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SDSU Agricultural Experiment Station

Fall 1965

South Dakota Farm and Home Research: 78th Annual Report to South Dakotans

Agricultural Experiment Station

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Vol. XVI

No. 4

Fall 1965

South Dakota

FARM & HOME RESEARCH

**78th
Annual
Report
to
South
Dakotans**

**Agricultural Experiment Station
SOUTH DAKOTA STATE UNIVERSITY
Brookings, South Dakota**



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1965
Fall



Orville G. Bentley

“... South Dakota a bright and rewarding future”

Orville G. Bentley, a native of Midland, S. Dak., and a graduate of South Dakota State University, early this fall moved up to one of the top agricultural leadership positions in the Nation when he became Dean of Agriculture at the University of Illinois. Previously he was Dean of the College of Agriculture and Biological Sciences and Director of the Agricultural Experiment Station at South Dakota State. Because of his position at SDSU, his associations, contacts and background, Dean Bentley is one of the keenest overall observers and evaluators of South Dakota agriculture. Dean Bentley's optimism and faith in South Dakota's future are impressive. He recognizes that many problems exist—but they are problems which he believes can be resolved. He isn't willing by any means to sell short the possibilities of his native state and its people. Shortly before leaving SDSU, Dean Bentley discussed some of his thoughts as reported in the following interview.

A steadily-growing awareness of the need for changes plus a willingness of people to make them to keep abreast of current developments are factors which augur well for a bright future in South Dakota agriculture.

Those are conclusions of Orville G. Bentley, former Dean of Agriculture at South Dakota State University who now occupies a similar position at the University of Illinois.

“Change is the keynote of the times — not adjustment,” Bentley emphasizes. “Merely adjusting is not enough for by the time a person adjusts much of the changing parade has already passed him by.

“We've had some pretty dire predictions for agriculture lately, for the Upper Midwest in general and South Dakota in particular,” Bentley notes. He suggests the people use these predictions as warning

signs pointing toward the disaster road. “But signs leading to the success road are also posted,” he adds. “To follow them South Dakotans must use their abilities to change to meet modern demands of marketing, consumer preference, new scientific developments in agriculture and other fields.

“If you think I am talking about changes only the rancher and farmer must make, you are wrong,” Bentley continues. “All South Dakotans are involved in the changing times. Those in the planning and execution phases of education and research, for instance, must carry a heavy load in the effort to solve many of the State's basic problems. Don't forget, we always pay for research and education—either on a planned, orderly basis or at a much higher price in terms of reduced efficiency and quality of products.

Defending the status quo, although a popular diversion, is a ‘luxury’ South Dakotans just cannot afford.”

Education, Research and People

Turning to relationships of education, research and people to needs of South Dakota agriculture, Bentley lists some future requirements, past accomplishments and problems facing the Agricultural Experiment Station, of which he was director from the time he returned to his alma mater in 1958 until early this fall.

Water resource development is high on Bentley's list of unfinished research business because of its relationship to the future. He points out that water—and its distribution—is one of the major factors contributing to South Dakota's \$700 million annual income from agriculture. Since almost 70% of this income is

from livestock, the matching of irrigated crop production with livestock feeding must be emphasized.

Crop production, another important phase of South Dakota's economy, is tied in closely with water as well as soils. Bentley emphasizes the importance of getting the maximum production from the soils over the long pull. He acknowledges that South Dakotans don't have as yet a very progressive and forceful philosophy toward soils in the State, although some improvement can be noted. He says this shows up particularly in the use of fertilizers: low phosphorus levels this year, for instance, resulted in decreased barley yields.

"Research on water development has been and will continue to be important for the Experiment Station," Bentley says. "An initial objective of the Station when it was organized nearly 80 years ago was study of climate. Much has been done especially in relation to moisture received, where it goes, how it is used, and storage. A newer development involves use of water in another way: as a recreational resource when it is carried to or stored in reservoirs. Recreational possibilities are examples of a change in thinking about and use of a basic resource.

"And where does an *agricultural* experiment station and Extension Service fit into the picture of recreational resources? One basic concept of the experiment station idea is to help people—and people of South Dakota certainly have a big stake in development of the State as one of the Nation's foremost recreational areas.

Water Evaporation Studies

"We have been able to experimentally measure and control evaporation from water surfaces in reservoirs. From this, further studies undoubtedly will bring out practical methods for saving vast amounts of water normally lost in evaporation.

"Another phase of irrigation research has involved the introduction of water, its diffusion and final drainage from a section of the State characterized by its almost tabletop-smooth topography. Establishment of huge reservoirs by the Federal government has provided new sources of water in other regions of the State. Studies have established guidelines to help interested dryland farmers and ranchers decide if they can profitably make the somewhat difficult change to irrigated farming.

"Computers—the 'modern' way—are being used to summarize climatic data ranging over 80 years in a form useful to the farmer. Another new possibility is relating this weather data to the ground-level weather layer where plants grow in temperatures which may vary considerably from those only a few feet higher. This is the study of microclimate and may introduce the possibility of 'stretching' the growing season.

"Quality of products is a phase of agriculture becoming ever more important and, in part, represents the farmer's immediate concern to meet consumer demand. For sure it represents one of the changes which must be made in South Dakota to face stiff outside competition.
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SOUTH DAKOTA FARM AND HOME RESEARCH

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78TH ANNUAL REPORT

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Orville G. Bentley, Dean of Agriculture and Director, Agricultural Experiment Station

Frank J. Shideler.....Editor

Leland L. Sudlow.....Photographer

Nathanial S. Cole.....(Cover)

agricultural engineering

Soil Drainage. In cooperative drainage research with the Bureau of Reclamation at Redfield, results indicate that in a stratified lake bed soil, core measurements of permeability in the laboratory underestimate the actual tile flow. In connection with the amount of drainage needed by grain sorghum to prevent damage, it appears that during the latter part of the growing season grain sorghum is resistant to high water table conditions. During 1965 a study began using lysimeters to establish the effect of water table depth on salt accumulation in Lake Plain soil.

Weather Summaries. The first detailed weather record summary for a specific weather station in South Dakota other than First Order Stations was published. The goal is for summaries to include 60 to 65 weather stations with statewide coverage and distribution. The summaries include data back to the late 1880's and furnish 28 different usable items such as probability dates of first temperature occurrence in the fall at various temperature levels and percent of probability. Programming is also underway to compile and analyze wind velocity and direction.

Watershed Runoff. Preliminary analysis of hydrologic studies on the Scott Creek Watershed in southeastern South Dakota is being completed. It includes total volume of runoff as compared to total precipitation of a number of severe storms for the 1955-1962 period.

Till Planting. A 4-year study of the effect of till planting of corn on weed growth and control started in 1965. Five treatments have no primary tillage other than chopping the stalks. The treatments vary in the amount of cultivation and use of chemicals for weed control. A sixth treatment is a check in which conventional practices are used. Effectiveness of the weed control methods and corn yields are being evaluated. A 30-inch row spacing is used on all test plots. A study to determine the best seed bed shape and orientation for corn started in 1965. Soil

temperatures for nine seed locations were recorded from May 18 to June 17 on an hourly basis. An energy method is being considered for evaluating seed germination and plant emergence.

Grain Sorghum Losses. Preliminary work in 1964 indicated relatively high machine losses when harvesting grain sorghum with a self-propelled combine. Several modifications in the design of header components are being studied during the 1965 harvest season. Overall objectives are to: (1) evaluate machine losses for grain sorghum and corn, (2) evaluate the timeliness of the harvesting operation, (3) modify machine components to minimize crop losses, and (4) develop methods to select best machine size for South Dakota conditions.

Feed Handling Center. Feed handling on the farm is steadily moving toward a highly mechanized system of structures for storage and conveyors for handling the various feeds. A feed handling center has been constructed to study the suitability of component parts. Two types of "bottom of bin" auger systems have been installed. For dry grain, the performance is satisfactory. For high moisture grain the auger system will probably take additional mechanisms for complete unloading. A 30-foot belt and bucket elevator has been installed for test of power requirements per rate of loading and rate of belt travel. Tests show that higher than "normal" belt speed is possible, thus increasing delivery rates. The vertical 6-inch auger, also installed for a 30-foot lift, gives considerable noise and vibration for the rated 500 r.p.m. as specified for operation. Overhead bins of plywood have been developed for installing in groups of four or more. These can be built in place in an existing structure and, being square, utilize space to better advantage than cylindrical bins.

Livestock Management Systems. Overall research analysis of livestock management systems as affected by automated segments is underway on both swine and dairy cattle. At the Southeast South Dakota Experiment Farm swine production system, objectives include evaluation of animal waste handling facilities and the operation of a disposal lagoon, labor requirements in managing swine on slatted floors, and continuous temperature and humidity recordings in the housing structure. At the new Dairy Research and Production Unit information is being secured on feed and labor requirements and materials handling in different types of dairy housing—comfort stalls, loose housing and stanchions.

Animal Shelters. Nailed construction joints and changing moisture cycles are critical parts of most

livestock structures. A farm building is generally constructed with wood at a higher moisture content than that of final conditons. Through laboratory research, practical equations may be used to determine the decrease in strength of a nailed joint caused by drying of the wood. The data for relating the strength of a wood joint to its modulus of elasticity has been collected.

Rural Electric Research. Excessive electrical demand loads of automated materials handling systems on the farmstead are of considerable concern to many farmers and ranchers. A partial practical solution is a metering device giving a constant flow of feed to avoid overloading the electrical system and materials handling equipment. Such an arrangement would also increase the equipment life and reduce the cost of operation.□

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- Weather Information for Agriculture, Hatch 291 (NC-26).
 - Adaptations of New Construction Concepts to the Design of Farm Service Buildings and Animal Shelters, Hatch 216.
 - Rural Electric Research, State 317.
 - Hydrologic Studies of Small Watersheds in South Dakota, Hatch 335.
 - Drainage Investigations of Proposed Irrigated Soils in Oahe Unit, Hatch 338.
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 - Application and Development of Principles and Methods for More Efficient Harvesting of Grain Sorghum and Corn, State 448.

Cover page of first detailed South Dakota weather summary . . .

CLIMATOLOGICAL SUMMARY

Climatography of the U. S. No. 20-39

NO. 1

● ● ●

WATERTOWN

South Dakota

LATITUDE 44° 55' N

LONGITUDE 97° 09' W

ELEVATION 1,465

PRECIPITATION		Av. monthly snowfall		Greatest monthly snowfall		Year		Greatest daily snowfall		Year Day		.01 & over		.10 & over		.50 & over		1.00 & over	
09	5.3	27.0	16	10.0	16	29	5	2	0										
46	5.5	24.7	46	13.5	46	05	4	2	0										
11	5.8	20.0	37	16.0	37	24	5	2	0										
05	2.3	11.5	45	10.0	45	16	7	5	1										
14	0.1	6.0	07	3.0	54	02	9	6	2	1									
19	0.0	0.0		0.0			9	7	3	1									
03	0.0	0.0		0.0			8	5	2	1									
09	0.0	0.0		0.0			7	5	2	1									
11	0.0	1.2	42	1.2	42	26	6	4	2	1									
20	0.4	4.9	32	4.0	32	30	4	3	1										
24	3.4	23.3	47	8.0	58	17	4	2	0										
03	4.5	22.3	55	11.0	53	03	4	2	0										
JULY		MAY		JAN		MAR													
20.85	10.36	63	7.14	31	27	27.3	27.0	16	16.0	37	24	72	45	13	5				

. . . and how some of the 28 different items are presented.

agronomy

Corn Inbreds. The investment by South Dakota farmers in support of corn research is paying handsome dividends. Long hours of tedious work and careful evaluation have brought the payoff stage for corn producers. Released in 1965 after years of research are two new inbreds that have definite and specific utility in creation of new corn hybrids. These inbreds SD10 and SD15, were released through the Foundation Seed Stock Division to commercial corn seed concerns to produce hybrids for farmers. By making the inbreds available for commercial hybrid producers to incorporate them into new, superior hybrids, agronomists believe corn growers will receive maximum benefits sooner.

SD10 is a specific response to the need for corn lines with resistance to the western corn rootworm, a pest that has increased rapidly in recent years and threatened corn production in much of the northern Corn Belt. This inbred is from a cross made in 1953 between Iowa B58 and Ohio 56A inbreds. During development of SD10, selection was also made for standability, plant type and seed quality. After 12 years of continued research and development this inbred is now going into hybrids for areas where corn rootworm is the number one insect problem.

SD15 was developed from a backcross. Ohio 56A was crossed to an open pollinated variety, Silver King, obtained from a farmer near Selby. The resulting line was backcrossed to Ohio 56A and subsequently inbred. SD15 is one of the lines selected from this program. It is similar to Ohio 56A but has better quality grain and a higher yielding ability in many hybrid combinations. It offers good possibilities as an inbred parent for hybrids in the drier areas of South Dakota. It is the male parent of SD248 and should find a place in other important hybrids as well.

Hume Wheat. Concentration of resources in a wheat breeding program has resulted in release of a new winter wheat variety, Hume, that can be a boon to growers in South Dakota. The new wheat released to the South Dakota Seed Stocks Foundation in the fall of 1964, and made available to farmers in 1965, has exceptional qualities of earliness, hardiness, and resistance to stem rust. Hume was tested and deve-

loped over a long period, being known only as C1 13526 or SD-5653 in the breeders' records for years. It was developed from a series of crosses involving Minter Kharkof, Cheyenne, Nebred, and some other strains. The progenies were recurrently selected for earliness, hardiness, and resistance to stem rust.

Hume resists shattering and lodging, has intermediate straw length, is bearded and has brown chaff. It showed up exceptionally well in the winter wheat area of South Dakota in 1965 because of its resistance to stem rust. How long it will retain this resistance is not known because of the ever-changing genetics of stem rust and the possibility that a strain of rust may develop which will attack this variety.

The quality of Hume for milling and baking is good. Yields and test weights have been good. Under some conditions, certain other varieties may exceed Hume slightly in yields, but because of its remarkable hardiness, earliness, and stem rust resistance, it is regarded as an excellent wheat for practically all South Dakota winter wheat areas.

Fertilizing Small Grains. Many South Dakota soils are now severely deficient in nitrogen and moderately deficient in phosphorus for small grain production. Five years of extensive testing of fertilizer practices on small grains have definitely shown that on medium or low phosphorus soils, the same amount of phosphorus fertilizer applied with grain drill attachments instead of applied broadcast will increase wheat yields at least 2 bushels an acre. Grain drill attachment application also boosts barley yields in most cases by 5 to 7 bushels an acre compared to the same amount of phosphorus broadcast. Oats, although not as responsive to phosphorus, still requires a considerable quantity, and when yields are brought up to respectable levels by adequate nitrogen application, real economy can be obtained by using drill attachments for phosphorus application.

Conservative estimates indicate that if South Dakota farmers used fertilizer attachments on their drills for only barley and spring wheat crops, annual net income would be increased by upwards of \$7 million.

In addition to yield boosts from proper use of fertilizers themselves, another spectacular benefit has been demonstrated: increased efficiency (up to 100%) of moisture use when grain drill attachments are used to apply phosphorus. In many experiments of the past 5 years in counties from the northwestern to the southeastern corners of the State, soil moisture and rainfall records have been kept. Researchers evaluate these records to determine the efficiency of water use by the crops. By measuring the amount of water in the soil at planting and again at harvest,

plus the season precipitation, scientists can calculate how many bushels of a given grain or units of feed are produced with an inch of water.

Application of fertilizer by any technique has always shown an advantage in economy of water use. However, the spectacular thing is the increase in efficiency of water use when phosphate is applied with a drill attachment. This has been as much as 100% in some cases and averages about 50% to 60% over broadcast application. This increase in efficiency of water utilization means the difference between a satisfactory crop and a loser in many years.

Pasture Research. Aided by a federal grant of \$90,000, a new research facility for pasture work has been obtained. This pasture research center on 2,700 acres leased for 10 years in Faulk County will enable studies to be made which cannot be accomplished on any present experiment station or substation facilities in the State.

The project will study efficiency of beef cattle production with various methods of land and cattle management. Other studies will include pasture fertilization, weed control, renovation of native pasture, interseeding of grasses and pasture-type legumes. Obtaining satisfactory stands of new seedings; determining differences in capacities of various native and introduced grasses; hardiness, standability, or palatability of grasses—these are also examples of information sought.

To study the basic objective on efficiency of beef cattle production, three major treatments have been installed. To evaluate these land management practices, a herd of 300 cows will be used. The cows and calves will be used to measure productivity of the various land treatments. The cow-calf operation, rather than steers or heifers, is expected to give a more correct measurement of the productive efficiency.

Silage and hay will be produced for the winter feed program. Small grains, corn and sorghum for grain will also be grown to determine relative economic value of these crops in comparison with pasture crops grown on the same type soils.

Researchers believe that information from the pasture center studies will apply to much of central South Dakota and perhaps some principles will apply in the far western part of the State.

Raw Subsoils. Through a grant by the South Dakota State Highway Department agronomists studied techniques in vegetating newly exposed subsoil materials on disturbed areas. The Highway Department was interested in developing information that would help contractors regrass grades and exposed banks.

Greenhouse and laboratory experiments were used to evaluate conditions of density and the air-water-solid relationships which need to be created in order to obtain vegetative cover. Also investigated were the fertility conditions of the soil which had to be modified to get stands of desirable plants on these exposed areas. The study resulted in conclusions which also can be of value in getting crop growth started on newly leveled areas for irrigation or on terraces. □

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- Weeds and Weed Control, Hatch 32.
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animal science

Carcass Variations. Apparently selection of beef breeding stock based on growth rate should result in improvement of gaining ability and also carcass desirability. The use of measurements, live animal estimates and muscling scores in predicting carcass merit indicate that live weight accounts for most of the variation in either edible portion (lean) or fat trim.

Rate of Gain Selection. Genetic correlations measure the extent to which genes affecting one trait also affect another trait. They are considerably more important to the breeder than visual relationships which are a combination of genetic and environmental effects related to the two traits. Estimates of these genetic correlations indicate that selection for rate of gain should substantially reduce pounds of carcass fat while at the same time improve marbling. They also show that selection against fat thickness not only would reduce pounds of fat in the carcass but would reduce marbling.

Beef Tenderness. Two factors were used in studies of beef quality: maturity (degree of bone and muscle development in the carcass which indicate age of the animal) and marbling (fat within the muscle). It was found that as maturity advanced and marbling decreased, steaks were less tender. Steaks from more youthful carcasses were also most flavorful. Steaks from "modest" marbled ribs were more tender, juicy and flavorful than those from "traces" marbled ribs. Aging of the carcass up to 15 days increased beef tenderness. The greatest increase in tenderness was between the 5- and 10-day periods. The "traces" marbling level increased in tenderness more than the "modest" marbling level.

Grub Control. Systemic insecticides were quite effective for grub control when used before November 1. Application of these insecticides in late December caused ill effects in some animals and also did not give a complete control of grub infestations. The importance of following the manufacturers instructions in using systemic insecticides cannot be overly emphasized. Split applications (applying a lesser concentration of insecticide at two different times) provided late season fly control, winter louse control and grub control at a minimum cost.

Alfalfa Haylage. Silage crops used for cattle feeding give a relatively high production value of pounds of beef per acre. Alfalfa haylage, a home grown protein source, was used to supplement corn

and forage sorghum silage rations. When alfalfa haylage was fed with corn silage, steers gained 2.23 pounds daily compared to 2.17 pounds when linseed oil meal was fed to balance the ration in protein content. However, with forage sorghum silage the alfalfa haylage did not produce as good results. Daily gains were 2.05 pounds when linseed oil meal was fed but only 1.76 pounds when alfalfa haylage was fed with the forage sorghum silage.

Corn Silage. Various levels of corn silage in finishing rations did not affect carcass grade when cattle were fed to about the same market weight. However, rate of gain decreased with increasing amounts of corn silage but the gains per acre increased. Gains per acre varied from about 725 pounds for a high grain ration to nearly 1,500 pounds for an all silage ration. "In-between" levels of corn silage did not offer the advantages of low or high levels. Alfalfa hay had a greater value in high corn silage rations when fed at 4 pounds daily with 1 pound of protein supplement than when fed at 8 pounds without a protein supplement.

Mineral Supplements. Only small amounts of dicalcium phosphate and limestone were consumed when offered free choice to calves on a wintering ration of prairie hay and protein supplement. Feeding about 2 ounces of salt in the protein supplement resulted in only a small reduction in consumption of free-choice salt. The failure of forced feeding of salt in excess of requirements to have much effect on free-choice consumption of salt would not indicate a close relationship between free-choice consumption and the requirements. This observation and the low consumption of dicalcium phosphate when the rations only slightly exceeded the recommended requirements for phosphorus may indicate that factors other than the mineral content of the ration have an important influence on consumption of mineral supplements.

Sheep Management. These studies have revealed: Early shearing increased clean wool yield about 6.5% over late shearing, however, it did not affect fertility or conception rate of ewes. Under good management little difference was noted in net profit from early or late lambing. Early lambs gained faster thus reaching market weight at an earlier age and sold on a higher market. However, higher feed and labor costs offset the increased selling price.

Sheep Breeding. The usefulness of selection coupled with crossbreeding (as a means of introducing new genes) to change a population has been shown in a longtime sheep breeding experiment. Original Siberian fat-rumped, tailless rams were crossed with ewes of mutton breeding. Selection was made within the closed crossbred foundation to increase the in-

cidence of taillessness and to hold genes for improved mutton, wool and lamb production. Taillessness proved to be a multiple factor trait genetically so that it did not become fixed in the flock. In recent years, about 40% of the lambs were tailless at birth, another 20% had tails of an inch or less and the remaining 40% had tails ranging up to 6 inches in length. Ewes of recognized breeds would require four successive backcrosses to tailless rams to produce a lamb crop with important numbers of tailless or short-tailed lambs.

Supplements for Ewes. The effect of nutrition on lamb production was shown when ewes were fed a pelleted ration of $\frac{2}{3}$ prairie hay and $\frac{1}{3}$ barley after lambing. Four hundred ewes were grazed as a band during the winter and fed $\frac{2}{3}$ pounds per head every other day of a supplement containing 20% protein until 6 weeks before the estimated average lambing date (March 1). From this date until she lambbed, each ewe was fed $\frac{2}{3}$ pounds of the supplement daily. After lambing, half of the ewes were self-fed the pelleted prairie hay-barley ration until May 7. The other ewes were fed prairie hay while they were in the lambing sheds but none on the range after April 15. Death loss of both singles and twins was substantially reduced by the self-fed ration. Weaning weights were increased and salable lamb production was increased 17.2 pounds per ewe fed.

Forage Quality. Quality of forage appeared to be important in lamb rations where comparisons were made between the method of feeding the forage and the level of grain in the rations. Lambs fed alfalfa-brome-corn rations gained faster when the rations were pelleted than when the roughage was fed as hay or haylage.

Sheep, Swine Breeding. Factors affecting female reproduction of both sheep and swine have been studied. To study effects of temporary nutritional stress on fertility in swine, gilts were mated and removed from feed for periods up to 72 hours. Fertility was evaluated from slaughter data obtained 25 to 33 days after mating. Short periods of fasting were shown to have no detrimental effect on embryonic survival.

One hundred thirty-six ewes were used to evaluate the effect of various PMS (pregnant mare serum) treatments on the induction of estrus and fertility in anestrus ewes. Estrous response was quite poor except in the group receiving supplemental estrogen following PMS. A definite age difference in occurrence of estrus and fertility was indicated. Best over-all response was obtained from yearling ewes with 69% in heat and 50% conceiving.

Fortified Drinking Water. A new method of adding vitamins, antibiotics and amino acids to

swine rations is the objective of an experiment in which these micro-ingredients are added to the drinking water. Pigs weaned at 2 weeks of age and given vitamins or an antibiotic in their drinking water gained about 3 pounds more over a 4-week experimental period than pigs fed the same feed without additives in the drinking water. However, the fortified water did not improve nursing pigs or growing-finishing pigs. In another swine trial, pigs limited to 72% of a full feed gained 21% slower thus requiring 2 weeks longer to reach market weight. The limited fed pigs were more efficient, however, requiring about 7% less feed per pound of gain.

Nitrate Levels. It has been reported that relatively low levels of nitrate in drinking water will cause adverse effects on the health of swine. In order to obtain more information on this problem, two trials were conducted. A level of sodium nitrite equivalent to 100 parts per million (p.p.m.) of nitrate nitrogen did not adversely affect growth rate, feed efficiency, water consumption or liver vitamin A content of pigs. A level of sodium nitrate equivalent to 300 p.p.m. of nitrate nitrogen did not adversely affect growing gilts or their subsequent reproductive performance. No evidence was obtained to indicate that these levels were harmful under the experimental conditions. □

RESEARCH PROJECTS IN PROGRESS

Inbreeding, Linecrossing and Selection Within the Hampshire, Duroc and Yorkshire Breeds, Hatch 124.
The Improvement of Beef Cattle Through Breeding (NC-1), Hatch 167.
Corn and Sorghum Harvesting and Storage, Hatch 324.
Protein and Energy Requirements of Beef Cattle, Hatch 325.
Reproductive Phenomena in Female Domestic Animals, Hatch 355.
The Carbohydrate Composition and in vitro Digestibility of Prairie Grasses at Various Growth Stages, as Determined by Leaf Number, Plant Height and Cutting Date (NC-63), Hatch 380.
Improvement of Reproductive Performance in Beef Cattle, Hatch 384.
The Influence of Carcass Maturity and Marbling on the Physical and Chemical Characteristics of Beef (NC-58), Hatch 388.
Pork Carcass Quantity and Quality Evaluation, Hatch 419.
Nutritional Requirements of Sows During Gestation and of Sows and Pigs During Lactation, State 212R.
Summer Grazing of Beef Cows for Calf Production, State 216.
Mineral Requirements and Mineral Supplements for Cattle and Sheep, State 218.
Protein and Amino Acid Studies with Swine, State 251R.
Supplementation of Cereal Grains for Swine, State 268.
Range Management and Range Nutrition Studies with Sheep, State 421.
Investigations to Develop a Systemic Chemotherapeutic Method of Controlling Cattle Grubs, State 244.
Characteristics of Diet and Rumen Microbial Activity, Hatch 441.
Effects of Nutrition and Method of Feeding on Beef Cattle Performance, State 392.

bacteriology

Waste Disposal. Out of 33 manure lagoons used by livestock and poultry producers in South Dakota 11 have been investigated intensively to gain specific information relating to this system of waste disposal. These manure lagoons have been constructed to receive the wastes of swine, poultry and in two instances the wash water from a dairy milking parlor has been added to some animal excretory materials. These lagoons were constructed to reduce cost of livestock operations by providing an immediate disposal of animal excreta. This aim appears to have been achieved.

Examination of the lagoons provide the following information: (1) most of them serve swine producers in northeastern South Dakota; (2) a single lagoon may serve from 16 to 2,000 head of hogs; (3) the volume of the lagoons varies from 8,000 to 136,000 cubic feet; (4) they have been in operation from 1 to 4 years; (5) without exception they are anaerobic; and (6) the biochemical demand (BOD) under the best condition has never been below 600 mg/liter or 600 p.p.m. of oxygen. Raw untreated sewage from an American city varies from BOD of 160 to 250.

The manure lagoons in South Dakota do not provide reduction of the organic matter sufficiently to permit calling them anything other than storage pits for manure. In most instances the storage of the manure in water results in less loss of fertilizer value (nitrogen) than occurs in the older method of piling manure.

There is no biochemical evidence to indicate that the manure in these anaerobic pits will be reduced by microbial action to a sufficiently low level of organic matter so it could be introduced into natural waters (streams and lakes) without causing pollution. There is reason to believe that seepage from the manure lagoon can cause serious ground water pollution. Where seepage occurs the manure lagoons should be constructed of concrete. The liquid handling of manure has the advantage of providing storage until it can be spread on the land at the most opportune time. Tank trucks and pumps are available for handling liquid manure.

Considering the current emphasis on prevention of water contamination, if it becomes necessary to

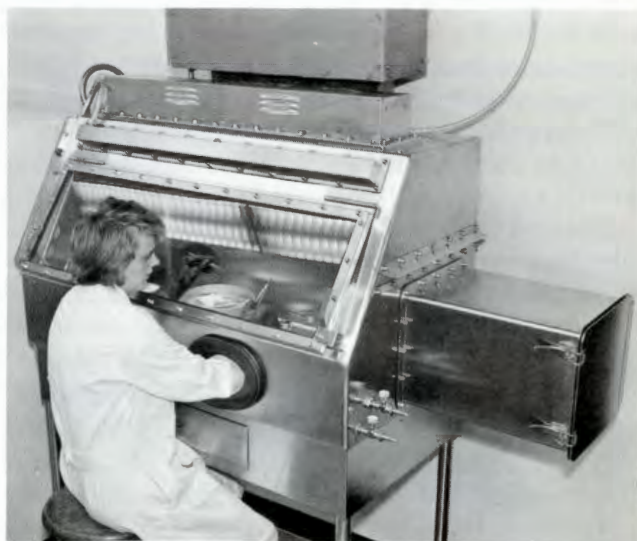
process excretory wastes of animals by the same methods as used for domestic sewage the magnitude of the problem would be tremendous.

For example: One beef animal in a feed lot produces organic waste (excreta) equivalent to that of 20 men. A 40,000-animal feed lot would have a waste disposal problem of a city of 800,000 people, about the size of Milwaukee. Hogs have an organic waste equivalent of 2.5 men. Two thousand hogs would produce a disposal problem equivalent to that of a city of 5,000 inhabitants. Five laying hens produce an organic waste equivalent of 1 man. A poultry operation of 30,000 laying hens would have a waste disposal equivalent to a city of 6,000 people.

For economic reasons large concentrated units are necessary to meet competition in the production of livestock. The problem of waste disposal is one that must be solved to prevent the pollution of natural waters by these industries. South Dakota climate is such that the outdoor manure lagoon cannot be a satisfactory stabilization unit. Research is aimed at determining the conditions necessary for complete mineralization of the animal wastes; and to investigate handling—utilization of manure solids and bedding that cannot be placed in a manure lagoon.

The problem of water pollution is largely the result of man's inability to properly care for the waste products of his activities. One troublesome example of this problem is whey resulting from manufacture of cheddar cheese. Research in the bacteriology laboratory has shown that with proper conditions whey can be used as a nutrient base for the bacterium *Lactobacillus shermanii* to produce commercial vol-

An isolator lab for transferring viruses without endangering the technician.



ume yields of the valuable vitamin B₁₂. This vitamin as an additive to livestock rations can serve two important functions: (1) eliminate a troublesome waste product, and (2) provide an extremely valuable product for use in animal nutrition.

Nitrogen Fixation. Attempts are being made to determine the chemical process or pathway by which certain soil bacteria utilize atmospheric or gaseous nitrogen. It appears that the process is inducible, that is the bacteria must become adapted to using the elemental form after they have been growing on ammonium or protein nitrogen. In this adaptive development the bacteria must manufacture some "new" enzyme molecule to help them use nitrogen gas. The synthesis of these protein enzymes is stimulated by several amino acids in small quantities in the growth medium. It is very possible that the root secretions of plants might supply these amino acids. A study of nitrogen fixing bacteria in the rhizosphere or root zone is being started to determine if this is true.

Soil Bacteria. Continuous cropping removes elements from the soil. One of the first elements depleted in this manner is nitrogen. Unless the nitrogen is returned to the soil, plant growth is soon limited and the soil becomes "worn-out." In modern methods of farming, nitrogen is returned to the soil by applying fertilizers.

Chemical analysis of the soil and crops shows that the amount of nitrogen removed from soil in the form of crop proteins is often more than the amount lost by the soil during cropping. This reserve supply of nitrogen is from the air which is taken into the soil by certain bacteria by an important process called "nitrogen fixation."

Presence of nitrogen fixing bacteria in the soil has been known since the 1890's. Much has been learned since about nitrogen fixation with bacteria grown in the laboratory. But as yet little is known about the process of soil enrichment by bacteria or even which groups of bacteria are most important in the process.

South Dakota soils and surface waters are being surveyed in an effort to learn more about these bacteria. Most soil types and most counties in the State have been sampled over the past 4 years and nitrogen-fixing bacteria have been found in about half of the samples taken.

Future work will try to answer these questions about nitrogen-fixing bacteria in South Dakota: Why are the bacteria not in all soils? What effect does the application of pesticides have on their pre-



Inoculation of whey culture in the production of Vitamin B₁₂.

sence and their effectiveness? How significant are these organisms in maintaining soil nitrogen levels?

Deer Virus Disease. Outbreaks of epizootic hemorrhagic virus disease of deer have occurred in South Dakota in alternate years (1952, 1954, 1956, 1958, 1960, 1962) primarily in white-tailed deer but at times in mule deer and antelope. The disease generally occurs in the summer-early fall period, and has a high mortality rate. In experimental animals up to 80% of the cases resulted in death after an incubation period of about 7 to 13 days. Prior to death the animal is generally in shock, unable or too weak to walk or stand and may have bloody stools. At post-mortem, excessive hemorrhagic conditions may be observed in the intestines, lungs, liver, kidney, epiglottis and trachea. The animal may have a "blue" tongue at time of death.

The disease has been reported in 10 South Dakota counties since 1952. Thus far there has been no confirmed report of the deer disease in the Black Hills. However, deer from the Black Hills are highly susceptible to it and are routinely used in experiments. Investigations continue to determine if the disease occurs in any other counties of the state.

In North America the disease has been reported as far north as Alberta, Canada and as far south as Florida. A South Dakota strain has been isolated from the spleen of an infected deer. Deer inoculated with this virus showed excessive bleeding in the intestines and passed bloody urine.

A motion picture film has been produced on this deer disease showing the entire process of infection

until death, as well as gross and histopathological changes in all major affected organs. Viewers of this film will be able to more readily recognize the clinical signs of infection and to report cases to the SDSU laboratory. The major objectives of the research on the deer disease are to determine:

- (1) How the virus spreads from deer to deer.
- (2) Whether there is another alternate animal host in which this virus survives.
- (3) How to prevent the disease.
- (4) How to diagnose the disease by a simple laboratory test.
- (5) The biological characteristics of the virus.

EHD virus strains isolated from New Jersey, Michigan, North Dakota and Alberta outbreaks have been obtained for laboratory studies. These virus strains along with South Dakota strains have now been grown in mice and deer. The deer virus properties (size and shape) are currently under investigation. Comparative studies of this virus with other

known viruses of human and animal types will be undertaken.

Preliminary experiments show that this disease is not simply transmitted by direct contact or aerial transmission. The probability of insect transmission is suspected and will be investigated. This research is conducted in cooperation with the South Dakota Department of Game, Fish, and Parks, the Wildlife Department and the Department of Veterinary Science.

RESEARCH PROJECTS IN PROGRESS

The Significance of Non-symbiotic Nitrogen-fixing Bacteria in Soil, Hatch 428.

Farm Animal Waste Disposal, Hatch 411.

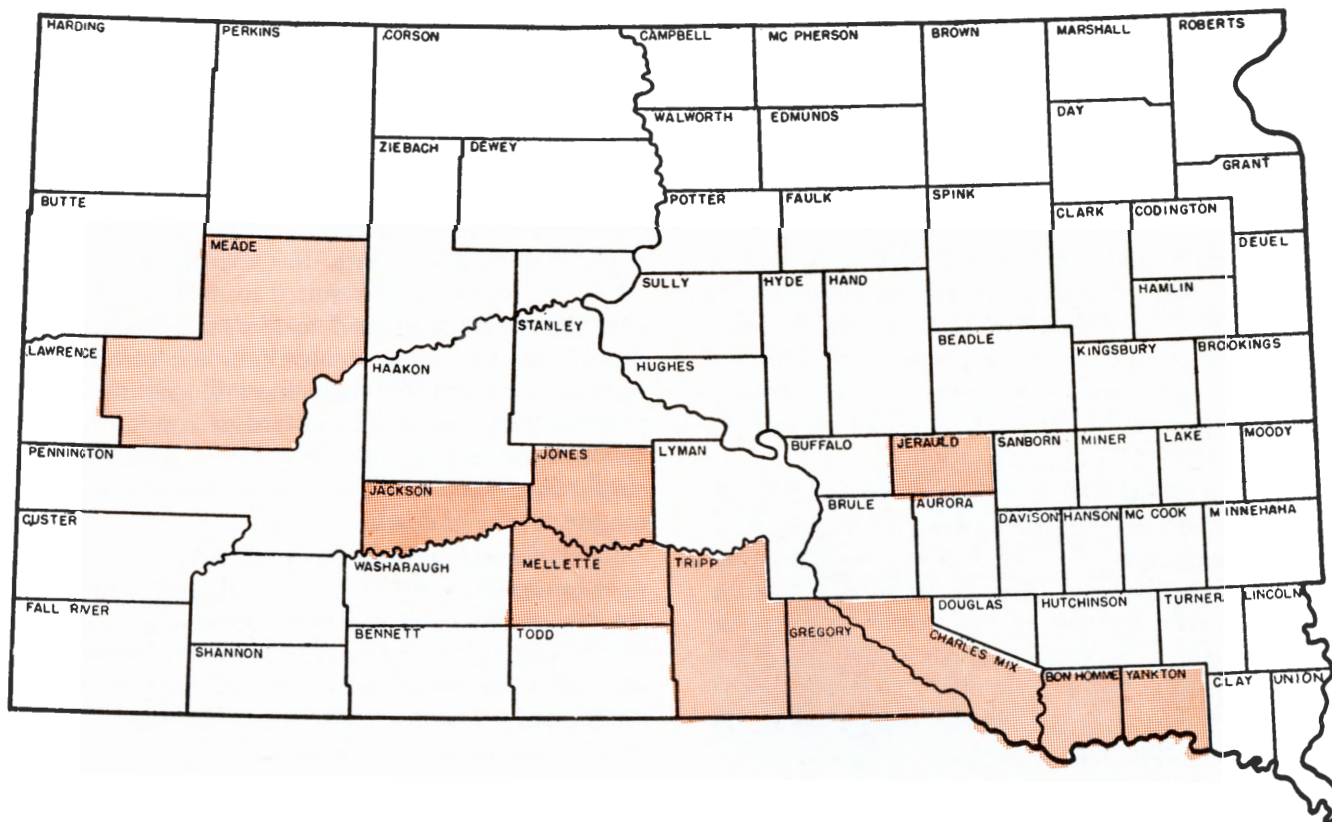
Mechanism of Nitrogen Fixation, State 376.

To Study the Epizootic Hemorrhagic Disease of the White-Tailed Deer, State 412.

Market Quality of Convenience Foods as Related to Bacterial Content, Hatch 445.

Identification of Actinomyces sp. from Normal and Infected Cattle, Hatch 436.

South Dakota counties which have reported outbreaks of epidemic hemorrhagic fever in deer since 1952.



botany

Tissue cultures of somatic (body) cells of carrot have resulted in the formation of new plants by two methods. The first method is the formation of callus on tissue from leaf, root, petiole or other tissue that contains parenchyma cells. This cancerous-like (callus) growth continues almost indefinitely if continuously supplied with an energy source and hormone (1 to 2 p.p.m. of the weedkiller 2,4-D). If removed to lower level of hormone (2,4-D at 0.1 p.p.m. or less) adventitious root formation takes place. (An adventitious root is one which arises from any point of the stem not the normal point of origin for roots). This tissue is then placed on fresh medium at a still lower level of hormone and the roots elongate and adventitious shoots develop.

The second method is the induction of a callus as in the first method. After the callus has been formed it is placed on a liquid medium and then on an agitator. This process produces large quantities of single cells. Somewhere during this process there is a transformation of the specialized somatic cells to cells possessing embryonic characteristics. Some of these embryonic-like cells behave like zygotes (or a fertilized egg) and begin to recapitulate the embryonic sequence of events leading to a mature embryo. These embryos usually grow associated with a

Formation of adventitious roots and shoots from sorghum (var. Norghum) callus tissue.



Formation of carrot plants from adventitious embryos which developed on callus tissue derived from the leaf of the cultivated carrot. (The callus originally came from a single carrot cell.)

mass of unorganized tissue and embryo development occurs in numerous places over the surface of the tissue. These embryos can now be isolated and placed on fresh nutrient media lacking hormone or they can be directly planted into sterile media and fed a balanced mineral solution. The result in both cases is the formation of a full grown plant. Thus, in the second method is the formation of an entirely new plant from a single cell. Since this new plant has bypassed the usual sexual mechanisms, from all indications it possesses the identical genetic capabilities of its single original parent.

After successful completion of the study with carrots, attempts have been made to culture tomato, cucumber, radish, and sorghum. Single cell cultures have been produced in most cases but as yet no new plants. As is characteristic with biological material, each other species behaves somewhat differently than did the carrot. Therefore, each new problem must be solved before continuation. Sorghum offers an interesting challenge since no really successful culture of this type of higher plant (a monocot) has been achieved. Encouraging results in this area have produced sorghum callus with adventitious roots and buds. However, single cells have not been produced and it is not known if the callus tissue can be maintained through several transfers.

This basic research already poses possibilities of several practical applications. One would fill this need of agronomists and plant breeders: a "bank" of plant material or cells which have the same characteristics for generation after generation. □

RESEARCH PROJECT IN PROGRESS

Study of Somatic Cells of Higher Plants by Means of Tissue Culture Techniques, State 426.

dairy science

Inbreeding. Two inbred lines of Holsteins have been developed by sire-daughter and other close matings. A comparative outbred group was developed by random mating to highly proven bulls in artificial insemination studs. Analysis of production records indicates that the outbreds averaged 3,161 pounds milk more per lactation than the cows 25% or more inbred. The line females less than 5% inbred produced 2,646 pounds more than the 25% or more inbreds. In other words, production was reduced about 19% to 21% by sire-daughter inbred matings. Crosslines produced by matings of the two inbred lines has resulted in vigorous calves which show slightly greater weight gain rates than either the outbreds or the original lines. The crossline phase of this project will be continued to determine milk producing ability of these animals.

Forages. Conventionally in South Dakota, corn silage is made in early fall, often just before, or just after the first frost. Currently, some interest is being shown in the relative feeding value of early and later cut corn silage. Corn was cut for silage in early September in early milk stage of maturity and compared with more mature silage made in November. Also, medium dent stage corn silage was made in early October and compared with the late-cut silage for dairy cows.

Dry matter equivalent consumed by the cows from the most immature corn silage was somewhat lower than from silage cut at medium dent stage and later. The cows on the most immature silage declined more rapidly in milk production than those on later-cut silage. Dry matter consumption was also higher by cows on the more mature silages. The most mature silage appeared more satisfactory when ground with a large hammer mill before ensiling.

Field loss estimates of the late-cut corn silage indicated some ear loss through normally-dropped ears. However, the chopping loss was negligible. Most of the field loss was in leaves previous to chopping.

The energy furnished by the medium dent and most mature silages, based on calorimetry tests and feeding trials, appeared to be quite close, and both more mature silages appeared higher in feeding value for milk production than the immature milk-stage

corn silage. More research is planned concerning estimates of feeding value of medium dent stage and more mature late-cut silage. An advantage of late cutting is that silage can be fed during the fall and silos can be refilled later, thus reducing length of winter-storage feeding period. It is essential that the late-cut silage be chopped or ground finely enough to crack corn kernels and to reduce the cob and stalk size. In this way the silage will be readily consumed and digestibility will be improved.

Bloat Studies. Radio telemetry instruments and techniques have been developed for use in the collection of data on rate of heart beat, body temperatures and intraruminal pressures of unrestrained cattle. Temperature sensitive transmitters surgically implanted in different areas of the body were used to indicate rates of temperature change in these areas when the animal drank cold water or milk. Likewise, the time required for the temperature to return to normal was recorded.

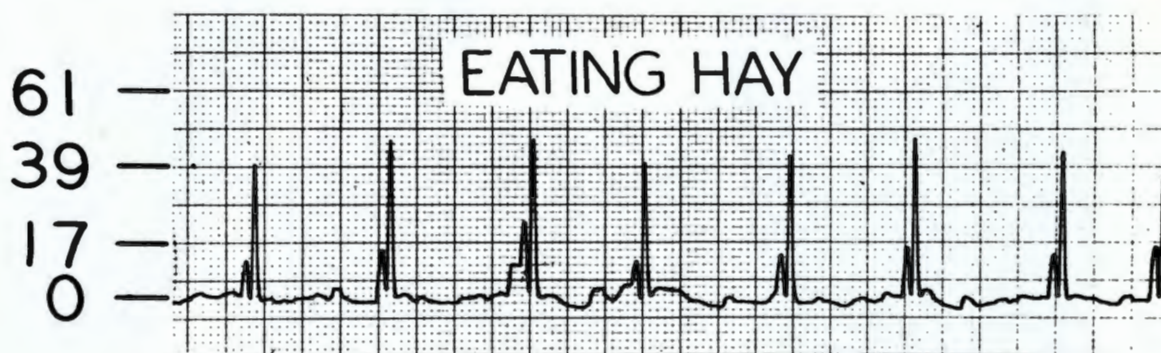
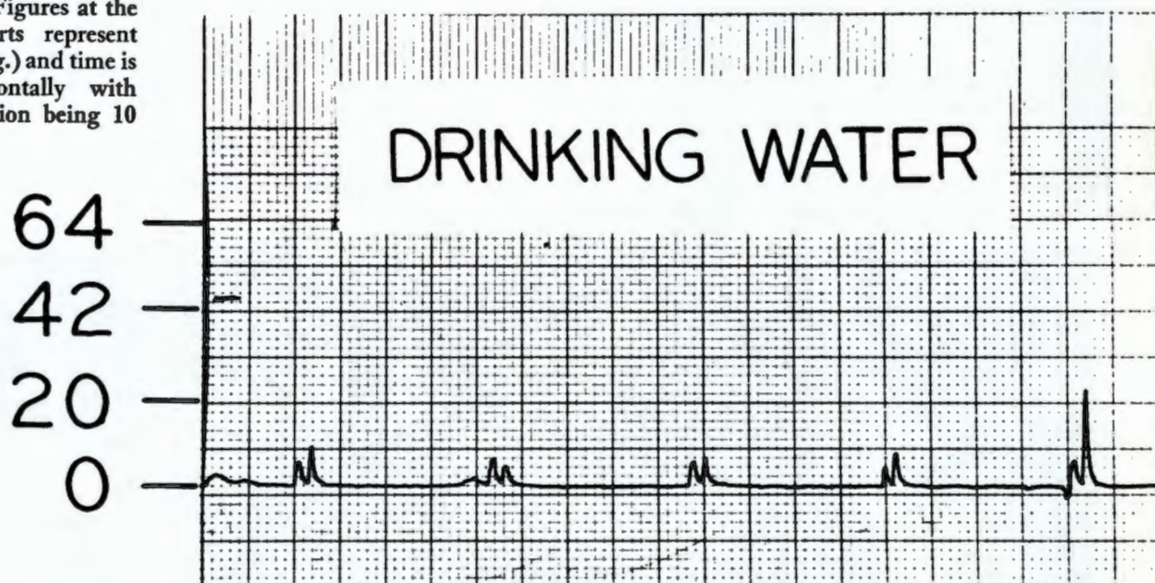
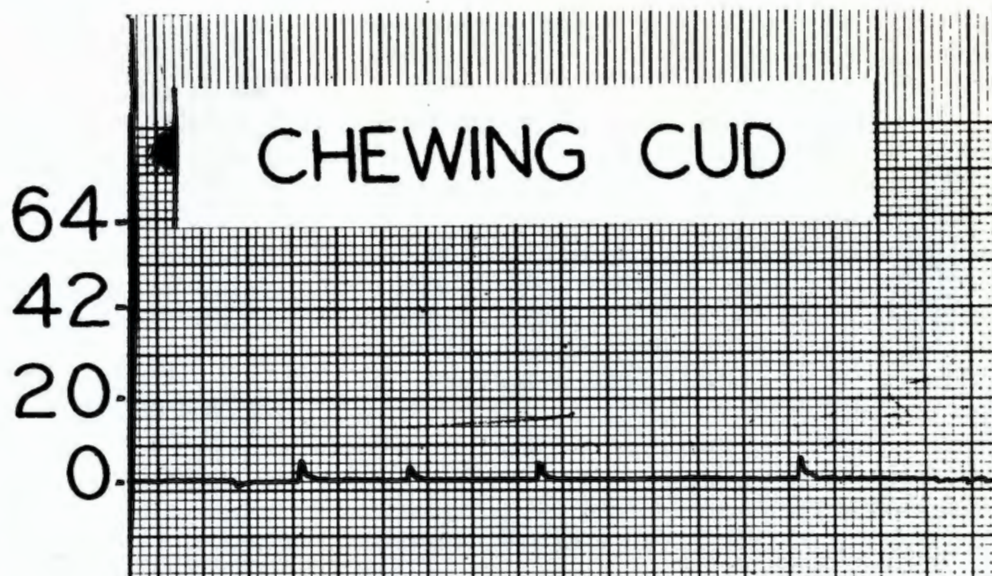
In a similar manner recordings were made of ruminal pressure and contractions by placing a pressure sensitive transmitter in the rumen via the esophagus, without surgery. These recordings were made while the cow was grazing in a pasture a few hundred feet from where the receiving and recording instruments were located. With this kind of information available for normal eating and drinking, it would appear that this technique should be of value in the study of abnormal conditions such as bloat.

Cheese Making. The manufacture of cheese requires formation of a curd from milk followed by separation of whey from the curd (syneresis). The forces responsible for this syneresis are not well understood. A better understanding of these forces should be useful in control of the cheesemaking operation and should facilitate design of equipment for mechanization of cheesemaking.

Studies thus far indicate separation of whey from the curd results from collapse or contraction of the sponge-like structure of the curd. This collapse or contraction of the structure is opposed by materials which give the structure rigidity. When calcium, which is necessary to form the curd, was removed from the curd by various means the result was a greater separation of whey from curd.

Manufacture of cheese from concentrated milks has been shown to be feasible. The advantages of such a procedure are a greater yield of cheese from a vat of milk and higher percentage of solids in the whey than from conventional milk. The question

These are readings of activities in the rumen of a cow made by radio telemetry. From top to bottom the charts show rumen activity (pressure-contraction) while the cow is chewing cud, drinking water, and eating hay. Figures at the left of the charts represent pressure (mm. Hg.) and time is measured horizontally with each major division being 10 seconds.



as to whether these advantages would offset the cost of concentrating the milk has not been answered.

New Dairy Product. Continued research has produced encouraging results on a different type of dairy product. It is neither a cheese spread nor butter but has some characteristics of these products. It can be used as a spread and has excellent spreading qualities, even when taken directly from the family refrigerator. It does not separate and oil off or become too soft to spread when it has been out of the refrigerator for several hours. In addition to its use in the preparation of sandwiches and as a spread on various kinds of bread and toast there are many other desirable uses for this product.

It makes a convenient tasty topping for hot vegetables such as broccoli, cauliflower, peas and baked potatoes. When used on pancakes it resembles whipped butter in appearance in that it melts slowly and does not run off the cake. Its flavor also blends well with various syrup flavors. Preliminary experiments have indicated many possible uses in pastry products.

This new product, as yet unnamed, is made from cream, skim milk solids, whey solids and milk with

the addition of food colors, salt and stabilizer. Part of the milk used is cultured for added flavor and tartness. Although various combinations of these ingredients have been used, the composition that presently seems most desirable is approximately 40% fat, 11% lactose and 5% protein.

Experiments are in progress to test consumer acceptance of the product and preferences for intensity of color, firmness of body, sweetness or tartness and amount of salt.□

RESEARCH PROJECTS IN PROGRESS

- Growth Studies of Calves and Growing Heifers, State 153.
- Improvement of Dairy Cattle Through Breeding, Hatch 184-R.
- Effects of Preservation Methods on the Feeding Value of Alfalfa for Dairy Cattle, State 227.
- Consumer Preferences, Demand and Potential Supply for Butter of Various Flavors and Qualities, Hatch 272.
- Comparative Value Forages for Dairy Cattle, State 350.
- A Study of Some Physiological Phenomenon Associated with Bloat in Ruminants, State 351.
- State Wide Services—Dairy Products, State 405.
- A Study of Milk Gels as Related to Manufacture of Cheese, Hatch 414.
- Development and Evaluation of New Spread-Type Dairy Products Containing Approximately 40% Milk Fat, Hatch 442.

The new dairy product developed by the Agricultural Experiment Station has been served on several occasions—"taste panel tests"—in order to obtain comments on its acceptability.



economics

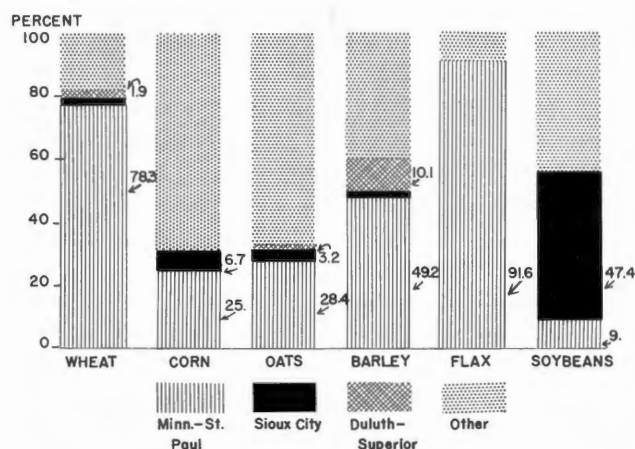
Adjusting to Changes. One aspect of a livestock marketing project explored how cow-calf operators in the U.S. adjust production to changes in prices, costs and improved technology. Conclusions from the study, using a mathematical supply model with four independent variables, were that cow-calf operators were slow to adjust production to changes in price of livestock, to changes in costs of production and to improved technology. Perhaps the important factor explaining the slow response was the 1½ to 4 year time lag required for making adjustments and the extreme uncertainty as to prices that far in the future.

Transport of Grains. The origin and destination of major grain shipments from South Dakota was the concern of a recently completed study. One conclusion was that railroad shipment has been the prevailing mode of transportation for all grains other than soybeans shipped by South Dakota elevators. Soybeans have been shipped most frequently by truck. Another conclusion was that the most common destination for wheat, oats, barley and flax was Minneapolis-St. Paul; and the most frequent for soybeans was Sioux City. Results of this study are being incorporated into a larger regional report on factors affecting the location of grain production and processing in the North Central region.

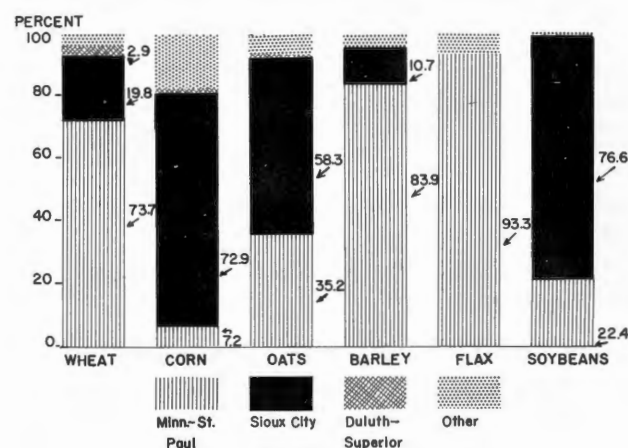
Dairy Plants. A dairy marketing study attempted to determine how much dairy plants in South Dakota could lower costs if their patrons reduced seasonal variation in milk production. Conclusions were that a constant supply of milk that allowed plants to operate throughout the year at peak capacity would lower plant costs and permit more efficient operation. However, there was a considerable range in possible savings by individual plants.

Economic Ethics. A pioneering study in economic ethics has resulted in guidelines for the study of ethics related to management decisions, agricultural program administration and agricultural policy. As a result of this study, the individual is helped in reviewing his own ethical perspective and in determining actions which are consistent with his beliefs.

Production Survey. Thirty-five representative farm situations were developed for the project on



Truck shipments (above) and rail shipments (below) of major South Dakota grain crops according to destination (for the year 1962).



livestock production potential and limitations in eastern South Dakota. These situations ranged from large to small, from dairy to hogs and beef cattle, and from livestock to cash crop. Soon these situations will be programmed on electronic data processing machines to determine most profitable organizations. Results then will be summarized and described for the use of farmers and ranchers in helping them improve the profitability of their operations.

Beef Production Efficiency. During the year the economics phase of an interdepartmental study of ways to increase the efficiency of beef cattle raising in South Dakota was started. The project concerns efficiency of beef cattle production in South Dakota with various methods of land use and cattle management, in cooperation with Agronomy and Animal Science.

One part of the economics phase is concerned with determining the resources, methods, and levels

of efficiency for raising beef cattle presently being used by farmers and ranchers in central South Dakota. Such information was obtained in June by personal interview of 160 farmers and ranchers in Faulk, Hyde, Aurora and Gregory counties. The next phase will be to use this information in working out representative farm and ranch situations that compare the profitability of present systems with experimental systems proved out at the pasture research center near Norbeck.

Water Resources. The project, Economic Appraisal of Proposed Oahe Water Development in North Central South Dakota, was closed out at the end of the fiscal year with five popular and technical publications about the results. A summary of findings was reported in the 1963-64 annual report. However, work on water resource development will continue under a Water Research Institute grant. The scope of this project will be much broader than the Oahe study, for it will be concerned with evaluating the potential contribution of water resource development in South Dakota to the economy of the State, the Missouri Basin region and the Nation. Specific studies of the Big Sioux river basin and the saline water conversion plant at Webster are in progress. These two studies are financed by three separate research grants. □

RESEARCH PROJECTS IN PROGRESS

Agricultural Economic Trends in South Dakota, Hatch 157.
Conflicts in Means and Ends in the Federal Commodity Price and Income Programs, Hatch 330.

Ethical Factors in Management Decisions: Ethical Dilemmas in the Day-to-Day Activities of Managing, Financing, and Operating Small Business Enterprises, State 356.
Changing Market Structure and Organization of Midwest Dairy Industry (NCM-38), Hatch 357.
Marketing Aspects of an Expanded Livestock Feeding Industry in South Dakota (NCM-36), Hatch 446.
Varying Degrees of Problem Recognition Among South Dakota Farm Operators and Their Implications for Agricultural Adjustment, Hatch 361.
The Effects of the Soil Bank and Other Land Retirement Programs on the Business Conditions of Small Towns in South Dakota, Hatch 362.
Adjusting the Arrangements for Owning, Transferring, and Leasing Agricultural Land in a Rapidly Changing Agriculture (NC-53), Hatch 371.
Livestock Production Potential and Limitations in Eastern South Dakota (NC-54), Hatch 393.
Facilitating the Marketing of Grain Sorghum Seeds Through Improved Handling Procedures (with Agronomy), Hatch 410.
Ring Analysis of South Dakota Tree Samples, State 413.
Pork Carcass Quantity and Quality (with Animal Science), Hatch 419.
The Efficiency of Beef Cattle Production in South Dakota with Various Methods of Land Use and Cattle Management (with Agronomy and Animal Science), Hatch 423.
Financial Management in South Dakota's Agricultural and Economic Development, Hatch 435.
The Potential for Cooperative Marketing of Livestock in South Dakota, Hatch 440.
Economics of Farming Adjustments on Wheat Farms in Central South Dakota (Economics Research Service USDA), FE 9-17.
Use and Development of the Agricultural Resources in the Area of the Belle Fourche Irrigation Project and the Associated Economy (Economics Research Service USDA), FE 9-8.



Water is a prime resource of South Dakota. The Experiment Station Economics Department is making an evaluation of the potential contribution of water resource development in South Dakota to the economy of the Missouri Basin region, the State, and the Nation.

entomology- zoology

Pesticide Residues. Tests conducted in Lawrence County for alfalfa weevil control showed small amounts of residues in the soil and first crop of alfalfa hay after heptachlor granules were applied to fields prior to growth in the spring. Utilizing the gas chromatography technique, residues in the hay of .0251 p.p.m. (parts per million) of heptachlor and .0257 p.p.m. of heptachlor epoxide were found in fields where $\frac{1}{4}$ pound of actual heptachlor in the 10% granule form had been applied. The same amount of actual heptachlor applied in the $2\frac{1}{2}\%$ granule form produced a slightly lower residue. In addition to the hay, fresh cut alfalfa and the top inch of soil also had small residues at first cutting time.

Tests with short residue insecticides for alfalfa weevil control were made at pre-growth, early bud, and post-hay removal times. No economical controls

developed from the pre-growth treatments. Ground applications at the early bud stage gave larval kills varying from 64% to 95%. Despite the relatively incomplete kills, most treatments reduced damage sufficiently to provide economic control. Aerial applications of $\frac{1}{4}$ pound of actual ethyl parathion in 2 gallons of water per acre gave 99.3% control at the least cost of all materials tested. Results of preliminary tests with low volume applications of insecticides at the early bud stage were unsatisfactory. Several of the insecticides applied to stubble following removal of the first crop of hay provided economic controls.

Beneficial Insects. Continued investigations with the alfalfa leaf cutter bee for alfalfa pollination have shown that this insect can also overwinter in eastern South Dakota if given the proper protection, such as that found in unheated buildings. For several years bees imported from Utah have been "planted" in various parts of South Dakota in efforts to get this beneficial insect established. Until this year they have overwintered only in some places in the western part of the State.

Mosquito Survey. The survey of mosquito species occurring in South Dakota has been completed. Of the 40 species identified, only four are sufficiently

Battery operated light trap as used in mosquito survey in Oakwood Lakes area in 1965.



abundant to be serious pests. These are *Aedes vexans*, the dark prairie mosquito; *Aedes nigromaculis*, the banded pasture mosquito; *Aedes dorsalis*, the brown pasture mosquito; and *Culex tarsalis*, the encephalitis mosquito.

Investigations for the development of mosquito control techniques for safe use in wildlife production and public recreation areas have been started. The Department of Entomology-Zoology is cooperating with the Department of Game, Fish and Parks in conducting mosquito control studies at Oakwood State Park.

Mite Survey. A survey—the first of its kind—for phytophagous (plant feeding) mites in South Dakota was completed. A publication showing the species, distribution, and plants attacked is in preparation. Direct feeding on crop plants by mites causes damage and in addition they transmit some serious plant virus diseases. Wheat streak mosaic is the only mite-vectored plant disease known in South Dakota.

Rootworm Control. Western and northern corn rootworm control was the number one insect problem in southeastern South Dakota last year and will probably continue to be for the next few years. So far the only effective control measure has been use of soil insecticides. Continued use of certain specific insecticides has contributed to increases in populations of a strain of western corn rootworm resistant to materials embodying chlorinated hydrocarbons such as aldrin or dieldrin. This is the reason the main area of work in the corn rootworm project has been screening of insecticides, particularly organophosphate and carbamate formulations, for use under South Dakota conditions which are different than those of any other state.

The sale of organo-phosphate insecticides for treatment of rootworm infested soil in South Dakota has jumped tremendously—from zero in 1963, to 45% of all material sold in 1964, to 70% of the total this year. This latter figure projected means that more than one million acres in South Dakota were treated with organo-phosphate insecticides in 1965.

Before any insecticide can be recommended for use in the state it must be tested under South Dakota conditions. Funds for the project of screening insecticides are derived from grants from companies which develop or manufacture insecticides for distribution in South Dakota. As a result of the insecticide screening completed last year, materials recommended for use in South Dakota in 1965 included stabilized ethyl parathion (Niran), thimet, and diazinon.

In addition to larval damage to root systems, adult rootworms can damage silks so that pollina-

tion does not take place. If control of rootworm adults became necessary to protect silks during the critical period, the materials recommended were malathion or carbaryl (Sevin). Besides traditional methods of applying insecticides for adult rootworm control, a new system is under test. It is called L-VC, or low-volume concentrate. In this case technically pure materials are applied in very low-volume by aircraft specially adapted for the purpose. A typical concentration of insecticide has been 4 to 6 ounces of malathion per acre. It may be difficult to visualize applying only a cup of material on an acre, but it has been done and proved effective.□

RESEARCH PROJECTS IN PROGRESS

Investigations of the Alfalfa Insect Situation in South Dakota, Hatch 288.

Investigations of the Spotted Alfalfa Aphid in South Dakota, Hatch 311.

The Character, Magnitude and Persistence of Insecticides Used in Alfalfa Insect Control in the Northern Great Plains, Hatch 374 (NC-33).

Study of Distribution of Mosquito Species in South Dakota with Special Reference to the Distribution, Ecology and Control of *Culex tarsalis* Coq., a Vector of Western Equine Encephalitis, Hatch 399.

A Study of the Distribution of Phytophagous Mites in South Dakota with Special Reference to Species of Agricultural Importance, State 433.

Investigations in the Ecology and Control of the Western and Northern Corn Rootworms in South Dakota, State 434.

Control or no control of the corn rootworm may mean the difference between a good crop or a crop not worth harvesting.



home economics

Blanket Qualities. Blanket research has been continued to study a new type of blanket of thermal cellular construction. Manufacturers claim these blankets without a top layer serve as a summer blanket, and with a top layer are warmer for winter. Preliminary studies have started on warmth and dimensional stability of all-cotton and all-wool thermal blankets. Loan exhibits to supplement published material about blankets have been prepared and are in use by home economists.

Fabric Stress. Textile workers have sought—so far unsuccessfully—a method of predicting how a fabric will perform during use. Tests under controlled laboratory conditions are being conducted in an effort to find means of making these predictions. Problems involved make this research too much for one laboratory to attempt. For this reason several laboratories in the North Central Region are working cooperatively on the project. Cotton fabrics made to specification are undergoing abrasion tests in the laboratory. Effects of abrasion will be assessed by measurements of weight, thickness and wrinkle recovery plus microscopic study of fiber and yarn degradation.

Water Problems. South Dakota and Minnesota water often contains such a high proportion of dissolved materials that it is excessively hard. It may also contain enough iron or other minerals to cause laundering problems. In a cooperative project, South Dakota and Minnesota Experiment Stations are making preliminary studies of the effects of laundering white nylon fabrics repeatedly in various types of water. Working through Extension Home Economic Agents in two counties women have been provided white nylon slips to wear and launder in “problem water.” The slips are returned periodically to the laboratory for visual inspection and analyses of changes which might occur in laundering. The garments have been inspected once and have been returned to the women for a second period of wear and laundering.

Laminated Fabrics. Foam-backed fabrics characteristic of those used in outer garments were evaluated to determine effects of laundering, dry cleaning and ease of stain removal. Knit and woven foam-backed fabrics satisfactorily withstood both dry cleaning and laundering. Fabrics dry cleaned in

synthetic solvent shrunk less than those cleaned in petroleum solvent. Linings in which foam was laminated to satin by an adhesive were completely separated from the satin faced fabric after dry cleaning. Home as well as professional methods satisfactorily removed stains with no adverse effects on the laminated fabrics. Catsup and mustard stains were not completely removed as evidenced by spots on the foam or tricot side.

Dietary Practices. Additional information about Indian dietary practices and nutritional status was sought in evaluating boarding school diets of Indian children of South Dakota. Together with observations on the growth and development of these children, the work revealed that diets of older groups, especially the 12-14 year-old girls were below recommended allowances in certain nutrients. Mean heights of these girls were below the norm, but weights were near average. Further investigation is needed since nutritional status is strongly modified by genetic as well as cultural factors.

Venison Flavor. What affects the flavor of venison more—is it what the deer eats, or the way the meat is handled and cooked? In cooperation with other departments (Wildlife, Animal Science) and the South Dakota Department of Game, Fish and Parks, the acceptability of various cuts from deer taken in several different feeding areas of the state was investigated. The taste panel preferred meat held in frozen storage 6 months. Surprisingly, the method of preparation or eating habits of the deer didn't show big differences in the ratings.

Amino Acids. A quantitative study was completed of the human requirement for the essential amino acid, phenylalanine, when various levels of its relative, tyrosine, were substituted into the controlled diets of 22 young adults. Tyrosine, at relatively low levels, showed a phenylalanine replacement value of 35% to 40% for women and about 50% for men. With this low level of tyrosine, the subjects maintained a nitrogen balance on a limiting amount of phenylalanine much better than had been anticipated. □

RESEARCH PROJECTS IN PROGRESS

- Blanket Qualities, Hatch 319.
- Evaluation of Certain Properties of Soft Floor Coverings, Hatch 337.
- Problems in Maintenance of Laminated Textile Products, Hatch 385.
- Fatty Acid Content of Raw and Cooked Beef, Pork and Lamb, Hatch 396.
- Determination of the Mechanisms of Fabric Stress Absorption and Performance, (NC-68).
- Care, Preparation and Cooking of South Dakota Wild Game, State 368.
- Fabrics and Water Problems, State 429.

horticulture

Establishing Shelterbelts. A critical factor in establishment of trees in the Missouri River reservoir area is moisture. The usual method to create more favorable moisture conditions for tree planting is summer fallowing. However, fallowing is not feasible because of steep banks and the large area involved. To simulate a fallow operation, chemical plots were established to kill all vegetation in narrow strips preparatory to planting in 1966. A combination of simazine and dalapon was used. It was necessary to apply dalapon twice to eliminate both warm and cool season grasses. Neutron probe tubes were installed for moisture determinations. The 1965 furrow plantings were given the same combination of chemical treatments to control competing vegetation. Plots were established in shelterbelt-type plantings (1965) for tree irrigation, with and without fertilization.

New Tomato. Extensive testing of a selected standard variety type of tomato indicates it is superior in producing large, meaty, high quality tomatoes that tend to be crack resistant. Release of this selection, that is especially well-adapted to South Dakota, is pending.

Potato Fertilizer. Application of 16-32-8 fertilizer at the rate of 200 pounds per acre 2-3 inches under the potato tuber produced higher yields when compared with the standard methods of broadcast, band application and side dressing.

Test Juice Grape. One of several first generation hybrid grape selections produced a highly flavored, deep red juice. This selection has potential as a juice grape and will be tested further.

New Apple Selections. Several apple selections were made from trees bearing fruit for the first time. Progenies of Minjon x Jonsib and Haralson x Jonathan were outstanding in producing superior seedlings. The Minjon x Cortland progeny was also good. One selection of Haralson x Jonathan shows especially good potential as a long-keeping apple of excellent quality. However, seedling apples must be observed for several years, because fruit produced in the early bearing years frequently is not typical of fruit produced later.

Move Ornamental Plots. The ornamental plots, including annual and perennial flowers, woody ornamentals and turf plots, were moved to a new location north of Highway 14 at the east edge of Brookings. A new basic irrigation system was installed and a garden shed constructed. The first trees and shrubs were planted during April 1965 but development of the area will not be complete for several seasons. The area will serve as a vital outdoor laboratory in studying cultural practices, and in testing and demonstrating the proper use of ornamentals. □

RESEARCH PROJECTS IN PROGRESS

Production and Breeding of Early, Drought and Disease Resistant, High Quality Tomatoes for Home Use, Hatch 49.

Selection of Adapted Species and Strains of Trees and Shrubs for South Dakota Farms, Hatch 142.

The Collecting, Preserving, Cataloging, Propagating and Testing of Fruit Plants Having Potential Genetic Value, Hatch 174.

The Effect of Spacing on the Survival, Growth and Effectiveness of Windbreaks and Shelterbelts in South Dakota, Hatch 239.

Breeding Small Fruits for South Dakota, Hatch 252.

Breeding Improved Varieties of Tree Fruits for South Dakota, Hatch 354.

The Establishment of Tree Plantings to Enhance the Recreation Potential of Selected Sites on Missouri River Reservoirs in South Dakota, McIntire-Stennis 420.

Modification of Wind and Temperature to Improve Vegetable Yields and Quality, Hatch 118.

Growth and Yield of Strawberries and Raspberries as Influenced by Cultural Treatment, State 145.

Vegetative Propagation of Hardy Ornamental Plants, State 258.



A new high quality tomato variety, expected to be released soon by the Experiment Station, is meatier than most varieties commonly grown in South Dakota (compare the two new tomatoes at right with those at left) and tends to be crack resistant.

plant pathology

Chemical Rust Control. Chemical rust control experiments near Presho and Hayes indicated that yield losses to winter wheat in 1965 amounted to an estimated 20 bu/A. Two applications of several fungicides (Manzate D, Dithane S-31, or Zineb) resulted in profitable rust control (yield increase of 8 bu/A or more) when applied at early heading and again 10 days later. Of these chemicals, Manzate D (or Dithane M-22 Special) was most promising on the basis of chemical cost and degree of rust control. At present, however, Zineb is the only chemical with Food and Drug Administration approval for use in controlling wheat rust.

Wheat Streak Mosaic. Proper choice of planting date provided effective control of wheat streak mosaic at the South Central Research Farm near Presho. Low mosaic levels and highest yields were obtained when wheat was planted between September 4 and September 24. This marks the seventh consecutive year that planting date has controlled wheat streak mosaic at the Farm. The recommended date to plant winter wheat to control mosaic is September 10.

Wheat Curl Mite. Experiments on spread of wheat streak mosaic virus by the wheat curl mite indicate that virus-free mites feeding on diseased wheat plants can pick up the virus in about 3-4 hours and are able to carry the virus for several weeks in their bodies. Virus-carrying mites feeding on healthy plants can infect these plants during short feeding periods of 1-2 hours. Electronmicroscopy revealed presence of the virus in the body of two non-transmitting mites which are frequently found on wheat or grasses. It appears that circulation or multiplication of the virus is blocked within the body of these mite species. Detailed studies were also made of the feeding behavior of the mite on winter wheat.

Field studies provided additional evidence to show that air-borne mites are the primary source of mosaic spread in winter wheat following fall planting. Plots of winter wheat planted adjacent to virus-infected spring wheat had the same amount of infection as wheat planted adjacent to virus- and mite-free oats. All native grasses were found to be resistant either to the virus or the mite vector. Thus, the

native grasses seem to be of little importance in the spread of wheat streak mosaic in the field. Furthermore, mites found feeding on native grasses did not adapt to living conditions on winter wheat.

Soil-borne Diseases. The conditions in soil needed for root infections of cereals by soil-borne micro-organisms and the ways that micro-organisms survive and become active in soil is under investigation. One of these, which causes the "take-all" disease of wheat, was found only in soil in infected plant debris (roots and stems of plants previously infected by this pathogen), not in soil devoid of such debris. The form of its presence there was not determined, but it is assumed to have been wholly mycelial. Wheat roots became infected only when they came in physical contact with the debris. The situation with other micro-organisms has not been determined, but it is expected to be different depending on the species. They form different kinds of reproductive structures in the roots they infect; but which ones of these survive best and are the source of new growth to infect a host is not known. A difference in growth requirement exists between species of these pathogens, however, as some are readily isolated from soil and grow from one plant debris to another while others can be isolated only from susceptible living hosts. Of interest in regard to spread of these micro-organisms in soil is that one of them releases abundant motile zoospores from infected roots of living plants.

Fungus Diseases in Sorghum. Weekly determinations of sugar content and pith density of sorghum stalks showed a slight but gradual increase from mid-August to late September. Leaf and root pruning failed to significantly alter the values for sugar content, pith density or stalk rot development. No correlation could be established between these values and stalk rot severity.

The distribution of the stalk rot fungus in inoculated stalks was determined by examining very thin stalk sections and by isolation of the causal organism. The stalk-rotting fungus spores moved quickly through the water-conducting vessels within the plant. After 24 hours, spores could be found in some vessels in the joint region immediately above and below the inoculated point. Spores were found in the adjoining internodes after 48 hours. Ten days later the spores were present in some vessels of all internodes of the plant. Within the vessels the fungus made only slight growth, but the number increased greatly as the fungus reproduced within the plant. There was no spread from the vessels to the pith during the time of observation. The fungus

attacked and grew in injured pith cells in the region of the inoculation puncture. Systematic isolation from inoculated stalks showed a similar distribution of the fungus.

The source and pathway of natural infection could not be established. No stalk infection occurred from artificially inoculated roots or from spores deposited beneath the leaf sheath.

Nematode Diseases. Soil samples from various localities have shown that at least 20 genera and 48 species of plant-parasitic or potential plant parasitic nematodes occur in South Dakota soils. Most prevalent and damaging of these is the American dagger nematode (*Xiphinema americanum*) which occurs in all soils except those in some areas of the Black Hills. Although all types of plants are susceptible to attack, woody perennials are most severely damaged. It is becoming apparent that the dagger nematode may be one of the major factors in early decline and failure of windbreak tree plantings. Lesion nematodes (*Pratylenchus* spp.) have been found severely damaging tomato and chrysanthemum in the southeastern part of the state. They also commonly attack field corn but apparently without visible injury. The root-knot nematode (*Meloidogyne hapla*) is a factor in reduced growth and winterkill of strawberries in some areas. While their role as plant pathogens is not fully understood, the stunt nematodes (*Tylenchorhynchus* spp.) and spiral nematodes (*Helicotylenchus* spp.) occur generally in South Dakota soils and are always associated with such problems as decline and summer dormancy of turf and range grasses. The stunt nematode frequently heavily parasitizes field corn and soybeans. The heavy silt loam and clay soils of South Dakota make it difficult to use chemicals for control of nematode pathogens on most crops. With continued research, however, the scattered areas of lighter, sandier soils should prove to lend themselves to use of fumigants on high cash value crops.

Fungicide Controls of Diseases. Leaf spot, one of the major factors in the recent termination of the sugar beet industry in South Dakota, shows promise of control with the proper use of effective fungicides. The Food and Drug Administration and U.S. Department of Agriculture have cleared three fungicides for use on sugar beets. New fungicides are being observed for their efficiency in disease control and effect on yield. Some of these have reduced leaf spot severity by more than 50%, increased beet yields 2-7 tons per acre, and increased sugar yields by 3,000 lbs./A. It is expected that the best of these chemicals

will be cleared for use by 1967. Research has shown that the spores of the leaf spot fungus are dispersed principally by wind-driven rain and overhead irrigation water and that infection occurs within 48 hours after the spores settle on the leaves. Results indicate the need for proper timing of fungicide applications and the need for continuous fungicide coverage throughout the growing season.

Survival of Winter Barley. Winter barley is potentially a valuable feed and grain crop for central and western South Dakota. The varieties now available, however, do not survive the winters well except in the extreme south central and western sections of the state. The problem of winter survival is complex, probably involving many interacting factors such as weather and soil conditions and soil-borne diseases. The role of disease in winter survival of winter cereals has been under investigation at this station for several years. It has been found, for example, that by fumigating the soil with a fungicide (chloropicrin—"tear gas") before planting, winter survival of cereals may be greatly improved. Barley grown on chloropicrin-treated soil shows a marked increase in growth during the early stages of development, and in recent studies it was found that certain minor elements were higher in concentration in these plants than in plants grown in untreated soils.□

RESEARCH PROJECTS IN PROGRESS

- Pathogenicity and Control of Common Scab and Bacterial Ring Rot of Potato, Hatch 386.
- Seed Treatment and Soil Amendments for the Control of Seed Rot and Seedling Blight, Hatch 296.
- Diseases of Spring, Winter and Durum Wheats and Their Control, Hatch 353.
- The Selection of Superior Virus-Free or Virus-Tolerant Plum Rootstocks, Hatch 343.
- Control of Diseases Affecting Shelterbelt, Forest, and Shade Trees in South Dakota, State 292.
- Corn Diseases and Their Control, State 185R.
- Epiphytology and Control of Cereal and Legume Viruses, Hatch 389.
- Diseases of Oats and Barley and Their Control, State 283.
- Flax Diseases and Their Control, State 276.
- The Role of Fungus Diseases in the Lodging of Sorghum, Hatch 390.
- The Biology and Control of Important Grass Diseases, State 250.
- Nematode Diseases of Plants and Their Control, State 375.
- Investigations and Control of Alfalfa and Other Forage Legume Diseases, Hatch 230.
- Pythium and Ophiobolus graminis Root Rots of Cereals, Hatch 352.
- Mechanisms of Survival of Root-Infecting Fungi in Soil, Hatch 425.

poultry science

Pelleting Improves Alfalfa Meal. The yellow pigments in alfalfa meal were more effective in adding color to egg yolks when the meal had been pelleted and reground than when it had remained in meal form. One pelleting gave the maximum effect. Repelleting and regrinding the pellets showed no additional benefit. Lutein was shown to be the chemical material in alfalfa that was largely responsible for its yellow pigmenting effect.

Diet Affects Palatability. Male turkeys were grown on diets without added fat, and with the addition of 4% to 6% yellow grease. Taste panel tests of meat from each group showed a preference for the meat from birds which had received no added fat. While the palatability scores from the fat-fed birds were not undesirable, this suggests that the addition of this level of yellow grease to the diet may impart a less desirable flavor to the meat.

Chicken Inbreeding Problems. The use of individual cages and artificial insemination has increased

Twenty-weeks-old turkeys on feeding studies at the Experiment Station.



ed the effectiveness of maintaining high priority inbred lines. Further reduction in fertility has occurred in both random and select inbred lines. When selection has been based only upon percent egg production of females, egg size has been reduced in succeeding generations.

Corn-Soybean Diets for Turkeys. Large white male turkeys grown to 4 weeks of age on a 28% protein corn-soybean type diet were 36% heavier than similar poults fed a 20% protein diet supplemented with additions of lysine (0.10%) and methionine (0.10%). This suggests that further studies on amino acid balance and requirements are needed. Lysine supplementation (0.10%) of low-protein growing diets (12-24 weeks) gave a marked response. When 5% corn oil was added to the diet, growth was improved, but lysine gave no further response in diets containing the corn oil. At this stage of growth, the presence of fat may exert a sparing effect on the lysine requirement. Lysine supplementation appeared to result in improved finish, as measured by skin thickness.

Wind Losses of Mash Feed. When range raised turkeys were divided, with one group receiving mash-type feed and the other pelleted feed, preliminary observation indicates considerable wind loss from the mash feeders. This loss may easily be great enough to more than pay for the additional costs of pelleting.

Sex-Reversal. Later studies involving gamma irradiation of embryonated eggs failed to confirm a preliminary observation that this treatment resulted in the hatching of a preponderance of male chicks. Since the 9-day embryo seems to be the most susceptible to changes resulting from irradiation treatment, further studies of dosage at this stage of development are underway. Reduction in adult body weight is one of the most apparent results of radiation treatment of embryos. □

RESEARCH PROJECTS IN PROGRESS

- Effects of Inbreeding Upon Economic Qualities of Chickens, NC-47.
- Factors Affecting Quality and Fatty Acid Composition of Turkey Meat in Market Channels, NCM-7.
- Coordinating Egg Production and Marketing in South Dakota, NCM-31.
- Amino Acid Requirements of Turkeys, Hatch 381.
- The Effects of Feed Additives in Diets for Poultry, Hatch 382.
- Amino Acid Requirements of Laying Hens, Hatch 383.
- The Comparative Values of Rape, Sudan Grass and Other Forages for Growing and Finishing Turkeys, State 79.
- Performance Testing of Poultry, State 287.
- Sex-Reversal Studies of the Fowl, State 289.
- The Antirachitic Factor(s) in Soybeans and Other Feedstuffs (State and National Institutes of Health, 432).

rural sociology

Population Change. A part of the population project research concerned where native South Dakotans lived in 1960. This research examined four aspects of South Dakota's native population: (1) location in 1960 of native South Dakotans; (2) states from which people have come who now reside in South Dakota; (3) amount of net gain or loss to South Dakota through interstate migration; and (4) age structure of the population born in South Dakota and residing in other regions of the United States.

The rate of loss (47%) due to interstate migration is high compared to other states. Over 430,000 native South Dakotans reside in other states. Thirty-four states had over 1,000 ex-South Dakotans each. California has by far the greatest number of former South Dakota people—nearly 99,000. Vermont recorded the least number of ex-South Dakotans, only 97.

The place of birth of the 171,000 people not born in South Dakota but who resided in the state in 1960 revealed a picture quite different from the out-migration situation. The largest number of in-migrants came from Iowa, over 37,000. Minnesota, Nebraska, and North Dakota contributed over 15,000 each. In contrast, California which received the largest number of South Dakotans, had contributed only 3,798 persons to South Dakota's population.

The movement of South Dakotans to other states and natives of other states to South Dakota resulted in a net loss of 258,665 people. This was nearly one-third of the total population of South Dakota in 1960. The West Coast states of California, Washington, and Oregon received one-half of the net loss of native South Dakota population (see map next page).

An examination of the age structure revealed that of native South Dakotans living in other states, the largest proportion was adults 15 to 65 years of age. On a percentage basis, the native South Dakota population residing in other states contains, on the whole, a much smaller proportion of children and a larger proportion of adults and aged population than the native South Dakotans who have remained in the state. Results of this study are being published in Experiment Station Bulletin 528.

Communal Farms. As part of the research on the State's communal farms, a survey of the South Dakota Hutterite colonies was conducted in 1964.

The survey was designed to give a complete census of the population and land holdings of the South Dakota colonies. In 1964 there were 2,443 Hutterites living in South Dakota. These people lived in 24 colonies and operated approximately 123,000 acres. Of this land, slightly over 113,000 acres (92%) were owned, and about 10,000 acres (8%) were rented or leased from non-Hutterite land owners.

Data from the 1964 survey show that the Hutterites comprise 341 families with an average of seven persons per family. The "average" colony had approximately 14 families with a total population of 102 persons. This average colony operated 5,100 acres, 400 of which were rented.

Because Hutterite colony land is owned and operated by members of the colony working cooperatively, it is not possible to determine acreage operated by separate families or individuals. However, statistical averages indicate that each family operated 360 acres of which approximately 200 acres were cropland. This amounted to about 50 acres per person in 1964.

A section of the survey dealt with the major crop and livestock enterprises of the Hutterites and the findings are reported in a forthcoming Experiment Station bulletin on South Dakota's communal farms.

Farm, Home Study. The 1964 study of Deuel County farmers who participated in the Farm and Home Development Program initiated in 1956 to implement optimum farm management along with extensive use of fertilizer, measured the changes made in family living, economic characteristics, and farm practices between 1958 and 1964. In addition, comparisons were made with the changes occurring among other farmers in the County selected to match each farmer participating in the Program.

Between 1958 and 1964 the Farm and Home Development farmers significantly increased in acreage operated and gross farm income, high level of family living, and showed more favorable attitudes toward the Development Program. During this period these farmers decreased their participation in community organizations and in county agricultural programs.

Comparison of the two groups of farmers in 1964 showed the Program farmers generally higher on all characteristics measured. Program farmers had made more contacts with all agricultural agents, were more favorable toward the adoption of recommended farm practices, had adopted more of the recommended livestock and general farming practices, had used fertilizer according to the recommended methods to a greater extent, and held more favorable attitudes toward South Dakota agricultural

agencies, including the Experiment Station and Extension Service. The farmers who had worked with the program generally felt the agents' service had helped them to reach higher levels of economic development, and soil and livestock improvement as well as better general farm management. Most of them expressed a need for the extension of Development Programs to include more farm and home management areas and to include more farmers across South Dakota.

Food Practices. The traditional food habits of the Dakota Indians were investigated to obtain a background in the literature for this project. This preliminary phase of the research was reported in "A Social System Analysis of the Changing Food Practices of the Teton Dakota Indians, 1800-1900." The contemporary situation on the Pine Ridge Reservation relating buying practices in the trading posts to the economic position of the Indian family and their conception of health was reported in "A Study of the Food Practices, Economic Position, and Conception of Health on the Pine Ridge Indian Reservation."

Based on these two pilot studies, a design was prepared for investigating the food practices of the Pine Ridge family, and the functional relationship of dietary beliefs, values, and actions to the individual Indian's conception of his own health. A survey schedule was prepared and administered to 180 families in a number of reservation villages. The data is expected to determine the influence food practices

and health have on such intervening variables as level of living, education, participation in community activities, social status, and value orientation.

Aftercare Resources. An exploratory study concerned use of aftercare resources in South Dakota by a selected group of patients discharged from Yankton State Hospital. Patient characteristics for the study sample included: most common type of admission to the hospital was voluntary; almost twice as many men as women were discharges; age group with largest number was 20-29 years; most common mental diagnosis was schizophrenic reaction and next was alcoholism; type of release was most often an unqualified discharge. The study pointed to needed additional investigations and recommended certain specific areas. More understanding is needed in human relationships. As families are taught these lessons, mental illness may often be averted, and in the case of "aftercare" many patients would improve to the point of carrying on a normal life. The study found that in virtually all categories, the shortage of trained, qualified workers was acute. □

RESEARCH PROJECTS IN PROGRESS

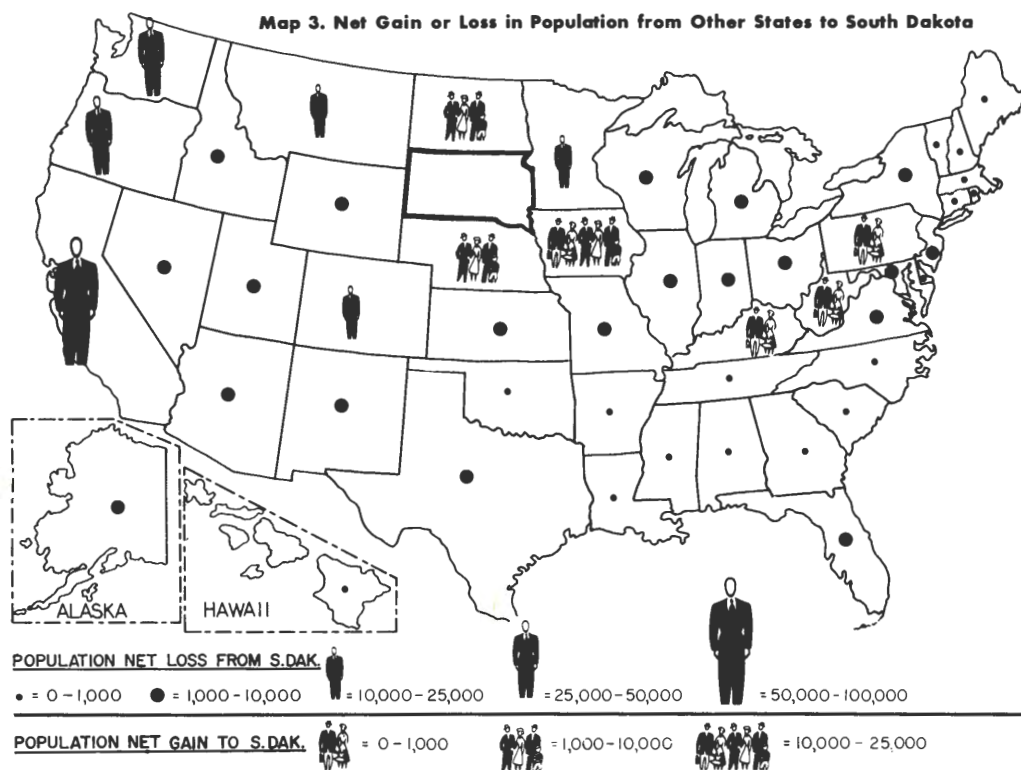
The Impact of Population Changes Upon Rural Communities in South Dakota, Hatch 222.

Concepts of Retirement, Attitudes Toward Retirement and Retirement Plans of South Dakota Farmers, Hatch 279R.

The Socio-Economic Influences of the Communal Type Farm on the Rural Community in South Dakota, Hatch 255.

Evaluation of the Extension of Farm and Home Development Program in Deuel County, Hatch 332.

Cultural and Social Factors Related to Food Practices Among the Sioux Indians of South Dakota, State 369.



station biochemistry

Urinary Calculi. On rations containing a rather high level of phosphorus (0.55%), increasing the calcium content from 0.37% to 1.27% decreased the incidence of urinary calculi in sheep from 73% to 13%. Magnesium could replace a part of the calcium in producing this effect, but its effect was no greater than an equal amount of calcium. It did, however, give a different effect on serum levels of phosphorus and on excretion of phosphorus in the urine. (This work was cooperative with the Animal Science Department).

The organic matrix material which occurs in calculi has been separated from the inorganic material for studies on its composition. Attempts to grow calculi in urine, using small calculi as nuclei, have been made without success. Continued work on these matters should aid in establishing the cause of urinary calculi.

Nitrate Investigations. Preliminary studies have indicated that the addition of lime to high nitrate silage may reduce the nitrate content. However, the level of lime required may be much too high to be practical. Levels most generally recommended (10 pounds per ton of silage) seem to have no effect and only at an excessively high level (40 pounds per ton) was the reduction in nitrate content found to be of significance.

Cooperative studies with the Poultry Science Department have shown that as compared to other animals, chicks, laying hens and turkey poults are especially insensitive to damage by nitrate or nitrites in water.

Sulfate Utilization. In studying sulfate utilization with the artificial rumen, it has been found that sulfate is reduced to hydrogen sulfide and then incorporated into protein. When rumen juice from animals fed good quality alfalfa hay was used, sulfate additions did not improve hydrogen sulfide formation. With rumen juice from animals on low quality alfalfa hay, sulfate improved hydrogen sulfide production. It appears that under certain feeding conditions sulfate additions to the ration of ruminants may be beneficial, but this must be demonstrated in feeding experiments.

Selenium Poisoning. Investigations on selenium poisoning have covered a wide range of subjects: the reaction of inorganic selenium with blood albumen; extraction and separation of selenium com-

pounds from seleniferous plants and from urine; the metabolism of selenium by yeast; effect of selenium on the amino acid content of blood and liver; distribution of selenium in phospholipids; and the selenium content of wool from sheep on seleniferous range (with Animal Science Department). Two additional studies have yielded information of considerable interest. In one of these, it was found that death in rats on chronically toxic diets is just preceded by massive hemolytic anemia, spleen enlargement, increased deposition of iron in the kidney, and increased excretion of iron in the feces. The other study, carried on at the Poultry Science Department, has shown that in long term studies using purified diets containing 8 parts per million of selenium the reproductive system of the male chicken is much more adversely affected than that of the female. These observations with rats and chicks add to our understanding of how selenium exerts its toxic effects.

State Services. Analytical services for residents of the state, for other agencies, and for other departments of the Experiment Station (excluding such work done on cooperative projects) are summarized below:

Analysis	Number Done
Water analyses	471
Feed analyses	
Proximate analyses	201
Protein	604
Nitrate	259
Carotene	200
Salt	6
Selenium	20
Calcium	50
Analysis of various materials for poisons	125
Mineral substances analyzed	32
Blood analyses	
Sodium and potassium	138
Calcium	443
Magnesium	459
Phosphorus	611
Plant samples analyzed for zinc	75
Soil analyses	
Calcium	26
Magnesium	35
Zinc	126
Feces and plant materials	
Calcium	375
Magnesium	351
Gas chromatographic analyses	
Fatty acids on meats	334
Sewage gases	37
Progesterone	116
Volatile fatty acids	158
Insecticides in waters	45
Assistance with cobalt 60 irradiations	12
Miscellaneous analyses	56
Total	5,365

RESEARCH PROJECTS IN PROGRESS

Metabolism of Sulfur (AEC Contract AT (11-1)-1031)
The Biochemistry of Silicon (NIH Silicon A-3717).

veterinary

Bovine Encephalomyelitis. The virus of sporadic bovine encephalomyelitis (SBE) is readily cultivated in the yolk sac of embryonated eggs. Attempts to increase elementary bodies of virus in allantoic fluid by serial passage in embryonated egg failed with several strains tried. Concentration and purification of viral elementary bodies from infected yolk sacs with fluorocarbon was not successful. In a pilot immunization trial, guinea pigs were injected with formalinized vaccine prepared with a related enteric virus (*M. bovis*). When challenged with a virulent SBE virus no immunity was demonstrated.

Mucosal Disease. Virus diarrhea (mucosal disease) continued to appear in sporadic outbreaks during the year. Twelve separate outbreaks were investigated. Animal inoculations, tissue cultures, fluorescent antibody reactions and gel diffusion techniques were studied as aids in diagnosis of the disease. Surgical removal of the thymus of an experimental calf was attempted to increase susceptibility to infection. This trial failed. The other laboratory diagnostic procedures will also require further study.

Fowl Cholera. In preparation of bacterins for most effective immunization against fowl cholera, attention must be given to selection of strains of *Pasteurella multocida* which will stimulate antibody production against field exposures. Most *Pasteurella* strains isolated from fowl cholera infections in turkeys may be classified into either biochemic group I or II. Occasional isolated strains have differing biochemic reactions. Bacterins prepared from two such strains were used in cross immunization tests in turkeys. One, a group III strain, was found to be most closely related to group I strains immunologically. The second, an unclassified strain, more closely resembled strains of group II in immunizing properties.

Diagnostic Service. The animal disease diagnostic laboratory conducted 32,607 tests and examinations during the year ending June 30, 1965, compared to 27,184 during fiscal 1964 and 23,284 during 1963. Not included in the listed total this year are

approximately 7,500 tests for anaplasmosis conducted in a survey in cooperation with the Livestock Sanitary Board.

Much of the diagnostic material handled by the laboratory is submitted by practicing veterinarians or referred by them. This is encouraged because the laboratory's services can be more helpful when the local veterinarian is consulted on disease problems. The increasing demands for diagnostic services is indicative of the concern of livestock and poultry producers for disease control.

The principal increase this year over last year was in the number of serological tests for brucellosis, leptospirosis, vibriosis, and pullorum-paratyphoid. The total number of necropsy cases remained about the same. There was some decrease in the total number of rabies examinations conducted.

Diagnostic work at the Animal Health Laboratory at State University from July 1, 1964 to June 30, 1965 is summarized as follows:

Serological		
Brucellosis		9,907
Cattle	5,913	
Swine	3,994	
Leptospirosis		5,623
Cattle	3,374	
Swine	2,249	
Vibriosis		1,008
Pullorum-Paratyphoid (fowl)		14,102
Necropsies (cases)		824
Cattle	83	
Swine	184	
Sheep	149	
Fowl	386	
Small Animals	22	
Rabies Examinations		393
Positive	73	
Negative	320	
Organs and Parts		370
Milk		157
Water		18
Physician and Hospital		46
Unclassified		159
Total		32,607

RESEARCH PROJECTS IN PROGRESS

Sporadic Bovine Encephalomyelitis (SBE), Hatch 171.
 Virus Diarrhea (Mucosal Disease) of Cattle, Hatch 253.
 Leptospirosis of Farm Animals in South Dakota, Hatch 270.
 Nature and Control of Fowl Cholera, Hatch 391.
 Animal Health Laboratory (Diagnostic Service), State 408.

wildlife

Insecticides and Pheasants. One unknown aspect in management of pheasants is effect of pesticides on population. To evaluate these effects a two part study was started at midyear. One part is the analysis of birds collected in the wild to determine occurrence of residual insecticide in their tissues. In the second phase, pheasants with a known intake of insecticides will be maintained in pens. Eggs from the penned pheasants will be analyzed to determine residual deposits. Fertility and hatchability, as well as mortality, of young hatched will be evaluated. Chicks hatched from eggs laid by hens with known intake of insecticides will be carried over to furnish information on the second generation of young. Similar procedures will be conducted with hens and eggs collected in the wild.

Farm Fish Ponds. Farm ponds in South Dakota are highly productive as revealed through the farm fish pond study. Standing crops (total fish in a body of water) in the ponds under study range from 450 pounds to 850 pounds of fish per surface acre. This high production is also evident in the nutrient content of the farm pond waters. High production causes problems of under harvest, resulting in stunting of the fish population. Some ponds in this study have been converted to bait fish production. Tests indicate that farm ponds are suited for the production of fathead minnows and white suckers. A large problem in converting farm fish ponds into bait fish ponds is developing adequate and economical methods of harvest.

Importance of Raccoons in South Dakota. The scores of raccoons captured alive, marked, and

released at the site of capture show that individuals remain in a clearly defined home range. Individual raccoons on which radio transmitters were attached were tracked each night and day for several weeks. The animals denned in ground holes, tree cavities, old buildings, and heavy marsh vegetation but wandered nightly to sources of food along water holes, streams and corn fields. Analysis of foods in stomachs of dead animals revealed that abundant animals such as frogs, crayfish, grasshoppers and other insects, wild fruits, and corn comprised the staple diet. Limited depredation on sweet corn plantings occur when the corn is in the milk state. In other seasons raccoons do very little damage to crops or poultry as long as ample wild foods are available. □

RESEARCH PROJECTS IN PROGRESS

Farm Fish Pond Management in South Dakota, Hatch 422.
Economic Importance and Life History of the Raccoon in South Dakota, State 308.

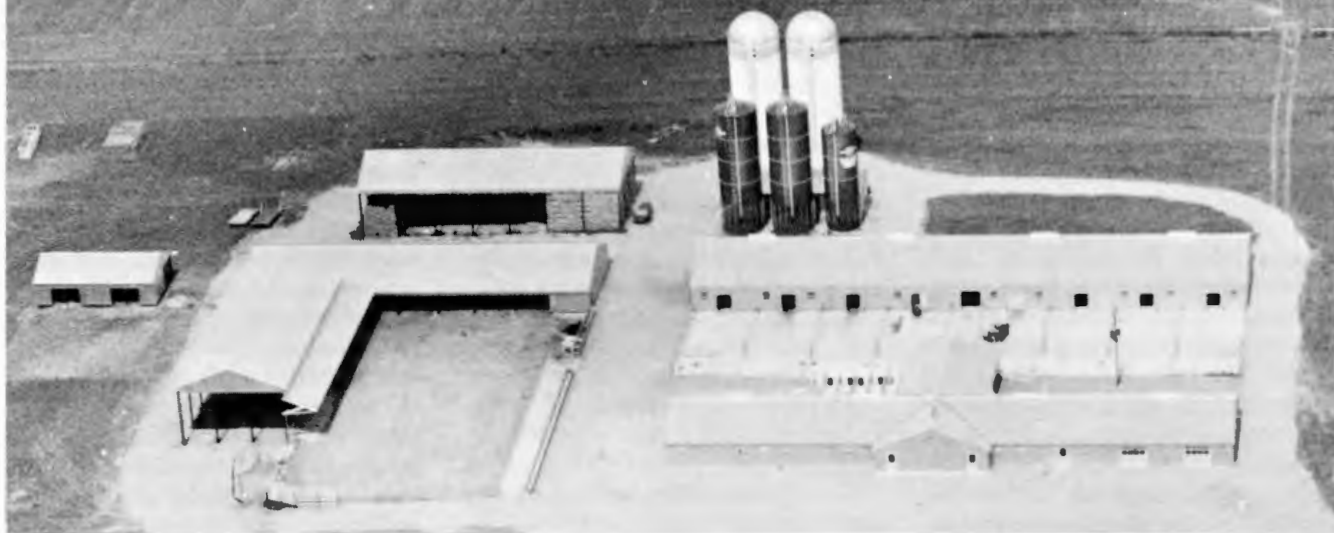
Relationships of Insecticides to Pheasants in South Dakota, Hatch 438.



(Above) Trapping raccoons for study of the animal's home range. (Lower left) Tuning tiny radio transmitter prior to attaching to raccoon. (Below) Radio-equipped raccoon shortly after release.



New Dairy Research Unit



The new dairy research and production facilities became operational in August 1965, just a year after construction started. These new structures are 2 miles north of the South Dakota State University campus along Highway 77, on 160 acres of land known as the Wilson farm. The new facilities replace the old stanchion barn constructed on the campus in 1909.

Designed to handle a maximum of 100 milking cows and about the same number of younger cattle and dry cows, the new unit includes three types of housing. The main herd of milking cows will be kept in a free-stall type of barn. This building is 210 feet long and 46 feet wide. A feed alley and feed bunk extend the length of the building. There are 8 pens, 25 feet wide with 5 free-stalls on each side of a paved alley. This free span pole barn will accommodate 80 cows. An alley in the center of the building is used for moving cows to and from the milking parlor and for equipment for cleaning and hauling feed. The primary reason for the 8 separate pens of 10 cows each is for research in which one group may be compared with another in various kinds of feeding trials.

CHOICE FEEDING

Paved exercise lots 25x40 feet in size are provided for each of the 8 groups of cows. These are on the south side of the barn. Double swinging doors on the barn give the cows complete freedom of being inside the barn or in the exercise lots. Feed bunks along the lot fences provide the cows a choice of feeding inside, outside or both.

Additional housing is available for 12 cows in stanchions and 6 in maternity pens in the main part of a multiple purpose T-shaped building 40x202 feet in size. The 32x35-foot milking parlor-holding room area extends towards the exercise lots of the free-stall barn. This building also includes the milk handling room, an observation room for visitors, the herdsman's office, a small laboratory, locker room, classroom and an equipment storage area also used for a judging arena.

A conventional loose-housing barn is provided for dry cows and heifers. It will also be feasible to keep some of the milking herd in these quarters especially when research is involved on efficiency of milk production as affected by types of housing. This building is

45x135 feet with south exposure opening into a 90x150-foot exercise lot. Adjacent to the west side of this lot is a 40x105-foot hay and straw storage shed. This will provide some wind protection as well as late afternoon shade for the cattle.

HAY AND STRAW STORAGE

A second identical-size hay and straw storage is a few feet north of the loose housing barn. A small structure to house four bulls is west of the loose housing barn. This has exercise pens on the south side of the building.

Waste products from the milking area and paved exercise lot are run into sewer tile and thence to a lagoon. This lagoon measures 80x125 feet in size, is 5 feet deep, and is about 500 feet southwest of the buildings.

These new facilities were constructed with funds appropriated by the State Legislature in 1963 and 1964 totaling \$275,000 for land and buildings. Contractors for the project were: general contract \$151,571, H. E. Mills Construction Co., Brookings; mechanical contract, \$23,627, Carl Sheesley Plumbing and Heating, Mitchell; and electrical contract, \$17,770, Sand's Electric, Brookings. □

New Research Equipment

FOR MORE EFFICIENT USE OF TIME

By A. L. MUSSON, *Assistant Director,*
South Dakota Agricultural
Experiment Station

New knowledge and increasing demands have greatly accelerated the tempo of agricultural research. More than ever, scientists need to take advantage of every possible means to help them keep up with the times—if not, their work is restricted and the benefits to South Dakota agriculture may be too little, too late.

Research is characterized by advanced study by competently trained and experienced personnel. The increasing pace in the search for new knowledge emphasizes the researcher's need for more efficient use of his time. Moreover, he needs facilities and equipment with which to work that will not only help him gain efficiency but also will provide the means whereby intricate experiments are carried out with mean-

ingful results. What is available and what is required, in both manpower and equipment, must undergo a continual appraisal for a successful research program.

The scientist is normally a discerning student; he is always looking at new experiences and gaining new knowledge. He has to do this. For example, in the study of living cells knowledge is now said to double about every 2 years. A researcher in this field must be alert or he will fall hopelessly behind as the gap in his knowledge widens. The needed extra time for study and for keeping his own research program up-to-date must virtually be created out of his already full day.

Use of Computers

High speed electronic computers summarize and reduce to under-

standable size masses of data. For example, its use to predict hybrid corn yields eliminates weeks of tedious calculations for the corn breeder. Applications of computer techniques to research in other areas of agriculture is gradually increasing and effectively freeing the scientist from the more tedious and mechanical parts of his job.

But agricultural research still deals with the economic advantage of crops and livestock and with family living. Such experiments still require the acquisition and periodic replacement of standard laboratory equipment. As with the improvements in computers, so also new developments in laboratory equipment have made available to researchers newer and more sophisticated instruments.

During the past year, new equipment for the Agricultural Experiment Station has been added in three general areas.

Bacteriological and virological research has acquired a preparative centrifuge and a refrigerated centrifuge, a fluorescent microscope and incubators for work with viruses. Work with viruses is often dangerous. The new isolator lab, costing about \$2,400, is used to transfer viruses without endangering the technician. Other new laboratory equipment includes a water bath, autoclave, pipetting machine and a cryostat for preparation of frozen tissue sections.

For Chemical Analyses

Biochemical research and chemical analyses are often an essential part of many projects associated with agriculture and home economics research. New equipment acquired to support this phase of the Experiment Station's activity during the past year include a recording spectrophotometer for rapid



Expensive equipment, needed in research, often comes in small packages. This ultracentrifuge is used for purifying viruses and studying biophysical properties.

chemical analysis; scintillation and gamma counting equipment for research utilizing radioisotopes; an atomic absorption spectrometer for determining amounts of calcium, magnesium and zinc present in samples; and a fluorometer for magnesium, selenium and disulfide analyses. Other items of equipment included a gas chromatograph, chromatograph drying oven, thin layer chromatograph equipment for pesticide analyses, a refrigerated centrifuge for enzyme chemistry and Kjeldahl equipment for protein analyses. The new gas chromatography equipment permits researchers to detect the presence of infinitesimal amounts (one part in a billion) of substances, especially the complex chemicals now being used in pesticides and weed-icides and which should be kept out of food but which sometimes are found as contaminants. Funds for this equipment were provided by private and federal grants as well as by the state.

The area of research dealing with crop improvement, tillage practices and livestock nutrition also obtained some new facilities and equipment. The South Dakota Wheat Commission shared the cost of a new \$20,000 greenhouse making it possible for the Experiment Station to obtain 2 generations of wheat

seed a year thus doubling the effectiveness of the wheat breeders.

Pasture Research Equipment

The Pasture Research Center at Norbeck was established with the aid of a basic grant from the federal government of \$90,000. The operation of this center required a full line of farm machinery as well as plans for establishing a 300-cow herd in the following fiscal year.

Several thousand dollars worth of farm and field laboratory equipment was purchased for the departments at Brookings with a few items for outlying field stations. This equipment included a soil grinder; a fertilizer attachment; a scale for weighing feed and excreta in an animal experiment; a balance for weighing chemicals and small plant samples; a fat extraction rack; a pH meter; and a vacuum drying oven. For meats research, a continuous temperature recorder was obtained. Several metabolism crates will improve our sheep nutrition studies.

Just as fertilizer is needed by the soil to produce a good crop or retooling is required by a factory for a new model, adding to or replacing of physical equipment is a critical need for a continuing research program. The search for new knowledge to benefit all of South Dakota entails the provision of adequate

tools for the wide-ranging needs of the research staff. Most of these tools represent an investment in essential equipment that can be used for many years.

Largest New Facility

The largest new Experiment Station facility of the past year, both in cost and size, is the \$275,000 Dairy Science Research and Production Unit north of the SDSU campus which replaces the dairy barn constructed in 1909. This facility should provide the physical plant for a strong program in research in dairy production and nutrition.

In other areas of research, new equipment will be of material help to the research staff. A new abrasion testing machine is being used by textiles researchers in Home Economics to study the process of fabric breakdown which could lead to methods of predicting how a fabric will perform during use. A microscope with camera attachment has been purchased to examine the abraded textiles and to aid researchers in comparing results.

Special stainless steel equipment is used to prevent contamination of experimental diets with unwanted minerals. One example is a stainless steel diet mixer used where some ingredients may constitute only a few parts per million. □

A 300-cow herd and a full line of farm machinery were but two necessary items in establishing the Pasture Research Center at Norbeck.





spent on
research

gives you
returns of



What does agricultural research cost? How much does it benefit the economy of South Dakota? Is it worth it? People who pay the cost of the research—generally the taxpayer—want to, and are entitled to, know what they get for their money. But putting a price tag on the value of research is difficult. To give an idea about the costs and benefits, Experiment Station personnel estimated values of only a few of the new developments in wheat, grasses, corn and soils within the past 18 months.

A return of \$10 for every \$1 invested isn't bad business at all.

In fact it's a virtual gold mine and, to cap it off, shares are held by all South Dakotans.

Let's figure it this way:

Soils research for the past 10 years at the Agricultural Experiment Station at South Dakota State University has cost around \$400,000 in both State and Federal funds. The possible value of only one facet of this soils research (drill attachment technique of phosphate fertilizer application for small grains) for just one year is estimated by agronomists at \$7 million. This return includes \$4 million on 1,600,000 acres of spring wheat and \$3 million on 225,000 acres of barley. That's a return of \$17.50 to \$1 in tax money spent a dime a year during the past 10 years.

WHEAT RESEARCH

All wheat breeding research at the Experiment Station cost \$28,000 in 1965 and averaged about \$20,000 annually for the past 10 years. Taking only one result of this work—the new Hume winter wheat released this year—and its estimated value of \$3 million annually, you get a return of \$15 to \$1 invested. Hume, which has earliness, hardiness and stem rust resistance, is also good for winter wheat areas in

parts of North Dakota, Montana and Nebraska.

Within the past 18 months the South Dakota Agricultural Experiment Station has released two new grasses—Summer switchgrass and Oahe intermediate wheatgrass. Grass breeding research costs amounted to about \$200,000 the past 10 years. The new switchgrass, adaptable to all but the northeast one-third of the State, has an estimated value of \$150,000 annually. Oahe, of use throughout the State, is valued at an estimated \$350,000 a year. Taken together, they give a return of \$2.50 for \$1.

CORN RESEARCH

It is difficult to estimate the value of two new corn inbreds released by the Experiment Station. One of them, SD10, is for corn hybrids with resistance to corn rootworm, an insect pest which entomologists estimate cost South Dakota corn growers \$5 million in 2 years. While SD10 will not be the complete answer to corn rootworm, it does pose encouraging possibilities. The other inbred, SD15, is the male parent of the hybrid SD248 and is characterized by better quality grain and good yielding ability. Together these two inbreds are presently valued at \$250,000 a year. Corn breeding research the past 10 years has

cost a total of about \$280,000—a return of only about 90 cents per \$1 spent, based on preliminary estimates of the value of SD10 and SD15 for only 1 year. But remember, corn breeding also includes developing other desirable characteristics such as resistance to certain diseases and other factors. When these become available—and it may be fairly soon—corn breeding research costs will plummet in comparison to benefits derived.

\$10 FOR \$1

Combined, 10 years of research on wheat, grass, soils and corn cost about \$1,080,000. Estimated value of only some of the benefits derived from this research totals \$10,750,000.

This 10-to-1 ratio on the plus side, doesn't take into consideration two other benefits resulting from research with small grains. Agronomists estimate that if purified Justin spring wheat is used as recommended instead of Lee, the value to northeastern South Dakota would amount to \$2 million a year. Dickson barley, a North Dakota variety released cooperatively with South Dakota, should benefit the northern edge and northeastern part of South Dakota to the tune of about \$375,000 annually. □

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financial statement

SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION STATEMENT OF RECEIPTS, DISBURSEMENTS AND BALANCES FOR THE YEAR ENDED JUNE 30, 1965

RECEIPTS:

	Grand Total	Hatch	Coop. Forestry Research Act.	Regional Research	Grants for Basic Research	Experiment & Substation (Sales and endow- ment income)	Experiment Station (State appropriated)
Balance July 1, 1964	\$ 267,919.34	\$ 9,104.94	\$ 8,985.95	\$ —	\$ —	\$249,828.45	\$ —
Receipts and Appropriations	2,424,166.22	451,724.00	13,095.00	155,049.74	50,000.00	555,607.04	1,198,690.44
GRAND TOTAL	\$2,692,085.56	\$460,828.94	\$22,080.95	\$155,049.74	\$50,000.00	\$805,435.49	\$1,198,690.44

EXPENDITURES:

	Grand Total	Hatch	Coop. Forestry Research Act.	Regional Research	Grants for Basic Research	Experiment & Substation (Sales and endow- ment income)	Experiment Station (State appropriated)
Personal services	\$1,515,995.47	\$395,481.08	\$ 6,091.68	\$ 99,041.92	\$ 2,109.66	\$139,828.57	\$ 873,442.56
Travel	50,639.46	110.80	373.45	5,500.00	—	12,235.03	32,420.18
Interdepartmental charges	5,480.53	—	—	—	—	5,480.53	—
Transportation of things	3,593.89	—	—	—	—	2,087.14	1,506.75
Communication service	3,985.74	—	—	—	—	2,411.31	1,574.43
Rents and utility service	30,696.10	1,352.88	—	20.24	—	22,462.89	6,860.09
Printing and binding	1,284.72	—	—	—	—	1,087.18	197.54
Other contractual service	65,055.80	922.21	—	143.72	—	36,412.25	27,577.62
Supplies and materials	350,846.68	4,140.07	1,101.62	1,713.11	7,780.90	203,127.26	132,983.72
Interdepartmental charges	59,009.42	—	—	—	—	22,760.06	36,249.36
Equipment	287,857.39	36,532.34	1,978.39	17,203.87	1,890.90	144,373.70	85,878.19
Buildings	—	—	—	—	—	—	—
TOTAL	\$2,374,445.20	\$438,539.38	\$ 9,545.14	\$123,622.86	\$11,781.46	\$592,265.92	\$1,198,690.44
Balance June 30, 1965	317,640.36	22,289.56*	12,535.81	31,426.88*	38,218.54	213,169.57†	—
GRAND TOTAL	\$2,692,085.56	\$460,828.94	\$22,080.95	\$155,049.74	\$50,000.00	\$805,435.49	\$1,198,690.44

* Obligated balances on federal funds.

† Reverted to State General Fund by Act of the 1965 Legislature.

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G. C. PARIKH, Ph.D.	Ass't Professor
R. M. PENGRA, Ph.D.	Assoc. Professor

BOTANY

D. J. HOLDEN, Ph.D.	Assoc. Professor and Head
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R. O. FELBERG, M.S.	Ass't Professor
HARRY GREENBAUM, Ph.D.	Ass't Professor
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MAX MYERS, Ph.D.	Professor
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S. RAY SCHULTZ, Ph.D.	Assoc. Professor
W. M. SCHULTZ, D.Ag.	Ass't Professor
JOHN TRIERWEILER, B.S.	Ass't in Economics
W. K. ULLMAN, M.S.	Assoc. Professor
ERWIN ULLRICH, M.S. (USDA)	Ass't Professor
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C. O. CALKINS, M.S. (USDA)	Instructor
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RALPH GUSTIN, M.S. (USDA)	Instructor
E. W. HAMILTON, Ph.D. (USDA)	Ass't Professor
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W. L. HOWE, Ph.D. (USDA)	Professor
E. J. HUGHINS, Ph.D.	Professor
P. A. JONES, Ph.D.	Ass't Professor
R. W. KIECKHEFER, Ph.D. (USDA)	Ass't Professor
D. R. LEMKE, B.A.	Administrative Ass't
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E. E. ORTMAN, Ph.D. (USDA)	Ass't Professor
W. N. STONER, Ph.D. (USDA)	Assoc. Professor
L. D. WHITE, Ph.D.	Ass't Professor

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DOROTHY DEETHARDT, B.S.	Ass't in Home Economics
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EVELYN HOLLEN, Ph.D.	Professor
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D. D. WILLIAMS, B.S.	Ass't in Forestry

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S. G. JENSEN, Ph.D. (USDA)	Ass't Professor
R. B. MALEK, Ph.D.	Ass't Professor
C. J. MANKIN, Ph.D.	Assoc. Professor
G. B. ORLOB, Ph.D.	Assoc. Professor
V. D. PEDERSON, Ph.D.	Assoc. Professor
GEORGE SEMENIUK, Ph.D.	Professor

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EDMUND GUENTHNER, M.S.	Instructor
W. C. MORGAN, Ph.D.	Professor
P. E. PLUMART, M.S.	Ass't Professor

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FRANK J. SHIDELER, B.S.	Ass't Publications Editor

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H. M. SAUER, M.A. Professor and Head
JEANNE BIGGAR, M.S. Instructor
V. D. MALAN, Ph.D. Professor
M. P. RILEY, M.A. Assoc. Professor

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R. F. DERR, Ph.D. (USDA) Ass't Professor
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A. W. HALVERSON, Ph.D. Professor
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E. I. WHITEHEAD, M.S. Assoc. Professor

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R. L. LINDER, Ph.D. Ass't Professor
N. D. SCHOENTHAL, M.S. Ass't Professor
P. F. SPRINGER, Ph.D. (USDI) Assoc. Professor

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GARY HAIWICK, M.S. Superintendent
Pasture Research Station, Norbeck
FRANK HOLMES, Acting Superintendent
Central Substation, Highmore
JOHN NESVOLD, B.S. Superintendent
Range Field Station, Cottonwood
B. B. BEER, B.S. Superintendent
Range Field Station, Cottonwood
PHILIP SEVERIN, Superintendent
Reed Ranch Field Station, Presho
W. R. TREVILLYAN, B.S. Superintendent
Antelope Range Field Station, Buffalo

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Newell
J. F. FREDRIKSON, B.S. Superintendent
Southeast South Dakota Experiment Farm,
Beresford
L. A. NELSON, B.S. Assistant Superintendent
Southeast South Dakota Experiment Farm,
Beresford
LLOYD B. DYE, Superintendent
Development and Irrigation Substation,
Redfield

APPOINTMENTS

Agricultural Engineering

PAUL TURNQUIST, Associate Professor...10/1/64

Agronomy

A. O. LUNDEN, Associate Professor...9/4/64
J. T. NICHOLS, Assistant Professor...8/15/64

Animal Science

DARRELL BUSCH, Assistant in Animal Science...9/9/64
ROGER MAGSTADT, Assistant in Animal Science...7/1/64

Bacteriology

G. W. ROBERTSTAD, Professor and Head...9/1/64
G. C. PARIKH, Assistant Professor...3/15/65
P. R. MIDAUGH, Associate Professor...11/1/64

Economics

JOHN SANDERSON, Assistant Professor...10/1/64
JOHN TRIERWEILER, Assistant in Economics...10/1/64

Entomology-Zoology

T. F. BRANSON, Instructor...9/1/64
C. O. CALKINS, Instructor...9/1/64
P. A. JONES, Assistant Professor...2/1/65
D. R. LEMKE, Administrative Assistant...1/14/65

Home Economics

COILA JANECEK, Instructor...7/1/64
LOUISE GUILD, Assistant Professor...7/1/64

Horticulture-Forestry

D. D. WILLIAMS, Assistant in Forestry...2/1/65
G. L. JENSEN, Assistant in Forestry...3/1/65

Plant Pathology

R. B. MALEK, Assistant Professor...7/1/64

Station Biochemistry

YVONNE A. GREICHUS, Instructor...7/1/64

Veterinary

KEITH VAN STEENBERGH, Assistant Professor...8/1/64
W. U. KNUDTSON, Assistant in Veterinary...1/1/65

Wildlife Management

R. L. LINDER, Assistant Professor...7/1/64

Substations

B. B. BEER, Field Station Superintendent...6/1/65
GARY HAIWICK, Field Station Superintendent...6/1/65
L. A. NELSON, Assistant Field Station Superintendent...7/1/64

RESIGNATIONS

Agricultural Engineering

C. N. HINKLE, Associate Professor...2/28/65
C. R. UMBACK, Assistant in Agricultural Engineering...12/22/64

Agronomy

ROBERT HEIL, Instructor...5/31/65

Animal Science

D. E. RAY, Assistant Professor...1/18/65

Economics

W. F. RAILING, Associate Professor...9/30/64
W. M. SCHULTZ, Assistant Professor...8/31/64

Entomology-Zoology

W. E. BOUNDY, Administrative Assistant...11/21/64
JOHN MATTESON, Assistant Professor...11/2/64
S. D. HINTZ, Survey Entomologist...11/30/64

Home Economics

LIDA M. BURRILL, Professor...3/31/65

Horticulture-Forestry

J. W. RAWSON, Associate Professor...12/31/64

Rural Sociology

JEANNE BIGGAR, Instructor...1/31/65

Station Biochemistry

R. F. DERR, Assistant Professor...11/2/64

Substations

JOHN NESVOLD, Field Station Superintendent...4/30/65

DECEASED

H. C. SEVERIN, Entomology Professor Emeritus...8/31/64

“... South Dakota a bright and rewarding future”

(From page 3)

tion. More lean—less fat hogs and cattle, and improvement of wheat quality are only two examples. Establishing more accurate measuring guides and gaining actual experience to learn what's 'beneath the hide' illustrate how research is working toward helping producers select breeding stock with specific desirable characteristics.

Animal Disease Diagnosis

“Livestock producers say one of the biggest drains on profits is animal disease. Prevention of disease—partly through prompt and effective diagnosis—is an effective and economical method to insure more profits. The steadily increasing number of requests for services by SDSU's veterinary diagnostic lab-

oratory reflects the growing interest of livestock producers in such a facility. The animal disease diagnostic laboratory conducted 32,607 tests and examinations this year—nearly 10,000 more than in 1963 and with virtually the same inadequate facilities.

“Research must be a continuing process, and its successful use usually hinges on applying accumulated knowledge,” Bentley continues. Examples he cited included these: South Dakota, as a leader in beef cattle production testing, seeks more production per cow through management and selection of breeding stock. Culminating thousands of man-hours of work

was last year's introduction of Hume, a new winter wheat with earliness, hardiness, and stem rust resistance, and SD10, an inbred, which corn breeders can use to develop hybrids with resistance to corn rootworm. A low fat spread under development may someday help enlarge dairy markets. The major part of the genetic material used in current alfalfa breeding originated from South Dakota work started more than half a century ago.

"Another change in research concepts is the 'team' approach in which scientists from several different specialties tackle a problem with a coordinated, all-out effort," he continues. "The best current example is the new pasture research center near Norbeck. Agronomists, animal scientists, soil specialists, agricultural engineers, and economists all work on this project which features a full agronomic program on grasses and legumes with a beef cow unit to evaluate it. To fit needs and requests, it is based on a cow-calf enterprise, not only to find out how to boost production but to establish costs and returns. One goal is to devise a system for profitable use of pastures for 6 or 7 months a year.

Community Development

"Community development and the impact of technology on people are phases of education and research which must have greater emphasis to meet demands of our rapidly advancing and changing society. Needed is a steady stream of new ideas, approaches and knowledge from teachers, scientists, and people of the community in order to attain the upgraded kind of quality living South Dakota is fully capable of providing for all of its residents. Usable information must be obtained and then applied so that intelligent decisions can be made. Included must be even such acknowledged sensitive areas as school district reorganization, tax reform, consolidation of hospitals, use and development of resources.

"Education must be better ap-

preciated, supported and stressed. Education is a key part of the entire process for people to sense, prepare for and carry out changes in agriculture and elsewhere which are speeding forward faster than ever before. These developments also make it necessary for a decided step-up in the pace of research and the rapid adaptation of research results in such form that they can be quickly given to people who need and can use them. This is another of the places where the Extension Service comes in—getting research results to farmers and ranchers. Many states are considering what they term a 'new' look for Extension: use of area specialists to help county agents. For several years now South Dakota Extension has used area specialists with success. This is a change in which South Dakota is in the vanguard of new concepts for making research work better for more people.

Two-Way Communications

"The ability to change, which is an all-important ingredient for future success, must also be based on cooperation and a two-way communication flow. This will permit ranchers and farmers to pinpoint and give priorities to their needs. Researchers then can better aim their work toward meeting these needs.

"An example of this two-way flow is the Southeast South Dakota Experiment Farm near Centerville. Farmers of a 9-county area in southeastern South Dakota decided they needed additional research to deal with specific, selected problems. Fifteen hundred, \$25 memberships in a farm corporation were sold to cover purchase of land for research. The state legislature provided operating funds. Directors of this farm corporation listed nearly a score of problems which needed investigation. Experiment Station researchers then estimated acreage, time, man-hours and other needs. From these estimates the farmers themselves selected the specific research projects which could be carried out with available facilities.

"Meeting the demands of change and putting ideas into reality will cost hard dollars. There is no way of getting around it. The key, however, is in using these dollars wisely so that full value is received. The current facilities for research, teaching and Extension at South Dakota State represent some pretty good thinking and planning of 5, 10, and even 20 or more years ago. Twenty years hence will our young people have at least equal but preferably better educational opportunities? Will our scientific know-how and know-what be up-to-date and ready to meet South Dakota's needs in 1985?

Carefully Planned Development

"The State is fortunate in that when recommendations are made by President Briggs to the Regents of Education for improvements and expansion at South Dakota State, they represent the concentrated results of much careful planning and deep thinking to provide practical, useful facilities which South Dakotans have indicated they want and need. Every recommendation points to a dollar-stretching plan for improvement.

"Needed new facilities in agriculture alone at SDSU make up what some might consider a formidable list. These include laboratories for veterinary research and animal disease diagnosis, poultry science facilities, a meats laboratory, more land for crops and livestock research, greenhouses, a classroom-office addition to Agricultural Hall, competition-meeting salaries, new positions to meet expansion.

"It would be a physical (and fiscal) impossibility to fill all these needs immediately but an ongoing and continuous program is essential. They must be included in the over-all picture now in order to show that South Dakota State's progress is being planned in a logical, step-by-step manner.

"I am firmly convinced," concludes Bentley, "that people and their abilities plus resources and their best total use will make up the combination to give South Dakota a bright and rewarding future." □



spent on
research

gives you
returns of



In dollars and cents, how much does agricultural research benefit the economy of South Dakota? How much does it cost? What "return" might you expect from money spent for agricultural research? Actually, research is a mighty good investment. For only a few examples of how it pays see page 34.

Agricultural Experiment Station
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O. G. Bentley, Director
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