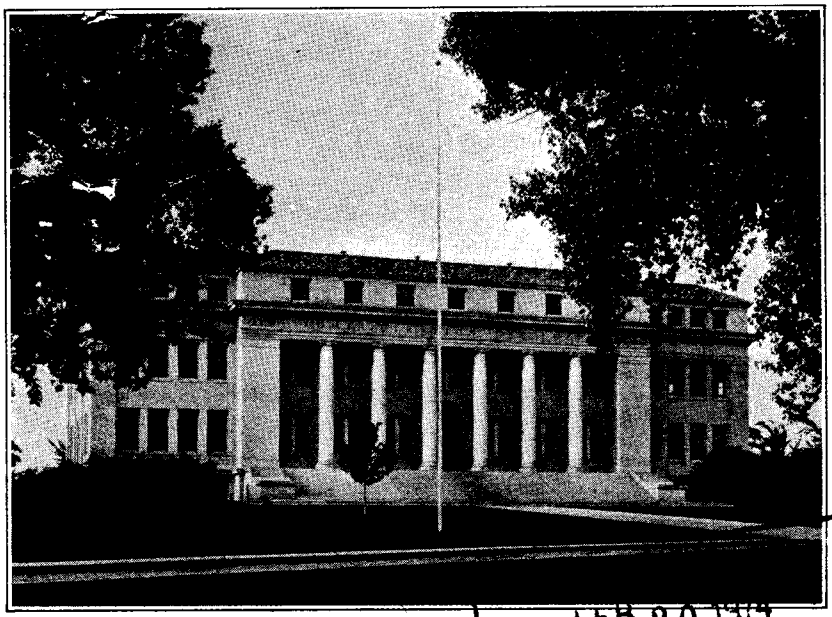
Forty-ninth Annual Report

Colorado Experiment Station



Fiscal Year 1935-1936
Colorado Experiment Station
Colorado State College
Fort Collins

Colorado State College

FORT COLLINS, COLORADO

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EXPERIMENT STATION STAFF

Agronomy

Alvin Kezer, A.M., Chief Agronomist
David W. Robertson, Ph.D., Associate
Robert Gardner, M.S., Associate (Soils)
*Warren H. Leonard, M.S., Associate
L. A. Brown, Ph.D., Associate
Dwight Koonce, M.S., Assistant
Robert Whitney, B.S., Assistant (Soils)
Otto Coleman, B.S., Assistant

Animal Investigations

George E. Morton, M.S., in Charge
H. B. Osland, M.S., Associate
John O. Toliver, M.S., Assistant
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Botany

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Anna M. Lute, A.B., B.Sc., Seed Analyst
Bruce J. Thornton, M.S., Associate
E. W. Bodine, M.S., Assistant
A. O. Simonds, Ph.D., Assistant
C. G. Barr, Ph.D., Assistant
*W. A. Kreutzer, M.S., Assistant

Chemistry

J. W. Tobiska, M.A., in Charge
Earl Douglass, M.S., Associate
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Earl Balis, B.S., Assistant

Entomology

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Miriam A. Palmer, M.A., M.S., Associate
Leslie B. Daniels, M.S., Assistant

Grazing and Range Management

E. W. Nelson, M.S., in Charge
Melvin S. Morris, M.S., Associate

Home Economics

Inga M. K. Allison, M.S., in Charge
Mark A. Barmore, Ph.D., Research Associate.

*On leave.

Horticulture

A. M. Binkley, M.S., in Charge
E. P. Sandsten, Ph.D., Horticulturist
Carl Metzger, M.S., Associate
George A. Beach, B.S., Assistant
Louis R. Bryant, Ph.D., Assistant
L. E. Evans, M.S., Assistant
Herman Fauber, B.S., Assistant
Ralph Manuel, B.S., Assistant

Irrigation Investigations

R. L. Parshall, B.S., in Charge
Carl Rohwer, B.S., C.E., Associate
W. E. Code, B.S., Associate
R. E. Trimble, B.S., Meteorologist

Rural Economics and Sociology

L. A. Moorhouse, M.S., in Charge
R. T. Burdick, M.S., Associate
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Pathology and Bacteriology

I. E. Newsom, D.V.M., in Charge
H. W. Reuszer, Ph.D., Associate Bacteriologist
C. W. Barber, D.V.M., Ph.D., Assistant
A. H. Groth, B.S., D.V.M., Assistant
Frank Thorp, Jr., D.V.M., Ph.D., Associate

Engineering Division—Mechanical Engineering

L D Crain, M.M.E., Head of Division, in Charge of Mechanical Engineering
E. M. Mervine, M.E., Agr. Engineer, U. S. D. A.

Civil Engineering

E. B. House, M.S., in Charge
A. R. Legault, B.S., Testing Engineer

Editorial Service

James R. Miller, Editor

Letter of Transmittal

To His Excellency Edwin C. Johnson,
Governor of Colorado:

In compliance with the law establishing agricultural experiment stations, I herewith present the Forty-ninth Annual Report of the Colorado Agricultural Experiment Station for the Federal and State fiscal years of July 1, 1935, to and including June 30, 1936.

Fort Collins, Colorado
July 1, 1936

E. P. Sandstrom, *Director*

FINANCIAL REPORT OF THE EXPERIMENT STATION

For the Year Ending June 30, 1936

	Hatch fund	Adams fund	Purnell fund	Bankhead-Jones fund	State mill levy fund	Special fund	Pure seed fund	Total funds
DR.								
Balance July 1, 1935	.....	.....	.....	.....	$25,215.44	$12,464.36		$37,679.80
From the treasurer of the United States as per appropriations for the fiscal year ending June 30, 1936, under 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	$5,607.74	.....	.....	.....	95,607.74
Other sources than the United States					85,883.51	47,500.33	$10,000.00	143,383.84
	$15,000.00	$15,000.00	$60,000.00	$5,607.74	$111,098.95	$59,964.69	$10,000.00	$276,671.38
CR.								
To salaries	14,863.70	15,000.00	45,714.36	1,099.98	38,879.16	1,574.03	3,496.04	120,627.27
Labor			7,455.90	.....	19,066.40	5,715.67	742.50	32,980.47
Stationery and office supplies			385.83	339.53	891.42	376.75	194.82	2,188.35
Scientific supplies, consumable			724.32	19.35	640.08	816.46	.....	2,200.21
Feeding stuffs			95.65	.....	7,573.26	137.80	.....	7,806.71
Sundry supplies			213.20	2.85	1,446.11	2,383.28	.....	4,045.44
Fertilizers			57.00	.....	.....	.....	.....	57.00
Communication service			59.04	.40	1,027.02	249.33	31.90	1,367.69
Travel expense	136.30		1,536.94	30.85	3,274.63	2,835.50	4.90	7,819.12
Transportation of things			6.85	.....	1,216.92	173.70	1.06	1,398.53
Publications			785.00	.....	3,130.96	24.09	.....	3,940.05
Heat, light, water, power			239.39	.....	2,201.09	4,569.38	.....	7,009.86
Furniture, furnishings and fixtures			211.96	.....	440.09	923.86	130.99	1,706.90
Library			143.27	.....	206.09	807.99	13.00	1,170.35
Scientific equipment			1,760.41	2,089.44	639.72	341.41	196.73	5,027.71
Livestock			65.50	.....	.....	6,440.30	.....	6,505.80
Tools, machinery, and appliances			476.59	2,025.34	4,513.57	3,999.08	43.00	11,057.58
Buildings and land			68.19	.....	2,362.51	7,028.78	.....	9,459.48
Contingent expenses			.60	.....	498.91	521.95	18.00	1,039.46
	$15,000.00	$15,000.00	$60,000.00	$5,607.74	$88,007.94	$38,919.36	$4,872.94	$227,407.98
Balance on hand June 30, 1936					23,091.01	21,045.33	5,127.06	49,263.40
Grand total	$15,000.00	$15,000.00	$60,000.00	$5,607.74	$111,098.95	$59,964.69	$10,000.00	$276,671.38

ANNUAL REPORT OF THE DIRECTOR

of the

COLORADO EXPERIMENT STATION

To the President and the State Board of Agriculture:

I PRESENT my report as director, which is the 49th annual report of the Agricultural Experiment Station.

The work, on the whole, has been satisfactory. There is a better spirit of cooperation between the various sections, and the younger members on the station staff are taking a greater interest, not only in the work of their own but in neighboring fields.

While the work of the station should, in the main, be that of research, we must not neglect the immediate problems of the farmer, and also the seasonal problems that often occur, such as the outbreak of animal diseases, insect pests, and plant diseases. These have been taken care of immediately. Research, however, must always occupy the most important part in our program. To do effective research, a trained and energetic personnel is necessary, and every effort is being made to build up such a personnel.

Two new divisions have been created by the board during the past year: the Section of Grazing and Range Management, and that of Poultry. The head of the former section is Enoch W. Nelson, formerly of the University of Montana. This new section has already been organized and projects approved, and the work is well under way.

The new head of the Poultry Section is Dr. H. S. Wilgus, Jr., from Cornell University. These two departments will do much to strengthen not only the teaching of these subjects in the college, but also to strengthen the work of the Experiment Station and render a greater service to the state. The professional training of these two heads is excellent; they have had considerable experience and have gained reputations in their respective fields.

I give herewith a summary of the work at the several substations:

At Avon the work has been continued along the same lines as in the past, with the exception that we are increasing the demonstration work with field crops, making the station more

representative of agriculture in the mountain sections. The main pyrethrum work has been transferred to Avon. Tests during the past two seasons show conclusively that this crop is better adapted to the mountain sections than to the plains area. Not only is the yield of flowers higher, but the alkaloid content is also higher. Pyrethrum seems to winter perfectly, and we are now trying it out on a larger scale. Last year we shipped 700 pounds of flowers from Avon.

The possibilities of producing sugar-beet seed in the mountain sections was tested last year with promising results. Increasing plantings for seed were made this year, and we shall get a very good line on the future possibilities of this seed crop for the mountain sections.

The livestock program at Avon is moving forward, with considerable improvement in the herd. I believe we now have one of the best herds in that part of the state. We plan to carry a sufficient number of animals to utilize the feed produced. No feed is to be bought and none to be sold, making the farm a self-sustaining unit. The cost of operation at Avon is cared for by a budget of $6,000. So far as the actual farm project is concerned, the farm is on a self-sustaining basis. The budget assignment is to pay for the experimental work and permanent improvements, such as clearing of new land and adding special equipment. Ralph Manuel, superintendent, has proved himself very efficient, and the farm is a credit to the institution.

The Austin Substation is purely a fruit station, where demonstrations in the best methods of orchard management, spraying, washing, and packing fruit are carried on. It is also a testing station where new varieties of fruits are tested to determine their value for Colorado conditions. All varieties of fruits that can be grown are under observation. In addition to the demonstrational work, experiments in the use of commercial fertilizers are being carried on, along with the use of cover crops to furnish organic matter to the soil. Ferris M. Green, the superintendent in charge, is also chief deputy horticulturist, his salary and some expense being paid from this source. The annual station budget is $1,800.

It is a pleasure to report that the Rocky Ford Substation is now on a productive basis. We have overcome the effect of the bindweed and the bad condition of the soil caused by the chemicals used in killing the bindweed. Crop production has increased, and the farm is a credit to the institution. A plan has been worked out whereby demonstrations and trials of various horticultural crops are to be grown to demonstrate their adaptability

to the conditions of the valley. Considerable improvements have been effected; the land surrounding the residence has been put in shrubbery and shade trees planted. The house has been stuccoed and a new roof put on. The people of the valley take great interest in the work that is carried on, and as far as we can judge are greatly pleased with what is being done for the benefit of the farmer. Herman Fauber, superintendent, fits into the work very well, and has created an admirable place for himself in the community.

At the College Farm during the past year many changes and improvements have been made which we expect will increase the efficiency of farm operation, as well as making it more attractive. During the year three 12-inch pipe lines from the No. 2 County Ditch have been completed and are now in operation. New steel headgates for these pipe lines have also been constructed. The total length of these lines is over 5,000 feet. The farm roads have been graveled and side ditches cleaned up, making an attractive drive through the farm property. Much labor has been put into the weed-control program, and it may be stated definitely that as far as the College Farm is concerned the weeds are under control and are gradually being eliminated. A new pipe line has been installed from the main farm ditch to the reservoir hill, making it possible to irrigate the adjacent land where the new poultry department is to be established.

One of the biggest jobs this winter has been the work in connection with the hydraulic laboratory: the furnishing of gravel and some other materials and much grading. This has been a great expense to the farm and made our labor bills higher. New farm machinery has been purchased, as the old was in bad condition and needed replacement. The budget assigned to the farm was $6,000. The water assessment amounted to around $2,500, and the cost of pipe line to the farm was approximately $1,500, with machinery purchased about $1,100. These form the main items of cash outlay which, under normal conditions, should not be charged to the farm against the operating cost.

The aim has been to place the farm on an efficient operating basis, and to do this a certain amount of expenditure is necessary. The sales and service rendered to other departments amounted, for the year, to $11,317, and there is still an appreciable balance despite the heavy cost of improvements. The aim, of course, is to make the farm entirely self-supporting, and this will be an easy matter when once the improvements have been completed and production has reached its maximum. William P. Kintzley, as farm superintendent, is doing excellent work, and due credit should be given him.

Naturally, with the beginning of a new fiscal year the question of salary increases comes to the fore. I wish to assure the president and members of the board that the director will not ask for increases in salary for persons who are not earning them or showing proper energy and initiative in their work. The increases asked for are strictly on the basis of worth, and a reward that is due the recipients. They are all within the limit of salaries set by the board. The recipients are mostly young men who, the director feels, should be retained and encouraged. Several of these have had offers from the outside, but they like the work and opportunities and will stay, provided we recognize their services. On the other hand, there are a few who seemingly have reached a stationary place in their respective positions. They are not showing the proper attitude and interest. While no reduction in their salaries has been made, we believe that cases of this kind should be encouraged either to step out or to suffer a reduction in salary. In many instances such action would work a real benefit to the individual.

James R. Miller, the station editor, is doing excellent service. Our publications are models so far as English and composition are concerned, and a credit to the institution. Since December 1, 1935, when he entered upon his duties, 10 bulletins have been issued, with two due from the printer.

The individual reports of the sections are herewith submitted, and they give a fairly accurate picture of the work that is being done.

AGRONOMY SECTION

Personnel

Warren H. Leonard has been absent from the Agronomy Section during the year. His work has been supervised by Dr. D. W. Robertson but mostly carried by Dale E. Hodgell, who was employed as Professor Leonard's substitute.

The inauguration of a new Land-Use and Soil Survey under the Bankhead-Jones Act has progressed slightly, but as rapidly as possible under the circumstances. This act did not pass Congress until September 18. The intervening time, after our project was approved, has been used to get a leader, which was accomplished by obtaining Dr. Lindsey A. Brown. Dr. Brown comes to us with seven seasons of soil-survey experience.

During the year James B. Goodwin resigned to go to the Soil Conservation Service. His place was filled by employing Robert S. Whitney, who had been previously appointed as teach-

ing assistant for the year. Professor Goodwin put in half time teaching and half time on the Experiment Station.

Critical Periods in Use of Irrigation Water

Basic work on this project was aimed to discover primarily the best time to irrigate, knowing that to be related to the best use of water. The studies have given fundamental information on the behavior of the crop when water is applied at different growth periods. Where one irrigation only can be applied, the best time is between jointing and heading. This project is developing and will not be completed in its present phases for at least two or three more seasons. The work so far shows that to allow the soil to go into the fall of the year dry will not reduce the crop next year but will require earlier irrigation to bring crop yields up to normal. This feature seems to be largely a fertility factor.

Early irrigation is known to retard small-grain growth. Our studies indicate that this retardation was not due to the temperature of the water but to water itself washing nitrates out of the surface soil into the subsoil, thus getting them out of reach of the small-root systems which have developed up to this time. This was shown first by soil analysis and second by the effect of applying nitrogen fertilizers which prevented the yellowing and retardation of growth. Temperature, in this case, was not the factor involved. Water washing soluble fertility from the surface causes the crop set-back which in field practice often amounts to a retardation of growth for a period of from 2 to 3 weeks.

Control of Excessive Soil Nitrates

The project has shown in its present development that on impermeable soils nitrates will not increase in place to a damaging extent unless soils are impermeable due to a high water table or impermeable subsoil. In this case the problem is a salt problem, of which nitrates constitute one salt of the group. The work has been continued, with sugar beets as a test crop, on the behavior of nitrates in varying degrees of heaviness. Much heavier dressings can be applied than was formerly thought to be the case without damaging the the crop. On the particular soils with which we are working phosphates do not give returns until nitrate applications or nitrogen applications are increased. It is probable that these increased amounts are beyond amounts which would commercially pay.

Control of Bacterial Wilt and Winter Killing

Bacterial wilt has been a heavy factor in maintaining stands

of alfalfa on all the Eastern Slope since 1928. Our first attack on this problem was to see if a physiological resistance could be induced by soil treatment. The approach has so far yielded no helpful results. The second approach started at the same time was to find, if possible, alfalfas which would resist the disease. So far Hardistan, a strain of Turkestan alfalfa, has given the most promise. Ladak is more resistant than Baltic and Grimm. Hardistan, Baltic, and Grimm are winter hardy. Hardistan is resistant to wilt but is susceptible to leaf-spot and mildew. The most promising attack at present seems to be finding resistant strains, producing selfed lines, and hybridizing between resistant and hardy, high-yielding strains. This is slow work because five or six generations of self-fertilization are required to produce homozygous or pure strains.

Genetic Studies in Linkage Relationships

This project, carried by Purnell funds, is a fundamental piece of research. Dr. D. W. Robertson's work has shown seven linkage groups and has brought out the behavior of many of the genes, which information is useful in practical breeding work and has already resulted in very promising strains. Several papers have appeared in the Journal of Agricultural Research and elsewhere.

Soil-Plaque Method of Determining Mineral Deficiencies

Improvements have been made in the modified Das method of determining soil fertility which make the method more accurate and also less liable to error in the hands of inexperienced workers. Water-soluble methods give some promise as auxiliary helps. Robert Gardner's study of plant petioles is giving a new approach to the study of soil-fertility needs. The study of the plant as a measure of fertility needs has been carried elsewhere, but the particular development in Mr. Gardner's work is promising and brings out a new angle of attack. We are at the point where some attention needs to be given to rare elements, their role and determination.

Land Use

This project was inaugurated during the year, supported by Bankhead-Jones funds. The funds became available too late for field work before winter set in. The project is attacking the problem of land utilization and land classification. It will include basic soil surveys and basic plant-cover surveys. Dr. Lindsey A. Brown has been employed to be immediately in charge of the surveys. At this writing most of the needed equipment is in, and student parties are being trained so that they can go into

the field as soon as class work permits their leaving the campus, which probably will be the week of May 25.

High-Altitude Crops

Most of our high-altitude work is carried at Fort Lewis. Manuscript for a bulletin on oat production is in the hands of the director. This contains a high-altitude section based on the Fort Lewis work. A manuscript for a barley bulletin, containing a high-altitude section, is in preparation. Part of the work is in cooperation with the federal government, and its approval of the manuscript must be obtained before the bulletin is submitted to the director. One of the two government departments which must approve has already given its approval.

Plains Crops and Management

The season of 1935 was generally a good crop year at Akron. Rains came in May. These rains were late; consequently all crops were somewhat delayed in maturity. This delay made it possible for our winter wheat to be attacked by black-stem rust, which reduced yields. Yields of our better barley and oats were above 40 bushels for barley and above 60 bushels for oats on increase fields. The barley and oats produced at the Akron station for drylands are still the best adapted for that region.

Sorghum breeding, while not pushed as rapidly as desired because of a lack of means, is promising a wider adaptation of the sorghum crops to our plains through the development of earlier high-yielding strains.

Improved Seed

The hybrid-corn work previously reported is progressing. Colorado No. 13 still has a wider adaptation than the other produced strains. The possibility of producing F_1 hybrid corn is being thoroughly tested. A new hybrid oat, unusually smut resistant, is being given its final field test.

ANIMAL INVESTIGATIONS SECTION

Beet Tops for Fattening Steers

This experiment on the value of beet tops for fattening steers, using eight lots of 10 steers each, will not be completed until the first part of June.

The objects of the experiment are to determine changes in chemical analyses at periodic intervals after topping; to determine changes in feed nutrients during storage by various methods; to show loss of moisture at periodic intervals after topping;

to determine the tonnage ratio existing between tops and beets under field conditions with yields of 10, 12, 14, and 16 tons of beets per acre; to determine the value of dried tops as a substitute or partial substitute for alfalfa hay in a standard beet by-product ration; and to find the relative feeding value of dried tops, stacked tops, and beet-top silage in a standard beet by-product ration.

Wintering Calves

Following are the results secured in this experiment: One ton of cottonseed cake replaced 9,772 pounds of North Park hay in a wintering ration for calves; one ton of No. 1 dried beet-pulp pellets replaced 5,067 pounds of North Park hay in a wintering ration for calves; one ton of No. 2 dried beet-pulp pellets replaced 4,563 pounds of North Park hay in a wintering ration for calves; one ton of ground corn replaced 4,484 pounds of North Park hay in a wintering ration for calves.

Range Survey

A range survey was made in cooperation with the Botany and Chemistry Sections to determine the composition of winter forage on Colorado wintering-range areas. Pastures were classified according to botanical composition, and representative samples of the forage were taken. These samples are to be analyzed by the Chemistry Section of the station.

Range Management

Three different systems of management of the range are being practiced: lot 1, continued grazing; lot 2, deferred grazing; and lot 3, deferred-and-rotated grazing. The experiment is in its final stage and probably will be completed at the end of the present grazing season.

Mineral Supplements for Fattening Lambs

The lambs used in this test showed a rather high amount of calcium and phosphorus content of the blood, with an average ratio of 2.348 parts of calcium to one part of phosphorus. The mineral intake through the average daily rations varied from .084 parts of calcium to one part of phosphorus to 1.046 parts of calcium to one part of phosphorus. With these narrow calcium-to-phosphorus ratios, the lime-carrying supplements showed up to better advantage than those carrying phosphorus.

This test again points to the fact that the value of a mineral supplement depends largely on the following factors: the amount of calcium and phosphorus in the blood of feeder lambs, which

is largely determined by the range upon which the lambs were grazed and the forage consumed; and the relationship between calcium and phosphorus in the average daily ration.

This test brings out the fact that self-feeding is as efficient as force-feeding.

Protein Supplements for Fattening Lambs

With a ration of barley and alfalfa hay, this check-test again indicated flax to be the most efficient protein supplement because it produced greater gain than either cottonseed cake or linseed oil cake and also produced cheaper gain than cottonseed cake or linseed oil cake, and the returns per lamb were greater. Flax and cottonseed cake both showed a greater feed-replacement value than their market cost; linseed oil cake did not.

The standard beet by-product ration composed of barley, wet beet pulp, and alfalfa hay again produced the greatest gain and cheapest gain, and the lambs showed more finish than any other lot in the experiment. The addition of protein supplements, such as cottonseed cake, linseed oil cake, and flax, to this beet by-product ration was not profitable, and none of the supplements showed a replacement value equal to their market cost.

Advanced Registry

HOLSTEINS.—Two Colorado herds have cows which secured places in the 1935 honor list of the Holstein-Friesian Association of America as foremost producing cows of America.

In the C. W. Henry herd, in the 10 months' butterfat record, Class B, Johan Lady Gerben at 4½ years and under 5 years of age, producing 16,889.6 pounds of milk and 564.5 pounds butterfat, was tenth in her age class. Betty De Kol Cragdale, producing 14,249 pounds milk and 537.7 pounds butterfat, was eleventh in the age class of 3½ years and under 4 years of age.

In the Colorado State College herd the cow Katy Ormsby Wayne Rose rated thirty-second for the year on the Holstein-Friesian honor list for cows under 2½ years, with a production of 19,728.9 pounds milk and 597 pounds butterfat. Both herds averaged over 500 pounds butterfat.

GUERNSEYS.—The Robert Roemer herd of Guernseys on herd improvement has given for the sixth successive year an average production of over 500 pounds of butterfat per cow. The records have been certified to the American Guernsey Cattle Club, but official notice of the average has not yet been received.

Summary of Work

Summary of work of Animal Investigations Section since May 1, 1935

Month	Number of cows on yearly test, one day per month	Number of cows on yearly test in Herd Improvement Division	Number of herds	Fees
May	33	97	9	$22.55
June	29	78	9	14.25
July	39	106	10	20.35
August	39	64	9	16.15
September	35	102	10	19.45
October	36	68	9	15.80
November	36	104	10	19.40
December	35	60	9	14.75
January	41	80	10	21.55
February	25	64	9	14.20
March	39	89	12	18.40
April	38	52	11	17.70
Totals	425	964		$214.55

BOTANY SECTION

Range Improvement

GRASS NURSERIES.—Last year the Botany Section maintained grass nurseries, and 16 new exotics were added to the collection. Tests were made in the nursery of dates of planting and the effects of different methods of watering. Seed-increase plots of three very promising exotic grasses were planted.

NORTH PARK GRASS MEADOWS.—The results of 3 years' work on methods of irrigating hay meadows was compiled. Yield studies on these meadows show that timothy out-yields the native grasses, and that continuous irrigation produces the greatest yield. The seeding of alsike and domestic grasses in native sod is not successful. Some method of renovation is first necessary. In the cleared sagebrush areas crested wheat grass made the best showing; it was established most readily, as would be expected, in prepared soil. Little difference was shown in results between spring and fall planting.

COLLEGE PASTURE AREA.—The deferred-rotation areas continue to be superior to those where continuous grazing is practiced. They are superior in terms of quantity of forage and condition of the plants. The effect of drouth during the past 2 years was less evident in deferred pastures.

RANGE-FORAGE RESOURCE SURVEY.—A range-forage survey

was made, and data on forage composition, carrying capacity, and range conditions have been secured for the winter-range areas in Western Colorado, the San Luis Valley, and the plains adjacent to the foothills. The composition records obtained in the range survey have been utilized to determine the forage composition on western ranges. Collections for chemical analysis were made of these same ranges.

The vegetation map of Colorado made last year has been revised.

Work on Pathology

The chief work done by the section has been that on peach mosaic. Last year, in cooperation with the state entomologist and the Office of Entomology and Pest Control, Washington, D. C., a thorough survey of the peach districts was made. Mosaic is confined to the Palisade-Grand Junction area. An energetic campaign of eradication was carried on, and more than 6,000 infected trees were removed. Studies were made of the transmission of the disease, and repeated proof was made of its virus nature; also, tests were conducted on the susceptibility of different varieties and of other stone fruits. The results this spring indicate that control so far is between 60 and 70 percent effective. It appears very hopeful that all infestations may be destroyed in a few years.

Weed Project

POISONOUS WEEDS.—Last summer a survey was made of the Blue Mountain area, in the northwest corner of the state, where timber milkvetch was found. For years this region has suffered from a cattle disease known as "cracker heels". The veterinarian and station chemist disproved the possibility that this might be caused by potash deficiency or selenium, as was at first suspected. Feeding experiments showed that the disease is due to eating timber milkvetch. Symptoms were produced in a few days in animals fed this plant. Bulletin 425, jointly published by the Veterinary, Botany, and Chemistry Sections, covers the work.

Bulletin 429, "Poisonous and Injurious Plants of Colorado," has been jointly published by the Veterinary and Botany Sections. It discusses the known poisonous or injurious plants in the state, with 89 illustrations.

WEED CONTROL.—A large amount of data on chemical control of field bindweed has been analyzed and prepared for publication. The conclusions indicated by the analysis of the data are as follows:

Of the chemical treatments, sodium chlorate is the most effective in direct proportion to the amount of sodium chlorate contained.

There is a great variation in the results obtained from the use of chlorates in Colorado. Two pounds per square rod in one application has given a 100-percent kill, while 20 pounds per square rod in five applications during two seasons has failed to give a 100-percent kill.

Spray applications are somewhat more effective than dry applications under the conditions common to these tests. The nozzle pressure employed in applying the spray bears no relation to the results.

The amount of water used in making up the spray solution bears no apparent relation to the results. The time of day of applying chlorate bears no apparent relation to the results.

Increasing the rate of sodium chlorate application is accompanied by a gradual decrease in effectiveness. A single application of 3 pounds of sodium chlorate per square rod appears to be the optimum rate under Colorado conditions. Increasing this amount does not increase the effectiveness enough to warrant the added cost.

An application of 6 pounds per square rod appears to be the maximum amount warranted by results where the greatest effect from a single treatment is desired.

In amounts up to 3 pounds single applications are superior to multiple applications during one season. Above 3 pounds multiple applications may be desirable.

Making single relatively light applications over several seasons is productive of better and more economical results than applying a large amount of chlorate in one season, either in single or multiple applications. That is, a prolonged toxicity is more effective than a very high toxicity at any one time and effects a material saving in the amount of chemical required.

Data on the control of whiteweed, Russian knapweed, povertyweed, and other weeds has, in a similar way, been analyzed.

A rather complete bibliography on subjects pertaining to weeds has been compiled on the basis of authors and of subject matter.

New experiments have been established on the relation of cultivation and cropping to bindweed control, frequency of cul-

tivation, time of starting cultivation program, effect of irrigation, effectiveness of various smother crops, and rotation involving clean cultivation; and row or smother crops are being studied.

A study of the anatomy and morphology of the whiteweed is being conducted; also, the trend of root reserves of whiteweed and bindweed is being studied on cultivated and undisturbed areas.

Seed Laboratory

SEED TESTING.—Samples of seeds for test from various sources were received at the seed laboratory as follows: Farmers and dealers, 1,511; Seed Registration Service, 512; Soil Conservation Service, 44; inspection, 123; longevity studies, 165; examination, 10; identification, 8; total, 2,373.

A distinct change in source of samples submitted has taken place since seed testing has been on a free basis. During the year just closed more than 80 percent of all samples were sent by farmers.

Tests of nearly 400 samples of corn brought out the fact that the seed-corn situation was less serious in Colorado than had been supposed. The average germination for all samples was 83 percent. A few very poor samples, however, were responsible for the low average.

SEED INSPECTION.—Seed inspection was carried on in three separate lines: Interstate shipments, several lots of which were found to be mislabeled (by agreement with shippers, all such seeds found were removed from the state); seeds bearing labels of Colorado dealers, some of whom were found to have complied with the law nearly 100 percent, while others failed to comply to nearly the same degree; and a drill survey to determine the quality of seeds actually being planted in four counties, which brought out the fact that while there is great demand for assistance in weed control, many farmers are planting seeds of povertyweed, wild morning-glory, and other serious weed pests.

PROJECTS CONTINUED.—Projects on longevity of cereals, germination of sugar-beet seeds, and range grasses, started at various times, have been continued.

In cooperation with John Gaskill of the U. S. Department of Agriculture, germination tests are being made annually to determine longevity of sugar-beet seed and the effects on germination on certain chemical treatments to prevent insect damage.

A cooperative study also is being carried on by the International Seed-Testing Congress in order to standardize methods for testing sugar-beet seeds. Since the Colorado seed analyst is the only American member of this committee, this laboratory has made cooperative studies of the following media: special blotters, paper towels, and soil; this laboratory also has studied the value of pre-soaking and seed disinfectants. Comparisons were made of untreated, steam-sterilized, and dry-sterilized soils.

Results from the studies of the participating nations are now being assembled by the chairman of the committee at Halle, Germany, and will be made available to all laboratories as soon as compilation is completed.

Many tons of seeds of native grasses were collected in 1935 to be planted by the Soil Erosion Service in 1936. The seeds having been collected for planting, the question which needed a solution was the quality of the seed and how this might best be determined. Some wild grasses have a prolonged dormancy, while others have adhering parts which make it impossible to determine optically whether seeds are present or not. The following were studied: *Sporobolus* spp., *Boutelous* spp., *Agropyron* spp., and *Oryzopsis mileaceum.*

COLLECTION SYSTEMATIZED.—With the aid of an NYA student, the entire reference seed collection of approximately 3,000 vials of seeds has been relabeled and arranged in philogenetic order.

CHEMISTRY SECTION

Relation of Minerals to Potato Quality

A project to determine the relation of soluble soil minerals to the quality of Colorado potatoes was initiated late in 1933, with the Chemistry, Horticulture, and Home Economics Sections cooperating. In that year we were able to obtain only 22 samples of tubers of uniform source for a preliminary examination. No soils were examined this year.

In 1934 the seed stock, choice of growers, and general conditions of the experiment were better controlled, and a large number of samples of tubers as well as of soils on which they grew were collected and chemically examined.

In 1935 the procedure of 1934 was repeated and somewhat extended. The Home Economics Section joined in this project in order to study the cooking qualities of Colorado potatoes. The chemical data on the 1935 crop should be completed by the first of June.

Owing to the fact that 1934 was one of the driest years experienced in Colorado, and moisture conditions in 1935 were very much altered, it appears advisable to continue our projects unchanged for another year before attempting to follow any suggested leads on the basis of the work thus far.

Mineral Deficiencies and Nutrition Diseases

This project for study of mineral deficiencies and nutrition diseases in range cattle was begun in the spring of 1934, with the Chemistry, Veterinary Pathology, and Botany Sections cooperating. At that time a study was made at monthly intervals of soils, range grasses, and blood of cattle in western Moffat County. At the onset this appeared from all available evidence to be a nutritional-deficiency problem. At the end of one grazing season it became evident that nutritional deficiencies, while present, were only secondary, primary indications pointing to some form of forage poisoning.

Accordingly, in 1935 the Botany Section was called in to cooperate on the project. About 25 species of range-weed samples were collected and tested for presence of selenium or other mineral poisons. Nothing more than mere traces, (less than .5 p.p.m.) were found.

The primary cause of the reported disease was found to be the timber milkvetch (*Astragalus campestris*). The bulletin containing results of this work is now in press, and the project as it relates to the Chemistry Section is completed with this report.

Nutritional Characteristics of Hay Plants

This study of nutritional characteristics of mountain hay plants of Colorado, in which the Chemistry and Botany Sections cooperated, included a study of the chemical composition of individual species, as well as of a few mixtures of North Park grasses sampled at the time of haying in the several locations. Some vitamin studies dealing with vitamins A, B, and G were also made. The chemical data cover the crops of 1933 and 1934. These data have been completed for some time but have not been prepared for publication for lack of time. It is hoped to continue some phases of this project further, in cooperation with the newly created Grazing and Range-Management Section.

Analyses for Animal Investigations Section

For the third successive feeding season our section is doing the analytical work for the Animal Investigations Section, involving blood analyses and analyses of fodders. These final services are being closed out during May 1936.

Analyses for Fruit Inspector

During the autumn months of 1935, in cooperation with the state fruit inspector, some 300 fruit-spray residue analyses for arsenic, lead, and fluorine were made, and this service is to be continued again during the fall of 1936.

Analyses for Individual Farmers

The many and various requests for chemical service to individual farmers have been met to the best of our facilities this year, as in the past. These include water analyses, soil tests, and other miscellaneous services and information. These are growing so rapidly in volume that we fear some curtailment will soon be necessary, or else more facilities will have to be furnished our section.

RURAL ECONOMICS AND SOCIOLOGY SECTION

Agricultural Adjustments

Beginning in June 1935 the members of the Rural Economics and Sociology Section staff gave special attention to the an alysis of a planning project in cooperation with the Agricultural Adjustment Administration, U. S. D. A. This study involved the assembly and tabulation of crop production data by counties and districts for a 10-year period; the preparation of summaries dealing with scattered information on crop and livestock production for a 10-year period; the compilation of data showing crop failure and fallow land for crop-reporting districts; the preparation of a feed and livestock balance for the state which, over a 10-year period, indicated a fairly close balance between the two but did point out an excess of livestock in Western Colorado and a shortage of livestock in Eastern Colorado; the assembly of existing data on desirable land use for Eastern Colorado with opinions on the application of these facts in the development of practical plans for the use of the different grades of land in this portion of the state; and a study of possible cash income from average production with given prices. This project has emphasized the need for more exact data concerning farm expenses on different types of farming in order to permit the preparation of adequate budgets for these various types.

Type of Farming

The adjustment project to which reference has been made may be considered as an extension of our type-of-farming study. The latter analysis was based in part upon detailed census figures for 1930; these were supplemented with information assembled by the Division of Crop and Livestock Estimates, and

also with records made available through studies in this department covering a period of 15 years. The descriptions which are given for the 17 type-of-farming areas in Colorado (Sta. Bul. 418) are, in many cases, rather general; hence further work should be done in each of these regions in order to provide more specific recommendations with regard to the most profitable combinations for each area. It is our plan to develop some refinements in connection with a farm-business survey associated with the soil and plant-cover project outlined for the plains area in 1936 and 1937 and subsequent years.

Sheep and Cattle

Early in October 1935 this department undertook cooperative work with the National Forest Service in attempting to secure ranch organization data which may be used as a guide in formulating the future grazing policies of the federal government. Approximately 30 ranch records were obtained from our field work in this region. The summarized data for the year 1935 indicate that the sheepmen appeared to have somewhat larger incomes than the cattlemen in that region. This study has also revealed the fact that the cattle industry in this area has been decreasing in importance, while the sheep industry, on the other hand, has been increasing. Sound recommendations with respect to proper land utilization and the correct size of farm units in relation to profitable operation can be given only after a detailed study has been made of the results of this survey. A further analysis of the ranch business in this area could well be worked out around the problems of proper type and size of ranch best adapted to the region, the wise and efficient long-time use of the range, and the conservation of the land resources of the area.

Highway Taxation

A study of highway utilization and finance in Colorado, carried in cooperation with the Bureau of Public Roads, the State Highway Department, and other agencies in the state, has engaged our attention during the past two or more years. The purpose of this investigation was to reveal where funds for highway uses were obtained and where they were spent; to analyze the direct and indirect highway receipts and expenditures of the state, counties, cities, towns, and other governmental units; to develop information showing the facts of highway and related taxes; to show the total amount of revenues raised and expended for all other governmental purposes of state and local governments as compared with the revenues raised and expended for highway purposes; and to provide information for high-

way-planning programs and methods of financing highways so that there may be a proper distribution of highway costs in proportion to the benefits derived. From the standpoint of agriculture this study shows the proportionate amounts of taxes assigned for highway purposes in comparison with the extent to which roads are traveled for each section of the state. It also indicates the proportionate amounts used for highway purposes from the standpoint of farm folks compared with city dwellers.

Rural Sociology

Research in rural sociology has been concentrated on the activities conducted under what is known as the Cooperative Plan of Rural Research, an arrangement whereby studies of rural relief problems have been initiated and financed by the Division of Social Research and the Federal Works Progress Administration. The Experiment Station has contributed Olaf F. Larson's time as state supervisor of rural research and has furnished office space. The major studies completed or to be completed by June 30, 1936 are as follows:

Survey of current changes in the rural relief population; study of public and private assistance in rural areas; re-study of agricultural villages, including three community centers, Akron, Burlington, and Delta; rural youth study relative to all persons aged 16 to 29 in the Akron and Delta communities; survey of Spanish-speaking beet workers on relief in Weld County; and survey of applicants for WPA aid in Weld County during February 1936.

Data gathered in these surveys were sent to Washington for immediate use by relief administrators. These data are also being analyzed to obtain basic information on Colorado's rural problems. The first report, "With Rural Relief in Colorado, February-November 1935", issued as a mimeographed bulletin, describes the nature of relief problems in rural areas of Colorado, rural relief trends and characteristics of the rural relief population, and tells what happened to the rural cases when they left the ERA relief rolls.

The second report, "Social Security and Rural Relief in Colorado," depicts the extent to which the rural relief population is composed of people more or less permanently unemployable or eligible for aid by such social-security measures as old-age pensions and aid to dependent children. Special problems facing rural social workers are indicated.

In conclusion mention should be made of a study relating to farm mortgages, tax rates, and land transfers that has been in

operation since January 1936. This is a cooperative study in which the Colorado Experiment Station, the Bureau of Agricultural Economics, U. S. D. A., and the Works Progress Administration are participating. Records are being assembled from 17 typical counties.

During the year Colorado Station Bulletin 418, "Type of Farming Areas in Colorado," was completed and published. A manuscript dealing with ranch organization and operation on some 20 units in the North Park area is practically ready for publication. Similarly the manuscript relating to a study of highway utilization and finance in Colorado has been completed and will be submitted for publication shortly.

ENGINEERING SECTION

(Civil Engineering)

This section's testing engineer, E. A. Lawver, spent the summer making and testing oiled-gravel cylinders with varying water and oil content in an attempt to determine the percentage of water which could be permitted in an oiled-gravel matrix for road-surfacing purposes. Varying aggregates were also used. Mr. Lawver devoted his entire time to this work.

When, on December 3, Mr. Lawver resigned, he had prepared a report giving the data he had collected, with a full statement of the work he had done and suggestions as to how his successor, in his judgment, should proceed with the work he had started. The work has been continued by his successor, Adrian Legault, an engineer from the Bureau of Public Roads.

Mr. Legault has been giving half his time to teaching in the Civil and Irrigation Engineering Department, and the remaining half he has given to the research project of oiled-gravel roads. Forty oiled-gravel cylinders were constructed as outlined to complete the group of test specimens made in connection with the experimental road constructed a year ago last summer. About the middle of February the breaking of 200 test cylinders which had been out of doors in the test lot for the required time was begun, and about 1 month was spent on this work.

On April 10 Mr. Legault began compiling and assembling the data to be used in the bulletin to be published on this project. This work was completed about May 1, 1936, and is now in the possession of the section head, E. B. House. As soon as college work ceases for this year it is his intention to write this bulletin and submit it for publication.

Research work on seal coats for oiled-gravel roads is the

next phase of the project we wish to take up for the work of next summer and fall.

ENGINEERING SECTION
(Mechanical Engineering)

Progress has been made on several phases of the sugar-beet machinery project.

The hill-drop planter on which the station started experimental work several years ago may now be considered closed. Two commercial concerns are now building hill-drop planters which are in their second season. The principal advantage of this machine is in its saving of seed, representing a saving to the grower of approximately $2 per acre.

Work is being continued on the beet planter with two objectives: first, to handle individual seed balls; and second, to more positively locate the seed balls in the furrow. The ultimate objects are to increase the germination stand and to facilitate "mechanical thinning."

Experimental plots have been planted for comparing various planting devices.

"Ridge planting," wherein beets are planted 14 inches between rows on top of ridges—the ridges being 20 inches across the flat top and the 5-, 6-, or 7-inch depth ditches between ridges being spaced 40 inches on center—is being demanded in certain localities. This method of planting has required considerable attention in adapting machinery to this system. Progress has been made.

Fertilizer-placement trials have again been made. The indications are that appreciable gains in tonnage may be expected in deficient fields just by the location of the fertilizer with reference to the seed.

Progress has been made in preparation of harvesting equipment for the coming season.

ENTOMOLOGY SECTION

Non-Arsenical Insecticides

Work under the Entomology Section's non-arsenical insecticides project was limited largely to the control of the insects of cabbage and cauliflower, and to the alfalfa looper on head lettuce. Sixty-one field tests were made during the season.

During 1934 the insect infestation on cabbage and cauli-

flower consisted largely of the imported cabbage worm. A satisfactory control of these was secured with pyrethrum dusts containing .18 percent pyrethrins and with derris or cube dusts carrying .5 percent rotenone. The minimum amount of material and the number of applications to give seasonal protection remain to be determined. The infestation of the imported cabbage worm was so light in 1935 that this part of the work could not be completed.

The 1935 infestation consisted of the cabbage looper, alfalfa looper, and the diamond-backed moth. These are more difficult to kill. Dusts carrying .2 percent pyrethrins or .75 percent rotenone, which is higher than most recommendations and also higher than the contents of most commercial dusts, failed to give satisfactory control.

Plant-Louse Investigations

A paper describing four new species of aphids and giving figures of the same has been prepared and is now in the hands of the Editor of Annals of the Entomological Society of America.

A supplement to the Aphidae of Colorado is being prepared. Eleven species have been figured and the descriptions prepared. This will include at least 14 species that were not described in the original publication.

Syrphidae in Relation to Plant Lice

The work on this project consisted of systematic studies, principally with the genera *Syrphus* and *Metasyrphus*. Some new material, including several European specimens received in exchange, were added to the collection.

Insect Vectors of the Peach Mosaic

In cooperation with the Office of State Entomologist this new project started during the year. The rapid spread in the Palisade section of the virus disease known as peach mosiac indicates that insects, possibly several species, are responsible. A careful study of the insect fauna of the peach, in both cultivated and uncultivated orchards, is under way. Fourteen species of insects were used in the transmission studies last season, and several have been used this spring. There is positive evidence that the disease was transmitted under control conditions by two species.

Tomato Psyllid Project

Two phases of this project have been carried during the season.

TOMATO PSYLLID IN RELATION TO POTATOES.—Further testing of combination sprays and dusts at the Greeley station has indicated that the flea beetles and psyllids may be controlled successfully with a lime-sulfur and zinc-arsenite spray when applied in two or three applications. Combination of sulfur and calcium arsenate dusts were not as effective.

Studies of weather records indicate that dry and hot seasons favor psyllid development in certain of the potato areas.

Two surveys made through the potato sections of the state gave evidence that the psyllid trouble was not serious except in the Wet Mountain Valley and the Grover potato area.

Western Nebraska and Eastern Wyoming have been found to be potential breeding grounds which may supply psyllids to Northeastern Colorado. The abundant native ground-cherries and favorable climate furnish desirable conditions for the insect to breed. The over-wintering forms were taken in the fall and spring in the Nebraska-and-Wyoming area.

A bulletin manuscript on potato insects has just been completed.

TOMATO PSYLLID IN RELATION TO TOMATOES.—This work consisted largely of field tests of treatments that had shown promise in psyllid control. These were liquid lime-sulfur spray, dry lime-sulfur spray, wettable sulfur spray, and sulfur dust. Under conditions of light infestation the control results were not as positive as in 1934. There was a significant difference in yield between the untreated and the treated plots, with no significant difference in the yield between the plots receiving the various treatments. None of the sulfur compounds showed serious injury to the plants as some of them did in 1934.

The insect proved to be quite injurious to the spring crop of tomatoes in greenhouses in the Denver section. Many houses had almost a complete loss of crop during the month of June. There was quite conclusive evidence that the psyllid was a factor in the spread of mosaic on the tomatoes in two houses.

For a number of years we have been puzzled over the fact that the psyllid is a serious pest on early potatoes in the Grand Valley but disappears in early summer and never becomes a serious pest on late potatoes or on tomatoes that are grown very generally in that section. In studying this it was found that data collected under control conditions indicate that 80° F. is about optimum, and that higher temperatures are very detrimental. Temperatures of 95° and 100° practically stop all egg deposition

and hatching and larval development. These temperatures are very common ones for the Grand Valley and apparently are responsible for the disappearance of the psyllid in the tomato fields.

In this same section there are very few psyllids present with the approach of winter. The population for the spring infestation evidently comes in from hibernating places out of the valley or from more southerly spring breeding grounds. Wind traps were operated in the Grand Junction section for the third season to determine the appearance of the insects. These were operated in cooperation with the U. S. Bureau of Entomology and Plant Quarantine in connection with their studies of migration of the beet leaf hopper. The infestation in this section was for the third season in proportion to the catch made in the traps. This has promise of being a method of determining the early spring population responsible for outbreaks on the early potatoes.

General Insect Pests

COMMON RED SPIDER.—Raspberries are each year injured by this pest, but during the past season injury was much more severe than usual. Many plantings were largely defoliated before the fruit was harvested, with the result that the crop was almost an entire failure. Twenty-eight tests, including summer oils, nicotine, a selenium compound, lime-sulfur, wettable sulfur, and dusting sulfur, were made. The oil and nicotine treatments gave only partial control; the selenium compound proved quite effective but leaves an objectionable residue on the fruit. All the sulfur treatments gave good control, but injury to the raspberry resulted. The injury from lime-sulfur, used at the rate of one part to 100 parts of water, and wettable sulfur, 1 pound to 10 gallons of water, was very severe. In some cases much of the foliage dropped, and there was a definite effect upon the quality of the fruit. Even the dusting sulfur had some detrimental effect. There is need of further work on this problem.

PINE-LEAF SCALE.—A number of tests with various insecticides were made for the control of this pest at its hatching time. No satisfactory control was secured. Lime-sulfur used at the rate of one part to 40 parts of water, and wettable sulfur at the rate of 1 pound to 10 gallons of water, gave a partial control, but this was not as satisfactory as a dormant application of lime-sulfur.

EUROPEAN EARWIG.—This pest was found in the state during the year for the first time. The premises and buildings of a government institution near Denver are quite heavily infested.

Observations were made on the insect, and some preliminary tests were made in poisoning it in cooperation with the officers in charge.

CODLING MOTH LARVAL PARASITE.—A shipment of this parasite (*Ascogaster carpocapsae*) was secured from the U. S. Bureau of Entomology and Plant Quarantine, and liberations were made in an orchard near Fort Collins and in one at Canon City. Introductions of this parasite were made on the Western Slope by the Office of the State Entomologist in 1928 and again in 1934. The insect became established from these liberations, but apparently the heavy spray schedule has been detrimental. It is hoped that under Eastern Slope conditions, where spraying is not so heavy, the parasite may be of the value it appears to be in some eastern sections.

Indexing of Correspondence

A great deal of correspondence in connection with insect problems of the state has been carried on by the Experiment Station since 1891. This material, until the year of 1922, had never been indexed, and the amount of information in it was unavailable. A Works Progress Administration project has been under way for several weeks in which this has all been gone over carefully, the useless material discarded, and all the material relating to insects of the state indexed.

State Entomologist's Work

The station entomologist has also acted as state entomologist. Even though some far-reaching changes have been under way in this organization, cooperation has added a great deal to the insect-research work. The work on vectors of peach mosaic has been mentioned; equally valuable work has been done through cooperation on certain fruit-insect problems, especially that of the codling moth. This has given very valuable information on spray schedules and especially on certain combinations of sprays that have given a much better coverage on the fruit and therefore better protection.

Publications

Bulletin manuscripts approved for publication are in the hands of the station editor as follows:

"Insect and Mite Pests of the Peach in Colorado," by George M. List and J. H. Newton.

"Some Injurious Plant Lice of the American Elm," by George M. List and C. P. Gillette.

"Notes on *Cryptolestes ferruginous* Steph., a Cucujid Occurring in the *Trichogramma Minitum* Parasite Laboratory of the Colorado State College," by Elwood H. Sheppard.

HOME ECONOMICS SECTION

Publications

During the year now closing one bulletin has come from the press for the Home Economics Section of the station; reporting on findings in connection with the project dealing with the baking of flour mixtures at high altitudes, it appeared as Technical Bulletin 15 under the title "The Influence of Various Factors, Including Altitude, in the Production of Angel Food Cake."

This third bulletin of the series appearing in the last 3 years is of primary interest to the scientific laboratory and the baking industry. The readily applicable findings reported therein were reproduced in language and form more acceptable to the lay person in April 1935 as Technical Bulletin 13, under the title "Baking Angel Food Cake at Any Altitude." Recently the Extension Service has put the essential facts into a very abbreviated form adapted for general distribution.

Cooperative Research

The second project on which the Home Economics Section has been engaged is a cooperative piece of research in which this section plays a minor part, with the Chemistry and Horticulture Sections of the station directly in charge. The Home Economics Section will not publish independently on this project.

Personnel

Dr. Mark Barmore, associate in research directly responsible for all laboratory procedures, is completing his fourth year at this institution. He is highly qualified for research and is producing excellent results. One assistant is detailed to the work in which he is engaged. Lafayette Butler has just returned after a half-year's leave of absence.

From a progress report by Dr. Barmore there are quoted herewith statements regarding activities of the section since the semi-annual report submitted in November.

Baking Flour Mixtures at High Altitudes

"The work on this project has consisted, after standardizing the procedure, of the investigation of the effects of various factors on the characteristics and the tensile strength of yellow sponge cake, which is next in simplicity to angel food cake.

From the data collected an equation has been built up which expresses the tensile strength (tenderness) of this type of cake for all the successful combinations of ingredients and for variations in altitude. However, to date some trouble is being encountered in applying this information to practical cake baking, but it is believed this will be overcome soon.

"It has been particularly satisfying to learn that the information published on the practical results of the angel food cake study has been so readily sought after, and especially that it meets the test of the domestic baker.

"Two papers have been prepared and delivered during the past year: one at the Colorado-Wyoming Academy of Science meetings on 'The Properties of Coagulated Egg White,' the other at the Colorado Section of the American Chemical Society on 'Recent Developments in the Chemistry of Foods.'

"The east half of the porch on Guggenheim Hall, adjacent to the Altitude Laboratory, has been enclosed, doubling the floor space and improving conditions 100 percent.

Culinary Qualities of Potatoes

"Tests were made to determine the rate of cooking, by penetration, of six varieties of potatoes grown at two locations, Avon and Carbondale. In addition these same varieties grown at 12 different locations throughout the state were tested for percentage sloughing, and scored for texture, flavor, and color. Several other tests of our own invention were tried but with little or no success.

"A statistical analysis was made of the data obtained by this section and that obtained by the Chemistry Section so far, but the only thing of any value which resulted was that the amount of penetration of the samples was related to their starch content; i. e., the higher the starch content the longer the time required to cook them to a 'done' stage.

"The trouble is that there is only this one method of testing potatoes objectively—the degree of doneness by penetrometer—and this characteristic is of minor importance. Until some group succeeds in developing methods other than those based on score-card practice, only meager results may be expected."

Inspection of Laboratory Work

Last summer the assistant director of the Washington Office of Experiment Stations spent the greater part of 2 days carefully going into the work under way in the laboratories in

the Home Economics Section. The report given was to the effect that the Colorado Section was one of the several outstanding sections in the country at large, and that the findings were an outstanding contribution.

HORTICULTURE SECTION

Potato-Improvement Project

The work of the Horticulture Section on potato improvement has been carried for a number of years, and during the past year the variety testing and description phase has been completed. The compilation and preparation of this material is now being arranged for publication.

One of the important developments which originated from this project was the selection of the Dark Red Peachblow, or Red McClure variety. This new stock is an improvement in color and yielding ability, and is equal in quality to the old type. It is rapidly replacing that variety, particularly since it outsells the old type and has topped the Chicago market again this year. Further selection work is necessary to better fix the dark-red color, as it is not uniform on all soil types; however, disease in the supply of seed stock has been reduced to a low point.

This project also made it possible to test the new varieties released in the United States, and the new Katahdin has been released to growers. So far this variety shows exceptional promise on the Western Slope, particularly in Montrose County, and in the San Juan Basin and in Routt County. The variety appears to be too thin-skinned for the San Luis Valley and is being further tested in Northern Colorado this season.

The new Chippewa is being tested in the potato-growing districts of the state. While it is earlier than the Katahdin, it is more susceptible to scab and not as well shaped.

Crosses have been made again this year between Katahdin and Russet Rural, Katahdin and Irish Cobbler, and Seedling 252 x Rural. The object of these crosses is to produce a seedling more resistant to scab, earlier in maturity, and with more tolerance to virus diseases. Inbreeding on several varieties and seedlings is also under way.

This year 15,000 tubers were indexed from seed stock sent in by growers, principally from the San Luis Valley. The disease situation in potatoes is so complicated by masking of symptoms in the field that growers cannot always produce good seed stock. The stock is cleaned up for growers without charge and returned to them as foundation seed stock. This year 50

sacks of Brown Beauty were tuber-indexed in the greenhouse during the winter, and a considerable quantity of Bliss Triumph seed was cleaned up.

The work on abnormalities found in seed potatoes has been completed and published on, although there is much more work that needs to be done, and the work should be carried further.

Quality of Colorado Potatoes

This project is carried in cooperation with the Chemistry and Home Economics Sections of the station. Wide variation in chemical composition and cooking quality of potatoes have been found in different varieties and under different soil and growing conditions. A very large amount of data has been accumulated, which will be correlated and published in a preliminary form after this season's results.

Variety Testing of Tree Fruits

The testing of tree fruits as carried at Fort Collins was started last year. Severe weather during February caused considerable injury to young fruit trees planted in 1935. Nine varieties of Japanese plums were killed outright, and a number of other plums were severely injured. Varieties killed were Blood X, Flaming Delicious, Formosa, Great Yellow, June Blood, June Redskin, Satsuma, and Wickson. Burbank, Imperial Epineuse, Sannois, and Red Ace were severely injured, but growth is expected to start.

May Duke and Early Honeyheart were the only two varieties of cherries which failed. May Duke did not start well in 1935.

The number of apple varieties under test has been increased to 91 this year. To date no trees have been killed completely, although some of the trees do show considerable killing back of 1 year's growth.

Sour-Cherry Cultural Methods

This project is carried in cooperation with the soils work of the Agronomy Section, and was started last year. A series of soil treatments is used, including commercial-fertilizer applications. There is but a small amount of data collected, and most treatments show no definite reaction. However, from 1 year's data on work with commercial fertilizers indications are that early spring applications of quickly available nitrogen on soils deficient in spring nitrogen will cause an increased set of fruit. This increased set may not be necessarily accompanied by an increase in size of individual fruits.

Sour-Cherry Orchard Management

This project was started in 1935, and all trees came through the winter in good condition. This work is on pruning tests and soil management, but it also has not been in progress long enough to show definite results.

Strawberry Varieties

Out of 40 varieties under trial, Dorsett and Fairfax showed the most vigorous and the most highly productive of all, based on 1 year's results. Another year's yield record will be taken this year.

Raspberry Investigations

Plots for the comparison of hill and hedgerow training on the varieties Cuthbert, Latham, and June are now established, and should bear normal crops for yield comparison this year. The growth was so vigorous this year that it was necessary to cut out many canes above average size to conform to the 10-cane per hill standard set up in the experiment.

Grape Varieties

There was about 20 percent winter loss on the 42 varieties of American grapes planted last year. It is planned to replace those lost for another year, after which only those that survive at least one winter will be continued in the test for hardiness, which also is later to include some work on trimming and pruning.

Sweet Spanish Onion Breeding

While the work is slow on this project, very good progress has been made. From this work Colorado Sweet Spanish No. 6 has been developed by selection and inbreeding methods. This variety has been placed in comparative tests at Rocky Ford with all of the very best home-grown and imported stocks, and the results definitely show the selection to be the highest in percentage of marketable bulbs, lowest in storage losses, and an improvement in color and shape. After more extensive tests during the coming season in six counties of the state, the variety will be released.

There are also other selections being carried which are not as yet ready for field test. A number of inbred lines are carried, and several crosses between the Grano and the Sweet Spanish have been made with the idea of securing an earlier, milder flavored, yet good storage-type of onion.

Onion Curing and Storage Work

This work is carried on the Rocky Ford Substation, and due to lack of proper temperature-controlled storage chambers the storage results are not definite enough to be of value.

The field-curing experiments show a definite trend toward reducing storage losses as a result of the delayed topping after harvesting. A 6- to 9-day field-curing period reduced storage losses by cutting down on the amount of loss due to premature sprouting in storage. Differences in disease losses are variable from season to season because of the difference in amounts of yearly field infection. This work is being continued and will require several year's results before final conclusions can be secured.

Onion-Strain Trials

Seed grown by local growers in the onion districts of the state from carefully selected bulbs, properly isolated, have consistently produced a higher percentage of marketable bulbs and have shown less storage loss than has imported seed grown in other states.

Development of Tipburn-Resistant Head Lettuce

The tests of selections made from crosses now in the F_5 generation were planted at the Mountain Substation and at Fort Collins this past year, and out of 22 lines only three were saved for further improvement. The problem of securing a high degree of resistance to tipburn and yet maintaining all the desirable edible qualities, as well as meeting the requirements of the shippers, involves many complications. The lines that are very resistant do not form a high percentage of solid marketable heads; however, the results are encouraging. The work here has been delayed somewhat by the light seed-yields produced at Fort Collins. One cross appears to be very fine in quality and is early, but lacks size necessary for commercial shipping.

Pyrethrum Investigations

Selection for higher content of the active principle has made some progress, as shown by the comparative chemical tests of selected and inbred lines. The selections are now averaging slightly higher than the best commercial strains of seed. Progress is slow due to the perennial nature of the crop and to the limited number of chemical analyses which can be run. While it is too early yet to recommend the growing of this crop commercially, there is sufficient information available from the work to indicate that the crop is best adapted to the high mountain valleys of the state.

General Vegetable Variety Testing

Many new varieties released by seedsmen and growers, and from the Foreign Plant Office, are planted to test their value commercially and for disease resistance. Several hundred varieties of vegetables are planted on a trial-ground basis to observe their performance, and in order to supply growers with information as to their possible adaptability to the state.

Publications

Following is a list of bulletins and papers published by the Horticulture Section:

BULLETINS.—"Lawns," by George Beach; "Grape Growing in Colorado," by George Beach; "A Study of Some Abnormalities Occurring in Certain Potato Varieties in Colorado," by R. D. Anderson.

MIMEOGRAPHED CIRCULARS.—"Spray Residue Removal," by L. R. Bryant and F. M. Green; "1935 Results of Onion Strain Trials," by A. M. Binkley; "1935 Results of Tomato Variety Trials," by A. M. Binkley; "Practical Hints on Growing Onions" (revised), by A. M. Binkley; Summary of Florist's Short-Course Notes.

TECHNICAL PAPERS IN JOURNALS.—"Pyrethrum Plant Investigations in Colorado, III, Effect of Spacing Interval in the Row on Yield of Flowers," by L. E. Evans, published in Proceedings of the American Society for Horticultural Science for 1935; "Pyrethrum Plant Investigations in Colorado, IV, Effect of Different Irrigation Practices on Plant Losses Due to Crown Root," by L. E. Evans, published in Proceedings of the American Society for Horticultural Science for 1935; "Some Preliminary Notes on the Effect of Psyllid Yellows on Seed Stock from Infected Plants," by C. H. Metzger, to be published in the American Potato Journal.

IRRIGATION INVESTIGATIONS SECTION

The work carried on in the Irrigation Investigations Section is in cooperation with the Bureau of Agricultural Engineering, United States Department of Agriculture, under the immediate supervision of R. L. Parshall, senior irrigation engineer. During this fiscal year work has been done on our various projects.

Design and Invention of Apparatus

Under this continuing project attention has been given to various features of this phase of our investigational work,

namely sand-trapping devices, Parshall measuring flumes, adjustable-tube orifice meters, snow-surveying equipment, and current meter rating equipment.

During the fall of 1935 work was continued at the Bellvue Hydraulic Laboratory on the investigation of an improved vortex tube. This new design of tube is essentially the same as that formerly called the standard tube and differs from it only in the modification of the shape of the cross section and in having a wider gap or opening between the lip and downstream edge of the tube. An extended series of tests indicates that this new design has a good efficiency in catching the bed load carried in the stream. Since April of this year there has been in operation a vortex-tube sand trap in the Jackson ditch at Bellvue, patterned after the new design. The operation has been efficient and satisfactory.

Because of the apparent high efficiency under the more moderate channel velocities, as found for this improved tube under laboratory settings, a large vortex-tube sand trap has been designed for the Imperial Irrigation District, Imperial Valley, Calif. This vortex-tube sand trap will be one of the major installations of this type of sand-trapping device and should be successful because of the favorable conditions under which it will operate.

At Wellington during the summer of 1935 two experimental sand traps were operated: a grating type of sand trap in the Cheyenne lateral and a vortex-tube trap in the Railroad lateral. These ditches are under the North Poudre Irrigation Company's system. No marked success was obtained in the use of the grating type of trap, but the vortex-tube installation has proved to be quite satisfactory. The capacity of the Railroad lateral is about 20 second-feet. The design of this sand trap permits returning the water discharged from the three vortex tubes back into the lateral at the downstream end of the structure, thus providing for the efficient operation of the device without loss of water. It is to be pointed out in this connection, however, that water is wasted incident to the sluicing out of the sand accumulation in the catchment basin. Observations show that a deposit of about 5 cubic yards can be sluiced out in less than 10 minutes.

The Parshall measuring flume continues to find wide usefulness, not only in irrigation but in other fields as well. The new Denver municipal water supply through the Moffat water tunnel will be measured through a 15-foot reinforced concrete flume at East Portal and later at the Eldorado Springs diversion

of South Boulder River through a 12-foot flume of similar construction. These two flumes were designed and constructed for a capacity of 1,200 second-feet.

A design for a 20-foot reinforced concrete Parshall measuring flume has been prepared for the United States Indian Service for installation in the Casa Grande Canal near Coolidge, Ariz.

Further work has been done on the adjustable-tube orifice meter. A more recent design of this measuring device has been perfected which is believed to be the more practical and easier to operate. It has the further advantage of permitting simplification of the method of calculating the discharge.

An improved weighing balance has been designed to be used in connection with the snow-surveying equipment. One of the important features of this new instrument is that it is moisture proof.

Experimental apparatus is to be designed to operate in connection with the new current meter rating station, whereby it is expected that a current meter can be completely calibrated in much less time than was formerly required. The new method when developed will eliminate the paper-tape record and will plot directly the relation between velocity and revolutions of the meter turbine. The present method of calibration requires several individual excursions of the rating car, while for the proposed method a single trip of the car will suffice.

Meteorology

For more than 45 years R. E. Trimble has been in charge of this work and during this long period of service has, with limited interruptions, personally taken the weather observations twice each day. His untiring devotion to this work and his methodical manner of conducting the observations justify the highest appreciation of his faithful performance of duty and of the responsibilities carried during this time of service, which approaches a half century.

It was with sincere regret that Mr. Trimble was retired from his work at the close of the fiscal year, June 30, after having given to this institution practically a lifetime of service. The Irrigation Investigations Section congratulates him on his excellent record of service.

H. O. Caperton has been appointed to succeed Mr. Trimble.

Pumping for Irrigation and Drainage

This project, since its inception in 1928, has provided data

for several station bulletins on the subject of pumping for irrigation. The recent deficiency of the normal surface water supply has been the cause of a material increase in the pumping of supplemental irrigation supplies from wells. Because of improved methods of sinking wells, together with high efficiency of pumping equipment properly selected and installed, the cost of a ground-water supply is practically on a par with that of surface supplies in typical sections of Colorado. Increase in the number of new irrigation wells has been confined to the northern part of the state and has been somewhat accelerated during the year in spite of the more favorable condition of surface water supplies.

Observations of the ground-water level in the pumping districts have been continued. In the northern part of the state some rise occurred except in the Keenesburg area, where the recession seems to be progressing at a rate of about 2 feet per year. It is felt that further development should be curtailed in this area.

Irrigation Water Supply Forecasting

This project is in a formative period. Recent improved snow-survey equipment and extended cooperation made possible through the Bureau of Agricultural Engineering have brought about the establishment of snow-course surveying in Colorado in cooperation with the station. The main supporting agency in this work is the Forest Service, whose rangers travel on skiis and snow shoes into the high mountain areas during the late winter and early spring months to make observations on these permanently located snow courses. Experience gained elsewhere in snow surveying indicates that reliable forecasts cannot be made until after 3 to 5 years of continuous records have been available. The average water content of the snow-course samples, expressed as a percentage of the normal, is set up in relation to the stream run-off, also expressed as a percentage of the normal. By means of this relation it becomes possible to observe the snow cover on the course and forecast within reasonable limits the extent of the water supply held in snow and ice storage that will be later made available for irrigation, power, and domestic purposes.

New Hydraulic Laboratory

This new building has a floor plan of 96 by 119 feet, including space occupied by the three calibration tanks, and provides space for the erection and testing of hydraulic models of considerable size. The estimated cost was $18,325. The plan was approved September 9, 1935 as a Works Progress Administration

project. Construction started on October 25, 1935 and was completed in June 1936. In connection with this improvement a new current meter rating station was built. This consists of a reinforced concrete tank 5 feet deep, 5 feet wide, and 250 feet long. The new laboratory was built in part by funds contributed by the Bureau of Agricultural Engineering and the Office of the State Engineer of Colorado.

The newly enlarged laboratory building provides space for a workshop, office and drafting rooms, fireproof vault, steam heating plant, and ample storage for supplies and equipment.

The Bureau of Reclamation has occupied the laboratory since August 1, 1930. The plans of the new laboratory were largely prepared by this bureau under the direction of the station, and the construction work was done under the bureau's supervision.

Publications

During this fiscal year the following reports have been prepared: "Equipping a Small Irrigation Pumping Plant," by W. E. Code, to be published as a station bulletin; "Irrigation Wells," by Carl Rohwer, to be issued as a bulletin of the United States Department of Agriculture; "The Parshall Measuring Flume," by R. L. Parshall, published by the station as Bulletin 423, as a revision of Station Bulletin 336 entitled "The Improved Venturi Flume," issued in March 1928.

PATHOLOGY AND BACTERIOLOGY SECTION

Timber Milkvetch

As stated last year, the phosphorus deficiency project in Moffat County proved to be a misnomer. Our work showed the disease to be the result of the consumption of timber milkvetch which had replaced much of the forage on the range as a result of overgrazing. This work has all been summarized and put into bulletin form; the final proof has been read, and the bulletin should be out before the end of this fiscal year. Cooperation between the Sections of Chemistry, Botany, and Pathology and Bacteriology and the Extension Service resulted in the successful culmination of this investigation.

Death Losses in Lambs

A continuation of the work on intestinal filtrates has shown that out of 56 specimens 16 were highly toxic, 21 were slightly toxic, and 19 produced no injury. We were also able to isolate a considerable number of organisms of the *Cl. welchii* group,

which are being held for further consideration. We are now engaged in producing antitoxins from known members of this group in order that our toxic filtrates and our cultures may be typed.

Sheep Losses

Additional information has been gathered on the prevalence of parasites, and in cooperation with the Animal Investigations Section an experiment was carried on last year to determine the value of routine parasite treatment for feeder lambs. Two lots of 25 lambs were selected and fed the same ration. One of the lots was treated with a single dose of 2 ounces of a 1-percent solution of copper sulfate containing 1 ounce to the gallon of a certain commercial preparation. The untreated lambs showed a slightly greater gain than those treated, indicating that routine treatment of feeder lambs in the Fort Collins area is still a questionable procedure.

Contagious Abortion

Due possibly to the activity of the federal Bureau of Animal Industry in the eradication of this disease, we have not been able to take on further herds in this project. One of our herds still remains clean after three negative tests. The other, after showing a great reduction, has now materially increased in the number of reactors and in the number of abortions. In this herd, unfortunately, the reactors to the third test were not removed. Apparently one of these animals aborted and reinfected the herd. It seems probable that beginning next fall we shall add two or three more herds to this project.

The past year the blood tests in connection with the federal Bang's disease eradication work in Colorado have been run in our laboratory under our supervision, but at federal expense. There have been 10,869 samples, 8 percent of which were positive.

Encephalomyelitis

Last year the state experienced the third outbreak of this disease within 4 years, there being no cases reported in 1934. Unfortunately this outbreak showed a larger number of cases than in any previous year, and in addition to this, the disease extended to the Western Slope, where it had not previously existed. As has been our practice, a survey was made through a questionnaire to the veterinary practitioners and the whole epidemic tabulated. As in previous years, the disease began in July, reached its peak in September, and faded out in November, indicating again that the disease is probably insect-borne.

Serum was quite widely used as a means of treatment and apparently with some reduction in the mortality. Not a sufficient amount of vaccine was administered on which to base a conclusion as to its efficacy.

Continuing in November and extending even into January, there were a few cases of a brain disease which simulated encephalomyelitis, but which is believed to be separate and distinct from that malady. These cases are probably of the same nature as the disease described in Indiana and Illinois throughout the last two winters and known there as encephalitis. The disease appears to be more frequently fatal than encephalomyelitis, and so far has not been shown to be due to a virus. This is probably the so-called cornstalk disease of horses of previous years.

Oat-Hay Poisoning

In April we were startled by the report that some 67 head of cattle died on a ranch southeast of Denver following the consumption of oat hay. The loss was estimated at $5,000. Forty-two head of cattle died in 1923 under similar conditions at a distance of about 16 miles from the place mentioned. Either the same year or the following year 21 head of cattle died after consuming oat hay on the place first described. This brings to mind reports from other states, notably Wyoming and Minnesota.

For some years we have felt that under certain conditions a very toxic substance is eliminated from oat hay that results in heavy losses in cattle. Believing that more should be known of this condition, we purchased six head of cattle and fed them the hay in question. Of these six head five sickened and three died. Two of the three showed a positive test for hydrocyanic acid when picric-acid paper was placed through an opening in the rumen soon after death.

There was also in this case the possibility of cane being mixed in with the oat hay, although the cattle had been on cane for several months previously and had been recently changed to the oats. We are now continuing the experiment by using sheep, but so far without positive results. The Chemistry Section is cooperating with us in this work. Symptomatically these outbreaks should be caused by hydrocyanic acid, but much of the chemical work has not borne out that assumption. This offers a very interesting field for further investigation.

Work in Soil Microbiology

ACTIVITIES IN "SLICK" SPOT SOILS.—The work on this project has continued to deal principally with microbiological nitro-

gen transformations in "slick" spot soils as compared with normal soils. Both total nitrogen and soil carbon were lower under "slick" spot conditions. The nitrogen of both "slick" and normal soils from the Western Slope underwent more rapid nitrification than did the nitrogen of certain normal soils from the Eastern Slope of Colorado.

The results are in agreement with those previously reported in indicating that there are no significant increases in total nitrogen in normal or "slick" soils when incubated in the laboratory, either in the presence or absence of added cellulose. The inadequacy of the commonly used Kjeldahl methods for determining nitrogen increases due to non-symbiotic fixation has become apparent in the present investigation.

When the soils were incubated in the laboratory, bacteria, actinomyces, and fungi were all more abundant in the normal soils. By plate counts *Azotobacter* was more abundant in normal than in "slick" soils. Both soils, however, bring about nitrogen fixation when inoculated into mannitol solutions.

TESTS FOR AVAILABLE PLANT NUTRIENTS.—The plaque method was used in studying the importance of iron and molybdenum in the appearance of *Azotobacter*. Of the limited number of soils investigated, none showed a need for these elements. Experiments have been initiated using *Cunninghamella blakesleeana* as a test for available phosphorus in the soil. A number of soil fungi have been isolated with the view of determining their adaptability for plant nutrient tests of soils.

DECOMPOSITION OF ORGANIC MATTER.—Cultures of aerobic cellulose decomposing bacteria have been used in studying the effect of aeration of the culture medium on the rapidity of cellulose decomposition. Determinations of the carbon dioxide evolved and the nitrogen assimilated in the decomposition process have been made. Studies of the rate of decomposition of straw in soils with varying moisture contents have been made with the view of obtaining a better understanding of organic matter decomposition under dryland soil conditions.

GENERAL.—Nodule counts on alfalfa inoculated and seeded by the Agronomy Section showed an increased nodulation and slightly higher protein content for the artificially inoculated plants. The nodule type of these plants was that usually associated with infection by an effective strain of the legume bacteria, while nodules on plants from uninoculated seed were of the type associated with ineffective bacteria. The effect of inoculation will be studied on seedings made this spring of alfalfa and field peas under irrigation and on alfalfa on dryland.

During the period of July 7 to September 10, 1935 the soil bacteriologist was absent due to attendance at the Third International Congress of Soil Science held at Oxford, England. During this period also observations were made on research work in soils at various experimental institutions in England and the United States. On September 15, 1935, Lynn Gee began the duties of a fellowship in soil microbiology.

Diagnostic Work

Diagnostic work of this section has included the following: avian, 101; bovine, 35; canine, 2; equine, 6; feline, 1; miscellaneous, 7; ovine, 28; porcine, 9; water, 11.

Blood Samples

Of 3,720 samples studied, 681, or 18.3 percent, were positive.

Publications

This section published jointly with the Botany and Chemistry Sections Bulletin 429, "Timber Milk Vetch as a Poisonous Plant."

EDITORIAL SERVICE

The Station Editorial Service, since its establishment on December 1, 1935, has prepared for publication 11 bulletin manuscripts totaling 451 printed pages as follows:

Printed and Available for Distribution

POPULAR BULLETINS

No.

419—"Soil Blowing and Its Control in Colorado," by J. F. Brandon and Alvin Kezer; 20 pages.

420—"Lawns," by George Beach; 12 pages.

421—"Peach Mosiac Disease in Colorado," by E. W. Bodine; 11 pages.

424—"Grape Growing in Colorado," by George Beach; 14 pages.

425—"Timber Milk Vetch as a Poisonous Plant," by I. E. Newsom, J. W. Tobiska, L. W. Durrell, and others; 42 pages.

427—"Insect and Mite Pests of the Peach in Colorado," by George M. List; 30 pages.

PRESS BULLETINS

88—"Mineral Supplements for Fattening Steers," George E. Morton, H. B. Osland, and R. C. Tom; 12 pages.

TECHNICAL BULLETINS

15—"The Influence of Various Factors, Including Altitude, in the Production of Angel Food Cake," by Mark A. Barmore; 54 pages.

16—"A Study of Some Abnormalities Occurring in Certain Potato Varieties in Colorado," by Rudolph Daniel Anderson; 52 pages.

In Process of Printing

POPULAR BULLETINS

422—"Cattle Fattening Rations for Colorado," by H. B. Osland, E. J. Maynard, and George E. Morton; 120 pages.

423—"The Parshall Flume," by Ralph L. Parshall; 84 pages.

Additional Publications

Other publications than bulletins which have been prepared by the office are the following:

Annual Report of Colorado Experiment Station; 36 pages.

Confidential report of Annual Sugar Beet Round Table; 25 mimeographed pages.

Press Release on Annual Sugar Beet Round Table.

Manuscripts on Hand

Six bulletin manuscripts are in the office at present, either for preparation for printing or awaiting decision of the director regarding publication.

Additional Activities

Additional activities by the station editor include: Two radio broadcasts regarding late bulletins issued by the station; one radio broadcast, over a national hookup, on the work of the station and its relationship to the college and the extension service; an address before the convention of the Rocky Mountain Intercollegiate Press Association, held on the campus of Colorado State College.

Respectfully submitted,

E. P. SANDSTEN, DIRECTOR.