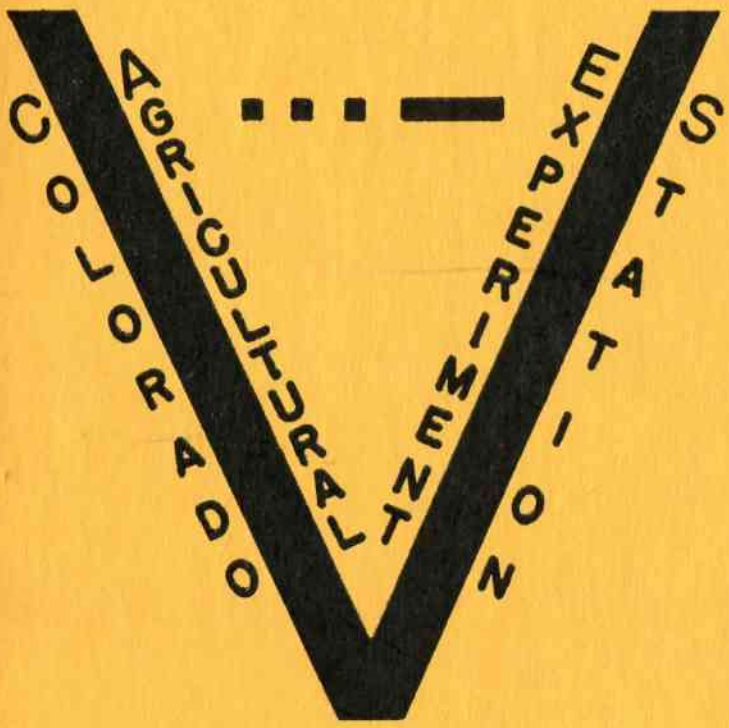
Fifty-Fifth Annual Report



1941-42

COLORADO STATE COLLEGE
Fort Collins

Fifty-Fifth Annual Report

COLORADO AGRICULTURAL EXPERIMENT STATION

1941-42

COLORADO STATE COLLEGE
Fort Collins

Colorado State College

COLORADO AGRICULTURAL EXPERIMENT STATION

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Animal Investigations

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Howard C. Dickey, Ph.D., Assistant Animal Husbandman
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A. O. Simonds, Ph.D., Asst. Botanist
W. A. Kreutzer, Ph.D., Assistant Plant Pathologist
M. E. Paddick, Ph.D., Asst. Plant Physiologist
J. L. Forsberg, M.S., Assistant Plant Pathologist

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C. E. Vail, M.A., Associate Chemist
‡William T. Newcomb, B.S., Assistant

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George M. List, Ph.D., Associate Entomologist
John L. Hoerner, M.S., Associate Entomologist
Leslie B. Daniels, M.S., Associate Entomologist

Horticulture

A. M. Binkley, M.S., Horticulturist
Louis R. Bryant, Ph.D., Associate Horticulturist
John G. McLean, Ph.D., Associate Horticulturist
¶George A. Beach, M.S., Assistant Horticulturist
‡Ralph Manuel, B.S., Assistant in Horticulture
§Walter C. Sparks, B.S., Assistant in Horticulture

Home Economics

Inga M. K. Allison, S.M., Home Economist
W. E. Pyke, Ph.D., Associate in Home Economics Research
‡Gestur Johnson, B.S., Assistant in

Pathology and Bacteriology

Floyd Cross, D.V.M., Veterinary Pathologist
I. E. Newsom, B.S., D.V.S., D.Sc., Veterinary Pathologist
Dudley P. Glick, Ph.D., Associate Bacteriologist
Hilton A. Smith, D.V.M., M.S., Associate Veterinary Pathologist
A. W. Deem, D.V.M., M.S., Assistant Veterinary Bacteriologist
G. S. Harshfield, D.V.M., M.S., Asst. Veterinary Pathologist
Frank X. Gassner, D.V.M., Assistant Pathologist
‡Thomas D. Kroner, Ph.D., Assistant in Bacteriology.
‡Alvin D. Hoerlein, D.V.M., Assistant in Veterinary Pathology
§Max E. Tyler, M.S., Assistant Bacteriologist

Poultry

H. S. Wilgus, Jr., Ph.D., Poultry Husbandman
Livingston P. Ferris, II, M.S., Assistant in Poultry Investigations

Range and Pasture Management

E. W. Nelson, M.S., Range Conservationist
Clinton H. Wasser, B.S., Assistant in Range Management
¶Frank J. Kapel, M.S., Assistant in Range Management

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L. A. Moorhouse, M.S., Rural Economist
R. T. Burdick, M.S., Associate Rural Economist
R. W. Roskelley, Ph.D., Assistant Rural Sociologist
§A. W. Epp, M.S., Assistant Economist
Robert T. Elliott, B.S., Assistant in Economics and Sociology

Seed Laboratory

Bruce J. Thornton, M.S., In Charge
†Anna M. Lute, A.B., B.Sc., Seed Analyst
§Helen M. Kroeger, B.S., Seed Analyst

Substations:

Herman Fauber, M.S., Supt., Rocky Ford
Ferris M. Green, B.S., Supt., Austin
Dwight Koonce, M.S., Assoc. Agronomist, Fort Lewis

ENGINEERING DIVISION

Civil Engineering

N. A. Christensen, Ph.D., Chairman Engineering Division
W. E. Code, B.S., Associate Irrigation Engineer
*Adrian R. Legault, M.S., Assistant Civil Engineer
*D. F. Gunder, Ph.D., Associate in Hydraulics Research
Maxwell Parshall, B.S., Meteorologist
Cooperators:
R. L. Parshall, B.S., Senior Irrigation Engineer, U. S. D. A.
Carl Rohwer, B.S., Irrigation Engineer, U. S. D. A.

Mechanical Engineering

J. T. Strate, M.S., In Charge
Cooperator:
E. M. Mervine, M.E., Agricultural Engineer, U. S. D. A.

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*On leave
¶On military leave
‡Resigned
†Retired

Letter of Transmittal

Fifty-Fifth Annual Report
Colorado Agricultural Experiment Station

Hon. Ralph L. Carr
Governor of Colorado
Denver, Colorado

Sir:

In compliance with the law, I herewith present the Fifty-Fifth Annual Report of the Colorado Agricultural Experiment Station for the fiscal year of July 1, 1941 to June 30, 1942, inclusive.

Homer J Henney

Director

Fort Collins, Colorado
July 1, 1942

Contents

In Memoriam

L D Crain, chairman of the Engineering Division of the Experiment Station for 20 years until his retirement in 1936, passed away on March 15, 1942, at the age of 74 while visiting his son at Long Beach, Calif.

Professor Crain was born in Steuben County, Ind., on February 3, 1868. He held the degree of Bachelor of Mechanical Engineering from Purdue University and Master of Mechanical Engineering from Cornell University. He came to Fort Collins in 1892 as assistant in the Department of Mechanical Engineering of Colorado State College. In 1903 he organized the Department of Electrical Engineering and became the first professor of electrical engineering at the College.

L D Crain

From 1905 to 1912 Professor Crain engaged in contracting and engineering work in Fort Collins, returning to the College in 1912 as associate professor of mechanical engineering. In 1917 he was appointed professor and head of the Mechanical Engineering Department and chairman of the Station's Engineering Division.

Professor Crain was a member of the following professional and honorary organizations: American Society of Mechanical Engineers, Sigma Xi, Phi Kappa Phi, and Sigma Tau.

55 Years of Service

With the ending of the fiscal year of 1941-42, the Colorado Agricultural Experiment Station brings to completion 55 years of scientific service to the agriculture of Colorado and the nation.

An experimental department was maintained in connection with the State Agricultural College, now known as Colorado State College of Agriculture and Mechanic Arts, from the time of its organization in 1879. In February 1888 the Colorado Agricultural Experiment Station was organized under the provisions of a Congressional act of the preceding year.

Management of the Station was vested in an executive committee consisting of three members of the State Board of Agriculture. Officers of the Station were the director and the secretary-treasurer, with a working staff representing the various departments of the experimental work.

The Station organization was effected at a special meeting of the State Board of Agriculture held at Del Norte on February 20, 1888.

During the 55 years of its existence the work of the Colorado Agricultural Experiment Station has been under the supervision of the following men who have served as directors: C. L. Ingersoll, 1888-91; Walter J. Quick, 1891-93; Alston Ellis, 1893-99; L. G. Carpenter, 1899-1910; C. P. Gillette, 1910-32; E. P. Standsten, 1932-39; Charles H. Kick, July 1-August 27, 1939; I. E. Newsom, 1939-41; Homer J. Henney, 1941 to date.

Director's Annual Report

Fifty-Fifth Fiscal Year 1941-42

Colorado Agricultural Experiment Station

To the President and State Board of Agriculture:

The Station research program in 1941-42 divides itself as a result of the war emergency into two definite parts. Research the first half of the year is easily recognizable as a revamped defense research program; that in the second half approaches a speeded-up research program streamlined for war purposes.

Early in the year it was evident that the Experiment Station must shelve or abandon some of the older long-time research projects in order to have funds to start some new defense projects. By the middle of the fiscal year statistics were available from Selective Service Boards and War Production Boards indicating the need of nutritional studies and data on substitute agricultural commodities. Much of the streamlining of projects was achieved by shelving or abandoning projects which, although important in peace time and from the long-time point of view, would contribute little to solving war-time problems. Also, funds provided by special interest groups have made possible an enlarged program.

War Research Started

Among the new research investigations initiated to answer war problems are: (1) The place of Colorado plants in the United States rubber production program; (2) the importance of Colorado vegetables and fruits in the nutrition program for men in service; (3) the possibility of new crops in Colorado to replace previously imported agricultural crops; (4) mechanization in agriculture to release labor; (5) research on new ways to pack and transport wool to woolen mills; and (6) reduced losses of animal by-products by decreasing the percentage of abscessed livers.

A rubber-crop production committee is studying the rubber content and distribution of poisonous and other wild plants in Colorado. Arrangements have been made with the U. S. Department of Agriculture to obtain guayule plants for planting trials in 10 locations in Colorado. A special chemistry unit has been assigned the task of making all the analyses of rubber plants grown in Colorado.

The nutrition committee has developed an over-all nutrition program and has published already a "yardstick" for measuring the daily diet. Also published are tables showing nutritional values of common foods and nutritional requirements of individuals. For the first phase three students are serving as experimental subjects in a

test of the value of pinto beans in replacing animal protein in the diet. Other phases will start as certain crops this season come into production.

The victory garden committee has outlined a program to test the adaptability of certain crops for both production and seed production at different altitudes in Colorado. Only those crops whose seed source has definitely been cut off for the duration will be tested in 1942.

The new-crops committee has compiled information for the use of Colorado's delegation in Congress and of the Office of Experiment Stations in consideration of a measure in Congress which would provide funds for finding new crops for use in industry to replace those previously imported but not now available. Colorado, because of its altitude and climate, is particularly adapted for the growing of certain drugs and condiments as well as high-quality fruits and vegetables and pyrethrum as an insecticide.

Projects Shelved or Abandoned for the Duration

Several projects have been shelved or are being abandoned because they are adapted only to peace-time economy, because results can be expected only after several years of research, or because a solution to the problem has been largely worked out. These include: Control of coccidiosis in feeder lambs through management; the lag phase in plant growth following soil disinfection; effect of varieties, plant spacing, and soil treatment on yield, fruit quality, and incidence of root troubles with strawberries; effect of mineral nutrient deficiencies upon vegetative growth and flowering of carnations; winter-injury control in raspberries; Colorado insect fauna; inorganic elements in poultry nutrition; sources of green feed for turkeys.

Research Organized Around Substations

In response to demands from the field and to fulfill the obligation of the Station when additional funds were granted it by the State Legislature in 1941, work has been done on the following problems:

1. Feeding cattle at Akron on feeds commonly grown on the dry lands of Colorado.

2. Discovery of the causes for and possible remedies for an unthriftiness of cattle wintered on certain Middle Park hay.

3. Discovery of the causes for and possible remedies for loss of pregnant ewes on the Western Slope.

4. Investigation on increasing the value of manure—study of the factors affecting losses while being made, stored, spread, and in soil but before utilization by plant.

5. Increased attention has been given to potato diseases in Weld County and the San Luis Valley.

6. Increased effort has been put on the study of peach mosaic in Mesa County.

7. Causes for pup losses and nonbreeders has been attacked for the growers of fur-bearing animals centered in Jefferson County.

Preliminary planning has been done on projects to answer acute problems presented by farmers at Cheyenne Wells, Craig and Briggsdale; most of these problems center around overgrazing, revegetation, and rehabilitation of cropland or contour farming.

The programs planned to date to solve these problems are set forth in the reports of the individual sections of the Station.

A substation program has been outlined and problems in the counties are being tied as nearly as possible to the substation manager. It is hoped that within another year all problems away from the main station will be directed by workers at the main station but supervised by someone at the following substations: Akron, Cheyenne Wells, Rocky Ford, Monte Vista, Fort Lewis, Austin, Craig, and Briggsdale. Problems in four to six counties can be centered through a substation. In this way farmers' suggestions and their needs can be correlated faster into the research program for Colorado. If such a revamped substation program can be perfected, county agents can save a lot of time and expense in getting the right answer to farmers and stockmen.

Functional Reorganization of the Station Staff

To assist with administrative problems an emergency advisory council was chosen by ballot by the Station staff. The council has as its members I. E. Newsom, D. W. Robertson, A. M. Binkley, W. H. Leonard, and L. W. Durrell, with alternates as follows: W. E. Pyke, G. M. List, D. P. Glick, Floyd Cross, and R. W. Roskelley.

Other committees appointed for special functions are as follows:

Nutrition committee—W. E. Pyke, chairman; George Beach, L. W. Durrell, D. P. Glick, E. M. Mervine, D. W. Robertson, L. E. Washburn, and H. S. Wilgus, Jr., with Miss Inez Eckblad and Miss Ruth McCammon as advisors.

Rubber-crop production committee—D. W. Robertson and C. F. Metz, co-chairmen; L. R. Bryant, C. H. Wasser, M. E. Paddick, and

J. W. Tobiska, with D. F. Costello, T. G. Stewart, and R. J. Preston as advisors.

Refrigerator locker and frozen food committee—Melvin Hazaleus, chairman; Elizabeth Dyar, W. E. Pyke, E. B. Williams, Joan Mabel Jones, and L. R. Bryant.

Committee in charge of substations—A. M. Binkley, chairman; W. A. Kreutzer, W. E. Pyke, L. R. Bryant, and D. W. Robertson.

Livestock improvement committee—temporarily inactive.

Crop plant improvement committee—temporarily inactive.

Station library-editorial committee—W. E. Pyke, chairman; H. S. Wilgus, Jr., W. H. Leonard, and L. E. Washburn.

Special equipment committee—E. W. Nelson, chairman; W. E. Pyke and H. S. Wilgus, Jr.

New crops committee—W. H. Leonard, chairman; J. G. McLean, W. A. Kreutzer.

Substation committee—A. M. Binkley, chairman; D. W. Robertson, R. C. Tom.

Station-Extension coordinating committee—A. M. Binkley, D. W. Robertson, and R. W. Roskelley.

Farm operation advisory committee—A. W. Epp, secretary; Robert Gardner, and A. Lamar Esplin.

Committee on coordination of all Colorado agriculture research agencies—A. M. Binkley, chairman; D. W. Robertson, H. B. Osland, C. A. Connaughton, and W. C. Edmundson.

Miscellaneous

A memorandum of understanding between the Station and the Extension Service has been worked out to improve cooperation between the two agencies so that each may be able better to serve the public.

A meeting of all Federal and State cooperators in agricultural research was held on the campus to develop better understanding and cooperation between the various agencies and, in keeping with recommendations of a resolutions committee, an organization of agricultural research workers in Colorado to further cooperation is being established.

Organization of the Colorado Agricultural Research Foundation which was begun last year has been completed.

Cooperation with the Agriculture Adjustment Administration consists mostly in a station technical committee which meets at call with the state committee in an advisory capacity.

Personnel

The war has taken a heavy toll of our manpower. Those who have been called to duty in the armed forces are George Beach, Ralph Weihing, Robert Whitney, and Vincil Bishop. William Newcomb and Frank Kapel have gone to war industry employment, and Gestur Johnson and O. H. Coleman have gone to other positions created by the emergency. Melvin Hazaleus is on call for the near future.

A. D. Edgar, an employee of the U. S. Department of Agriculture, now stationed at Scottsbluff, Nebr., is to be stationed at Fort Collins beginning July 1, 1942. His research will deal with problems of storage of potatoes, onions, and other perishable crops. He is an agricultural engineer especially trained in construction of farm buildings and storage cellars.

Arrangements are being completed whereby several members of the chemistry department of the college will be added to the Chemistry Section of the Experiment Station to do research relative to the industrialization of agricultural crops.

To meet this shortage in manpower at least partially and to aid the Dean of the Graduate School to improve the institution's graduate training at the same time, a 10-year program is being formulated under which 10 to 15 research fellowships will be granted each year.

Administrative Costs

The total cost for all projects for the fiscal year 1942-43 will approach $250,000, compared with $236,000 originally approved for the previous year 1941-42. Sales receipts from experiments for the 1941-42 fiscal year will be about $40,000 making a net cost from federal and state funds of slightly over $200,000. Receipts estimated for the 1942-43 fiscal year are about $45,000.

During 1941-42 a special effort was made to obtain funds from special interest groups to supplement the $110,000 of federal funds, the $90,000 of state funds, and the $40,000 obtained from receipts.

Proposals for financing a program of $250,000 for the 1942-43 fiscal year and one which it is hoped will approach a $300,000 item by the end of the proposed 5-year program is as follows:

It is hoped that the total federal funds (Bankhead-Jones, $20,000; Purnell, $60,000; Adams, $15,000; and Hatch, $15,000) will be increased to $125,000 by the granting of at least $5,000 to $10,000 of the national appropriation for nutritional research. To date the Colorado Station has not been allocated any of this special appropriation.

It is hoped that from any unused salaries budgeted at the be-

ginning of each year and not used because men are in service special equipment may be purchased as is being done for the 1941-42 fiscal year.

Funds from receipts are expected to be increased $10,000 to $20,000 per year over the average of the receipts for the 3 years prior to the 1941-42 fiscal year which were $32,000. From these expected increased receipts during the 3 years 1942 to 1944, inclusive, it is hoped that 10 to 15 percent may be impounded so that for the 5-year program there will be available $40,00 each year rather than $50,000 in the years of highest sales and $20,000 in the years of lowest sales.

The Director expects that special interest groups will provide funds about as follows: On an annual basis—commercial fertilizer and commercial feed interests, $1,000; breed associations, $1,000; fox farmers, $500; county research groups, $5,000; sugar beet companies, $3,000; irrigation companies, $1,000; potato growers, $1,000; and state publicity, $2,500. Other special interest groups added during the next year or two should make this total around $15,000 annually over the 5-year period.

It is hoped that the Colorado Agricultural Research Foundation will be able to provide $15,000 to $20,000 annually by the end of the next 5 years.

A rough estimate of the funds that might be obtained from the sources mentioned above approaches $300,000 annually compared with $225,000 for the 1941-42 fiscal year. The Station program when enlarged, revamped to meet the demands of Colorado farmers and stockmen should be able to spend this money so as to return many times this amount in increased agricultural income.

Agriculture Division

Agronomy

Alfalfa Winter Killing and Wilt Resistance

A study on technic of plot size and arrangement was completed. This study indicated that safe and comparable field yields could be obtained from a plot consisting of five rows 18 feet long, spaced 12 inches between rows. This finding very greatly reduces the expense of testing strains, whether created by ourselves or brought in from the outside. Studies were completed also on technics of determining plot yields. Tests using green weights as a measure of yield proved unsafe. Green weights vary too much to give values comparable to field hay yields. Tests using air-dry weights of hay to obtain comparative

yields were found to be safe. The error from such results was small enough so that trials could be safely checked against field yields. These methods permit a very great reduction of land and labor. By taking samples and later making moisture tests of the samples, comparable and more exact yields can be computed.

Barley Genetics

The barley genetics project has given rise to two types of results: Scientific results on the locations of genes and chromosomes; and, as a by-product, new varieties of barley out of progenies of the crosses. Tests of resistance to loose smut were successfully conducted during the year. Two new genes were located in chromosomes. One of these was a gene arising from X-ray treatment.

Factors Affecting the Availability of Plant Nutrients

Corn yields were greatly reduced from lack of nitrogen after corn, sugar beets, wheat, sugar beets, and barley had been grown in succession on the same plots. No such reduction of yield occurred on land with the same crops in rotation plus 4 years of alfalfa. Small-grain yields were reduced in the rotation without alfalfa but to a smaller extent than were corn yields. Sugar-beet yields were greatly reduced from an apparent decrease in available phosphorus in both rotations as well as low nitrogen in the rotation without alfalfa.

Western wheatgrass was found to suffer severe phosphate deficiency on samples of subsoil but showed no evidence of phosphate deficiency on samples of surface soil taken from immediately above the subsoils tested.

Optimum Nutrient Content of Soils

Sugar beets were found to contain a lower percentage of sugar on soil with more than enough nitrates to supply the needs of the crop than on soil with only enough for the crops needs. However, an excess equivalent to several hundred pounds of a concentrated nitrate fertilizer was necessary to lower the total yield of sugar per acre.

Land-Use Soil Surveys

Soil surveys were conducted in cooperation with the Soil Survey Office of the Bureau of Plant Industry and the Soil Conservation Service. In cooperation with the Soil Conservation Service, field work on surveys was completed in Weld, Morgan, Logan, Yuma, Sedgwick, Phillips, a part of Washington, a part of Lincoln, and Kit Carson Counties. These surveys have been made use of immediately by the Colorado USDA War Board. Field work on soil surveys in cooperation with the Soil Survey Office of the Bureau of Plant In-

dustry was completed in the Grand Junction-Palisade districts and begun in the Delta-Montrose districts. These surveys have been used extensively this year by the Bureau of Agricultural Economics, Farm Security Administration, county agents, county land-use planning committees, soil conservation districts, and the Soil Conservation Service. A county report on soil conservation surveys was made for Yuma County.

Disease Resistance of Small Grains

The project on disease resistance of small grains has been carried now 2 years with only preliminary results to report. In cooperation with the Cereal Office of the Bureau of Plant Industry, tests were made on Bannock oats which are proving quite resistant to smut. Arrangements have been made, through this cooperation, for farm introduction in 1942.

Akron Dry-Land Projects

One phase of a study of the rate and date of planting wheat with relation to foot-rot severity was completed and published. These studies show that wheat planted in the warmer weather of August suffers severely from the prairie foot rot. Wheat planted between September 1 and 15 escapes most of the damage. The behavior seems to be a temperature relationship. If the temperature is too high, the foot rots cause much damage; if the temperature is just right, foot rots do little damage; and if the temperature is too low at the time of planting, yields are reduced the next season.

Corn

The average date of first killing frost at Fort Collins from 1887 to 1937 was September 18; the years 1937, 1938, 1939, and 1940 were characterized by late frosts; and in 1941 the first killing frost came September 9. Accordingly, some of the early maturing hybrids gave higher yields in 1941 than some of the slightly later hybrids. Present data indicate that hybrid corn maturing about the time of Minnesota 13, or a few days later, will give a higher yield in all years of normal frosts. With early frosts the early types enter the picture. We have one hybrid of our own which outyields Wisconsin 570, which is one of the preferred hybrids. At Akron, up until the present, no hybrid has been good enough to replace the best adapted open-pollinated sorts. In the irrigated sections the hybrids have increased in acreage, occupying 50 percent of the present acreage. Corn acreage has fallen off on dry lands, while sorghums have increased. Corn acreages have increased heavily in the irrigated districts.

Fort Lewis

Irrigated and dry-land forage and field-crop tests have been continued at Fort Lewis. The recent wheat results are published in Bulletin 470. Mr. Koonce has cooperated with the Horticulture Section in special potato tests in their disease control program.

Miscellaneous

We had an inactive project under the title of "Sudan Grass Genetics." The Bureau of Plant Industry wished to continue some of this work and supplied us with a special grant for hiring labor so that 1941 plantings were continued in order not to lose certain strains in which they, as well as ourselves, were interested. The effect of inbreeding has caused reduction in some strains, but in any case the reduction has rarely occurred after the second year of self-fertilization. There are some very promising, vigorous inbreds in the lines carried on this special grant.

Service Work

Service work for the year has consisted of analyses of farm and county agents' soil samples.

Animal Investigations

Beef Cattle Feeding

Calcium and Phosphorus Supplements for Fattening Steers

The steers on experiment at Fort Collins completed 140 days on test April 2. At this time the experiment was making satisfactory progress with all lots of steers on full feed and making an approximate average daily gain of 2.2 pounds per head.

Grazing for Range Cows

This experiment has been in progress for a number of years in cooperation with the Range Management Department and will be continued again this year. The experiment started May 27, 1941 and closed October 28, 1941. The cattle in the deferred and rotated grazing lot were rotated from the North Pasture to the Middle Pasture July 26. This experiment, set up as a long-time project, has been making satisfactory progress.

Cattle Wintered on Middle Park Hays Showing a History of Toxic Properties

Eight Hereford heifer calves are being fed each a native meadow hay produced in a different locality of Middle Park. The hay is

supplemented only with sodium chloride. These hays have shown a history of mineral toxicity and imbalance. The calves have finished one complete balance trial of 15 days duration. While the computation of exact utilization values for the hays must await further detailed chemical analyses, the following observations have been made:

1. Symptoms such as diarrhea, loss of apetite, feed refusal, and so forth which typify the history of these hays have been duplicated in this experiment.
2. In general all hays appear to be low in phosphorus.
3. Unmistakable evidence of the metabolism of toxic elements by the cattle has appeared.

Sorghum Grain vs. Corn and Sorghum Silage vs. Cut Sorghum Fodder for Fattening Steers

The steers on experiment at Akron completed 150 days on test April 3. These steers have made a low rate of gain during the severe winter weather, but for the past 30 days have shown an increased rate of gain. For the entire experiment the four lots of steers have averaged 2 pounds gain per head per day.

The first Cattle Feeders' Field Day at the Akron Station was held on May 15. This field day was a cooperative one conducted by the Animal Investigations Section, the U. S. D. A. Dry Land Field Station and the county extension agent's office. About 200 livestock men attended a program planned to aid eastern Colorado stockmen to increase their output.

Dairy Cattle Feeding

Dried Beet Pulp for Dairy Cows

Although no definite results have yet been obtained, indications are that corn silage and dried molasses beet pulp are both proving satisfactory from a nutritional standpoint as a supplemental roughage to alfalfa hay.

Limited vs. Unlimited Pasture for Dairy Cows

During the summer of 1941 a study was made to determine the value of pasture as a feed for dairy cattle. Each cow receiving pasture as her sole source of roughage produced more milk and butterfat during a period of 120 days than did each of the corresponding pairs of cows receiving hay in addition to a limited amount of pasture. The cows receiving hay and part-time pasture gained more in body weight during the experiment than did the cows receiving full-time pasture. The average cow receiving full-time pasture and grain produced 22.6 pounds of milk containing .89 pounds of butterfat

daily. The average cow receiving part-time pasture, hay and grain produced 18.8 pounds of milk containing .75 pounds of butterfat daily. These results do not agree with those obtained during a 90-day pasture experiment conducted in the summer of 1940, when the pasture was not as productive as in 1941.

Nutritional Control of Mastitis

The study of the control of bovine mastitis by fasting has been applied in the field through the cooperation of a large commercial dairy unit. Reports from the owner-manager are that fasting causes increased milk production and in general improves the condition of the animals. The past year has also permitted us to obtain one complete lactation record of a cow in the College herd following the fasting treatment. In this case milk production increased about 50 percent above the period prior to fasting, and gross symptoms of mastitis seem to have disappeared. In the laboratory, emphasis is being placed on a study of the nitrogen fractions of milk and the blood-cell picture during the fasting treatment.

Sperm Longevity

This study has consisted entirely of service work in which vitamin C values of bull semen were measured.

Sheep Feeding

Beet Tops in Lamb Fattening Rations

This study revealed that beet tops can be fed as a sole roughage for lambs. However, the most efficient and highest gains were made by lambs receiving beet-top silage stacked above the ground and fed as a partial replacement of alfalfa hay. In the middle of the experiment the lambs in the check lot for this and the parasite study were damaged severely by a dog. In the packing house the lamb's carcass grade confirmed the feedlot finish on the rating of the beet tops in the different rations.

Utilization of Beet Tops Preserved by Different Methods and Representing the Only Roughage in a Fattening Ration for Lambs

Lambs fed during a 120-day period on a ration of corn, sodium chloride, and beet tops, consumed more roughage and made better weight gains when the beet tops were fed as trench silage. The effectiveness of the different kinds of beet tops on the weight gains are listed as follows in descending order:

Trench silage, tops stored in barn, stacked silage, tops stored in field in rows, tops stored in field in piles. Beet tops stored in the barn showed consistently the highest carotene values throughout the experiment. The silages showed the lowest carotene values.

Control of Coccidiosis in Feedlot Lambs by Management—(In cooperation with Pathology Section.)

PATHOLOGY: During the 1941-42 feeding season work was continued on the project on control of coccidiosis in feedlot lambs to study the effect of feeding and management on coccidiosis in lambs as determined by clinical evidence, oocyst counts, and rate of gain during the feeding period. One hundred twenty lambs were divided into six groups given different rations or management.

ANIMAL INVESTIGATIONS: Lambs in two lots came down with coccidiosis from the fifteenth to the twenty-first day. The 20 lambs receiving corn immediately, beet tops, and ground alfalfa hay self-fed, and the 20 lambs resting for 1 week on ground alfalfa hay alone, then started on corn, were the most seriously affected.

Some very high feedlot gains were obtained on the different rations and methods of management; lambs pastured for 21 days on alfalfa stubble, with beet tops hand-fed, and corn, started the tenth day making the largest gains and most economical gains of any of those in the experiment.

Crossbreeding Study with Native Western Ewes

Three hundred and fifty-five range ewes were divided equally and six allotment factors were used for breeding these ewes to six different breeds of rams in the fall and early winter of 1941.

The lambs dropped in the spring of 1941 from 180 ewes which had been crossbred to four breeds of rams were finished out in the feedlots during the fall and winter. The results of this crossbreeding revealed the Hampshire crossbred lamb to be the heaviest at birth and at weaning; also this crossbreed made the greatest feedlot gain, with a higher carcass grade in the packing plant. The Targhee cross followed second in the birth and weaning weights and feedlot gains, and rated third under the Corriedale cross on the carcass grading basis. The Rambouillet cross stood fourth, or last, in the four different crossbreeds from the standpoint of birth weight, feedlot gain, and grade in the cooler.

Feedlot Gains of Lambs as Affected by Drenching—(In cooperation with Pathology Section.)

ANIMAL INVESTIGATIONS: Drenching for internal parasites has little, if any, effect on feedlot gain as revealed by drenching with copper-sulphate-nicotine solution and phenothiazine.

PATHOLOGY: The effect of single treatments of lambs for parasites at the beginning of the feeding period was studied for the second year. The lambs were not heavily parasitized before treatment

as indicated by counts of parasite ova in the feces. The effectiveness of the drugs as determined by counts of the parasites present in the gastrointestinal tract at slaughter was as follows:

Both phenothiazine and copper-sulphate-nicotine were effective against common stomach worms (*Hemonchus* spp.) Phenothiazine but not copper-sulphate-nicotine was effective against *Nematodirus* spp. Copper-sulphate-nicotine but not phenothiazine was effective against small intestinal worms (*Trichostrongyles* spp.) Copper-sulphate-nicotine showed some promise against fringed tapeworms (*Thysanosoma actinioides*), judging from liver infestations.

Feedlot Gains of Lambs as Affected by Dipping

One lot of lambs was dipped for external parasites at the time of starting on feed. The lambs in this particular lot were more restful throughout the experiment and made exceptionally good gains which would lead to the conclusion that the dipping of feeder lambs prior to starting on feed is a very desirable practice. However, as reported under the study with beet tops, the check lot was damaged severely and the rate of comparison could not be accurately measured.

Urinary Calculi in Lambs

See Pathology Section for discussion.

Wintering Range Ewes

The range ewes were divided equally into two lots. Both lots have been wintered on ground alfalfa hay, with Lot 1 receiving a mineral supplement of bone meal and salt.

Wool Work

Commercial Wool Scouring

A total of 66 samples were scoured for different wool growers in the State. The sampling work was done in cooperation with the Extension Service. Shrinkage and grading results were submitted to the growers by the Extension service and the wool laboratory.

Service Work

Sixty samples were taken from H. T. Blood's Corriedale flock near Denver. These samples were measured for grade by the rapid cross-sectional method. The samples were from the shoulder, side and thigh of 20 sheep. The cross-sectional image of the shoulder samples was photographed and the pictures were sent to Mr. Blood.

Wool Display

An educational display dealing with the production and manufacturing of wool, showing some characteristics of wool fibers, and

including a chart showing the types and breeds of sheep which produce the wool was prepared and shown to wool growers at Fort Collins and at the National Western Livestock Show in Denver. In cooperation with us, the Home Economics Department prepared some charts on upholstery, blankets, and woolen material in relation to synthetics.

Swine Feeding

Colorado Sorghums for Fattening Hogs

Hogs in three lots fed corn, coes, and milo grain attained a very uniform finish. The average daily gain for the three lots was 1.7 pounds.

Official Testing

Following is a summary of the official testing work done since April 1, 1941:

Month	Number of cows on yearly test in advanced registry division	Number of cows on yearly test in herd improvement division	Number of herds	Fees
April	108	44	15	$15.55
May	125	47	17	17.30
June	127	50	16	18.95
July	128	48	16	17.60
August	134	43	18	16.60
September	136	45	16	17.20
October	132	43	15	16.50
November	122	53	15	16.35
December	194	61	16	18.15
January	172	67	17	19.65
February	193	50	18	15.80
March	196	47	18	14.90
				$204.55

Botany and Plant Pathology

Virus Diseases of Stone Fruits

Severe mosaic has been reduced from 28,934 trees in 1935 to 360 in 1941. The Botany and Plant Pathology Section again assisted this past year in eradication. Studies of artificial and natural infection indicate that a minimum of 100 days is required for the incubation period of mosaic. Study of the slight strain of mosaic was continued to determine whether trees infected with this strain should be eradicated. Some 900 trees were left standing for study of spread and effect on tree in the spring of 1942. During the season 1,600 cross

inoculations were made by budding and grafting. Antagonism between the strains of peach mosaic appears evident. The mild and medium strains seem to be antagonistic to the severe type.

A new virus of peach characterized by narrow, irregular leaf blades, severe cracking of bark, and the death of small twigs has been found to be infectious.

The X-disease so destructive in the Northwestern States was found in Colorado. Survey of territory adjacent to Palisade revealed no diseased wild cherry which carries the disease. "Golden net", another new disease of peach, was proved to be caused by an infectious virus. It also was found to go to apricot and plum. In Delta County a new disease of cherry termed "raspleaf" was discovered and its infectious virus nature worked out in cooperation with J. J. Newton of the State Department of Agriculture.

Ring spot of apricot work was continued and the results published.

A chemical test for the detection of mosaic-infected peach is being worked out and looks very promising.

Bacterial Ring Rot of Potatoes

See Horticulture Section for discussion.

Poisonous Plants

With members of the Veterinary staff several investigations were made of cases of plant poisoning. Puncture vine apparently caused bighead of sheep near Adena. Sage poisoning of horses was investigated. A large number of poisonous weed samples have been identified during the year for ranchers over the State.

Poisonous substances have been isolated from a willow that apparently poisoned some horses. Also, study is being made of the poisonous alga found in certain ponds; apparently neither of these poisons are alkaloides or glucocides.

Diseases of Greenhouse Crops

Forty-eight varieties of carnations have been tested for susceptibility to root rot. Some showed resistence; none was found completely resistant.

Preliminary tests show that chloropicrin (tear gas) put in the soil will kill *Fusarium dianthi*, the cause of root rot of carnation.

Chlorosis of Stone Fruits (Yellowing of Peaches and Cherries)

Chemical tests were made on yellowed peaches and cherries to-

gether with chemical tests of soils to determine the effect of absence or presence of iron.

New quick methods of iron analysis were tested. A systematic search was made for all available tests for iron. Tioglycallic acid has been found to be a most sensitive test for iron availability in plants. A number of nonpurchasable iron compounds were prepared for the various tests.

Miscellaneous

In cooperation with the Agronomy Section a large number of inoculations of barley crosses were made to test smut resistance.

Microscopic sections and preparations were made to determine the nature of a new tip-dying disease of sugar beets.

Anthracnose of honeydew melons in transit caused considerable loss the past season. There was strong demand by shippers for study of the trouble. Work done in the Arkansas Valley in cooperation with the Pathology and Bacteriology Section shows that the water in the wash tanks spreads the infection. Losses can be avoided by using chlorinated water in these tanks. Even concentrations as high as 10,000 parts per million will not injure melons. Injury by poles used to push melons furthers the disease.

Late blight of potatoes was found for the first time in northern Colorado. In a cooperative study with the Horticulture Section the trouble was traced to imported seed.

New Diseases

Several new diseases have been found in Colorado the last year: Macrosporium rot of potato; charcoal disease of corn; Basisporium rot of sorghum; a new blight of alfalfa; and in the Yampa Valley, western smut of wheat. Altogether 15 new plant diseases have been found the past year.

Chemistry

Causes of Urinary Calculi in Feeder Lambs

See Pathology Section for discussion.

Mineral Tolerance in Livestock Drinking Waters—(In cooperation with Pathology Section.)

The question of safe mineralization limits in drinking waters for man and livestock has never been adequately solved, although some literature on the subject exists. According to the best available in-

formation, mineralization of 1 percent and over of the common salts begins to exert acute toxic effects upon livestock. Experience in the feed pens of Colorado appears to indicate that there is a range of mineralization below the 1 percent level where, other factors being favorable, the drinking waters are a factor in production of proper weight gains in livestock. The purpose of this experiment with small animals (white rats) is to ascertain more nearly the limit of mineralization which can be tolerated without harm.

Several series of animals have been maintained on graduated amounts of the sulfates of sodium, magnesium and calcium and nitrates in their drinking waters. It will require much more work with many more animals before deductions are warranted.

Mineral Composition of Colorado Alfalfa Hays

A field study of alfalfa hays during two seasons has shown a much wider variation in mineral composition of these hays than would ordinarily be expected. Not only do alfalfas from different soil types show wide variation in mineral composition, but also the three cuttings from the same field show considerable differences.

Based on air-dry hays, differences in total mineral ash content varied roughly from 7 to 11 percent. Individual ingredients varied in ratios as widely as 1 to 3 and 1 to 10 in many cases.

The readily available minerals in the soils (in CO_2 solutions) varied from 1,500 parts per million to as high as 10,000 parts per million, and the amounts available in soil solution could not be directly correlated to the plant ash composition either qualitatively or quantitatively. Water relations were indicated to be quite important. These wide variations were not peculiar to widely different areas of the State but often occurred in close proximity to each other.

Classification, Composition, and Nutritional Value of Middle Park Hay Plants—(In cooperation with Range Management Section.)

RANGE MANAGEMENT: Nutritional deficiencies of various kinds are known to exist on various native ranges and mountain meadows. Seemingly where these conditions exist, range livestockmen have experienced certain difficulties with their livestock. Preliminary investigations of these problems in cooperation with the Chemistry Section were started last year.

A partial vegetative analysis was made last summer of 15 Middle Park hay meadows, preliminary to sampling for chemical analyses. In examination of the lowland and upland meadows, significant differences were found in the vegetative composition. One-half the meadows showed a rather low percentage of alsike clover, a plant of

high protein value. Some meadows had considerable quantities of noxious plants which may or may not be indicative of some of the difficulties of the livestock operators. It was noted that where meadows had been improved by artificial reseeding there was hay of better quality and of greater production.

CHEMISTRY: Because of increasing complaints from ranchmen about difficulties with livestock in the Middle Park Region, this study of range and meadow plants was undertaken.

In the spring of 1941 samples were taken from the 1940 hay stacks and from a group of native weeds and other plants. Because of the peculiar geologic character of this region, and the presence of uncommon elements in the soil, the presence of toxic elements in the mineral composition of the hay plants was suspected.

At hay harvest in 1941 many weeds and plants were again sampled in the field and 15 meadows were systematically sampled for chemical investigation.

The investigations thus far appear to show that hays of 1940, because of unusual drought conditions, were under par. The calcium-phosphorus ratios were out of balance and in some cases the phosphorus was quite low. Many weeds gathered from seleniferous soils carried much selenium, but only bare traces were found in the grass plants. Some of the plants carried traces of vanadium and more molybdenum than is commonly expected.

The meadow plants of the 1941 crop generally had higher mineral ash as well as protein content. The protein increase was due partly to much better stands of alsike clover in the meadows during this season—all influenced by the better moisture conditions.

In any consideration of the mineral composition of grasses it must be borne in mind that $\frac{1}{3}$ to $\frac{1}{2}$ of this mineral composition may be silica, and feed requirements should be adjusted accordingly.

The plants of this section should be studied at least one more season before even tentative conclusions are drawn.

Miscellaneous Service Work

During late summer and fall the usual testing for spray residues on fruits was done in cooperation with the State Fruit Inspector.

Entomology

General Insect Problems

The insect problems in general, outside a few severe outbreaks, such as grasshoppers, cutworms, flea beetles, army worms, and so forth, were about as usual.

PTINUS FUR—This pest, new to Colorado a few years ago, was reported the past season from Pueblo and Windsor.

HARLEQUIN CABBAGE BUG—This unusual pest of cabbage was reported as doing severe damage to cabbage in the Ault district. A control campaign was organized and the ravages of the pest stopped in time to save the crop.

Ant Control

The work on ant control was confined to varifying, by repetition of application, the experiments that showed most promise. Two sets of experiments gave on the first application 100 percent kill and a 98 percent control on the first check, at a cost of about half a cent per application.

Sprayer Efficiency

Flea beetle control experiments were carried along with the sprayer efficiency project through July to October. The tests consisted of a combination spray varying the speed of the machine, nozzle types, and the number of applications. This is the third year for these tests. There has always been a decided increase in yields in fields sprayed with three applications.

Flotation samples were taken periodically through July and August on five farms to ascertain soil insect populations. Well-sprayed fields averaged 2.2 flea beetle larvae per hill up to August 6. On August 12 an influx of adult beetles from unknown breeding areas and the heavy rains that followed were responsible for a distinct second flea-beetle brood, which caused the heavy late-season damage.

The flotation studies revealed a new beetle, *Pleurophorus caesus* (Panz.), abundant in all fields and in all stages. There is a possible relationship between this insect and potato scab. Wire-worm and nematode population were high. Undoubtedly these two forms affect potato quality.

Psyllid Resistance

Psyllid resistance work is now starting on its fourth year. The

production of epidemics of psyllid yellows under greenhouse conditions has become quite simple. The various strains of potatoes under test show extreme, mild, or no symptoms of the disease. Strain 891 has shown the most promise.

Peach Mosaic

Peach mosaic work has been greatly expanded the past season. A cloth house covering some 1,500 healthy 2-year-old peach trees, has been erected at the Whitewater substation and is used for testing of suspected vectors. Thirteen positive cases of severe mosaic in experimental tests begun in 1939 have been established.

Twenty-two detailed experimental tests involving some 200 trees are now under observation and a detailed study of the seasonal history of the green peach aphis is being undertaken. There is a distinct relationship between mosaic on peach trees and wild morning glory areas. The latter plant is a summer and fall host for this aphid. Peach trees in morning glory spots have 33.1 percent mosaic-infected leaves, trees adjacent to these areas 17.2 percent, while isolated trees show only 3.2 percent infection.

During the past 6 months a laboratory technique has been developed whereby the germination of peach seeds can be accomplished in 1 week. This is significant in peach mosaic study.

Fringed Tapeworm

Collecting, propagating, and rearing the orbatid mites under laboratory conditions are being perfected.

Nonpoisonous Insecticides

The effect of sulphur residues upon the keeping qualities of canned tomato products has been investigated by observing canned tomato products from fields treated with sulphur for insect control and by adding known amounts of sulphur (2, 4, 6, and 10 parts per thousand) to canned tomatoes. These samples have been stored at 98° F., and the last examination showed no significant loss of vacuum in treated and untreated fruits. These experiments show that tomato growers can safely protect their crops by use of sulphur or sulphur compounds as recommended for psyllid control.

Ring-Rot of Potatoes

See Horticulture Section for discussion.

Aster Yellows

A study of the possible transmission of aster yellows to lettuce, celery, and asters by insect vectors was undertaken. The results in-

dicate that it is carried by the aster leaf hopper *Macrosteles divisus* (Uhl.).

The malady that destroyed the celery crops at the Horticulture garden, Denver, and Arvada in 1940 was not transmitted by this insect but by the plant louse *Aphis heracella* (Davis). This indicates a new disease for celery, lettuce, and asters or a new carrier for the aster yellows virus.

A 2-percent pyrethrin dust failed to show control but the plots enclosed with a cloth fence 3 feet high received perfect protection.

The critical time for the aster yellows virus transmission was in July and August. Cloth-fence protection during these months is advisable for home gardeners and commercial florists.

Potato Psyllid Control

The continuation of the potato psyllid control project was made possible by funds received from the Crop Protection Institute. The yields from the randomized plots treated with wettable sulphur, 10 pounds to 100 gallons of water; a special wettable sulphur, 6 pounds to 100 gallons of water; barium tetrasulfide, 4 pounds to 100 gallons of water; and dusting sulphur, approximately 25 pounds per acre, were not significantly different from the plots treated with the recommended lime-sulphur, 1 gallon to 40 gallons of water. When dinitro-ortho-creosole was added to the barium tetrasulfide and wettable sulphurs, the yields were significantly lower.

Cucurbit Insects

The control on cucurbit insects has continued both at Fort Collins and Rocky Ford areas with combined efforts on squash bug and striped cucumber beetle controls. While squash insects were killed with treatment as formerly reported, the vines died in large numbers the latter part of June. The cause of the dying has not been determined. Cooperative work with the Plant Pathology Section failed to isolate any organisms from the dying squash plants that would cause the disease.

In at least 10 percent of the plants under observation a condition somewhat like mosaic developed. The plants showed a stunting and dwarfing.

Greenhouse-grown squash subjected to various lengths of feeding periods of squash bugs failed to develop the mosaic disease.

The control experiments with the striped cucumber beetle showed that the melon plants can be protected from the feeding of the beetles and the treated plants show slightly better growth early in the season. At harvest time no significant difference was obtained between the treated and check plots.

Home Economics

To meet demands placed upon the section to re-align its projects to better serve the state and nation in the national defense and war efforts, certain phases of the work have been temporarily shelved, while those phases directly related to the military and nutritional needs of the nation are being emphasized.

Baking Flour Mixtures at High Altitudes

The investigation of foundation cakes containing shortening has been developed to the point where it will now be possible to prepare a bulletin on this subject. Since a large percentage of the cakes baked throughout the country are variations of these foundation butter-type cakes, the results of this study should be of great practical value, as well as furnishing quantitative evaluations and deductions upon which future work may be based.

It has been established that the important factors to be controlled as the altitude at which the cake is prepared increases are the quantity of leavening, batter stability, and the water sugar ratio. Thus the investigation has made it possible, through the development of proper procedures and the correct ingredients and ingredient ratios, to bake cakes superior in both quality and nutritive value to similar butter-type cakes baked at low altitudes.

Dr. Pyke has served as a cooperator on the cake flour testing committee of the American Association of Cereal Chemists during the past year. The cooperative project was a study of the variation of the baking powder requirements in the official A. A. C. C. cake flour testing formula with altitude.

The experimental work on the baking project will be sharply curtailed during the coming year to allow more time for the study of the nutritive value of Colorado-produced food products.

Factors Which Determine the Cooking Quality of Eggs

Many hens have been classified according to the interior quality of the eggs they produce. By this examination of the eggs of hundreds of hens it has been possible to segregate certain individuals from an inbred strain of white leghorns which may serve as a nucleus from which to build a superior strain of the variety. For the time being the extension of this investigation to other breeds of hens must be deferred.

In cooperation with the Poultry Section it has been decided to emphasize a study of certain native sources of carotene in the diet of hens and their relationship to the vitamin A content of the egg.

This problem is now acute because the fish oils which had served as a source of vitamin A in hens' rations are no longer available. This situation has become so serious that something must be done quickly or the Colorado Poultry Industry is threatened with a marked curtailment in egg production.

Properties of Colorado Fruits and Vegetables—(In cooperation with Horticulture, Bacteriology, and Poultry Sections.)

Investigations this year have shown that hail-bruised Montmorency cherries may be utilized to produce a nutritious, high-quality cherry-juice product. In years when hail damage is considerable it may be desirable to convert a part of this juice into fermented products. Simple methods applicable on the farm have been developed to enable the cherry grower to do this. Studies related to the conversion of these products into a variety of salable specialties are under way.

Study of the firming effect of the calcium ion on canned peaches of different varieties has established that in general the firmness of the flesh of the canned fruit may be increased by 11 percent by the addition of small quantities of calcium chloride to the syrup used in canning. Different varieties of peaches respond differently to the influence of the calcium ion. Maximum firming is obtained by some varieties with the presence of 0.05 percent calcium chloride in the syrup. Other varieties require 0.10 percent calcium chloride to reach this maximum. With three varieties the firming effect continued to increase with the addition of 0.20 percent calcium chloride. Over-ripeness of the fruit at time of canning decreased the firming effect of calcium chloride upon the canned peach tissue. Additions of calcium chloride in the amounts used produced no firming of the tissue of the samples of Eclipse and Canadian Queen varieties tested.

Study of the effect of maturity at picking time upon the quality of Elberta peaches used for canning showed that peaches which gave a pressure test as high as 15 pounds at time of harvest would ripen when stored in the shade to give a satisfactorily colored and flavored canned product. These hard green peaches required about 1 week to develop a sugar content and acidity which approximated that of tree-ripe peaches. Shrinkage of the peaches, due largely to evaporation losses, was considerable. Lots of peaches which were more mature at picking time ripened in shorter periods and showed smaller evaporation losses. When these greener lots of peaches were subjected to prolonged periods of refrigeration before being placed to ripen, ripening did not proceed as satisfactorily as when the refrigeration was omitted.

The contention of canners that the highly flavored Colorado Elberta peach requires less sugar than most varieties used for canning in order to develop the most desirable flavor has been confirmed. A 39 to 40-percent syrup is most satisfactory for canning Colorado Elbertas of a proper degree of ripeness.

The firming of pear tissue in canned pears by small additions of calcium chloride to the processing syrup has been noted. This observation requires further study.

Satisfactory methods have finally been developed for evaluating the cooking quality of potatoes so that numerical values for these experimental observations may be obtained. The measures developed eliminate score-card methods and the attendant personal opinions of the judges. By these measures the characteristics of the potato samples are described so that a choice between lots may be made upon the characteristics displayed rather than by opinion.

Treatment of the highly saline soil of the potato experimental plots in the San Luis Valley with lime or limestone has again produced the highest quality and most uniform potatoes for the 1941 growing season. A high phosphorus supplement usually carrying a low nitrogen ratio is again indicated when both yield and quality of product are considered. Planting between May 10 and 25 gives the best results in this district for yield and quality combined.

College strains of canning peas being developed by the Horticulture Section showed with one exception somewhat higher values for ascorbic acid than those reported by most investigators. Of the commercial varieties tested, the Wisconsin Early and Green Giant were high in vitamin C content.

Dehydration studies have been initiated upon Colorado potatoes and carrots. This preliminary work indicates that carrots should not be allowed to wilt materially before dehydration or the carotene content will be greatly lowered. Suitable trench storage or, when conditions are suitable, allowing the carrots to remain in the ground until time for dehydration conserves the carotene content. Colorado grown carrots, trench stored until February, brought to the laboratory in crisp condition, and then dehydrated showed in general about 1,000 micrograms of carotene per gram. Carrots from the same lot allowed to wilt for 3 days in the laboratory storage room, then freshened by immersion in cold water and dehydrated showed only slightly more than half the carotene content of the samples dehydrated from unwilted stock.

Horticulture

Vegetable Crops

Commercial Fertilizers for Potatoes

The greatest increase in yield on Red McClure and Bliss Triumph varieties in the San Luis Valley was found to be on high-analysis complete fertilizers. A decided difference was found between the two varieties in their response to different individual fertilizer elements, and these differences are statistically significant. The McClure is most sensitive to a lack of nitrogen and responds with increased nitrogen. The Triumph is most sensitive to phosphate and shows a decrease in yield where phosphate fertilizer is missing. This accounts for the variability between varieties in response to fertilizer treatments. No single fertilizer element is sufficient for either variety and the need for nitrogen, phosphate, and potash in complete fertilizers was emphasized by the results. The addition of sulphur, gypsum, and lime at varying rates of application per acre produced no effect on size or yield during the past season.

Effect of Soil Treatments on Loss of Color

Ten trace element treatments including copper, zinc, iron, manganese, magnesium, boron, and sodium were applied at the rate of 50 pounds per acre to Red McClure and Bliss Triumph varieties. No differences in yield were found although copper, magnesium, and iron increased the red skin color of the tubers, while sodium and boron decreased the color. Limestone and magnesium had no effect on color. The sodium treatment resulted in a slight decrease in average size of potatoes, while copper and combined treatments increased the average size very slightly. Other indications of increased color were found with sulphur, fertilizer combinations high in nitrogen, and all dates of planting later than May 10.

Ring Rot of Potatoes—(In cooperation with Botany and Plant Pathology, Entomology, and Bacteriology Sections.)

BACTERIOLOGY: Chemical disinfectants have been found impractical for disinfecting the cutting knife, because of their rapid deterioration. Boiling water is recommended for sterilizing the cutting knife.

ENTOMOLOGY AND BOTANY AND PLANT PATHOLOGY: It has been demonstrated that the potato beetle (*Leptinotarsa decemlineata* Say) the blister beetle (*Epicauta pennsylvanica* DeGeer), and the grasshopper (*Melanoplus differentialis* Thomas), are capable of transmitting the ring-rot organism under controlled conditions.

BOTANY AND PLANT PATHOLOGY AND HORTICULTURE: The transmission of the ring-rot organism is reduced by permitting the cut seed pieces to dry from 24 to 48 hours before contact with infected cut seed pieces. The ring-rot bacteria will enter the potato through bruises and surface cuts but not through the uninjured skin, which emphasizes the importance of care in handling seed potatoes. Plants can be infected and not show recognizable field symptoms, which means that seed from such plants can carry the organism and be a source of infection. With environment constant, wilt symptoms have been found to be dependent upon the degree of bacterial invasion into the aerial portion of the plant. Extensive experiments with ultra-violet light have shown that for all practical purposes such light is effective in detecting ring rot when the potatoes are stored and tested at 40° F. It is not very effective, however, at 70° F. Treatment of cut seed using mercuric chloride 1 to 500 with various chemicals to reduce surface tension failed to give adequate protection. Shortcut methods of tuber indexing such as tuber smears and sprout smears (Gram stain) have not been found to be thoroughly reliable. Infected tubers may not show bacteria except in isolated portions of the vascular ring. Migration studies of the causal organism of ring rot show that bacteria move in underground portions of the potato plant more readily than in above-ground portions.

Potato Breeding—(In cooperation with U. S. Department of Agriculture.)

Fifty hybrid seedlings received from the Colorado Potato Station were tested and 18 were saved for further work. Six of these are to be included in next year's variety trial. In the variety trial 14 standard and new types were tested with several new seedlings. The yields varied from 180 to 300 sacks per acre.

The new Pawnee variety was introduced cooperatively with the Colorado Potato Station as a possible replacement of White Rural for the Greeley district. This new introduction was well received by all growers who tried it.

Onion Breeding—(In cooperation with U. S. Department of Agriculture.)

The results of Sweet Spanish onion trials at Rocky Ford indicate that the No. 6 strain is more tolerant to storage rot losses than other Sweet Spanish strains. This season purple blotch disease was very prevalent and it was a good year to make comparisons. There will be some 80 hybrids set out in the Western Slope district this year for tests of their thrip resistance. Thrip insects do so much damage there that it will be possible to make selections of resistant plants from a number of F_2 lines. Progress is being made on the development of hybrids that are resistant to purple blotch disease.

Commercial Fertilizers for Onions

Commercial fertilizer tests at the Rocky Ford substation indicate that the combination of nitrogen and phosphorus gives consistent increases in yield over phosphorus alone, over complete fertilizers, and over nontreatment. There is no significant difference between the fertilizer combinations and total storage losses. Use of 80 pounds of available phosphorus per plot did result in less total rots during the storage season than did other fertilizer combinations. While the trend favored phosphorus, the difference was not significant. Rots on phosphorus-treated onions amounted to 5.68 percent as compared to 9.33 percent rots on those treated with 6-30-0 fertilizer applications.

Fruit Crops

Sour Cherry Fertilizers

The project on sour cherry fertilizers has been closed and the data published. The results over a 6-year period indicate that nitrogen used alone and annual applications of manure have given consistent significant increases in yield.

Chlorosis of Stone Fruits—(In cooperation with Botany and Agronomy Sections.)

The project on chlorosis of stone fruits is being rested during the National emergency. The mulch and sulphur plots on peach trees at Palisade were checked this year. Mulch treatments apparently had no effect on the amount of chlorosis present, while all sulphur treatments reduced the amount of chlorosis present except on old trees which were past recovery and on a few other trees which were showing the effects of overirrigation.

Fruit Variety Tests

The trials at Fort Collins were severely damaged by hail, and many apples, plums and apricots were destroyed. Fire blight disease followed and provided an opportunity to discard susceptible varieties. On the Fruit Substation at Austin a report on the most promising varieties has been published for distribution to growers.

Winter Injury on Raspberries—(In collaboration with Botany Section.)

The project on winter injury of raspberries is being replaced with a project that better meets wartime needs. Various fertilizer treatments were applied and compared with irrigation applications to determine the relationship to winter injury. So far there has been no difference in the fertilized plots in regard to winter-killing, since

they were damaged as badly as the unfertilized check plots. The same is true of irrigation applications. Ammonium sulphate, however, when used alone seemed to improve foliage color and might indicate a need for some nitrogen fertilizer in the production of raspberries.

Flower Crops

Carnation Nutrients

A standard nutrient solution for carnations which will be termed the "Colorado Solution" has been developed. The solution is relatively higher in nitrogen and somewhat more calcium has been added. The additional sunlight common in Colorado during the winter growing period probably accounts for the desirability of more nitrogen than is present in standard eastern solutions.

Pathology and Bacteriology

Overeating (Enterotoxemia) of Feedlot Lambs

Attempts to reproduce the overeating syndrome by culture or toxin of *Cl. welchii* type D isolated from sheep have met with success in 3 of 12 lambs when included with feeds of corn meal and administered by stomach tube. Death resulted in 12 to 15 hours after the mixture was administered. Filtrates prepared from the contents of the abomasum or intestine were toxic for rabbits in two of the three cases. Dried toxin has been prepared from cultures of *Cl. welchii* type D which has a minimum lethal dose of 0.3 mg. for mice. Some immunization trials using alum-precipitated and dried toxin-reinforced toxoids are in progress on rabbits and sheep. Studies are in progress also to determine the effect of *Cl. welchii* type D toxin on blood constituents in sheep and in laboratory animals and to compare with field cases of overeating. Results so far are inconclusive except that blood sugar is markedly increased.

Feedlot Gains of Lambs as Affected by Drenching

See Animal Investigations Section for discussion.

Urinary Calculi in Lambs—(In cooperation with Animal Investigations and Chemistry Sections.)

ANIMAL INVESTIGATIONS: In the urinary calculi studies conducted with lambs during the period November 22, 1940, to March 21, 1942, the Animal Investigations Section was responsible for the allotment, feeding and management, of the lambs and collection of urine and fecal samples for analysis by the Chemistry Section. Com-

plete and detailed records of weights, feed, and water consumption were kept and these will be summarized for use in the writeup of results of this experiment.

CHEMISTRY: Restriction of water, high mineral intake, and lack of vitamin A have often been ascribed as primary causes and doubtless they are important. High mineral concentration alone is not as important as is the kind of mineral being ingested and eliminated and the reaction (pH) of the urine. With an inadequate diet even the feeding of vitamin A does not seem to prevent the formation of calculi.

Both urinary sediments and calculi analyzed indicate that about half this material is organic (sloughed tissues). The mineral fraction is largely magnesium ammonium phosphate, and in animals fed cane fodder as roughage, rather large amounts of silica are present.

PATHOLOGY: Three clinical cases of lithiasis developed during the trial in lambs receiving cane hay, white corn, and bran as the ration. One lamb died of other causes. At slaughter calculi were present in the kidneys of all but one lamb which had received the ration just mentioned. Three of these had received a limited amount of codliver oil. A trace (1 to 5 blue units) of vitamin A was present in the livers of these three lambs but it was totally absent in the others on the same ration but without codliver oil. Liberal amounts of vitamin A were found in the livers of the three lambs which had received alfalfa hay and yellow corn. No calculi were present in the urinary tract of any lamb of this latter group.

Control of Coccidiosis in Feedlot Lambs by Management

See Animal Investigations Section for discussion.

Poisonous Plants

Several occurrences of photosensitization or "big-head" in sheep were investigated. Feeding trials with puncture vine (*Tribulus terrestris*) and wild buckwheat failed to result in photosensitization in lambs, although both plants had been suspected of producing the condition. Several cases of "big-head" occurred where volunteer wheat pasture, relatively free of weeds, was the sole feed.

Wild lettuce, of which several species are recognized, is reported by some authorities to contain poisonous principles. Three occurrences observed last year tend to support that belief. The first two cases involved the deaths of 15 and 32 cattle respectively after they had consumed large quantities of wild lettuce. Later, apparently from the effects of wild lettuce, three horses died showing narcosis, constipation and paralysis, followed by death.

In two cases last summer of apparent plant poisoning of cattle, a considerable quantity of young cocklebur plants had been consumed, and no other known poisonous plants could be found. While cocklebs are known to be poisonous for swine and suspected for cattle, feeding experiments should be made to make definite determinations.

Fur-Bearing Animals

STUDY OF REPRODUCTION IN SILVER FOXES.—Organs from 190 silver foxes were studied histologically. Partially completed studies of 7,000 serial sections indicate that (a) the histological structure of these organs is almost identical with that of the dog; (b) the proestrus changes in the female reproductive tract begin at least 2 months prior to onset of heat; and (c) spermatogenesis in the male fox is cyclic and begins 2 to 3 weeks before the breeding period starts.

RELATION OF CELLULAR VARIATIONS IN VAGINAL SMEARS TO OESTRUS.—The study of several thousand vaginal smears indicates that there is a definite time relationship between the types of cells found and the approach of the heat period. While the other symptoms heralding the approach of oestrus are helpful in the determination of heat, the vaginal smear test is more reliable.

INFLUENCE OF HORMONES UPON REPRODUCTIVE SYSTEM OF THE FOX.—Controlled experiments with gonadotropic substances showed the females can be brought into heat early, while males refused to respond similarly. Further experiments to bring up stragglers and shy breeders for a more protracted breeding period on fox ranches proved 80 percent successful.

VITAMIN A RESERVE IN FOX LIVERS. As one phase of the investigation of annual pup losses on fox ranches, 104 fox livers from three ranches were assayed for vitamin A content. The average U. S. P. values per gram of liver obtained were:

Ranch A—adults— 172.3; pups— 80.9; males— 87.5; females— 124.7
Ranch B—adults—4035.5; pups—491.3; males—390.0; females—3045.0
Ranch C—adults— 145.7; pups— 63.0; males— 90.0; females— 135.0

Adult foxes on every ranch showed a reserve of from 2 to 8 times as many units of vitamin A per gram of liver as did the pups on the same ranch. Females showed vitamin A reserve of from 1½ to 8 times as great as did the males on the same ranches. The Lovibond blue units may be obtained by dividing the above values by 40.

PARASITES: Several hundred fecal examinations were made. All ranches were found to be infested. Hookworms, lungworms, ascarids, and coccidia were found in medium to heavy infestations. Tetrachlorethylene (0.8 cc. per 10 lb. body weight) with aercoline hydrobro-

mide (¼ gr.) was found to be most efficient in pilling foxes for worms.

AUTOPSIES. A total of 248 foxes, minks, chinchillas, and beavers were autopsied for histological and laboratory examinations.

WILDLIFE RESEARCH. Several hundred fecal examinations of Rocky Mountain Bighorn sheep, deer, elk, and grouse were made. The degree of infestation in Bighorn sheep was found to be less severe as compared with that of former years. This is probably due to a greater amount of forage present in the high mountain ranges. The parasite infestation of sage grouse sharply decreased during fall and winter.

Bacterial Ring Rot of Potatoes

See Horticulture Section for discussion.

Factors Influencing the Development of Cheese Starter Bacteria

To study the vitamin requirements of the starter bacteria a semi-synthetic or a synthetic culture medium is needed. Attempts to devise such culture media are being undertaken at present. Adsorption with activated carbon removed a large proportion of the growth factors from whey. These could not be replaced by the vitamins on hand. The addition back to the adsorbed whey of the eluate from the activated carbon used to adsorb the whey caused a definite growth stimulation.

Food and Nutrition

In cooperation with all other sections working on the newly initiated studies in food and nutrition, this section will investigate microbiological spoilage and means of preservation of Colorado fruits and vegetables, and other foods. A preliminary research is being undertaken into the more efficient utilization of green tomatoes by artificial preservation as developed by the section of Home Economics.

Late in the summer of 1941 experiments on melons were conducted in the Arkansas Valley in cooperation with the Plant Pathology section, the Arkansas Valley substation and growers and shippers in that region. Solutions of calcium hypochlorite were used experimentally to control the development of anthracnose on melons during shipment.

As a service to all sections cooperating in food and nutrition research, the microbiological assay of riboflavin will be conducted in a laboratory that is being prepared to be devoted especially to this work.

Miscellaneous

During the year minor investigations were conducted and services were rendered in connection with outbreaks of ropy bread, bacterial decomposition of irrigation dam canvas, and problems of dairy sanitation and of water and sewage.

PREGNANCY DISEASE OF EWES.—Investigations of losses in ewes in widely separated areas of the State from pregnancy disease have been made. In all instances the cause was an apparent lack of carbohydrate feed in the ration. The losses were controlled when the carbohydrate intake of the ewes was increased.

LISTERELLOSIS.—This form of infectious encephalitis, was again diagnosed in one lot of feeder lambs, in a band of ewes, and in a pen of feeder cattle all on separate premises.

ABORTION IN EWES.—Several outbreaks of abortion in ewes have been investigated. Bacteriological examinations made in one outbreak disclosed *Vibrio fetus* as the cause. This is the first time in several years that this type of abortion has been found.

PULLORUM TESTING OF TURKEYS.—Pullorum disease has become a serious problem for the turkey growers of Colorado. Laboratory testing service has been made available to the flock owners of the State. Samples numbering 12,755 have been tested by the tube agglutination test. Four hundred ninety reactors (3.84 percent) were found. Individual flock infections varied from 0.0 percent to 14.85 percent.

The diagnostic and service work of the laboratory for the period November 1 to April is summarized as follows:

No. of Bang's tests run	2,972	(285 reactors)
Avian	147	
Bovine	30	
Canine	1	
Equine	7	
Ovine	6	
Porcine	6	
Water samples	8	
Miscellaneous	11	

Poultry

Iodine Requirements of Poultry—(In cooperation with Pathology and Bacteriology Section.)

Observations on growth, production, and reproduction are now in the second and third generations of chickens fed various iodine levels in a practical ration. Preliminary observations indicate that the unsupplemented rations (200 to 400 micrograms of iodine per kilogram) do not support as good early growth of chicks and adult body weight as levels of 1,000, 18,000, and 180,000 micrograms of iodine per kilogram of ration. No pronounced effects have been noted as yet on production or egg size. Efficiency of food utilization was slightly benefited by iodine supplementation only during the first 6 weeks. On the other hand, mortality during the growth period increased slightly with iodine supplementation. The possibility that inbreeding within birds in each group may contribute to these variations has not been precluded, although limited observations do not support such a possibility.

Feathering in slow-feathering White Plymouth Rocks and in rapid-feathering New Hampshires was rendered practically perfect at 6 weeks of age by the addition of 500,000 micrograms of iodine from iodinated casein per kilogram of starting ration. Mortality in the White Rock chicks was somewhat increased. Levels of iodine up to 50,000 micrograms per kilogram from this source had no effect. Feed utilization was only slightly impaired in White Leghorns by the addition of 500,000 micrograms per kilogram. When a similar amount of iodine was supplied by potassium iodide, feathering was retarded in White Plymouth Rocks and White Leghorn chicks.

Thyroidectomy had a pronounced effect on chicks if done within a few days after hatching. If this was delayed 2 weeks, the effect was less marked. Either 500,000 micrograms of iodine per kilogram of ration from iodinated casein or 5,000 micrograms of iodine from dessicated thyroid enabled thyroidectomized chicks to respond approximately normally. No beneficial effects were noted in thyroidectomized chicks fed 500,000 micrograms of iodine from potassium iodide.

Carotene and Riboflavin Content of Alfalfa and Sprouted Grains—(In cooperation with Agronomy Section.)

The carotene content of nine varieties of alfalfa tested on three cuttings during the 1941 growing season was in the following order from high to low: Meeker Baltic, Colorado Common, Nebraska Common, Argentine, Ladak, South African, Orestan, Grimm, and Hardistan.

Preliminary data indicate that very early cutting of alfalfa resulted in a lower carotene content for the season. Little difference was noted between three and four cuttings. There appeared to be a tendency for carotene content to decline with the age of the stand. The practical significance of these observations must await further investigations now under way.

Methods of Feeding Alfalfa to Poultry

In the winter of 1942 the apparent unpalatability of a concentrate containing 20 percent of finely ground alfalfa as the sole vitamin A supplement is again resulting in impaired production. The use of this concentrate in pelleted form or the substitution of coarse ground alfalfa for the fine form resulted in improvement. However, results are still apparently inferior to the conventional mash-grain system of the same total composition.

Factors Affecting Reproduction in Turkeys—(In cooperation with Pathology and Bacteriology Section.)

In the 1941 hatching season the following criteria were used in comparing reproduction in eight pens of turkey breeders under different systems of feeding or lighting: Egg production, egg weight, gain in body weight, fertility, hatchability, embryonic mortality, shell thickness, shell spotting, poult livability and weight at 2 weeks of age, and feed consumption.

The use of artificial illumination on turkey breeders as young as 7 months of age had no appreciable effect on reproduction except the well-known stimulation of egg production. Egg size was slightly reduced when the hens were lighted at the youngest age.

The use of fish meal and soybean oil meal in addition to meat and bone scraps as protein supplements in the breeder ration resulted in slightly improved results over meat and bone scraps alone.

A pelleted concentrate fed in conjunction with whole grains permitted reproduction as good as that on any other system. These results were further improved by giving the birds access to grass range. There was an estimated saving of more than 20 percent in feed consumption of the birds on range during the 3 months of peak production.

Goiter was noted in breeder hens from most of the rations used. Histological studies are under way on the endocrine glands and the reproductive tracts of the highest and lowest hatching hens from each pen.

A satisfactory solution to the poor hatchability noted in the turkeys at the Station was not found. Exchange of hatching eggs with

two other Stations indicated that they had encountered similar though less acute difficulties. This comparison indicated that incubation may be a factor at this Station. Measurements in a commercial incubator by Dr. P. G. Koontz of the Physics Department show that air flow may vary as much as 10 times in different parts of the same incubator.

One hundred and fifty-six hens were tested for pullorum disease by the laboratory tube method and by the whole-blood stained antigen method, using chicken antigen and an experimental turkey antigen supplied by the Bureau of Animal Industry. Of the 17 hens that reacted to the tube test at a dilution of 1 to 25, 9 (53 percent) were found to be carriers of pullorum salmonella by culturing their ovaries. Of the 22 hens that reacted to the turkey antigen only 6 (27 percent) were found to be reactors by the tube test or by culturing the ovaries. Of the 19 hens that reacted to the chicken antigen only 6 (32 percent) were found to be reactors by the tube test or by culturing the ovaries. Both antigens missed three reactors.

Range and Pasture Management

Management of Native Range Lands—(In cooperation with Animal Investigations Section.)

The first 5-year period of a long-time study on management of native range lands was completed in 1941. During that period the experimental range pastures west of Fort Collins were grazed by range cattle under two systems, namely, the deferred-and-rotation and seasonal-conservative.

Climate was an important factor in the trend and forage yields of the better range plants. Furthermore it directly affected gains of livestock and seasonal grazing capacity. In the period 1937-1941, inclusive, there occurred 2 years, 1939 and 1940, in which rainfall was markedly deficient and 1 year, 1941, in which there was abundant rainfall.

The stand of the better grasses, (western wheatgrass and the short-grasses—blue grama and buffalo grass) was definitely influenced by the seasonal occurrence and distribution of rainfall. In the conservatively grazed pasture the decline in the stand of the better grasses due to the 1939-1940 drought was 17 percent greater in 1940 than in the deferred-rotation pasture. Because of the greater stand of grasses in the former pasture there was increased competition for soil moisture. Naturally with a decidedly reduced rainfall, available soil moisture became insufficient to support the heavier stand

of grasses. Consequently there followed a "breaking up" of the large-size grass tufts and a rapid loss in density.

The rate of recovery of drought-stricken grass stands in an exceptionally favorable rainfall year was clearly shown in 1941. In the conservatively grazed pasture the stand of better grasses increased 53 percent as compared to only 4 percent in the deferred-rotation pastures. This indicates that a grass stand heavily depleted by drought will come back rapidly if the range is properly managed year after year. However, it will take more than one year of good precipitation to bring back a range to its former productivity as indicated by results obtained in 1941: in the deferred-rotation pastures the stand of grass was 42.4 percent of the 1937 stand and in the conservatively grazed pasture, 35.6 percent.

Significant results in height growth of grasses, an indicator of seasonal plant vigor, and forage yields were obtained between 1940 and 1941. Increased height growth in 1941 which varied from 30 percent to 128 percent according to grass species was noted. For the first time since 1937 blue grama produced seed stalks in considerable abundance. This is highly significant because the improvement of a native range by natural revegetation is dependent to a great extent upon seed-stalk production.

The studies further indicate the importance of western wheatgrass in the management of western wheatgrass-shortgrass ranges. Data obtained on the utilization of the better grasses by cattle show that western wheatgrass is by far the most important grass when considered on a volume-weight basis. It is valuable feed in early spring and the forepart of the summer because of its luxurient growth in that period. This is in contrast to blue grama and buffalo grass which are "warm weather" growing grasses.

Several important indications from the 5-year study are: (1) The proper maintenance of a vigorous mixed stand of western wheatgrass, blue grama, and buffalo grass is good drought insurance; (2) the proper stocking rate of good mixed western wheatgrass ranges is about 2.5 surface acres per cow month; (3) on this type of grass range 50 percent of the total weight of annual forage may be grazed by livestock without permanent injury to the range (however, a 4-inch stubble and from 20 to 25 percent of the seed stalks should be left ungrazed at the end of the grazing season); (4) under heavy use by livestock, blue grama and buffalo grass increase in abundance, while western wheatgrass decreases, thereby reducing the amount of palatable range forage; and (5) on a western wheatgrass range the use of the conservative seasonal grazing system during drought years will result in better utilization of forage and better cattle gains than the deferred-rotation grazing system.

Browse Ranges of the Western Slope

The browse ranges of the Western Slope are important as "feed reservoirs" for range livestock and as a protective cover for important watersheds. The productive capacity of a large percentage of these ranges is considerably lower than formerly. In this area many ranchers in their year-long ranch operations are dependent upon Federal, State, and privately-owned lands for grazing and feed production for their livestock.

For several years the Forest Service, Grazing Service, and Soil Conservation Service have obtained information on the character and grazing capacities of grazing lands in Delta and adjacent counties. In 1941 this Section started a range resource survey of privately-owned range lands in these areas. A crew of three students with a staff member as leader obtained factual data on 111,160 acres of privately owned land.

The character of ranges varied from low-producing annual weed sheep ranges to excellent sagebrush-grass areas. Because of such diversified character of vegetation, proper land management becomes a complex problem. Some preliminary indications of the study are: (1) Climate and soil largely determine the potential productivity of these native range lands. Because of uncertain annual and seasonal precipitation, vegetative growth is extremely variable one year with another; hence stockmen must realize the need for a more flexible plan of livestock operation. (2) The proper maintenance of productive range land is necessary because of the continued encroachment of noxious and poisonous plants. For example, studies showed the variability in range plants in different vegetative types. In the oakbrush type palatable grasses made up only 8.0 percent of the total vegetation while browse species, of which oakbrush was the most prominent, made up 51.6 percent as contrasted to an excellent sagebrush-grass type, where palatable grasses still constituted 29.0 percent of the total vegetation and browse species 39.3 percent, of which sagebrush was the most prominent. At present this sagebrush-grass range will carry twice as many cattle as the oak-brush range. (3) The improvement of irrigated pastures to provide for additional summer feed for range livestock is offered as a partial solution of the summer range problem.

Shortgrass Ranges in Central and Eastern Colorado

A recheck of several range units in the shortgrass region last fall indicated a remarkable recovery of some ranges due to excellent climatic conditions. However, ranges that had been overgrazed year after year have not made any appreciable recovery. Blue grama-buffalo grass range properly grazed the past 5 years produced on the

average 260 pounds of palatable feed per acre in 1941 as contrasted to an overgrazed range which produced less than half that amount. Based on feed production, the better range required 2.88 surface acres per cow month while the overgrazed range required nearly 6.0 surface acres.

Artificial Revegetation of Depleted Ranges and Abandoned Croplands

The increased forage and seed yields of the various grasses in the favorable year of 1941 indicate their ability to recuperate from the effects of drought. It is interesting to note that the 1941 aftermath production of several spring-fall growing grasses amounted to one-half that of the seasonal forage production. The significance of such high aftermath yields is that areas seeded to crested wheatgrass, smooth brome, Russian wheatgrass, and western wheatgrass are invaluable for fall grazing.

The source-of-seed studies continue to emphasize the striking differences between strains of blue grama, western wheatgrass, and blue bunch wheatgrass from different parts of the country. The blue grama strain from Flagstaff, Ariz., continues to outyield other sources in both forage and seed. It shows remarkable drought resistance and ability to reseed naturally.

In tests of seeding rates for blue grama the 12-inch width rows produced greater yields of forage and seed than the 24- and 36-inch width rows, irrespective of the character of climatic year. Seeding at a rate of 4 pounds per acre yielded only 20 percent less forage than the 12-pound rate.

In cooperation with the Bureau of Plant Industry, uniform nursery tests of selected strains of several grasses were started last spring. Selections of buffalo grass from various Great Plains sources made by the Soil Conservation Service and planted in the nursery in 1939 indicate decided differences in rate of spread, foliage production, and other plant characteristics.

Nutritional Character of Native Range and Mountain Meadow Forage Plants

See Chemistry Section for discussion.

Miscellaneous

In cooperation with the State Extension Service, the adaptation trials of grasses and other forage plants throughout the State were continued. This work acquaints farmers and stockmen with our forage plants and permits them to select species that are desirable for reseeding in their respective localities.

Rural Economics and Sociology

Agricultural Economics

Effects of Recent Changes upon the Economic Relationship between Colorado Ranch and Range Properties

Records have been obtained from 17 cattle ranches and 22 sheep ranches which were visited in central and western Colorado. Seven ranch units producing both cattle and sheep were also included in this study. The records were tabulated so as to show the expense per head of cattle based on the number included in the opening inventory and similarly to show the expense per head for sheep based upon the number included in the opening inventory.

Type of Farming

A recent report covering 23 operating units in northeastern Colorado shows that these individuals had an average labor and management wage of $4,469 or they earned 18.95 percent interest on their investment. The most profitable group of farms had a labor and management wage of $7,895 or they earned 22.8 percent on their investment. The least profitable group had a labor and management wage of $1,500 or they earned 8.37 percent on their investment. Farm earnings for 1941 were much higher than for any year within the 5-year period 1937 to 1941. Financial records have also been obtained from some 18 or 20 farm units in the Greeley area. This analysis shows improvements in returns over the preceding year.

Economics of Soil Conservation

We have continued to cooperate with the Economics Section of the Soil Conservation Service and during the year have received one report relating to the Effect of Terraces and Contour Cultivation on Farm Operating Costs in the Southern Great Plains. This study shows that more time is required to grow and harvest crops on terraced and/or contour cultivated land than on untreated land, the increase amounting to 10.6 percent in growing and harvesting wheat to 26.3 percent in growing row crops. The amount of man labor is increased approximately 17 percent in performing field operations on a typical wheat farm, assuming usual crop production practices and average rates of performance and approximately 15 percent on typical row crop farms. Increases in time used and additional costs of operation may be kept to a minimum by (1) laying out terraces and contour lines so as to keep the area in point rows to a minimum and (2) planning in advance by the farm operator the methods of working fields to obtain greatest efficiency. Farm oper-

ating costs are not increased in proportion to the increase in time used in performing field operations and the increase in costs probably are low when compared with the derived benefits.

Rural Sociology

Attitude Toward and Observance of Some Health Practices by Rural People in Colorado

A relatively large proportion of the population considered in this analysis does not follow certain recommended practices of dental hygiene and sanitary measures which have been defined as essential for healthful living. Neither did these people seem to be conscious of a need for following such practices or measures. The situation was somewhat different with respect to diet in that people seemed to be more conscious of existing deficiencies and expressed more dissatisfaction with these seeming deficiencies. In general, children follow the pattern of their parents with respect to both dental and dietary practices.

Participation of the homemaker in organizations seemed to have a relationship to both dental and dietary practices and to the attitude of the homemaker toward adequacy in this respect. Families in which the homemaker participated moderately or to a high degree observed dental and dietary practices more completely than did families in which the homemaker was less active or participated in no organization. Possession of a garden seemed to have a definite influence on the frequency with which certain vegetables were eaten in the summer months but not in the winter months. Families with gardens ate more vegetables in the summer than those families who did not possess a garden. The most consistent trend shown is that as the education of the homemaker increased there was a corresponding increase in the observance of health practices that are prescribed for healthful living.

Estimate of Farm Population and Farm Population Movements

The statistical information assembled in Colorado that will be sent to the Bureau of Agricultural Economics for tabulation will become a part of the basic data on which estimates of the national farm movements for the year 1941 will be calculated. The figures for Colorado will provide the basis for a circular which will be published and distributed in this State.

Discoveries of Techniques and Procedures in Agricultural Planning

As a member of the State Planning Committee Dr. R. W. Roskelley has cooperated with the Extension Division in making an analysis of agricultural planning, particularly in the fields of techniques

and procedures, as well as agricultural planning in relation to the farm labor supply. Seventy-five representative farmers in Cheyenne and Otero counties were interviewed to determine (1) monthly and seasonal labor needs on the farm, (2) various skills of farmer members, (3) characteristics of farm labor, (4) ways of more effectively utilizing farm labor, (5) sources of labor supply, and (6) prospective procedures for solving labor needs. This project was initiated as a case study to indicate how research in agricultural labor can be utilized most effectively by agricultural planning groups.

Seed Laboratory

Summary of types of tests requested and reported for the fiscal year, July 1, 1941-June 30, 1942

	Purity	Germination	Examination	Identification	All tests
Requested	631	1,462	34	49	2,176
Reported	628	1,458	34	49	2,169
*Unreported 6/30/42	3	4	....	....	7

Summary by months of all tests requested and reported for the fiscal year, July 1, 1941-June 30, 1942

	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mch.	Apr.	May	June	Total
Requested	58	74	51	70	155	338	248	349	357	286	155	55	2,176
Reported	41	55	22	98	76	296	248	345	380	369	122	67	2,169
*Unreported month's end	17	36	65	37	116	158	158	162	138	56	39	7	7

*Actually in test.

Miss Anna M. Lute, state seed analyst for 20 years, retired on September 1, 1941.

On September 5, the State Board of Agriculture appointed Bruce J. Thornton to the position of head of the Seed Laboratory, in charge of seed and weed work, and Miss Helen Kroeger, who had her early training in the Colorado laboratory under Miss Lute, to the position of seed analyst.

The Director appointed an advisory committee consisting of Dr. D. W. Robertson, Station agronomist; A. M. Binkley, State horticulturist; R. H. Tucker, Extension agronomist; and E. W. Nelson, Station range conservationist.

The capacity of the Laboratory has been approximately doubled through providing space for more laboratory assistants and making

certain mechanical changes including the installation of alternating automatic temperature controls in the germinators.

The results of 20 years research on hard seeds of alfalfa was published by Miss Lute in the January number of the Journal of the American Society of Agronomy.

Inspection of seeds in the hands of the dealers, as conducted this spring, constituted the first extensive inspection since 1933.

Mr. Thornton was elected president of the State Seed Council at its annual meeting in Denver and was charged with the principal objective of promoting a better seed program in support of all-out war production. Considerable effort has been expended to this end.

Engineering Division

Civil Engineering

Government Cooperation

The work of the Civil Engineering Section is carried on in cooperation with the Division of Irrigation, Soil Conservation Service, United States Department of Agriculture. The work in the design and invention of irrigation equipment, investigations in connection with pumping for irrigation and drainage, and the snow survey work are the principal cooperative projects.

Materials Research

High-Strength Wire for Precast Concrete Beams

Research in the use of high-strength steel wire for the reinforcement of precast concrete beams was completed. It was found possible to make satisfactory beams of small cross-section (2 inches by 6 inches, for example) by use of wire instead of the regular reinforced bars. Furthermore it was found that beams of bending strength equal to beams with ordinary reinforcing could be obtained with half the volume of steel. It is believed that these beams might prove of value in the construction of fireproof farm buildings. Floors in adobe buildings, for example, may be supported on such beams, making them entirely fireproof. All operations in the construction of these beams can be done by the farmers themselves except for one difficulty; high-strength steel wire is very springy and hard to form into reinforcing units. In order to make these beams of practical value to the farmers, it will be necessary to have the reinforcing units pre-fabricated by steel companies.

Waterproofing of Adobe

Research for waterproofing methods for adobe has been completed and the report is now in preparation. Laboratory tests indicated that there are several satisfactory means of waterproofing adobe, to be reported later in a bulletin.

Meteorology

Check of Rohwer Evaporation Formula

The data for a 50-year period are summarized and are being put in graphic form to aid in the determination of any irregularities in the data. For the most part, computed and observed evaporation do not differ more than 5 percent.

Meteorological Observations

Meteorological observations continue in the usual manner. Airways observations are carried on by student assistance.

Design and Invention

Hydraulic Sand Separator

The object of this research was to construct a sand separator which would classify sands according to their fall velocity in water.

A small sand separator was constructed which would separate sand into fractions with the loss of only a very small part of the total sand used. To date it has not been possible to evaluate the dispersion of sand particles within each of the fractions separated. This problem needs solution before the separator can be put to use experimentally.

Irrigation Structures

Laboratory checks by means of hydraulic models of several designs were made for important irrigation structures, such as the sand-trapping device for the Colorado Canal in the Arkansas Valley east of Pueblo and the Parshall measuring flume which was improperly installed at the foot of a steep slope in Montezuma County.

Portable forms for casting Parshall flumes were constructed.

A new type of stilling well for use with Parshall flumes was perfected. This stilling well is made from a vitrified clay pipe, which is very inexpensive but which still gives accurate measures and is not subject to vandalism.

The use of Parshall flumes as a hydraulic measuring device is increasing. Sewage disposal plants and military camps are adopting it as the most reliable means of measuring fluid flow in open channels.

The use of current meters for measuring pump discharges has been thoroughly investigated in the laboratory. This method of measurement proved very successful in the field.

Pumping for Irrigation and Drainage

Use of Ground Water for Irrigation in South Platte Valley

Practically all the field work has been done on this project, but there still remains a relatively small amount of scattered information to be gathered, which came to light towards the end of the 1941 season.

Examination of the data indicates the desirability of further extending the scope of observation wells.

Ground Water Fluctuations

This is a continuing project in making semiannual measurements to the water table. New observation wells are continually being added to the list, especially in the South Platte Valley.

Investigation of Analytic Studies

An investigation has been made of the analytic studies in ground water problems. It is expected that these studies will lead to a bulletin indicating the application of analytical methods and describing present ground water problems which might lend themselves to an analytic approach.

Snow Surveys

Snow Surveys by Photograph

Photographs are being made of the range forming a part of the Cache la Poudre River drainage on the first, or near the first, of the months of February to May and on May 15. The year's photographs will be analyzed and compared to the snow course data taken at Cameron Pass. The past 4 years' records have shown good agreement between the photographic method and the snow-course method for April and May snow cover and rather poor agreement for the earlier months.

Snow-Course Measurements

During the past winter regular monthly snow-course measurements have been made on 202 courses located in Colorado, Wyoming, Montana, Arizona, and New Mexico. The data from these numerous courses have been summarized and monthly publications with an issue of about 2,000 each sent to the various interested parties. These snow survey records form a basis for crop planning, reservoir regulation, and agricultural financing.

Mechanical Engineering

Sugar Beet Machinery

Experimental developments at the Station in mechanizing sugar beet growing and harvesting are now being generally accepted by the industry as practical on a commercial basis. The work is in cooperation with the United States Department of Agriculture, Bureau of Agricultural Chemistry and Engineering, and has been given active support by the sugar association and growers, as well as by implement manufacturers.

Two approaches to the problem have been followed: First, to improve the planters and planting methods which, in turn, have made mechanical thinning more practical; second, to aid in the development of mechanical harvesting so that the same amount of labor could carry through the entire season.

The work at the Station has demonstrated the possibility of eliminating stoop labor at both thinning and harvesting time. This development work has been carried on experimentally for several years till this last year, when the operations were performed on a commercial basis. The results indicate that a very appreciable saving may be made in the man-hour requirements of sugar beet production, that the work is less arduous, and that the system is economically sound.

Editorial Service

Bulletins and Reports

The Station Editorial Service during the year 1941-42 has issued the following publications:

Popular Bulletins:

No.	*Title and Author*
468	"Propagation of Plants" by L. R. Bryant and George Beach.
469	"Pasture and Forage Crops for Irrigated Areas in Colorado" by D. W. Robertson, R. M. Weihing, and T. G. Stewart.
470	"Winter Wheat Production in Colorado" by D. W. Robertson, J. J. Curtis, J. F. Brandon, and O. H. Coleman.
471	"Sour Cherry Production in Colorado" by L. R. Bryant and Robert Gardner.
472	"Rate and Date of Seeding Winter Wheat in Eastern Colorado" by D. W. Robertson, J. F. Brandon, H. Fellows, O. H. Coleman, and J. J. Curtis.

Technical Bulletin:

28 "The Nitrogen Requirement of Sugar Beets" by Robert Gardner and D. W. Robertson.

Press Bulletin:

95 "Do Your Bit—Keep Your Family Fit" by the Nutrition Committee.

Quarterly Bulletins:

Vol. III, No. 3, Colorado Farm Bulletin, July-September 1941.

Vol. III, No. 4, Colorado Farm Bulletin, October-December 1941.

Vol. IV, No. 1, Colorado Farm Bulletin, January-March 1942.

Vol. IV, No. 2, Colorado Farm Bulletin, April-June 1942.

Annual Report:

Fifty-Fourth Annual Report, Colorado Agricultural Experiment Station.

Other Publications

During the year 43 papers by Station staff members have been edited for publication in scientific journals and elsewhere. Also, the following mimeographed circulars have been published:

"Outline for Preparation of Cherry Wine" by W. E. Pyke. Misc. Series 107.

"A Farm Business Report Relating to 18 Farms Located in Phillips, Yuma, and Washington Counties, Northeastern Colorado, 1940" by Ramey C. Whitney. Misc. Series 111.

"Net Returns from Winter Feeding Cattle and Lambs, Northern Colorado" by R. T. Burdick. Misc. Series 112.

"Preliminary Report 1940, Colorado Cattle and Sheep Ranches, Western Colorado" by R. T. Burdick. Misc. Series 113.

"Swine Erysipelas" by Pathology Section. Misc. Series 115.

"Pregnancy Disease of Sheep" by Pathology Section. Misc. Series 120.

"Infectious Bovine Mastitis" by Pathology Section. Misc. Series 121.

"Tests of Hybrid Corn under Irrigation in Colorado, 1941" by W. H. Leonard and Herman Fauber. Misc. Series 122.

"The Colorado Pure Seed Law" by B. J. Thornton. Misc. Series 129.

"Fifth Annual Farm Business Report—23 Farms in Phillips, Sedgwick, Washington, and Yuma Counties for the Year 1941" by A. W. Epp. Misc. Series 130.

Colorado Farm Bulletin

The quarterly Colorado Farm Bulletin was awarded third place in its class in competition at the 1941 convention of the American Association of Agricultural College Editors at Kingston, R. I.

News Writing and Radio

Since a year ago 102 news stories have been written. Since weekly Colorado State College radio programs were begun over KOA in June 1941, the Station's portion of 43 programs has been written.

Miscellaneous

A prospectus was published for the Colorado Agricultural Research Foundation, and a summary of Colorado agricultural data was prepared for the Industrial West Foundation.

From August 1, 1941, to March 20, 1942, there were 11,634 bulletins mailed out in answer to individual requests. In addition, 1,074 bulletins have been mailed to libraries and 11,400 quarterly Farm Bulletins have been mailed to persons on the Farm Bulletin mailing list, making a grand total of 24,108, or 3,014 bulletins per month.

Staff Contributions

Barmington, Ray. Mechanized Sugar Beet Growing. The Montana Farmer 20(15):5. April 1, 1942. Misc. Series 118

Beach, George. Carnations in Various Nutrient Solutions and Substrates. Proc. Amer. Soc. Hort. Sci. 40:573. Dec. 1941. Sci. Series 132

Binkley, A. M. Adaptation of Guayule Shrub, Desert Plant Which Bears Rubber, Doubtful in Colorado. Colo. Farm Bul. 3(4):14. Oct.-Dec. 1941

Binkley, A. M. Fourth Annual Colorado Canners' Conference. Colo. State College mimeo. Jan. 1942. Misc. Series 139

Binkley, A. M. Herbaceous Seasoning Plants. Colo. State College mimeo. Hort. Circ. 23. Feb. 27, 1942. Misc. Series 123

Binkley, A. M. Procedure Outlined for Freezing Fruits and Vegetables; Varieties Recommended. Colo. Farm Bul. 3(3):10. July-Sept. 1941

Binkley, A. M. Standard Varieties of Vegetables for Colorado. Colo. State College mimeo. Hort. Circ. 22. Feb. 6, 1942. Misc. Series 140

Binkley, A. M. and Herman Fauber. Sweet Spanish Bulb Development Most Rapid in Late August, Test Shows. Colo. Farm Bul. 4(2):11. April-June 1942

Bodine, E. W. Antagonism between Strains of the Peach-Mosaic Virus in Western Colorado. Phytopath. 32(1):1. Jan. 1942. Abs. Series 14

Bodine, E. W. Further Notes on the Incubation Period of the Peach-Mosaic Virus. Science 95(2462):256-57. March 6, 1942. Sci. Series 130

Bodine, E. W. and L. W. Durrell. Virus Diseases of Peach in Western Colorado. Plant Disease Reporter 25(19):474-75. Oct. 15, 1941. Sci. Series 144

Bodine, E. W. and W. A. Kreutzer. Ring Spot of Apricot. Phytopath. 32(2):179-81. Feb. 1942. Sci. Series 121

Bodine, E. W. and J. H. Newton. Rasp-Leaf of Cherry. Phytopath. 32(4):333-35. April 1942. Sci. Series 131

Bodine, E. W., J. H. Newton, and W. A. Kreutzer. Four New Virus Diseases of Stone Fruits Found in Peach Mosaic Study in Colorado. Colo. Farm Bul. 4(2):6. April-June 1942

Brandon, J. F. and D. W. Robertson. Tests Show Winter Barley Non-Hardy. Colo. Farm Bul. 3(3):13. July-Sept. 1941

Burdick, R. T. Colorado Cattle and Sheep Ranches, Western Colorado, Preliminary Report 1940. Sept. 1941. Misc. Series 113

Burdick, R. T. Net Returns from Winter Feeding Cattle and Lambs, Northern Colorado (As Shown by 30 Years Feeding Records). Colo. Exp. Sta. mimeo. Sept. 1941. Misc. Series 112

Burdick, R. T. $2,400 Yearly Farm Income Living Expense Shown from 19-Year Record in Colorado. Colo. Farm Bul. 3(3):5. July-Sept. 1941

Cross, Floyd. New Sheep Diseases Diagnosed by Station. Colo. Farm Bul. 3(3):9. July-Sept. 1941

Cross, Floyd, H. S. Wilgus, Jr., and O. C. Ufford. Controlling Diseases and Parasites of Poultry. Ext. Bul. 369-A. July 1941

Deem, A. W. Calfhood Vaccination Seen as Only an Aid in Eradicating Bang's Disease from Cattle. Colo. Farm Bul. 3(4):3. Oct.-Dec. 1941

Deem, A. W. Infectious Bovine Mastitis. Colo. Exp. Sta. mimeo. Feb. 22, 1942. Misc. Series 121

Deem, A. M. Swine Erysipelas. Colo. Exp. Sta. mimeo. Dec. 1941. Misc. Series 115

Epp, A. W. Fifth Annual Farm Business Report—23 Farms in Phillips, Sedgwick, Washington, and Yuma Counties for the Year 1941. Colo. Exp. Sta. mimeo. April 1942. Misc. Series 130

Epp, A. W. These Ideas Help Increase Needed Grain Storage Space. Western Farm Life 44(11):13. June 1, 1942. Misc. Series 142

Forsberg, J. L. New Fungus Disease Caused by Cytospora Threatens Chinese Elm Trees of Colorado. Colo. Farm Bul. 3(3):3. July-Sept. 1941

Gardner, Robert and D. W. Robertson. Basic Principles Outlined for Maintaining Soil Fertility on Irrigated Land in Colorado. Colo. Farm Bul. 4(1):3. Jan.-March 1942

Gassner, F. X. The College Column. National Fur News. Feb. 1942. Misc. Series 124

Gassner, F. X. The College Column. National Fur News. March 1942. Misc. Series 125

Gassner, F. X. The College Column. National Fur News. April 1942. Misc. Series 127

Gassner, F. X. The College Column. National Fur News. May 1942. Misc. Series 132

Glick, D. P. Water Superintendent's Relationship to Other Local Public Health Activities. Proc. Fifteenh Annual Meeting, Rky. Mtn. Sect., American Water Works Assoc. 1941

Harshfield, G. S. Pregnancy Disease of Sheep. Colo. Exp. Sta. mimeo. Feb. 17, 1942. Misc. Series 120

Harshfield, G. S. and Ivan Watson. Drenching of Feedlot Lambs. Colo. Farm Bul. 3(4):10. Oct.-Dec. 1941

Harshfield, G. S., Floyd Cross, and Alvin B. Hoerlein. Further Studies on Overeating (Enterotoxemia) of Feedlot Lambs. Amer. Jour. Vet. Res. 3(6):86-91. Jan. 1942. Sci. Jour. Series 127

Hazaleus, Melvin and H. B. Osland. Colorado Sorghums for Fattening Hogs. June 23, 1942. Misc. Series 152

Jones, C. R. Habit of the Harvester Ant, *Pogonomyrmex occidentalis* Cress. Jour. Colo.-Wyo. Acad. Sci. 3(2):60. April 1942. Abs. Series 17

Jones, C. R. and Sam C. McCampbell. The Harvester or Mound Building Ant, *Pogonomyrmex occidentalis*. Circ. No. 1721. Ext. and USDA. March 15, 1942. Misc. Series 138

Kreutzer, W. A. Host Parasite Relationships in Pink Root of Allium Cepa L. II. The Action of *Phoma terrestris* Han. on Allium Cepa and Other Hosts. Phytopath. 31(10):907-915. Oct. 1941. Sci. Jour. Series 113

Kreutzer, W. A., and D. P. Glick. Prevention of Rotting of Melons in Transit is Purpose of Tests Undertaken by Station. Colo. Farm Bul. 3(4):8. Oct.-Dec. 1941

Kreutzer, W. A. and D. P. Glick. Progress on Control of Anthracnose Spot on Honeydew Melons in Storage is Made. Colo. Farm Bul. 4(1):9. Jan.-March 1942

Kreutzer, W. A. and John G. McLean. First Report of Late Blight of Potato in Colorado. Plant Disease Reporter 26(4):91. March 1942. Sci. Jour. Series 141

Leonard, W. H. Inheritance of Fertility in the Lateral Spikelets of Barley. Genetics 27:299-316. May 1942. Sci. Jour. Series 125

Leonard, W. H. Inheritance of Reduced Lateral Spikelet Appendages in the Nudihaxtoni Variety of Barley. Jour. Amer. Soc. Agron. 34(3)-:211-221. March 1942. Sci. Jour. Series 129

Leonard, W. H. and Herman Fauber. Hybrids Help Growers Meet Production Goals on Corn in "Food-for-Freedom" Drive. Colo. Farm Bul. 4(2):25. April-June 1942

Leonard, W. H. and Herman Fauber. Tests of Hybrid Corn under Irrigation in Colorado, 1941. Colo. Exp. Sta. mimeo. Feb. 23, 1942. Misc. Series 122

List, George M. and W. A. Kreutzer. Transmission of the Causal Agent of the Ring Rot Disease of Potatoes by Insects. Jour. Econ. Ent. 35(3):455-456. June 1942. Sci. Jour. Series 142

Lute, Anna M. Laboratory Germination of Hard Alfalfa Seeds as a Result of Clipping. Jour. Amer. Soc. Agron 34(1):90-99. Jan. 1942. Sci. Jour. Series 126

McLean, John G. Progress Report of the Potato Experimental Work Carried at the Experimental and Demonstration Farm in the San Luis Valley in 1941 by the Horticulture Section of the Colorado Experiment Station. Colo. State College mimeo. Hort. Circ. No. 24. March 15, 1942. Misc. Series 126

McLean, John G. and W. C. Sparks. Soil Element Tests Help Food-for-Freedom Program, Pointing Way to Better Potatoes. Colo. Farm Bul. 4(2):23. April-June 1942

McLean, John G., W. A. Kreutzer, D. P. Glick, and G. M. List. More Potato Research Results in Stronger Endorsement of Zero Tolerance in Seed. Colo. Farm Bul. 4(2):17. April-June 1942

Pyke, W. E. Nutritional Values of Common Foods. Colo. Farm Bul. 4(2):14. April-June 1942

Pyke, W. E. Outline for Preparation of Cherry Wine. Colo. Exp. Sta. mimeo. July 1, 1941. Misc. Series 107

Pyke, W. E. and Gestur Johnson. Water Tolerance of New Shortenings Make Sweeter Cakes Possible at Higher Altitudes. Colo. Farm Bul. 4(1):5. Jan.-March 1942

Robertson, D. W., J. F. Brandon, and R. H. Tucker. Facts about Soybeans in Colorado. Colo. Ext. Serv. mimeo. June 1942. Misc. Series 131

Robertson, D. W., O. H. Coleman, J. F. Brandon, H. Fellows, and J. J. Curtis. Rate and Date of Seeding Kanred Winter Wheat and the Relation of Seeding Date to Dryland Footrot at Akron, Colorado. Jour. Agri. Res. 64(6):339-356. March 15, 1942. Sci. Jour. Series 122

Romine, Dale S. and Robert Gardner. Principal Colorado Soils Conserve Lime for War because Natural Supply is High. Colo. Farm Bul. 4(2):21. April-June 1942

Roskelley, R. W. Expert Tells How Labor Shortage Can be Cushioned. Western Farm Life (Herdsmen Edition) 44(5):15. March 1, 1942. Misc. Series 136

Roskelley, R. W. Planning for Victory on the Farm Labor Front. Western Farm Life 44(5):15. March 1, 1942. Misc. Series 119

Roskelley, R. W. Some Suggestive Procedures for Overcoming a Shortage of Farm Labor. Ext. mimeo. Jan. 1942. Misc. Series 117

Roskelley, R. W. Techniques and Procedures in Agricultural Planning. Part III of Ext. Bul. D-1, Agri. Planning Handbook. Dec. 1941. Misc. Series 116

Roskelley, R. W. When Labor is Scarce. Western Farm Life 44(6):3. March 15, 1942. Misc. Series 137

Roskelley, R. W. and Beatrice Young. Station Project Reveals Clue to 'Unknown Quantity' in Improving Health for Defense. Colo. Farm Bul. 3(4):5. Oct.-Dec. 1941

State Seed Council. Recommended Varieties of Field and Vegetable Crops for Colorado. Colo. State College mimeo. March 15, 1942. Misc. Series 128

Thornton, B. J. Colorado Pure Seed Law and the Use of the Seed Laboratory. Colo. Exp. Sta. mimeo. April 3, 1942. Misc. Series 129

Thornton, B. J. Drill Survey Reveals Need of Seed Testing as Part of All-Out Food Production Effort. Colo. Farm Bul. 4(2):3. April-June 1942

Thornton, B. J. For Profitable Production. Western Seed Company mimeo. April 1942

Thornton, B. J. Recommended Varieties of Field and Vegetable Crops for Colorado. Colo. Exp. Sta. mimeo. March 15, 1942. Misc. Series 128

Thornton. B. J. Sodium Chlorate Treatment in Late Summer Will Control Noxious Weeds in Small Areas. Colo. Farm Bul. 3(3):6. July-Sept. 1941

Tom, R. C. and H. B. Osland. Calcium and Phosphorus Supplements with Various Levels of Grain in a Standard Beet By-Product Ration for Fattening Steers. Ft. Collins Steer Feeding Exp. July 8, 1942. Misc. Series 153

Tom, R. C. and H. B. Osland. Sorghum Grain vs. Corn and Sorghum Silage vs. Cut Sorghum Fodder for Fattening Steers. Akron Steer Feeding Exp. May 12, 1942. Misc. Series 135

(Ufford, O. C.), Floyd Cross, and H. S. Wilgus, Jr. Pullorum Disease—Whose Fault? Ext. Bul. 372-A. July 1941

Weihing, R. H. and Dwight Koonce. Tests Show No Advantage in Mixing Grass with Alfalfa on Colorado Irrigated Land. Colo. Farm Bul. 4(1):12. Jan.-March 1942

Wilgus, H. S., Jr. Studies on the Iodine Requirements of Poultry. Cornell Nutrition Conference for Feed Manufacturers. Oct. 1941. Abs. Series 13

Wilgus, H. S., Jr. Studies on the Iodine Requirements of Poultry. Flour and Feed 42(6):18. Nov. 1941. Misc. Series 114

Wilgus, H. S., Jr. and O. C. Ufford. Chick Brooding Rules. Ext. Circ. 1688. July 1941. Misc. Series. 141

Wilgus, H. S., Jr. and O. C. Ufford. Feeding Chickens. Ext. Bul. 366-A. July 1941

Wilgus, H. S., Jr. and O. C. Ufford. Selection of Feedstuffs for Poultry. Ext. Bul. 367-A. July 1941

Wilgus, H. S., Jr. and O. C. Ufford. Symptoms of Nutritional Deficiencies. Ext. Bul. 368-A. July 1941

Wilgus, H. S., Jr. and O. C. Ufford. Turkey Production in Colorado. Ext. Bul. 370-A. July 1941

Wilgus, H. S. Jr., F. X. Gassner, and A. R. Patton. The Goitrogenicity of Soybeans. Jour. Nutrition 22(1):43-52. July 10, 1941. Misc. Series 116

Wilgus, H. S., Jr., G. S. Harshfield, A. R. Patton, L. P. Ferris and F. X. Gassner. Iodine Requirements of Growing Chickens. Poultry Sci. 20(5):477. Sept. 1941. Abs. Series 7

Respectfully submitted,

Homer J. Henney

Homer J. Henney, Director

DR.	Hatch fund	Adams fund	Purnell fund	Bankhead-Jones fund	State mill levy fund	Special fund	Pure-Seed fund	Total funds
Balance July 1, 1941	.....	.....	.....	.....	$11,875.99	$45,158.52	.....	$ 57,034.51
From the treasurer of the United States as per appropriations for the fiscal year ending June 30, 1942, under the Acts of Congress approved March 2, 1887, (Hatch fund), March 16, 1906, (Adams fund), February 24, 1925, (Purnell fund), and June 29, 1935, (Bankhead-Jones fund)	$15,000.00	$15,000.00	$60,000.00	$22,430.96	.....	.....	.....	$112,430.96
Other sources than the United States	.....	.....	.....	.....	105,077.08*	53,038.81	4,500.00	162,615.89
	$15,000.00	$15,000.00	$60,000.00	$22,430.96	$116,953.07	$98,197.33	$ 4,500.00	$332,081.36
CR.								
Salaries	15,000.00	13,324.73	44,583.90	13,135.79	53,464.17	1,291.12	2,969.62	143,769.33
Labor	.....	637.70	4,362.18	5,885.02	9,188.62	9,797.75	662.40	30,533.67
Stationery & Office Supplies	.....	.....	29.68	.....	264.10	457.30	45.08	796.16
Scientific Supplies—Consumable	.....	399.23	2,645.83	873.64	2,557.32	1,603.33	148.92	8,228.27
Feeding Stuffs	.....	11.35	.....	.....	4,451.13	5,861.00	.....	10,323.48
Sundry Supplies	.....	5.06	24.25	13.32	456.05	500.24	68.01	1,066.93
Fertilizers	.....	.....	.....	.....	120.00	23.10	.....	143.10
Communication Service	.....	2.90	101.06	48.09	1,282.86	180.73	45.51	1,661.15
Travel Expenses	.....	37.49	2,429.92	665.54	2,724.77	1,890.37	193.02	7,941.11
Transportation of Things	.....	.....	87.13	.60	801.52	710.14	11.90	1,611.29
Publications	.....	.....	38.36	.....	1,679.25	717.89	27.25	2,462.75
Heat, Light, Water & Power	.....	74.28	233.64	110.47	2,213.38	2,940.68	41.28	5,613.73
Furniture, Furnishings & Fixtures	.....	.....	45.36	33.34	231.98	73.86	4.50	389.04
Library	.....	4.90	34.20	.....	533.80	16.00	2.00	590.90
Scientific Equipment	.....	496.52	4,755.48	1,219.84	2,564.14	2,087.16	250.64	11,373.78
Livestock	.....	.....	486.80	.....	3,184.40	8,723.02	.....	12,394.22
Tools, Mach. & Appliances	.....	.....	91.62	389.29	1,733.88	1,925.55	.....	4,140.34
Buildings and Land	.....	5.50	38.99	56.02	1,255.39	479.74	22.22	1,857.86
Contingent Expenses	.....	.34	11.60	.....	520.12	621.50	7.65	1,161.21
Total	$15,000.00	$15,000.00	$60,000.00	$22,430.96	$ 89,226.88	$39,900.48	$ 4,500.00	$246,058.32
Balance on hand June 30, 1942	.....	.....	.....	.....	27,726.19	58,296.85	.....	86,023.04
Grand Total	$15,000.00	$15,000.00	$60,000.00	$22,430.96	$116,953.07	$98,197.33	$ 4,500.00	$332,081.36

*Includes $13,900, H. B. 83.