South Dakota State University Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange

Agricultural Experiment Station Circulars

SDSU Agricultural Experiment Station

4-1956

Better Agriculture Through Research in South Dakota, 1887-1956

I. B. Johnson South Dakota State University

Follow this and additional works at: http://openprairie.sdstate.edu/agexperimentsta_circ

Recommended Citation

Johnson, I. B., "Better Agriculture Through Research in South Dakota, 1887-1956" (1956). *Agricultural Experiment Station Circulars*. Paper 120. http://openprairie.sdstate.edu/agexperimentsta_circ/120

This Circular is brought to you for free and open access by the SDSU Agricultural Experiment Station at Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. It has been accepted for inclusion in Agricultural Experiment Station Circulars by an authorized administrator of Open PRAIRIE: Open Public Research Access Institutional Repository and Information Exchange. For more information, please contact michael.biondo@sdstate.edu.

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS College Station, Brookings, South Dakota

BETTER AGRICULTURE THROUGH RESEARCH IN SOUTH DAKOTA 1887-1956

CONTENTS

Introduction	3
Agricultural Economics	7
Agricultural Engineering	11
Agronomy	15
Animal Husbandry	23
Dairy	29
Entomology	35
Home Economics	39
Horticulture-Forestry	43
Plant Pathology	47
Poultry	51
Rural Sociology	55
Station Biochemistry	59
Veterinary	63

BETTER AGRICULTURE THROUGH RESEARCH

CAMPUS 1901

INTRODUCTION

FOREWORD

WITH NEARLY 70 years of active service in behalf of South Dakota's agriculture, one may well ask—"What has the South Dakota State College Agricultural Experiment Station accomplished? What is it doing to meet present and future problems of the farm, the home, and the rural community?"

Undoubtedly the future presents far more challenging problems than the past. Existing methods and practices in production, processing, and distribution of farm commodities will be inadequate to meet the needs of an expanding population and a changing economy.

Research is an organized method of finding what one might better do when he can not efficiently continue present practices. It involves discovering new information and often revising accepted conclusions.

Much of the research required by agriculture is of a long-term, continuous nature. It can not be turned off at will, nor can the time be accurately gauged as to when the solutions to problems will be acutely needed. However, we know research has opened the doors of progress and will continue to do so. It creates new methods and practices, new products, new industries, new jobs, and new wealth. A GRICULTURAL RESEARCH in South Dakota has progressed with the state. In fact, the early experimental work was begun even before South Dakota was admitted to statehood. Federal

funds to establish experimental work in the Dakota Territory were made available under the Hatch Act in 1887. Accordingly, the following year the first and main experistation was ment established at South Dakota State College, Brookings. There were five departments at the start – agriculture, botany-horticulture and forestry, chemistry, entomolo-

gy, and veterinary science. Each department employed one scientist.

As the agricultural problems became more apparent, it was necessary to inaugurate work in other fields. Additional funds were supplied through state appropriations and federal grants set up in the Adams, Purnell, and Bankhead-Jones Acts. Today there are 13 departments, and the staff is made up of more than a hundred members.

All departments have made outstanding contributions to the state's agriculture and home and community life. South Dakotans continue to reap benefits from this research.

Work by the Agronomy, Horticulture, and Plant Pathology Departments has resulted in higher yielding, better adapted crops and

THIS PUBLICATION records

I historically the develop-

ment and many of the re-

search achievements of the

Experiment Station. The ma-

terial was prepared by the

department heads and their

staffs in cooperation with

the station editor. Much of

the data had been assem-

bled beforehand by the late

J. W. Wilson and by A. N.

Hume and Turner Wright,

who have been on an emeri-

tus status in recent years.

improved crop practices. New varieties, especially adapted to the state's conditions, have been and continue to be developed.

In the animal sciences, the Departments of Animal Husbandry, Dairy Husbandry, Poultry Husbandry, and Veterinary Science are concerned with the improvement of livestock and poultry and their management and disease control.

Breeding projects and nutritional studies have provided valuable information for farmers.

Research on problems directly affecting the people is carried on by the Agricultural Economics, Home Economics, and Rural Sociology Departments. These studies pertain to education, financial matters, organization of rural business, and problems of human nutrition and clothing.

The Biochemistry Department has carried on cooperative research with the other departments. In addition, it has helped South Dakotans with many chemical problems. For example, it conducts analyses of feeds and water and aids in diagnosis of various animal disorders.

Studies of habits and methods of control of many insects is part of the work of the Entomology Department. Its work has brought a variety of insects under control, saving many crops from destruction.

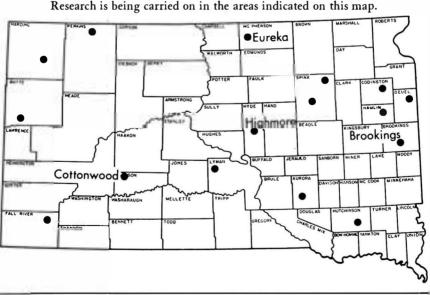
The Agricultural Engineering Department has directed some of its research toward developing improved farm structures. South Dakota products have been used in much of this work. Considerable work is done with farm machinery and irrigation equipment.

Besides cooperating among themselves on projects, the departments also work with other experiment stations on regional projects. This regional research started ir. 1940 and has become increasingly important in bringing about faster and more complete solutions to certain problems.

Land used for research at South Dakota State College consists of approximately 840 acres. Here research involves soils, farm crops, pastures, horticulture, livestock production and feeding, dairying, poultry, plant diseases and insects, animal parasites and diseases, agricultural chemistry and engineering, social and economic problems, and home economics.

To secure information tailormade for the various sections of the state, research centers have been established at many 1 o c a t i o n s. These substations and research farms undertake projects to develop improved crop, soil, livestock, poultry, and engineering practices.

Two substations, three field stations, two irrigation development farms, three weed research areas, and numerous experimental fields



on private farms are used for this work. Location and acreage of some of the stations follows.

- Buffalo—Antelope Range Field Station, 8,000 acres
- Cottonwood–Range Field Station, 2,640 acres
- Eureka–North Central Substation, 240 acres
- Highmore–Central Substation, 117 acres
- Newell–U.S. Irrigation and Dry Land Field Station (cooperative with USDA), 360 acres

Presho–Reed Ranch, 2,160 acres

The technical staff at the South Dakota State College Agricultural Experiment Station supervises the research at these stations.

Through the years, the over-all activities of the Experiment Station have been administered by these men:

Lewis McLouth:	1888-1896
J. H. Shepard:	1896-1902
I. W. Wilson:	1902-1938
Í. B. Johnson:	Since 1938

With a record of achievements as a background, the Experiment Station looks forward to paving the way to even greater benefits for South Dakota. On the following pages some of the more important activities of the station are reported, along with the trends research may take in the coming years.

23

AGRICULTURAL ECONOMICS

1.1.200

FARMERS WERE in a price squeeze. Beef cattle prices fell from \$10.18 to \$5.33 per hundred. Hogs dropped from \$16.38 to \$7.13 per hundred. Wheat fell from \$2.18 to \$1.02 per bushel, and corn fell from \$1.33 to 32 cents. In the meantime the cost of things farmers bought remained about the same.

This is not the story of the past 5 years but of 1919-21—shortly after World War I. As a result of the good crops and high prices during the war, land values had reached a new high. Young farmers who bought land at the end of the war suddenly found that at the new price level they had paid too much. Payment of mortgage interest and principal and taxes became difficult. Payments on machinery and livestock purchased at the end of the war fell behind. Farmers were in distress.

As a result of this distress, the 1921 State Legislature appropriated funds for a study of farm costs and returns. The objective was to increase farm incomes. The first surveys were made by the State Department of Agriculture. (In 1924 the work was transferred to South Dakota State College where the Department of Farm Economics was established the following year.)

A mimeographed circular published in 1922, "How Can Farming Be Made to Pay?" discussed many topics that are of interest today.

At one point the authors asked: "Is there any way to bring about better prices for farm products?" Their answer—"...there is but such adjustment is bound to come comparatively slowly" (by individual adjustment). What the farmers needed, they argued, was simple and practical information concerning production costs and supply and demand conditions. Next they had to plug the leaks in the farm marketing system.

Costs of Production Vary

That farmers continue to vary a great deal in their costs of production even during periods of favorable prices can be seen in figure 1. Here the labor and management returns of 36 farmers in eastern South Dakota for 1950 are shown.

While size of farm is important, it is interesting that even in the same size groups there is much variation in income. Some of the smaller farms have higher incomes than some of the larger farms. Therefore, a major objective of the department has been to provide information that will help farmers solve their problems.

These are some of the problems: What are the most profitable crops and livestock to produce? What are the most profitable proportions? How intensely can one produce and still have it pay? What quality will it pay to produce? How can market-

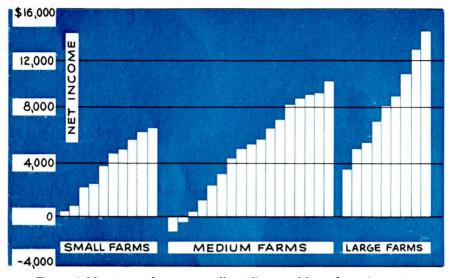


Figure 1. Net returns for some small, medium, and large farms in eastern South Dakota, 1950.

ing costs be reduced or economically spread? How can the insecurity of tenure be reduced to provide better community living as well as more efficient agriculture? How can the farmer get more for the tax dollar he plays?

Numerous studies have been made over the past 30 years based on farm record surveys, cost studies, and alternative plans for organizing the farm business. This information is then made available to help farmers make sound decisions in their farm plans and operation. The relation of size of farm to farm income has been stressed. New irrigation projects in western and c entral South Dakota have created interest and introduced economic problems which have been studied.

Taxes and public finance have also been studied because of their relation to the farmer's income. The recently enacted legislation to improve the county assessment procedures was recommended as a result of studies in this field. Currently a study is being made to determine whether the farmers' share of the total tax bill is proportional to their share of the state's total income.

Farmers in South Dakota not only have price risks characteristic of most farmers, but they also have unusual weather conditions such as short seasons, hot winds, and early frosts with which to contend. To help farmers deal with this problem the probability of killing frosts, scorching winds, and precipitation has been determined for much of the farming area of the state.

Study Marketing Problems

South Dakota farmers are a long way from the large cities where most of their grain, cattle, hogs, sheep, milk, cream, and eggs go. Any reduction of the cost of getting their products to market should help them get more of the consumer's dollar. Because of this, studies have been made of grain and livestock marketing practices.

Since livestock market prices frequently do not distinguish between good and poor carcasses, the economists and animal husbandry men have investigated for the first time the possibility of marketing lambs on the basis of carcass quality and weight. Wool marketing is now receiving attention. Costs of transportation, storage, and manufacturing have been studied. Improvements in financing and managing cooperatives have been suggested as a result of these studies.

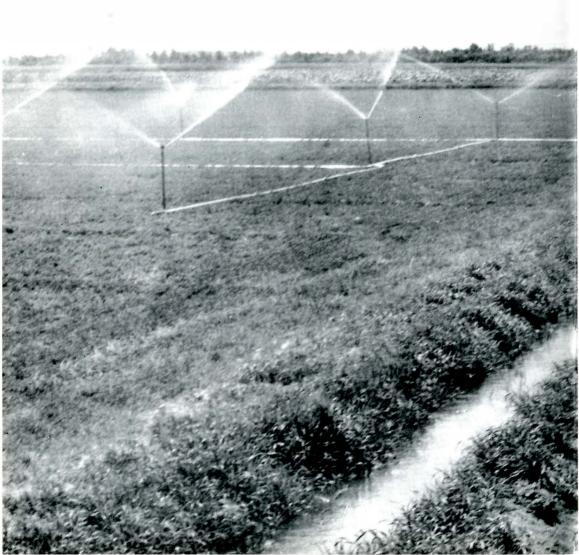
Farmers are not only interested in income or profits. They are also interested in their security on the land they operate. Security of possession is closely related to their freedom of operation and social well-being. Farmers who are uncertain as to how long they can keep a farm are reluctant to use their spare time to make improvements or to adopt soil conservation practices or crop rotations that will pay only after several years. Because of the importance of this problem, studies in land values, farm transfers, father-son partnerships, and leasing arrangements have been made. Studies of farm tenure problems continue.

Answers to Problems Change

Looking back we appear to have much the same problems today that we had 30 years ago. The fundamental question remains-"What, how much, and what quality shall farmers produce?" But the answers change with each new development in technology and each new shift in prices. The work horse has practically disappeared. Machines a r e larger and farms have grown accordingly. Improved seeds suited to South Dakota's weather and resistant to diseases and insects have been developed. Livestock, dairy, and poultry production and marketing techniques have changed. The farmer has to evaluate these changes in terms of his farm and family income.

Hence there needs to be a continued effort to provide the farmer with information and techniques to improve his farm business-to reduce costs, improve marketing, and increase profits. Special problems created by irrigation projects, the growing Indian population, and soil conservation need further attention, as do the problems of taxes, farm tenure, and farm price policies. Attention should be paid to more efficient and economical distribution of supplies that the farmers purchase, including machinery and electric power. And the atomic age may well have a great influence on farming. Economic research must keep this in mind as it progresses.

AGRICULTURAL ENGINEERING



LHE AGRICULTURAL Engineering Department has stressed work mainly in four fields—farm machinery and power, rural electrification, soil and water conservation, and farm buildings. The department was established in 1925.

Work on the Renner test line, most notable of the early rural electric lines in South Dakota, was one of the first projects. Observations were made and records kept on this line. The cost of operation and suitability for the farm home of refrigerators,

stoves, and other appliances was also studied.

Adapt Research to Needs

As tractors came into use, a project was begun to develop ways of adapting horse-drawn machinery to tractors. Multiple hitches for the disc, drill, and cultivator were one phase of the project. A plan was devised for changing a two-row cultivator to a weed control machine. Another development was the simple, but effective, two-binder hitch that allowed a tractor to pull two binders, orginally built for horse hitches.

The rammed earth project was one of the longest and most comprehensive projects. It was begun during the depression when farmers had little money to buy building materials. By use of rammed earth an inexpensive building could be erected.

Basic research was begun to find the soil mixture and the construction methods necessary to produce a good building wall. A machine shed and three poultry houses were built by the Experiment Station, and a number of other institutions and individuals used rammed earth for their buildings also.

In the early days of the use of the combine in South Dakota, elevator operators complained of high moisture content of direct-combined grain. A study was made of swathing and drying periods for grain.

Shortages of steel and other materials during World War II made it hard to get new farm machinery. Projects were begun on homemade or converted machinery to aid the farmers in their expansion program in food production. A homemade windrower and rubber-tired trailers and carts were developed. Homemade tractor-mounted equipment was developed in this period too.

Work on Numerous Projects

Work has been done on farm water supply and sewage disposal. Septic tanks built from cement silo staves and cement blocks have been proven satisfactory. Feasibility of use of the wind electric plant has also been studied.

An important recent development has been a light-weight



The Experiment Station has assisted farmers as they advanced from this type of farming to a more mechanized type.

aggregate for building blocks. This light-weight material is made by expanding South Dakota shale.

Storage of reserve feed has always been a problem. A current project involves the cooperation of several Experiment Station departments. The experiment concerns the storage and feeding of grass silage from various types of structures. Studies on the cost of operation of the field baler and the



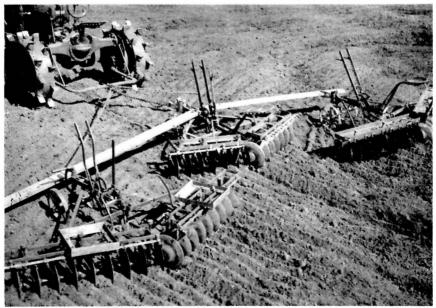
Experimental rammed earth poultry house built at the North Central Substation, Eureka, in 1940.

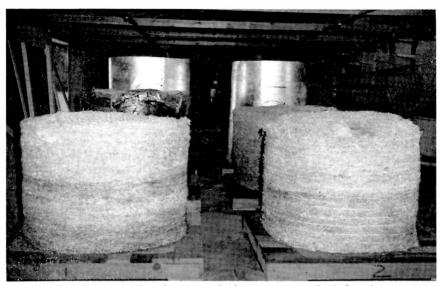
field ensilage harvester support this long-time study.

Irrigation work with special emphasis on sprinkler irrigation is in progress. This work is being done in cooperation with other Experiment Station departments, the Bureau of Reclamation, and the U. S. Department of Agriculture.

The South Dakota Experiment Station cooperates with the North Central States in a regional build-

As the tractor replaced the horse, considerable work was done on multiple implement hitches to convert horse-drawn machinery to tractor use.





Pilot silos are used to determine the best storage methods for silage.

ing plan service—the development of new plans for livestock and storage structures and farm homes.

Some of the future projects are likely to concern irrigation as it expands due to discoveries of aquifers and to Missouri River developments; mechanization of farm chores and crop processing as a result of farm electrification; a change of functional needs of farm structures for more convenient and enjoyable farm living; and the ever increasing use of a greater variety of farm machinery and power units for soil and water conservation as well as crop production.

Various methods of crop drying have been tested.



AGRONOMY

HGRONOMIC RESEARCH has sought to improve and stabilize South Dakota crop production. It began in 1887 when a series of grain and forage crop variety trials were planted at Brookings. The department was established in 1903. The aim of agronomic research during the entire period has been to maintain and increase yields of cash and forage crops on the farm.

At first, research involved introducing and selecting crops and varieties adapted to the state. In reponse to the need of the state's agiculture, and as problems could be anticipated, the work was expanded to include research in crop management and rotation, soil fertility, irrigation, weed control, and services to help the research program reach the farmer.

Check for Desirable Varieties

The dry nineties were years of depression and failure of cash crops on farms, years in which farmers survived primarily on a livestock economy. The problem of feed production for this livestock became of paramount importance. The limitations of the crop varieties farmers had brought with them from humid areas were clearly demonstrated.

Agronomic work was undertaken to solve these problems. Smooth or "Hungarian" bromegrass, first tried at Brookings in 1890, was speedily recognized as the best of the native and introduced grasses available at that time. Experiments using mixtures of bromegrass and alfalfa were so successful that the use of a "bromosal mixture" was recommended to farmers. The value of bromegrass in crop rotations was proved by Professor E. C. Chilcott.

The Highmore substation, originally conceived as a forage testing and breeding station, was started in the early 1900's. Extensive work on drouth resistance in grasses and legumes was done there. Dakota Black Amber cane was found superior to all other annual forages.

Irrigation was studied extensively in the James River area. Artesian wells as a source of irrigation water were considered satisfactory, contrary to our present knowledge of their water quality.

In the cash crops, a world-wide search for crops and crop varieties suited to Great Plains conditions was begun. The USDA did much of this work, but Professor N. E. Hansen made independent searches as well. The searchers concentrated on Russia, an area with conditions similar to those of the Plains. There, 2,000 years of agriculture were likely to have resulted in the selection of hardy crop varieties.

One new crop, durum or macaroni wheat, was introduced. Several outstanding varieties of existing crops, notably Odessa barley and

15

Swedish Select and Kherson oats, were brought in. Seeds collected by Dr. Hansen in the central Volga region formed the breeding basis for crested wheatgrass and Cossack alfalfa, two extremely important contributions to agricultural stability in South Dakota to this day.

Expand Work on Crops

A series of more favorable years began with the turn of the century and the crop work started to crowd the forage work. Widespread testing of durum wheat introductions occurred in these years. This crop had not yet found a market, but its suitability for the area aroused great interest, especially after the wheat rust year of 1904. Wheat crosses were first made at the station in 1905, and the period of breeding crops by artificial hybridization was under way. Dr. Hansen extended these methods to the production of artificial alfalfa hybrids between his Cossack and a very hardy creeping, but low yielding, species he found wild in central Siberia. The full benefits of this work are still to be realized.

This period established South Dakota as an alfalfa seed producer. The establishment of the Redfield Federal Station (discontinued in 1932) devoted to forage work, was culminated later by the release of the outstanding alfalfa variety Ladak.

Soils work during this period in-

Farmers learn about sorghum breeding during a field day tour. This is one of the many ways the Experiment Station passes on information.



cluded the first detailed soil survey in the state—the Belle Fourche Irrigation project. Phosphate trials in the eastern areas produced a strong yield response in barley.

Extremely critical food shortages in World War I put further stresses on crops research. Small grain production had expanded into high risk areas, and an extensive series of experiments by Dr. A. N. Hume provided important crop management principles for these areas. Many of the recommendations derived from this work are still in force today. Several new crop varieties were developed, including Turkey 144 winter wheat, Cole oats, Dryland barley, Acme wheat, and All Dakota corn.

Develop Rust-Resistant Wheat

The heavy stem rust year of 1916 prompted E. S. McFadden, then a student at South Dakota State College, to attempt what was considered the impossible feat of transferring the rust resistance of emmer wheat to spring wheat. In 1917 he crossed Marquis with Yaroslav Emmer; from the progeny he selected Hope Wheat at Highmore. Hope wheat itself had limited utility but kerved as a parent variety for nearly all wheat varieties produced since. The development of Hope wheat resulted in additional millions of dollars worth of income to farmers in the Northwest and did much to stabilize the world's food supply: "To a starving world, McFadden gave bread."

In a period of maximum stress on crop production, a desire for a more complete evaluation of the state's soil resources resulted in a 1919 legislative appropriation establishing soil surveys. Nine counties were studied and mapped.

Corn and Winter Wheat Increase

In contrast to the alternating stresses on cash crops and forages, depending on the climatic cycle, was the steady and dramatic upsurge of two crops, corn and winter wheat. From half a million acres of ^r corn, much of it grown for forage or silage in 1890, corn increased steadily until in 1930 five million acres were grown. This expansion was made possible by plant breeding at the farm level, modifying open pollinated varieties by careful and continuous selection to produce such outstanding strains as Wimple's and Fulton's.

The station's early corn work centered on the management and desirability of corn in farm operations. The proven advantages of corn in preference to summer fallow is a major contribution to successful farming in much of the state.

Winter wheat expansion is of more recent date than corn, but the pattern is equally remarkable. From no acreage at the turn of the century, this crop has expanded to 600,000 acres—one-fifth of the state's wheat acreage. Two excellent winter-hardy varieties from the station, Turkey 144, with its subsequent selection Nebred, and Minter, are the basis for today's crop area.

Begin Sorghum Breeding

The disastrous thirties, with drouth, dust storms, and grasshoppers, once again raised the problem of forage crops to save the cattle.



Two closely related sorghums show great difference in ability to stand after frost. Reliance is variety at right.

A sorghum breeding program begun in 1930 became critical as the state's sorghum acreage jumped from 30,000 to 1,750,000 acres in eight years. Sorghum was one crop farmers could grow in drouth; unfortunately its widespread forage use brought on heavy losses from prussic acid poisoning.

A high cyanide content was considered as normal for sorghum as its drouth resistance, and careful management of cattle on sorghum was considered the only way to utilize this extremely valuable forage. Agronomist C. J. Franzke undertook to breed a low prussic acid forage sorghum. Special methods of selection were developed, and in 1937 the selection 39-30-S, the first low prussic acid sorghum in the world, was released. This strain was followed by Rancher a few years later. What seemed the impossible had again been accomplished.

The extremities of the thirties are vividly illustrated when the station established the forage value of the extremely drouth resistant weed, Kochia. In the small grains, an entirely new, very early, drouthescaping series of varieties replaced almost all of the varieties previously grown. One specialty crop, hulless oats, was developed during this time. Matthew Fowlds, by crossing and selection, bred the excellent variety Nakota. The present variety, James, represents a further adaptation of Nakota.

Considerable vision and courage was required to work on soil fertility in a period when moisture was so critical. But J. G. Hutton's work on soil fertility took the long view and established the base from which subsequent fertility work could be expanded.

The importance of phosphate fertilizers in most of South Dakota and the increasing nitrogen shortages, resulting from about 40 percent depletion of soil organic matter after 70 years of cropping the "inexhaustible" plains soils, were clearly shown by his work. The importance of adequate fertility in obtaining maximum crop yields under drouth conditions was demonstrated.

Expand Research

The lessons of the thirties were not forgotten in the forties, when a great expansion of agronomic research occurred. More adequate facilities were provided by legislative appropriations; seed house, greenhouse equipment, and land have permitted research on the entire range of problems on crops, soils, and management under either drouth or humid conditions.

In crops, a hybrid corn program designed expressly to produce hybrids adapted to the state has resulted in nine hybrids so far, among which South Dakota 220, 270, and 400 are outstanding. These hybrids utilize inbreds developed f r o m some of the old open pollinated varieties of the state and have valuable qualities of drouth resistance.

A series of small grain varieties having drouth resistance, disease resistance, and a maturity level suited to the state were developed and released in this period: Vikota and Dupree oats, Plains and Feebar

Breeding corn that can withstand dry periods is an important consideration. Note how much less the corn at the left has been affected.



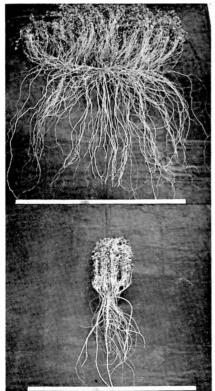
barley, Pierre rye, and Rushmore spring wheat.

Rushmore is a remarkable example of meeting changing needs of agriculture. Its stiffness of straw makes it suitable for growing on the large farm acreages resulting from adjustments to the drouth. Its low ash content removed one of the major quality defects of South Dakota wheat, and its yield stability under a wide variety of conditions of soil, climate, and disease hazards makes it a desirable form of crop insurance.

This concept of crop stability is further expanded in the grain sorghum varieties, Reliance and Norghum, which provide a full season grain crop for areas and y e a r s where corn is unadapted. Reliance especially lends itself to combining.

In the grasses, needs of dry years have been anticipated by the devel-

Root-creeping type of alfalfa (top) compared with standard alfalfa type. Note the yardsticks.



opment of Ree intermediate wheatgrass and Homesteader bromegrass. In alfalfa, work is under way to produce hardier, more persistent rangetype alfalfas. Soybeans are undergoing an expansion similar to that of winter wheat.

These practical results have been made possible by new breeding methods and techniques of selection, some of them pioneered at this station. The use of colchicine to increase variation and start true breeding lines in sorghum and flax will have profound effects on the future of these crops. Techniques for studying winter hardiness of cereals, grasses, and legumes; heat and drouth resistance in cereals and corn; and grasshopper resistance in wheat have established the inheritance of these qualities in crops, thereby making possible the future development of superior varieties.

Survey Soils

Soils research has come into its own with a fertility program devoted to utilization of commercial fertilizers, grasses and legumes, crop residues, rotations, management practices, and special problems arising on special soil types, such as claypan. Nitrogen today is the element most often in short supply in contrast to earlier periods when it was phosphorus. Sweet clover and alfalfa have taken on a second major role, that of soil improving crops as well as forage sources.

Soil survey work was reinstated in 1947 and six additional counties have been mapped. The information from soils experiments and mapping has permitted operation **20** of a soil testing laboratory. In this laboratory the fertility problems of the individual farmer are found and resolved by soil analysis, experimental data, and surveys.

Analogous state-wide services have been developed in the crops field where the seed testing laboratory, certification services, and Foundation Seed Stocks Division are the means by which seed of improved crop varieties reaches the farmer and its quality is maintained.

Weed control is one phase of agronomic work that has undergone a revolution with the advent of 2,4-D, MCP, and related compounds. Years ago, spraying weeds with iron sulphate was recommended. In recent years much more effective chemicals like MCP have been found. The airplane has entered the service of the farmer in applying these weed killers. New chemicals promise the control of grassy weeds such as quackgrass, foxtail, and wild oats. These controls do not supersede but are in addition to the cultural practices Dr. Hume summarized years ago.

Irrigation research has taken on new urgency with the impounding of large reservoirs in the state. Work under way involves the testing of management, cropping, and fertility practices to get maximum returns for irrigating and prepare recommendations in case large scale irrigation becomes a reality.

Research Frontier Expands

The research frontier is expanding. Progress in crop and soil research is expected to advance even more rapidly in the future.

Developments to watch for in the



At harvest the grain from each test row is carefully tied into separate bundles and marked.

next 20 years are: the production of new grasses and legumes made to order for pasture and range use; the development of drouth resistant, winter-hardy, disease resistant, and higher yielding adapted grain varieties; greater knowledge and use of fertilizers, particularly phosphorus and nitrogen; the acquisition of more information on soil types including their physical, chemical, and mineralogical characteristics; the collection of more knowledge on soils suitable for irrigation and the development of new crop varieties specially designed for irrigation purposes; and the development of more efficient and easier methods of weed control.

Predictions are in terms of present knowledge; besides these, there are the imponderables. Twice in 60 years, a South Dakota agronomist did the "impossible." With vision and courage, agronomists in future years may realize a few more impossibles, far beyond the scope of any present predictions.

21

ANIMAL HUSBANDRY

I HE ANIMAL HUSBANDRY Department has conducted a variety of projects since its establishment in 1903. Research on beef cattle nutrition, breeding, and production; swine nutrition, breeding, and management; and nutrition and breeding studies in sheep have been investigated. Carcass quality and meat studies have paralleled the investigations in breeding and nutrition in the three classes of livestock. The findings of these studies have contributed in a significant way to livestock production in South Dakota.

Determine Feed Value

For nearly 50 years South Dakota-grown feeds have been used in comparative feeding trials for fattening beef cattle. One of the earliest compared speltz, millet, corn, and oats. J. W. Wilson was among the earliest workers to compare corn silage with other roughages.

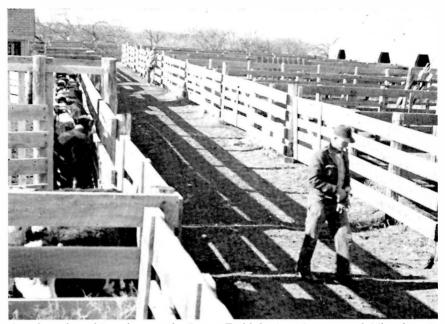
In recent years extensive research was done on the feeding value of soft corn not only for cattle but also for sheep and hogs. These studies revealed that in general the use of soft corn as a livestock feed produces satisfactory gains when the weight of the corn is figured on a dry matter basis. The big problem is to keep the corn from spoiling before it is fed, although the pigs evidently consume some of the spoiled corn anyway.

Through the years numerous feeding trials have tested the relative value of many different grains and supplements. These studies have included rations which used spring wheat, flax, barley, dairy byproducts, tankage, linseed oil meal, rye, alfalfa hay, proso, grain sorghum, shelled corn, and soft corn.

In feeding trials conducted to determine the best methods of feeding, if was found that in the majority of cases shelled corn with protein supplements self-fed free choice gave more economical results than the same feeds self-fed as a ground and mixed ration. Barley gave much better results when ground than when fed whole and the grain sorghums proved slightly more economical when ground.

Other recent experiments have shown that Norghum s o r g h u m grain compares favorably with corn in feeding value for pigs; that it is advantageous to include antibiotics in swine rations for the entire feeding period; that levels of protein feeding may be reduced w h e n rations are adequately balanced with respect to other nutrients and contain certain antibiotics.

The department has devoted its major emphasis in ruminant nutrition to studies of the nutritive value of prairie hay and grasses. Studies with native prairie hays cut at different stages of maturity have



Corrals and working chute at the Range Field Station, Cottonwood. The chute is arranged so cattle can by-pass scale (left) if so desired.

shown those cut in the early stages to be more nutritious than those cut in later stages.

These studies further demonstrated that not only did the protein content decrease rapidly with advancing maturity but that the digestibility of the protein was also materially decreased in the more mature hay.

R a n g e livestock management studies have contributed to a better understanding of the effect of heavy, moderate, or light rates of grazing on cow and calf production, on range forage production, and the effect on the ecology of the range plants. Stocking rate recommendations and maximum allowable utilization of range forage have been suggested. The s e experiments showed the need for supplementing winter range grazing with additional protein for optimum production of beef cows.

Another current project is to measure the effect of stocking rates during summer grazing on calf production. Six comparable range pastures at the Cottonwood Range Field Station have been grazed heavily, moderately, or lightly by Hereford cows since 1942. These studies have shown that prolonged heavy grazing will mean fewer calves produced per cow bred and lighter weight calves at weaning. Nutritional problems may be produced or aggravated.

Develop Adjustment Factors

In cooperation with other states in the north central region, the station is participating in a study on the improvement of beef cattle through breeding. The objectives are to investigate the methods of selection and the effects of inbreeding and crossing of inbred lines. Progress thus far has been mainly in developing adjustment factors for environmental differences between individuals. These adjustment factors will enable breeders to compare more closely the true breeding value of prospective replacements without the confusing effects of environment.

The calves that display superiority in performance tests are saved for replacements in the breeding herds maintained at the substations. These herds are carried under normal range conditions and selection is based on weaning weights and calving efficiency.

Other experiments have dealt with cattle management, beef cattle housing, and creep feeding calves.

Study Farrowing Systems

The relative merits of farrowing pigs in early spring, late spring, summer, or fall, the advantages of gilts or tried sows in the breeding herd, and a comparison of the oneand two-litter systems of farrowing have been studied. The data showed that pigs farrowed in the early spring brought the highest prices when marketed but cost slightly more to produce than did late spring or summer pigs. Fall farrowed pigs brought an intermediate price but required about 75 to 100 pounds more feed per pig than those farrowed in the spring or summer and fed on pasture during their growing period.

The use of gilts offers little choice over tried sows. The sows farrowed more pigs and their pigs were heavier at weaning and reached market sooner. The gilts, however, required slightly less feed and the total costs were about equal.

Nutrition studies on prairie hay are being carried out in this trial. The bags are used to collect feces, which are later analyzed.



Net returns per hundredweight of pork produced was slightly greater for the two-litter system than for the one-litter system. The biggest advantage was from farrowing the first litter in the fall and the second one in the spring. Then not only were the pigs marketed at high prices but the sows were also sold on a high market.

Breed No-Tail Sheep

A long-time project which has had considerable interest has been the work of J. W. Wilson on breeding no-tail sheep. Work on developing a no-tail breed originated in 1913 when Dr. N. E. Hansen brought from Siberia four ewes and two rams of the fat rumped sheep found in that region. These sheep were characterized by long and coarse hairy fleeces, fat rumps, and no tails.

The breeding work attempts to develop a breed that will not have to be docked and still retain desirable mutton and wool qualities. It is apparent that the inheritance of the no-tail characteristic is genetically recessive. The tail length has been variable, ranging from no tails to tails of 4½ to 5 inches. At present wool density is insufficient and too variable. Mutton quality still can be improved. Important characteristics of the breed are hardiness, ability to rustle for feed, and open face.

Through research the station has been able to answer many puzzling questions of South Dakota sheep producers. The relative value of speltz, macaroni wheat, barley, oats, sorghum, and corn fed either separately, in combinations, or as ground



This sheep was born without a tail. Work continues in an attempt to establish a good strain that breeds true for this no-tail characteristic.

or whole grains has been investigated.

Experiments proved that prairie hay was a poor roughage for sheep unless supplemented with protein and minerals. Recently tests showed that grass-legume silage is a good feed for the breeding flock or for fattening lambs.

Early work on the by-products of the sugar beet industry showed them to be beneficial as a feed component and as a means of lowering feed costs in feeding lambs.

Conduct Meat Research

For the most part meat research has been associated with swine breeding and feeding experiments. Improved strains and better feeding methods have tended to produce more desirable pork carcasses. Tests have been conducted on the effect of chemical composition of fresh pork sides and type of hog on bacon quality, the effect of rations containing antibiotics on characteristics of pork carcasses, and the effect of various rations on the quality and palatability of pork. Other studies have dealt with the freezing and storing of meat for quality and economy.

The major projects anticipated for the next few years are expected to be continuations of those now under way and in greater detail. New studies are likely to include requirements, tolerances, and toxicities of minor elements like man-

A good creep ration in addition to the sow's milk gives faster gains. Recent experiments have indicated the best type of ration to use.

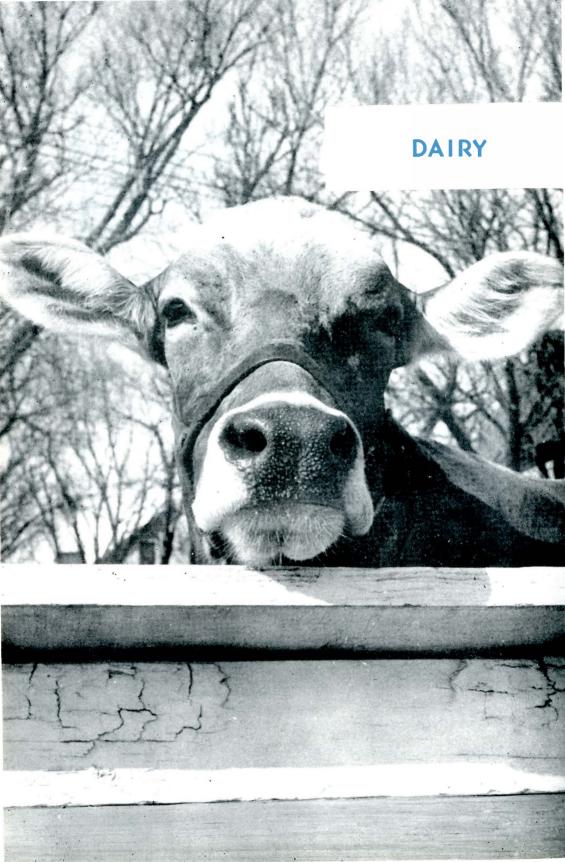




Pasture trials to determine the most productive and satisfactory combinations are under way. This work is done cooperatively by the Animal Husbandry and Agronomy Departments.

ganese, cobalt, zinc, and other minerals for all classes of livestock.

Breeding studies will be extended to range sheep production and there will be greater emphasis on beef cattle and swine breeding research. Other new areas of work will be in developmental research in the area of wool technology and marketing. Greater stress will be placed on the marketing problems of cattle, sheep, and hogs as well as the improvements in carcass quality and consumer acceptance.



LHE DARY HUSBANDRY Department, affiliated with the Experiment Station in 1891, has had two rather distinct lines of work—that pertaining to the manufacture of dairy products and that concerning the management of dairy cattle and the production of milk. A creamery building (still in use in 1956) was constructed in 1898.

The dairy herd was started in the summer of 1902 by purchasing cows from farmers in eastern South Dakota. This herd included a few purebred Holstein and Jersey cows but consisted mostly of grade Shorthorns. The herd has been expanded to about 140 head of purebred cattle representing the Holstein, Brown Swiss, Guernsey, and Jersey breeds.

Some of the early research in dairy manufacturing dealt with variations in milk and cream tests, creamery buildings, organizations of cooperative creameries, methods of cream separation, and suggestions for improving the quality of creamery butter. In dairy production much emphasis was placed upon feeds and feeding. More winter dairying was urged as a means of increasing profits. When the milking machine was developed, studies were made on its use.

By 1914 considerable emphasis was placed on high quality purebred dairy cattle. A dairy train toured South Dakota to display good-type dairy animals.

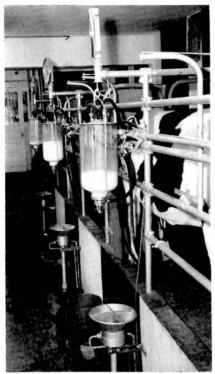
Much of the credit for research done during the period 1909-20 goes to Professor C. Larsen, a former head of the Dairy Husbandry Department. His publications deal with butter manufacturing problems, winter dairying, and feeding problems including the construction of a pit silo.

Contribute Important Data

Much of the research done by this department has been of a practical nature to give immediate help to farmers and creamerymen. Along with this some fundamental research has been done. This is important if the dairy industry is to make continued progress.

Examples of fundamental research are (1) a study reported in 1926 on the number and types of bacteria in normal cows' udders and (2) the work on vitamins A and D in dairy feeds and the requirements of dairy cattle for these vitamins. This nutrition research on the vitamins was done under the direction of Dr. G. C. Wallis during the period from 1934 to 1943 and is without doubt one of the most important contributions to date from this department.

Throughout the period in which research has been done in the Dairy Department, much attention has been given to feeding problems in



South Dakota's first milking parlor, installed in college dairy barn in 1941.

relation to milk production. Professor T. M. Olson made many valuable contributions along this line from 1920 to 1944.

Determining the weights of milk from individual cows was simplified when the milking parlor was installed in 1941. With this system the milk from individual cows flows into pyrex glass jars, which are suspended from spring-type scales. Although milking parlors are now fairly common in South Dakota, this one at the college continues to attract many visitors.

With the introduction of more complex equipment, such as this type of milking machine, new prob-30

lems arise in proper control of sanitation. Considerable work has been done with this machine in which more effective methods of sanitizing were found and labor costs reduced.

New Research Progresses

Recent research has demonstrated that nonfat dry milk solids can be used advantageously in the manufacture of cultured buttermilk and cottage cheese. Improvements and refinements in cottage cheese manufacturing are being sought.

A new field of research, physiology of reproduction, was started in 1948 and is still in progress. It is hoped that this work will indicate causes of sterility in dairy cattle and methods of treatment. Physiological factors that might cause bloat are being investigated. If bloat can be controlled, large annual losses to dairymen and other stockmen can be prevented; also, much better use can be made of legumes for pasture.

Calves dropped by vitamin D-deficient cows were usually weak. The legs of many were crooked.





A traveling exhibit of good-type dairy cattle at Mobridge, April 1, 1914.

Various methods of storing grass silage are currently receiving much attention. Better use is being made of valuable forage crops by making silage instead of hay and thus reducing the possibility of rain damage. The feeding value of the silage and methods of self-feeding to reduce labor are being investigated.

Future dairy research can be expected to solve many of the problems which dairymen now face. Production of milk at a lower cost may be realized through better utilization of feeds, better animal health, animals bred for high production, lower cost housing, and the use of more labor saving devices. Market research recently initiated may point the way to consumer preferences and greater utilization of dairy products. Improvement in manufacturing techniques and development of new products can be expected that will further increase the demand for milk.

Self-feeding grass silage to dairy cows. Portable panels, built on heavy sled-type runners, can be pushed forward as cows eat into the stack.



STAFF MEMBERS WITH 20 YEARS OR MORE OF SERVICE TO THE EXPERIMENT STATION





I. B. JOHNSON JAMES W. WILSON* Director and Animal Husbandry Director and Animal Husbandry

JAMES H. SHEPARD* Director and Biochemistry



BEYER AUNE* Superintendent, Newell



C. LARSEN* Dairy



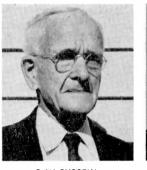
Agronomy



GABRIEL LUNDY Economics



J. G. HUTTON* Agronomy



S. W SUSSEX* Superintendent, Highmore



T M. OLSON* Dairy



RALPH PATTY* Engineering



TURNER R. H. WRIGHT Animal Husbandry



y y



A. N. HUME Agronomy



J. B. TAYLOR Veterinary





L. F. PUHR Agronomy



C. C. LIPP* Veterinary



H. C. SEVERIN Entomology



Rural Sociology



(Not pictured are former members Matthew Fowlds, Agronomy, and Frank Hussey, Superintendent, Vivian)



ENTOMOLOGY AT A Prine .

IHE FIRST IMPORTANT scientific studies of harmful insects in what is now the state of South Dakota were made by the U. S. Entomological Commission. Reports of this research appeared principally in bulletins and reports of the commission between 1877 and 1890. Grasshoppers and insects of forest and shade trees were the insects of primary concern at that time. The controls recommended then have been outmoded for a number of years.

 \mathbf{T}

The Dakotas, throughout the years, have experienced considerable damage to crops as the result of attack by hordes of grasshoppers. Some of the outbreaks were due to migrations of the insects into the state (notably 1874-77), while others were of native species which are found in varying numbers every year.

Study of the various species of grasshoppers, their life histories, preferred habitats, and economic importance, and a search for satisfactory control methods to use against them have been the concern primarily of Professor H. C. Severin, who became a member of the college staff in 1909.

During his 46 years of service to South Dakota, his research has also added greatly to our knowledge of field crickets, chinch bugs, corn insects, wireworms, and fruit tree pests.

South Dakota State College has one of the better insect collections in the United States. This collection, numbering an estimated million specimens, was built up primarily through the efforts of Professor Severin, aided by staff members.

Advance With Agriculture

A changing agriculture has necessitated continuous study of insect problems. New developments in agricultural machinery and methods of cultivation of the land were utilized in an evaluation of tillage methods in grasshopper control.

Within the last decade the science of chemistry has given the farmer powerful new insecticides with which to combat insects. These new weapons, made even more effective in combination with the use of recommended tillage practices, have made it possible for farmers to hold in check the threatening population build-up of cropland species of grasshoppers.

It is possible, now, to reduce greatly such losses as occurred to South Dakota agriculture in the 5-year period from 1937 to 1941 when grasshoppers did an estimated \$43 million worth of damage in this state alone.

New insect pests are occasionally brought to our shores from other countries. The European corn borer was first discovered in the United States in 1917. It is believed to have been brought to North America sev-

eral years earlier, probably in shipments of broom corn from Europe.

It made its way into the Corn Belt from the East and reached South Dakota in 1946. At that time a very few specimens were found in corn fields along the eastern border of the state. By 1949 this pest reached outbreak proportions, and in the fall of 1949 thousands of bushels of corn were dropped to the ground as a result of the borer's work. During 1954 the borer caused a reduction in profit estimated at \$22 million from the South Dakota corn crop. Most of this loss came from the eastern one-fourth of the state.

The borer has now made its way across South Dakota. For many of our farmers, the use of recommended control measures has resulted in the saving of thousands of bushels of corn.

Try New Control Methods

It is not within the scope of the entomologist to introduce new crop varieties or to improve livestock herds. However, a close parallel can be drawn. New varieties of beneficial insects, parasites, and predators of such pests as the European corn borer, have been brought to this country for use in biological control efforts against the pests. Five new species of such beneficial insects have been introduced into South Dakota. Two of these show promise of becoming established, and if so will help in our battle against the corn borer but not to the extent that we may disregard other control measures.

All animals raised on our farms and ranches are subject to insect attack. Cattle grubs, horn flies, stable flies, mosquitoes, lice and mites, and others take their toll from the farmer's profit.

Experiments have shown that with good cooperation on the part of ranchers on a large area basis, the cattle grub problem can be greatly reduced. With the use of "back-rubbers" saturated with insecticide, the horn fly problem can be very markedly reduced. The use of recommended controls can save many dollars for each farmer who is faced with these insect problems.

The Experiment Station is currently working on a problem in which a search is being made for a systemic control for cattle grubs.

With this method the grubs would be killed by injecting or feeding an insecticide to the animals to kill the maggots as they migrate through the tissues of the animal. If such a chemical can be found it will mean a saving of many thousands of dollars to the ranchers of the country.

A recently initiated project is concerned with control of insects that reduce the yield of alfalfa and sweet clover forage and seed. In connection with this study is the problem of how to use honey bees more effectively in the production of an alfalfa seed crop.

Another important study is concerned with intestinal parasites of cattle and how to control them. The fringed tapeworm of sheep is a problem being investigated by the station. At present the life history and method of transmission of this parasite are unknown. These facts must be known before we can possibly know how to control the tapeworm.



Grasshopper infestations can now be better predicted and controlled.

In summing up the combined effects of insects upon the well-being of South Dakota agriculture, one finds that insects and parasites are responsible for many millions of dollars of loss each year. Practically every crop and every product manufactured from crops is subject to attack by insects.

The entomologists of the Experiment Station investigate the life histories and seasonal histories of the most important insect pests that occur in South Dakota. They work to find practical and adequate control measures for these pests. The important beneficial insects are also studied and the role that they play in our economy is determined.

Research Changes

Research on insects is far different from that done in the early history of the station. At present the ecological factors that influence the abundance of any pest can be measured much more accurately than was possible 65 years ago.

Studies on natural, or biological, control of insect pests by parasites and predators are much more advanced and in some instances are now in practical use. Moreover, the entomologist has available in his control work numerous highly effective insecticides that were not known even 25 years ago. On the other hand, many of the new insecticides are very toxic not only to insects but also to man. The entomologist is in a position to inform and caution the public in the careful and correct use of insecticides.

It must be remembered that control of insect pests by the use of insecticides is only one method of control (usually a last resort) and that numerous other methods can be practiced to advantage. The ultimate control of insects will result from a combination of all possible methods, not just the use of one.



HOME ECONOMICS

IL ESEARCH IN Home Economics began at State College in 1926. Particular emphasis has been on foods and nutrition and on textiles. The department cooperates on various regional projects.

The first project undertaken in textiles was a study of the quality of material in women's coats. Since 1930 nearly all of the projects have been concerned with wool, the first one being a study of the quality of wool fleeces clipped from five breeds of sheep.

Study Fabrics

When the Wool Products Labeling Act became effective in 1941 much interest was evidenced in the effect on wearing quality of the addition of reprocessed or reused wool to new wool. Accordingly, two serviceability studies were conducted. Wool flannels of varying proportions of new and reprocessed wool were woven to specification, made into skirts, and worn for certain periods of time. Similarly, another series of flannels made from new and reused wools were woven and made into skirts and worn by students.

Another serviceability study was made on all new wool serge using three different weights of fabric. These were used for men's trousers and worn for several months to determine the effects of wear on each weight of fabric.

Currently, the consumer interest in textiles concerns the new chemically manufactured fibers. Two laboratory studies are in process. One is concerned with blended suitings and the other with using chemically manufactured fibers for shirts and blouses. Hard water, which is so common in South Dakota, also presents a textile problem. A study is being made to determine how to secure best results when laundering fabrics in excessively hard water.

Work With Vitamins

The first 15 years of foods and nutrition research by the Experiment Station were conducted by means of animal assays since chemical analyses of the vitamins had not yet been perfected. The vitamin C content of fresh and canned vegetables was determined by means of



This machine aids in testing the ability of various detergents to remove soil from fabrics.



A taste panel is one phase of determining the most satisfactory method of food preparation or preservation.

growth curves and microscopic examination of the bones and teeth of guinea pigs. White rats were used in determining the vitamin B_1 and B_2 content of lamb tissues and organs.

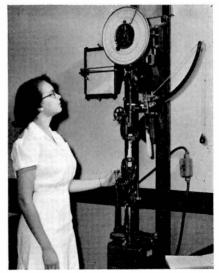
Studies on the freezing of foods were begun in 1937. The first work was on the effect of quick freezing on the vitamin B_1 content of lamb tissues and organs as determined by animal assay.

The animal laboratory was closed in 1940 and a series of projects on the freezer locker storage of fruits and vegetables was begun. The suitability for freezing of many varieties of South Dakota-grown fruits and vegetables was investigated. Methods of blanching, packaging, freezing, and storing that would result in the most palatable food products with a minimum of loss of such nutrients as vitamin A and ascorbic acid were studied.

During World War II there was a need for conserving all home-grown

fruits and vegetables, so different methods of preservation were tested. Due to the short supply of sugar nationally, various substitutes were evaluated as sweeteners for frozen fruits. In addition, work was

Tensile strength of a material is measured on this machine.



done on the National Cooperative Project for the conservation of the nutritive value of foods.

From 1948 to 1950 a comparison was made on three home freezers of different types as to their ability to preserve the palatability and ascorbic acid content of certain fruits and vegetables.

Conduct Nutrition Studies

The begining of studies in human nutrition in 1947 marked another era in foods and nutrition research at the Experiment Station. As part of the North Central Regional cooperative study of the dietary needs and nutritional status of women over 30 years of age, a state-wide survey was made of the food habits and health histories of a random sample of South Dakota women. A more detailed study was conducted on a selected group of Brookings women. The findings of these studies are being correlated and compared with those of women in the other cooperating states.

Observation of both low dietary intakes and low blood concentrations of ascorbic acid led to further investigation of ascorbic acid metabolism. New ways of using South Dakota-grown fruits and vegetables are being developed as one way to help raise the level of ascorbic acid consumption.

At present other aspects of this regional project are being developed. One phase is a study of the factors that affect the requirements and utilization of protein and amino acids by older women.

It is anticipated that in the future, work in foods and nutrition and in textiles will be broadened. In addition, it is planned to expand home economics research to include problems in family management, family life, and housing.

A study is under way on the wearing qualities of blue jeans. These boys give them a good trial.



HORTICULTURE AND FORESTRY

TIM

I HE DEPARTMENT of Horticulture-Forestry was formed with the establishment of the Experiment Station. In the early years the department also conducted some work in botany and entomology.

Bulletin reports show three stages of development since the department was organized. The first 10 to 15 years could be termed a period of establishment. During this time physical facilities were obtained, personnel selected, and work started. The second period was a time of devel-

opment and ran for 25 to 30 years. The third period might be considered a period of growth. It was during this period that the field of work grew into the program now being followed.

Forestry has always been an important part of Dakota history. With the establishment of the Experiment Station, a tree planting program was begun on the campus. The first bulletin published was a report on the growth of trees on the college grounds. The third bulletin told why trees should be planted, the kind to plant, and how to plant them.

Time has proven that these early workers selected important items for study. By 1890 work with vegetable and fruit crops was in evidence. A little later reports dealing with ornamental plants appeared to be fairly well established and development was evident.

Introduce Many Varieties

In 1895, the late Dr. N. E. Hansen started his work at the station. It was the beginning of an expansion period in horticulture and forestry. Foreign plant collecting expeditions assembled a great collection of germ plasm for breeding work. The reputation as a pioneer fruit breeding center was well established.

During the next 40 years approximately 500 new varieties of horticultural plants were introduced by

This plastic greenhouse performed satisfactorily throughout last winter. A greenhouse of this type is considerably less expensive to build than the glass type greenhouse.





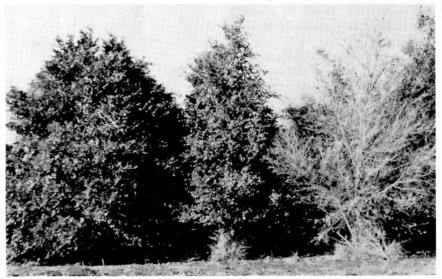
Manchurian apple root stocks produce wide-angle scaffold branching (upper), reducing breakage. Compare this tree with the standard type (lower).

the station. Such varieties as Sapa and Waneta plums and Dolgo and Hopa crab apples were offered by most every nursery in the country. These and many other varieties are still popular.

The native sandcherry became well known as a fruit plant through improvement work done between 1890 and 1935. Crosses between the hardy native wild plum and the high quality Japanese plum produced such varieties as Waneta and Kahinta and introduced a new idea in fruit breeding.

Interspecific crosses were also made with apples, pears, grapes, raspberries, and apricots. Much of

The Chinkota elm (right) has shed its leaves in preparation for winter. It is believed that this is one of the characteristics that help it escape winter injury.



the material used in this early breeding program was preserved and still serves as a source of germ plasm.

Begin Greater Specialization

By 1940 an increase in personnel permitted greater specialization by workers. Greater emphasis was placed on vegetable work. In 1950 a high quality hybrid tomato named Siouxann was released. Two years later another tomato, State Fair, was named. Siouxann is now known for its early, high yielding ability and State Fair for its ability to tolerate h i g h temperature and drouth.

In 1951 a hardy selection of the Chinese elm was named Chinkota. This plant survives under severe winters. A forest tree breeding program was started in 1950, and results show that a faster growth rate and other desirable characteristics will produce better trees for shelterbelt plantings.

Ways and means of protecting strawberry plants during winter have furnished information essential to strawberry growing. The value of wind protection to vegetable gardens and ways of lengthening the garden season have been determined by cultural practice studies.

New techniques as an aid to plant breeding were introduced in 1953. Refrigeration of pollen reduced the number of fruit trees required for breeding. By growing tree seedlings in the greenhouse during winter months, a much larger plant can be had in a short time.

The experimental work in horticulture-forestry now has nine active projects being carried on by five men. Extensive breeding work is being done with fruit and vegetable crops. Forest tree improvement is being carried on. Cultural practice studies receive major attention. The most recent addition is an expansion in the work with ornamental crops.

Siouxann is an early and good yielding tomato developed at the station.



The "tub orchard" makes it possible to grow high quality, but winter tender, varieties for fruit breeding.



PLANT PATHOLOGY

Z,

TO S

LHE PLANT PATHOLOGY Department was established in the Agricultural Experiment Station in 1940. Dr. W. F. Buchholtz was the first plant pathologist and head of the department.

Annual losses from crop diseases in South Dakota total over \$25 million. In seasons when any one of the major diseases reaches epidemic proportions, the losses are frequently doubled.

In 1953 the serious 15-B stem rust epidemic on wheat reduced the income of South Dakota wheat farmers by an estimated \$43 million, in 1954 by \$20 million, and in 1955 by \$6 million. These losses were due to a single disease; consequently, when one considers that there are seven or eight major disease organisms in the state that can attack wheat alone, the potential dollar loss is alarming.

One of the first projects was to investigate root rot diseases of small grains and forage grasses. These diseases were causing poor stands and vields throughout the state. Soil-borne diseases prevented the establishment of grass stands, particularly in the late thirties, on large areas of the range that had been planted to small grain and flax. It soon became evident to the growers that this land was better suited to grazing. The regrassing program on ten's of thousands of acres became difficult and costly because of these grass diseases.

Experimental evidence was obtained as to the microorganisms causing these diseases and the effect of seed treatments and crop sequences on its control. Later a search for strains of these crops that possessed resistance to certain of the soil-borne diseases was undertaken. The work progressed satisfactorily until 1945, when it was necessary to discontinue the research for several years due to a lack of personnel.

With the completion of the new plant pathology building and greenhouses in March 1955, it was possible to expand the crop disease research. Cooperative research between the Plant Pathology Department and the Cereal Crops Research Branch of the U. S. Department of Agriculture has been established. The U. S. Department of Agriculture has placed two scientists here to conduct research on crop diseases.

Study Many Diseases

Research in progress to combat the many complex diseases includes work with legumes and grasses, small grains, corn, flax, sorghum, potatoes, tomatoes, shelterbelt trees, and mold spoilage in silage. Some of the diseases are stem and leaf rust; mosaic; root rots of small grain and forage grasses; root rot and blight of corn and sorghum; scab, ring-rot, and leaf blight of potatoes; defoliation and crown rot diseases of alfalfa and forage and range grasses. Disease control methods being investigated include disease resistance, seed treatment, systemic chemicals, and crop rotations.

The Plant Pathology Department conducts field experiments on about 40 acres of land near Brookings. Likewise, other field experiments are conducted at the various substations and the irrigation station near Redfield. Many other experiments are conducted in cooperation with growers on their farms in other areas of the state where certain crop diseases have become a limiting factor in crop production.

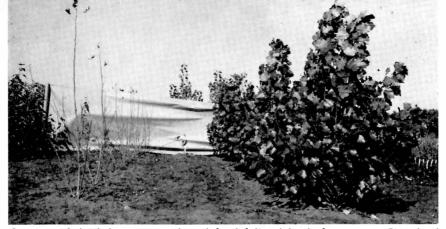
Wheat mosaic, a small grain virus disease new to South Dakota, was discovered in 1950. Experiments have shown that all recommended varieties are susceptible. It has been found that this disease is spread under field conditions by a tiny insect. This is an important research contribution toward the ultimate control of the disease. Mosaic caused an estimated loss of 10 to 15 percent in the winter wheat crop in 1954. Some fields of 200 to 300 acres were a total loss and plowed under.

Experiments are in progress to find sources of disease resistance in wheat, barley, and oats to such important diseases as mosaic, stem rust, smut, and root rot. These diseases can cut crop yields by as much as 75 percent in a single season. When the research involves the development of a variety possessing disease resistance as well as such things as adaptability and quality, the research is conducted in cooperation with the Agronomy Department.

A new strain of cottonwood for farm shelterbelt plantings was developed. It was released in 1955. This strain is highly resistant to leaf rust, a disease which each season usually defoliates the cottonwoods. This tree, named Siouxland, is also winter-hardy, does not pro-



The new plant pathology units.



Common shelterbelt cottonwood on left, defoliated by leaf rust, new Siouxland cottonwood on right, highly resistant to disease.

duce cotton, and is a rapid grower. Its dense branching at the base similar to that of the spruce—offers greater protection against wind and soil erosion. It should prove to be a valuable tree to South Dakota and the northern Great Plains.

Results of the research have provided up-to-date information. The most effective methods of control, based on experimental data, have been released to the growers.

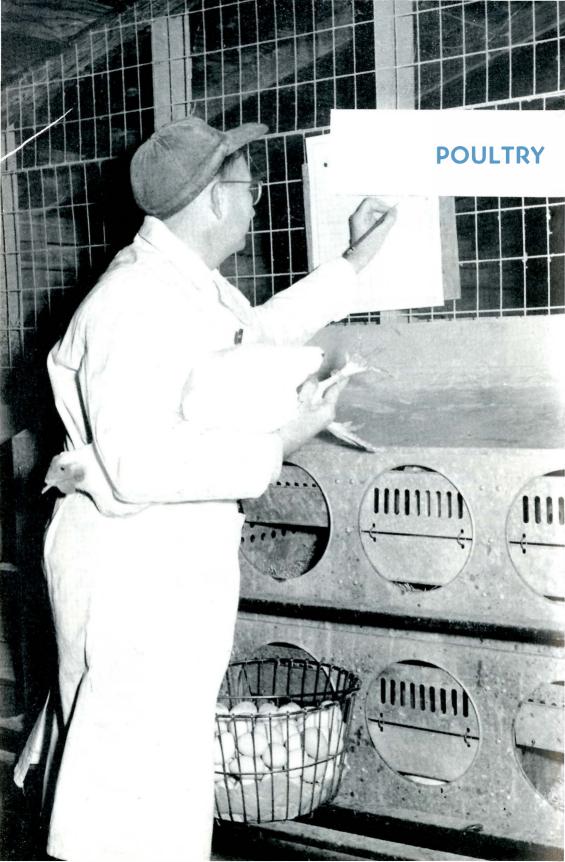
Need Additional Research

Further research expansion is needed to determine other and still more effective methods for combating crop diseases. In general, it can be assumed that as our agriculture continues in South Dakota, certain crop diseases may become more destructive and new diseases become established—unless we find new ways of controlling crop disease epidemics.

Over a period of time certain crop diseases can virtually eliminate a given crop from production. In fact, just such a situation has occurred in the case of durum wheat in South Dakota. In 1951 the acreage of durum wheat grown in the state totaled 375,000 acres. A new strain of stem rust, 15-B, in the state developed in epidemic proportions during a 3-year period. As a result, the 1955 acreage was reduced to 75,000 acres—a reduction of 100,000 acres per season due to a single disease despite a strong demand and premium prices for durum. A large portion of the durum fields were never harvested—the severe stem rust infection prevented the kernels from filling.

Accordingly, it becomes clear that crop disease research must be a continuing program to meet and control the ever increasing disease problems. The serious "ups and downs" in farmers' income due to crop disease epidemics is a weak link in our economy that can be improved through research.

Expanded research on virus and bacterial diseases and the nature of disease resistance in our crop plants is essential. Such new information will provide a broader foundation as a basis for determining more successful and satisfactory methods in the control of costly plant diseases.



DINCE POULTRY RESEARCH was begun at the Experiment Station in 1925 by G. L. Stevenson, drastic changes have taken place in the industry. The setting hen has been replaced by the mammoth incubator. Grain and table scraps diets have given way to scientifically formulated and balanced diets. Where once production was obtained only in the spring and summer months, many flockowners now obtain 70 to 80 percent egg production throughout the winter months.

Efficiency of production and marketing of poultry products has increased in this period. Poultry has become an expanded and more profitable industry throughout South Dakota. The average yearly egg production per hen has increased from 102 eggs in 1925 to 178 eggs in 1954.

Such progress has occurred quite largely because of research at this and other experiment stations and various private and commercial laboratories. This research has included the development of improved feeds and feeding practices, breeds and breeding practices, management, housing, and disease control.

Develop New Strains

Some years ago poultrymen noticed that some chickens feather early, some late. This was thought to be a matter of chance. Later workers studied the problem and discovered early or late feathering to be an inherited characteristic and that late feathering could be eliminated by proper selection. This led to the development of rapid feathering strains of heavy breed chickens. At this station such strains have been developed in the White Plymouth Rock, Barred Plymouth Rock, and Rhode Island Red breeds.

An improved White Plymouth Rock strain, S. D. 101, which also carries pure genes for gold, has been developed and released for public use. Also a light colored Barred Plymouth Rock strain, S. D. 122, was developed here and has been made available to poultrymen in the field.

Much effort has been devoted to obtaining improved performances through inbreeding and hybridization of chickens. Several inbred lines have been developed and tested and have shown much promise. One Rhode Island Red inbred line, developed by Dr. D. G. Jones, was released in 1955 and was used by several commercial groups in their breeding programs.

Study Nutrition, Marketing

Earlier nutritional studies were concerned with the feeding values of light weight grains, dehydrated grass meals, soft corn, and the use of oyster shells, clam shells, and limestone as sources of calcium.



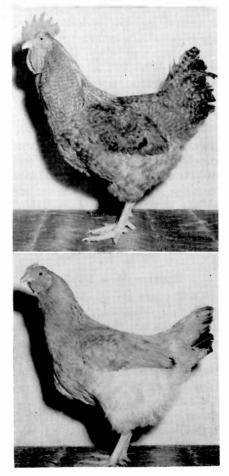
Mating S. D. 101 males and New Hampshire females (upper) produces a gold-barred offspring. The offspring (right) has lighter colored pin feathers, good growth rate, good meat type, and good egg size.

Recent experiments have demonstrated the value of vitamin B₁₂, unidentified factors, arsenicals, antibiotics, and high energy ingredients in diets for both growing and producing chickens and turkeys. The phosphorus requirements and the availability of various phosphorus sources for turkeys have been investigated as well as the self harvesting of certain grain and forage crops.

In cooperation with other departments, research has been conducted on poultry and egg marketing problems, the use of rammed earth walls and of hard surfaced floors for poultry houses, the nature and control of selenium poisoning in poultry, and the effects of chemical composition on the consumer preference of turkey meat.

Work on Fertility, Hatchability

As poultry production has become more specialized, research



workers often have been asked questions for which no satisfactory answers are available. For example with the development of more rapid growing strains of turkeys, fertility and hatchability of eggs has in general been reduced. As a result, much attention is being given to the possible reasons for poor fertility and hatchability. The search for more efficient methods and higher performance is unending.

Some further problems that are puzzling poultrymen and concerning the Experiment Station staff are: What can be done to prevent big-hock trouble and lameness in growing turkeys? Of what value are some of the new feed ingredients that are being brought on the market? How much can a flock-

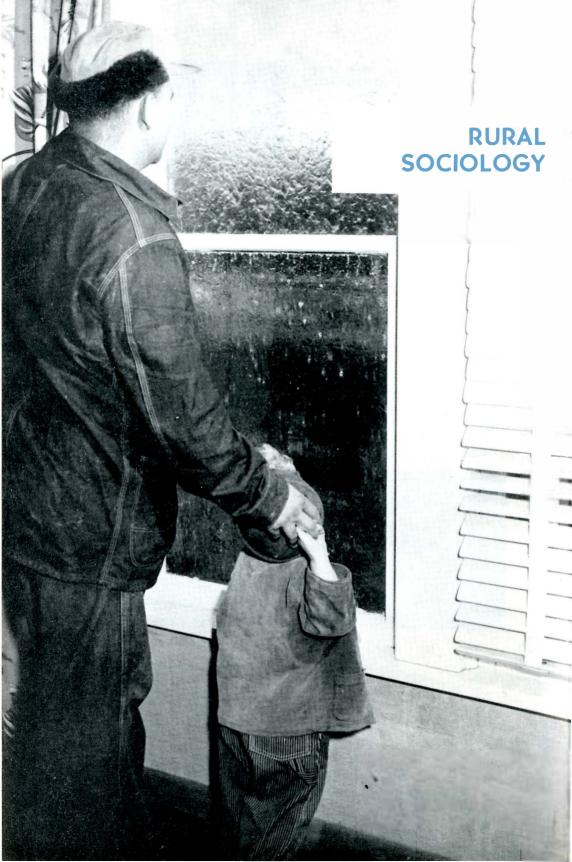


S. D. 122. The light color of this barred Plymouth Rock makes it valuable as a broiler.

owner afford to spend for ventilation and insulation in a new house for 500 hens? Will individually caged layers be profitable in South Dakota? How can egg quality best be maintained from the nest to the skillet? Can the new types of electrical floor brooders be used in South Dakota?

These turkeys demonstrated that high energy diets give superior growth. Turkeys on low energy diets (right) have tendency to consume more forage.





HE MAIN CONTRIBUTION of research in rural sociology has been that of helping the people of the state understand their social problems and recognize the conditions that gave rise to these problems. Provided with a greater understanding, individuals, organizations, agencies, and legislators were in a better position to weigh alternative solutions to the social problems confronting South Dakota.

Work on Many Projects

The Rural Sociology Department first became affiliated with the Experiment Station in 1925 under the leadership of W. F. Kumlien. The first research project concerned a study of rural social agencies. It was designed to determine the most urgent research needs of the time and explored a variety of subjects such as communication, education, welfare, religion, and community organization.

This was followed by a station bulletin in 1927, What Farmers Think of Farming, which indicated that many farmers were concerned with obtaining economic equality with industry and labor.

They also desired to obtain state and federal legislation providing economic relief through group action by farm organizations.

Other early projects and bulletins provided information for rural people on rural schools, rural churches, and rural health. For example, it was revealed in one of these bulletins that three-fourths of the rural enrollment in high schools did not return to the farm. This fact was influential in changing the educational philosophy of high school administrators. They came to the realization that it was necessary to provide a liberal high school education with some vocational instruction in agriculture and homemaking to make life richer for those who return to the farm as well as for those seeking nonfarm employment.

1930's Bring Problems

During the 1930's the research staff concentrated its efforts on the problems of drouth and depression. Some of the research findings follow.

Changing conditions made farms acquired under the Homestead Act too small to operate efficiently. Farm families on relief operated smaller units than nonrelief families. Larger farm units and livestock diversification were important factors associated with agricultural success.

The population on relief was younger, had less education, and included more semi-skilled and unskilled workers. Tenants more than owners, and especially those with larger households, were found among people on relief. The level

of living of many rural families was indicated by the lack of running water, electric lights, central heating, and telephones. It was shown that applications for old age assistance would continue to increase because of the larger number of people in the state 65 years of age and older.

Study Education, Trade, Population

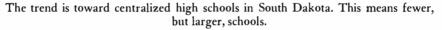
Considerable research has been undertaken to provide guidance for those engaged in school administration and educational policy formulation. A school district atlas outlining boundaries for various types of school districts served as the basis for much educational research. Station research has also been used for most of the recent school legislation.

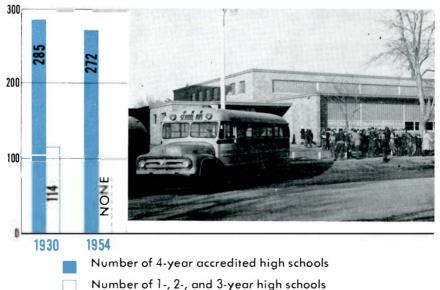
A study of town-country trade

relations provided a new perspective on social changes in South Dakota resulting from changes in merchandising, population adjustments, and new forms of transportation. This project has recently been brought to date in a bulletin entitled *Growth and Decline of South Dakota Trade Centers*, 1901-51.

Another project recently completed concerns the problems of irrigation development on one of the oldest federal irrigation projects in the nation. The bulletin, *Experience Gained on the Belle Fourche Irrigation Project*, has important implications for future irrigation development in the state.

Several research studies have been made of the population changes in South Dakota. The loss of population through migration was noted in the period from 1930







to 1950 and will influence the future growth of population in the state. The Rural Sociology Department is also cooperating with a regional population study on the population

Both pre-school children and elderly persons are increasing in numbers in South Dakota

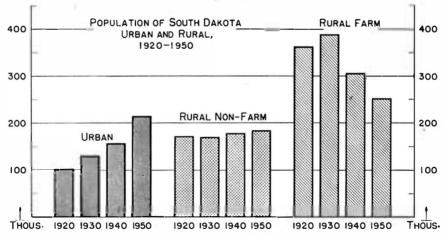
changes and migration in the North Central States from 1940 to 1950.

Basic Research Planned

A backlog of basic sociological research remains to be done. Significant post-war changes in mechanization of farms, rural electrification, and redistribution of population has increased the need for a better understanding of rural living conditions in South Dakota.

The department staff is attempting to meet some of the research needs in the areas of retirement and health of the aged and minority relationships. Other projects for the future include studies of the diffusion of farming practices and the educational and employment opportunities for rural youth.

Increase of urban population was greater during the 1940-50 decade than any other time previous.



STATION BIOCHEMISTRY

a support

I ESEARCH IN BIOCHEMISTRY was activated in 1888. Since that time this department's functions have fallen into three general classes—departmental projects, cooperative projects with other departments of the Experiment Station, and analytical work for citizens of the state.

For about 25 years Professor J. H. Shepard directed the work of the department. His first interest was in the quality of our artesian waters, especially from the standpoint of drinking and irrigation. The information he collected was immediately applicable in the solution of some farm water problems, and since the recent reactivation of interest in water quality it has again proven useful.

Professor Shepard later pioneered studies on the sugar content of beets and, with others, produced a high sugar-yielding beet especially adapted to South Dakota. His research on the milling and chemical properties of macaroni wheat were used in evaluating varieties of this crop grown in the state. Finally, with others in the Experiment Station, he contributed the first information as to the chemical composition of our native forage plants and the digestibility of grains and forages grown in the state.

Selenium Causes "Alkali Disease"

For several years a strange malady known as "alkali disease" baffled scientists in parts of the Great Plains and Rocky Mountain regions. The cause of this malady was unknown until the early 1930's. Dr. K. W. Franke, in cooperation with U. S. Department of Agriculture workers, then established that selenium, an element found in small amounts in certain soils, was involved. Plants absorbed selenium from these soils and the animals that ate these plants developed the typical symptoms.

By 1940 geological, soil, and plant studies made possible the generalized mapping of seleniferous areas.

It was discovered that sodium arsenite in small amounts would protect against the toxicity of selenium. Although satisfactory practical control of selenium poisoning with sodium arsenite has not been attained, new organic arsenicals now being investigated show definite promise.

Several other substances that protect against selenium poisoning in laboratory animals have been found, and testing of these in farm animals has been started.

Certain management practices under investigation on naturally seleniferous range along with the chemotherapeutic substances just referred to should give more practical control measures than presently available.



Study Nitrate Poisoning

Research on nitrate poisoning in cattle has shown some of the climatic and soil conditions that result in excessive accumulation of nitrates in plants. Finding of excessive quantities of nitrates in some stock water has also helped explain some formerly obscure reasons for cattle losses. Station chemists have suggested precautions and preventive measures against the development of nitrate poisoning.

The additions to basic knowledge of the nitrogen metabolism of plants resulting from investigations of this problem have value, not only in the Results of an advanced stage of selenium poisoning in a cow.

practical sense, but to a fundamental understanding of plant processes.

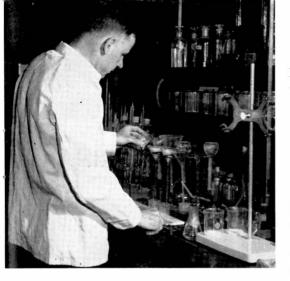
Cooperate on Other Projects

Through cooperative effort, information as to the proper handling of native grasses for hay has been obtained and is being used by farmers and ranchers throughout the state. In another cooperative project, a method for expanding some South Dakota shales was developed. This method is now used commercially within the state.

Methods of storing grass silage have recently been investigated cooperatively by several departments of the Experiment Station. Biochemistry has determined differences in chemical composition, losses in nutritient value, and factors concerned in these losses for several methods of storage. The information obtained will be used in assessing the relative merits and shortcomings of several silo types.

Symptoms of selenium poisoning include unthriftiness and a separation of the hoofs from the skin. Organic arsenicals have been found to counteract selenium poisoning in growing pigs.





Cooperative with other departments, methods for overcoming some of the problems of chemical nature in farm water supplies are being developed. Practical remedies for high salt content and extreme hardness and iron content are being sought. This project is aimed at making the everyday tasks of the farm homemaker easier.

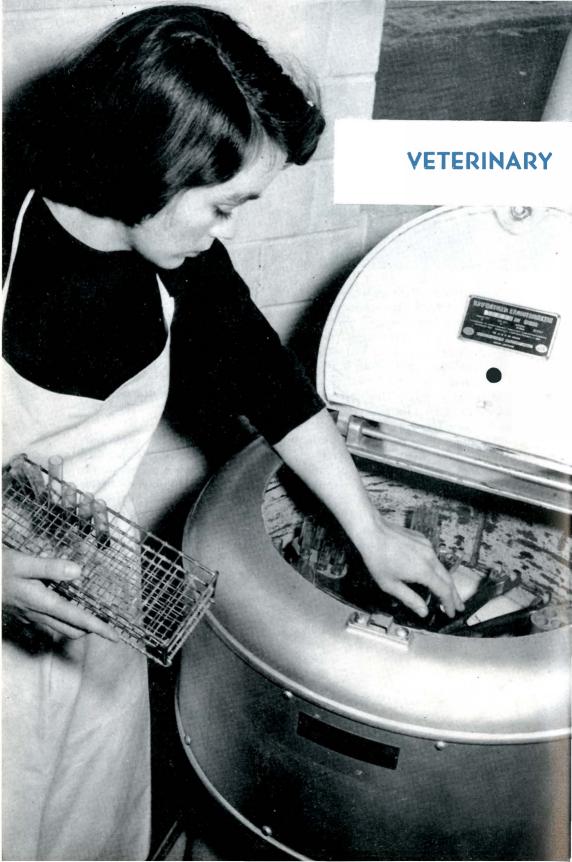
Legumes must take a larger role in our future crop rotation program than they now do. At present their use is limited because they cannot be pastured without the danger of bloat. Another cooperative project has recently been undertaken by several departments in an effort to solve the bloat problem. Biochemistry's part in this project concerns Numerous types of analyses are carried out by the Biochemistry Department many in cooperation with other departments.

the identification of the causative agent. Once this is established, the plant breeder may develop strains of legumes that do not cause bloat and our acreage of these important crops will be increased.

Biochemistry's investigations of the possibility of producing a lowfiber protein supplement from alfalfa may also help increase the future acreage of legumes.

Looking ahead at the many problems that must be dealt with, two stand out as needing the most immediate attention of 'our biochemists. One of these is urinary calculi or "water-belly," a disease that causes great losses for our stockmen every year.

The other deals with a more thorough understanding of the chemical nature of our feeds and forages essential to the development of better and more efficient methods for determining their feeding values. The biochemist will not solve these alone but as a member of the scientific team required in most of our present-day research.



LHE IMPORTANCE of research on animal diseases and their control was recognized in the organization of the Experiment Station. At that time glanders of horses and tuberculosis of cattle were of primary concern. Early investigation demonstrated the accuracy of the tests which were later used in eradication of the two diseases in South Dakota. Experiments were also conducted in the early years on the effectiveness of various dipping solutions for controlling scabies and mange of sheep and cattle. They were prevalent in several areas of the state.

In 1909, and continuing for several years, the Veterinary Department produced hog cholera antiserum, which was used in combatting outbreaks of the disease. This service was discontinued as soon as the production by commercial companies was sufficient to supply the demand.

Problems involving sheep parasites have received attention. Treatments for the removal of stomach worms were investigated. More recently, a study has been made of the trends in the build-up of worm infestations in sheep on ranges in western South Dakota. From this study a program of control by practical management practices can be recommended.

From time to time, livestock diseases which are uncommon or not previously recognized make their appearance. One such disease, bovine encephalomyelitis, has been under investigation since 1947. The causative agent, a virus, has been isolated and many of its characteristics determined. Leptospirosis of cattle and swine and mucosal disease of cattle are two diseases which are becoming increasingly prevalent. Research on these diseases has been initiated to seek information necessary to effectively combat them.

The poultry industry has become increasingly important in South Dakota. One of the disease problems in poultry in this area is fowl cholera. This disease is being investigated both from the standpoint of prevention and control.

There are many animal disease problems which still require solution. Swine raisers are concerned over the relatively high death loss in baby pigs and the effect of infectious rhinitis on efficient growth and production. Respiratory diseases of poultry are a cause of great economic loss through mortality and lowered production.

These are a few examples of the problems which will require study in the future.

CAMPUS 1955

