tall Oat Grass | | | | |
| One-foot spacing | 375 | 2563 | 216 | 1160 |
| Two-foot spacing | 251 | 1965 | 224 | 1500 |
| Three-foot spacing | 243 | 2340 | 292 | 2170 |
| Four-foot spacing | 120 | 1560 | 228 | 1970 |

**FINANCIAL STATEMENT**

**Detail of Expenditures of Federal Appropriations Idaho Agricultural Experiment Station July 1, 1936, to**

**June 30, 1937**

| | Abstract | Hatch | Adams | Purnell | Bankhead-Jones |
|---|---|---|---|---|---|
| Salaries | 1-A | $ 9,808.33 | $13,817.86 | $38,328.26 | $2,033.34 |
| Labor | B | 2,806.21 | 395.77 | 7,584.55 | 2,052.65 |
| Stationery and office supplies | 2-A | 12.43 | 3.80 | 373.32 | 60.32 |
| Scientific supplies | B | 315.53 | 235.87 | 2,654.50 | 106.49 |
| Feeding stuffs | C | 12.78 | | 1,890.02 | 948.00 |
| Fertilizers | D | 9.60 | | 12.61 | |
| Sundry supplies | E | 37.74 | 23.49 | 185.95 | 69.99 |
| Communication service | 5 | 70.62 | 1.60 | 213.29 | 2.17 |
| Travel expense | 6 | 944.31 | 99.89 | 2,013.54 | 741.22 |
| Transportation of things | 7 | 61.65 | 10.09 | 212.57 | 40.96 |
| Publications | 8 | 46.45 | | 1,722.16 | |
| Heat, light, water, and power | 10 | 24.56 | 215.85 | 424.32 | |
| Contingent expense | 13 | 10.00 | 37.10 | 37.85 | |
| Furniture and fixtures | 30-A | 14.36 | 20.96 | 786.58 | |
| Library | B | | | 74.04 | 6.40 |
| Scientific equipment | C | 135.25 | 129.66 | 2,688.16 | 148.82 |
| Tools and machinery | D | 35.25 | 2.20 | 207.83 | 33.92 |
| Livestock | E | 18.00 | | 1,000.00 | |
| Buildings and land | 31 | 636.93 | 5.86 | 490.45 | 615.00 |
| Total | | $15,000.00 | $15,000.00 | $60,000.00 | $6,859.28 |

## SUBSTATION DISBURSEMENTS

### January 1 to December 31, 1937

| | Aberdeen | Caldwell | High Alt. | Sandpoint | Total |
|---|---|---|---|---|---|
| Salaries | $ 3,299.96 | $ 2,169.96 | $1,800.00 | $3,080.04 | $10,349.96 |
| Help | 4,617.37 | 2,247.68 | 655.60 | 649.88 | 8,170.53 |
| Expense and supplies | 5,364.43 | 4,744.72 | 853.76 | 1,029.12 | 11,992.03 |
| Equipment | 6,149.12 | 1,471.91 | 57.79 | 116.25 | 7,795.07 |
| Total | $19,430.88 | $10,634.27 | $3,367.15 | $4,875.29 | $38,307.59 |

## DISBURSEMENTS BY DEPARTMENTS

### Detail of Expenditures of State Appropriations*
### Idaho Agricultural Experiment Station

### January 1 through December 31, 1937—Home Station

| | Admin. | Agr. Chem. | Agr. Econ. | Agr. Engr. | Agron. | An. Husb. | Bacter. | Dairy Husb |
|---|---|---|---|---|---|---|---|---|
| Salaries | ..... | ..... | ..... | 48.92 | ..... | ..... | ..... | ..... |
| Help | 36.75 | ..... | ..... | ..... | 241.82 | 80.00 | ..... | 266.80 |
| Expense & Supplies | 1489.41 | 33.10 | 160.85 | 16.89 | 311.51 | 175.35 | 16.12 | 852.60 |
| Equipment | ..... | 1.78 | 3.50 | ..... | 5.19 | 114.28 | ..... | 123.46 |
| Total | 1526.16 | 34.88 | 164.35 | 65.81 | 558.52 | 369.63 | 16.12 | 1242.86 |

| | Entom. | Home Ec. | Hort. | Plant Path. | Poultry | Soil Sur. | Total |
|---|---|---|---|---|---|---|---|
| Salaries | ..... | ..... | ..... | ..... | 48.52 | ..... | 97.44 |
| Help | ..... | ..... | 111.63 | ..... | 597.47 | 236.48 | 1570.95 |
| Expense & Supplies | 104.67 | .51 | 213.67 | 71.38 | 1112.88 | 771.25 | 5330.19 |
| Equipment | ..... | 1.77 | ..... | ..... | 17.70 | ..... | 267.68 |
| Total | 104.67 | 2.28 | 325.30 | 71.38 | 1776.57 | 1007.73 | 7266.26 |

*Includes general appropriation and institutional funds.