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South Dakota State University

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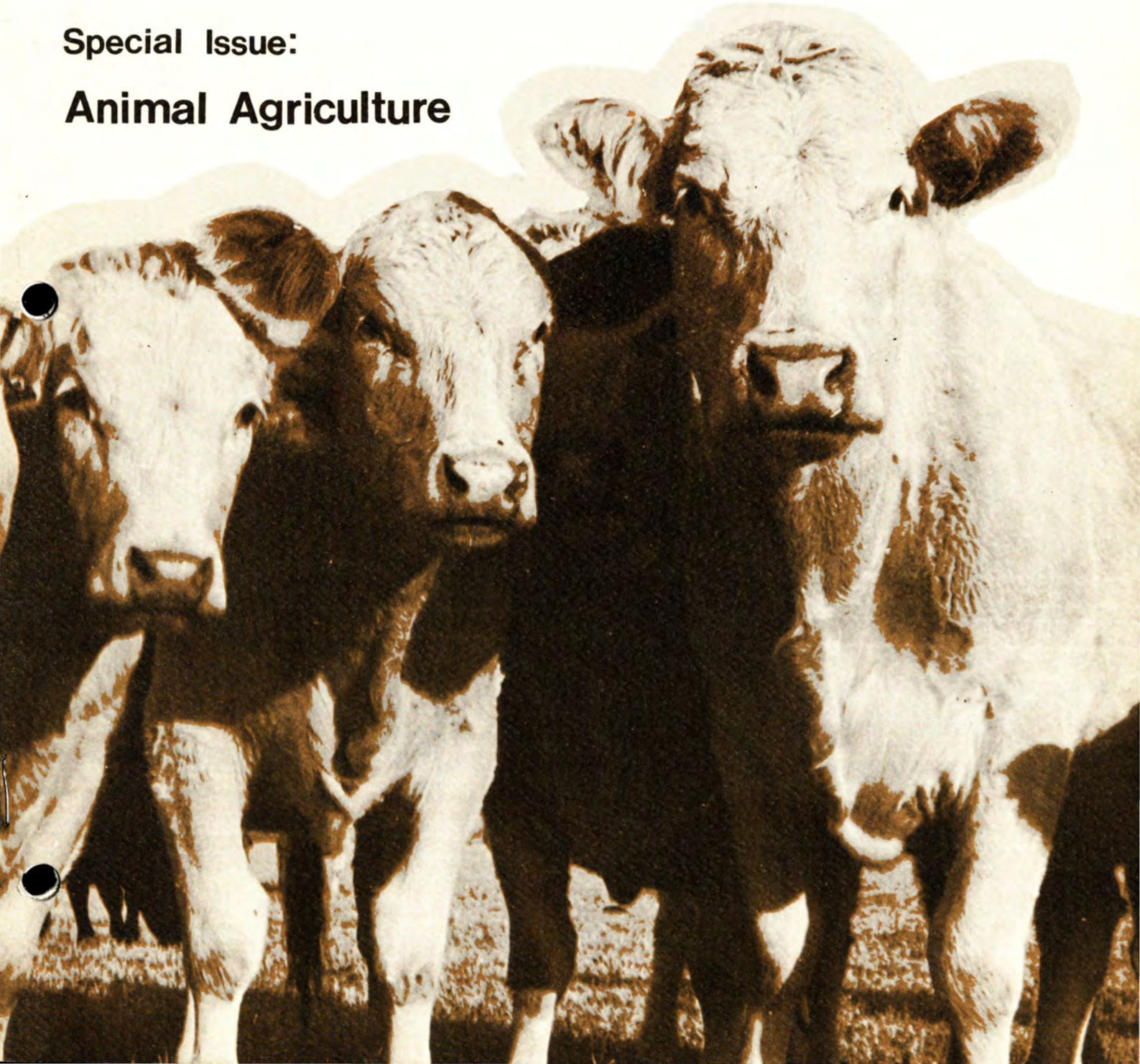
Special Issue:

Animal Agriculture



ANIMAL SCIENCE DEPARTMENT

Animal Science Building

Name	Area of Specialization
Harold Tuma	Department administration and Meat Science
Wendell Carlson	Poultry nutrition
Chris Dinkel	Beef cattle breeding
Lawrence Embry	Ruminant nutrition
Les Kamstra	Ruminant nutrition
Paul Kohler	Horse management and external parasites
Dick Luther	Beef cattle nutrition and marketing
Rick Wahlstrom	Swine nutrition
Boyd Bonzer	Poultry
Leon Bush	Beef and sheep management
Bob Gartner*	Range management
LaVerne Kortan	Swine
James Lewis	Range management
Walt McCarty	Coordinator, undergraduate curriculum
Bill McCone	Coordinator, departmental units and feed units
Joe Minyard*	Beef and sheep, administration
Charles McPeake	Beef cattle
Bill Costello	Meat research
Gene Deutscher*	Beef cattle reproduction and management
Dan Gee	Livestock evaluation
Ed Guenthner	Poultry nutrition
Herley Miller	Sheep
George Libal	Swine nutrition
Phil Plumart	Computer programs and flock record analysis
Gerry Kuhl	Ruminant nutrition
Lowell Slyter	Sheep and reproductive physiology
Steve Waller	Range management
Mick Crandall*	Beef and sheep
Mike Brown	Beef cattle production

* West River Research and Extension Center, Rapid City

Courtesy Appointments

Jim Bailey	Animal Disease
Walt Morgan	Poultry breeding
Royce Emerick	Nutritional diseases of livestock

CHEMISTRY DEPARTMENT

Station Biochemistry Section— Animal Science Building

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Royce J. Emerick	Nutritional Diseases of Livestock
George F. Gastler	Analytical Services
Yvonne A. Greichus	Pesticide Research and Analysis
Andrew W. Halverson	Analytical Services and Nutrition
Lawrence C. Novotny	Analytical Services
Oscar E. Olson	Biochemistry of Soil, Plants and Animals
Ivan S. Palmer	Selenium Metabolism
Deborah Pravecek	Selenium Analyses
Nancy J. Thiex	Analytical Services
Eugene I. Whitehead	Amino Acids and Radioisotopes Studies

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Serving the people of South Dakota through Teaching, Research, Extension

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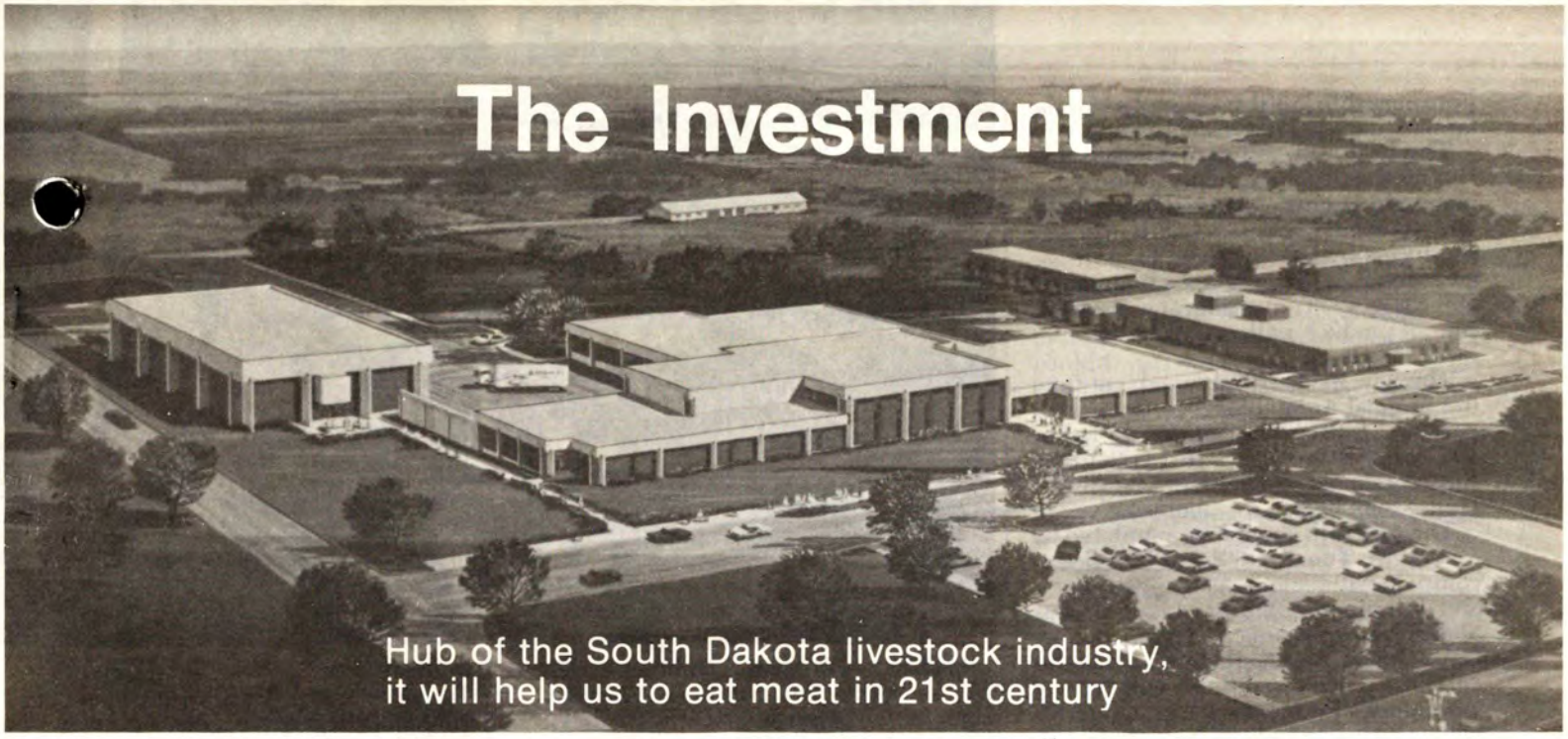
The Investment



Hub of the South Dakota livestock industry, it will help us to eat meat in 21st century

Lee Jorgensen
Ag News & Features Editor

When Dr. Hilton M. Briggs, president emeritus of South Dakota State University, gave the keynote dedicatory address for the new $4.6 million animal science complex May 6 (capping off South Dakota's first formally declared "Animal Agriculture Week") he predicted, "The facilities will soon return dividends.

"These new facilities will make it physically possible for the staff to use sophisticated research approaches that they could only dream about until now . . . just one more pound of calf produced per breeding cow or one more pound on each of the pigs produced in South Dakota will pay the bill in less than 6 years, not to mention the increased monetary worth to the state of hundreds of students coming from the program in the same short time," he said.

Vern Fritz, Huron, member of the Animal Science Development Council, used the words of Dr. William Pfander, head of the University of Missouri Animal Husbandry Department, "Animal diets for the year 2,000 will have to begin with basic research programs started in 1980, applied research programs started in 1990, and developmental programs started in 1995."

Board of Regent member Celia Miner, representing SDSU, noted that the facility "improves the total educational and learning environment. In the long run, that will improve the quality of life in South Dakota."

Harold Tuma, head of the SDSU Animal Science Department, said, "We look at this animal science complex as the hub of the livestock industry in South Dakota."

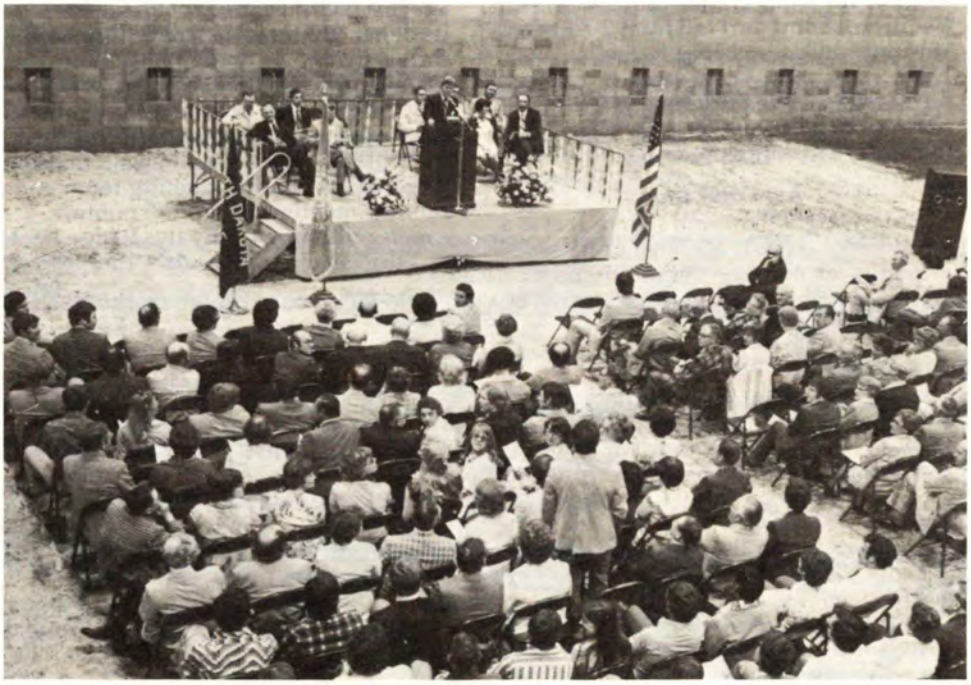
Three times larger

Just what kind of gift did the people of South Dakota entrust to South Dakota State University on May 6?

The new complex includes meat labs, classrooms, research labs, livestock Extension specialists, and Experiment Station and biochemistry personnel in some 98,000 sq ft of space plus a 100 x 188-ft livestock arena. Construction of a $980,000 research feed mill is set to start this summer and will complete the animal science complex.

The new facilities are three times larger and more completely equipped than those vacated in four separate buildings.

The arena will be used primarily for teaching and Extension functions including livestock field days, Little International, judging contests and other livestock-improvement oriented events. Introductory animal science laboratories and all livestock and evaluation judging courses, production course labs, and



horsemanship are also scheduled for the arena.

The feed mill, to be constructed this summer north of the SDSU campus along old Highway 77, replaces a 1921 structure and "will serve all livestock producers by helping them to more completely utilize their concentrates and forages," Tuma said. The old unit cannot produce pellets, flaked corn or liquid feeds.

The new feed mill, although cut from the original Animal Science Complex package in 1974, was approved by the 1977 Legislature with a 16-1 vote in the Appropriations Committee, 64-3 in the House and 30-4 in the Senate.

The feed mill should be completed by May 1978. Tuma said the mill will not compete with commercial operations and will support SDSU and Experiment Station research projects only.

Among the new facilities added to the animal science capabilities will be laboratories for meat science, range management and physiology studies plus individual feed trial units for beef, sheep and swine research.

The facilities will also aid some 35 research projects now being completed with all species of livestock and various disciplines including breeding, nutrition, physiology, meats and management.

The Animal Science Complex will also be able to seat more than 200 students at one time, plus provide additional study and resource environments for animal science instruction. The Animal Science Department enrolls more than 260 undergraduate and 25 graduate students, a 50 % increase in the last 10 years, the largest enrollment in the SDSU College of Agriculture and Biological Sciences.

The complex was funded with $1.6 million from the Higher Education Facilities Fund derived from 20% of all student tuition and fees in South Dakota's seven colleges and universities. The additional $3 million came from a general appropriation from the state legislature.

A guided tour

Ninety-eight thousand square feet is a lot of space—about the area of 81 average-size homes—so if a visitor wants to find his or her way around where does he start?

Walt McCarty and Wendell Carlson, professors of animal science, have been in charge of the tours. Here's how they or other animal science staff members would have greeted you in May when more than 2,000 persons toured the facility:

Good Morning. The building you have just entered from the main entrance on the south is divided into five areas. The lobby gives you access to all these areas.

On your left are the animal science offices and immediately in front of you to the north are the offices and laboratories

of station biochemistry, a unit which has a close working relationship with animal science. On your right are student areas. Classrooms are further east down the hall. Down the hall on your left are the large animal laboratories, and at the far end of the building on your left is the meat science area. Studies are being conducted in the building right now on small animals, ruminant and non-ruminant animals, and on the reproductive physiology of all kinds of animals.

Farmers and ranchers with crop and feed specimens for analysis can bring their samples to station biochemistry from the back where there are loading chutes for all sizes of trucks.

A new livestock arena is located in another building adjacent and to the northwest of this facility.

Two arena-type classrooms each seating 98 students, can be opened by a folding door for a mass class of 198 students. Both rooms are equipped for slides, overhead projections, and telelectures.

Across the hall are are a conventional classroom and an area wired for computer assisted teaching and research terminals, a faculty meeting room and another meeting room for students, which will be used by the Range Club and the Block and Bridle Club.

No more corn stalks on the desk

But what do these facilities mean to science?

Science is exacting. That is, another scientist should be able to repeat an experiment and end up with similar results to those of the first scientist. The new facilities should allow scientists at SDSU to do this with greater accuracy than before.

For example, there now is a sample receiving room in station biochemistry where corn stalks submitted for protein, nitrogen or nitrate tests can be brought in. They used to be plopped down on Dr. Oscar Olson's desk.

There are dust hoods in almost all of the laboratories. Dust will contaminate samples and affect test results. This was especially troublesome in studies involving trace metals in very, very small amounts.

There are safety facilities such as hoods for volatile perchloric acid in both departments.

Station biochemistry has an emergency shower and an emergency eyewash in the event of a chemical accident.

There is a glass blowing room for making laboratory glass ware.

There is an area to mix feed formulations.

There is a cage room and a separate equipment wash-up room for small animals in Station Biochemistry. Stainless steel cages which reduce contamination were given to the chemistry section by the poultry science unit.

The reproductive physiology surgery room and the viewing arena above the abattoir (or slaughter room) are other additions that allow the students to climb out of their textbooks and see firsthand what things are about.

There also are viewing ports for visitors to the ruminant and non-ruminant research areas. In both areas temperature control is an absolute necessity. Temperature control is built in to the new facilities, so now SDSU scientists no longer have to be concerned whether the results of their metabolism trials are due to temperature variations or due to experimental treatments.

Range research has moved out of the converted chicken coop at the Cottonwood Range Field Station into a modern laboratory where the work can be more precise and used and seen by the students.

In other words, the facilities help to up SDSU animal science researchers for the work that needs to be done if we are to eat meat in the 21st century.

Teamwork

It brought the building to reality, and it'll push us past $2 billion in total ag income

Delwyn D. Dearborn
Dean of the College of Agriculture
and Biological Sciences

It takes people working together to produce outstanding results, and that is especially true if animal agriculture is to reach its full potential in South Dakota.

The state celebrated its first Animal Agriculture week May 1-7. Highlighting that event for us was the dedication of the new $4.6 million animal science complex at South Dakota State University on May 6.

There are four significant points facing animal agriculture in this state: (1) Animal agriculture is very, very dynamic (or in a state of rapid change); (2) Animal agriculture is important to other populations as well as to South Dakotans; (3) Animal agriculture has room to expand even more in South Dakota; and (4) Growth and development of animal agriculture will depend on a team effort.

A recent article in the Wall Street Journal told about live steers being shipped by air cargo from California to Tokyo, Japan, to overcome a high import duty on carcass beef. Even though freight charges averaged about $600 per head, it was possible to ship live cattle, slaughter them in Japan, and make a profit because of the high present demand for beef by the Japanese consumer.

The numbers of beef weren't great in those shipments—only 2,000 live steers—but compared to the 70 head shipped the year before, it was a rather dramatic increase. It will be interesting to see what happens in the future.

Animal agriculture is changing very rapidly.

Though animal agriculture is our state's major economy, it is also very important to populations living outside the state. For example, in addition to producing the beef needed for South Dakota's 680,000 people, this state's livestock producers provided enough for an additional 6 million people (based on the nation's current average annual consumption).

South Dakota produces enough pork for the population of South Dakota plus 7 million additional people. It produces enough lambs for this state plus 12 million additional citizens.

If we return to the normal growing seasons that we experienced between 1971 and 1975, we have enough raw material in this state to improve that picture even more.

Each year during that period between 1971 and 1975, this state exported about 2.6 billion pounds of grain (corn, oats, barley, sorghum and other feed grains) and a little over a billion pounds of hay.

It takes about 1,760 pounds of roughage and about 2,760 pounds of grain along with 280 pounds of supplement to finish out a 450-pound steer to a market weight of 1,100 pounds.

If we kept that billion pounds of forage in this state and fed it to some of the feeder cattle that we export and used those feed grains and supplements, we could finish out to slaughter an additional 612,000 head. We export somewhat more than that number of calves each year for other states to feed out.

This would still leave us with about 921 million pounds of grain left over. If we could just assign all of that to the pork industry, we could feed out an additional 1,245,000 head of market hogs each year in this state (it takes about 740 pounds of grain to produce a market hog, including the feed needed by the sow to produce her pigs).

So you can see, we have a tremendous capacity to increase the production capabilities of this state.

There are other possibilities for increasing reproduction efficiencies, growth rates, and feed efficiencies. What will further stimulate expansion in these areas is the potential for profit and the pride of individual ownership by the producer.

In addition to the increased technology that we here at SDSU can help provide in identifying some of the ways to improve feed conversion, reproductive capabilities and sources of feed, growth in this industry will require help from many sectors of our economy, including allied industry, growers of feedstuffs and the marketing industry. In other words, it will require a team effort to push ourselves past the $2 billion mark in total agricultural economy for this state.

Cooperation, or people working together, is a very, very important ingredient to realize these goals which will keep this state competitive with agriculture in other states.

Aspen

Tree to chips to red meat to steaks, it serves as emergency livestock feed

Les Kamstra
Ruminant Nutrition

We must be resourceful. Our "natural" resources are becoming scarcer every day, while waste products mushroom in dumps, along roadsides, in the water and air.

If we are resourceful enough, we can use some of these wastes—crop residues, saw mill wastes, fiber processing wastes, and even standing but uneconomic trees—in other industries.

High feed costs and low cattle prices are severely testing South Dakota's agricultural economy. But researchers, hunting for alternatives in feeding methods as well as in feeds themselves, are beginning to show that certain wastes can themselves become resources.

Waste fiber research is new in South Dakota. It's slow and difficult because even yet, turning a "sow's ear" into a "silken purse" takes time. Oddly enough, these wastes must be available in sufficient and continual amounts for use in sustained feeding programs. The interest shown in this research by no less than two dozen federal, state, and private groups indicates the importance of our fiber research, however.

The most abundant renewable feed on earth

The ruminant animal is one of the ways these wastes can be processed. Mainly, these include beef and dairy cattle and sheep. The ruminant with its multi-unit stomach can use cellulose (roughage fiber) which is the most abundant, naturally renewable feed material on earth. Resident bacteria in the rumen (part of the animal's digestive system) break down these high-cellulose wastes into meat and other animal products.

Better methods of preserving our more valuable roughages is one phase of this research, while finding and using alternative roughage sources is another. This is especially necessary when traditional roughages are in short supply during droughts. Wood wastes potentially are a large source of fiber for ruminant feeds. But inherent nutrient deficiencies must be corrected and natural barriers to animal digestion removed, mainly through economical processing procedures that provide a product competitive with the conventional roughage. A 3-hour chemical treatment developed by SDSU cooperatively with Colorado State is one result of research that makes a highly lignin encrusted fiber such as ponderosa pine in sawdust form readily digestible by ruminants.

Various percentages of ponderosa pine sawdust were successfully used as a roughage for cattle rations in SDSU research several years ago. (At the time sawdust was not in a competitive price position with hay.) Sawdust is a lumber industry byproduct. It takes up space for storage or becomes a smoke pollutant if burned. A single mill in western South Dakota may produce more than 20 tons of waste fiber (sawdust) daily.

SDSU researchers have used ground-up mature aspen wood in a 2-year study with cattle. Whole aspen tree material was used in various feeding experiments ranging from maintenance to finishing rations.

"Calves in good shape"

These preliminary studies with aspen and ponderosa pine indicate these fibers (cellulose) can be used as feeds if properly supplemented or treated. Two hundred stock cows were wintered (1976-77) with aspen based rations and compared to cows on mixed hay in a demonstration on the Robert Healy ranch near Pukwana. Three rations were compared: an aspen:alfalfa (60:40) pellet, an aspen silage (88.5% aspen: 10% corn: 1% limestone: 0.5% urea), and mixed grass hay.

The alfalfa:aspen pellets were easiest to feed. They showed best results and under 1976-77 drought conditions were the most economical.

"I'm satisfied, the calves are in good shape and the pellets were easiest to feed," is how Healy summed it up.

County agent Delmer Moore who helped with the project agreed, adding, "the aspen mixture offers great opportunities but we need more verification research."

Ranchers from as far as Montana and Nevada, a race horse nutritionist from New Jersey, and several zoos have inquired for additional information relating to using aspen in animal feed.

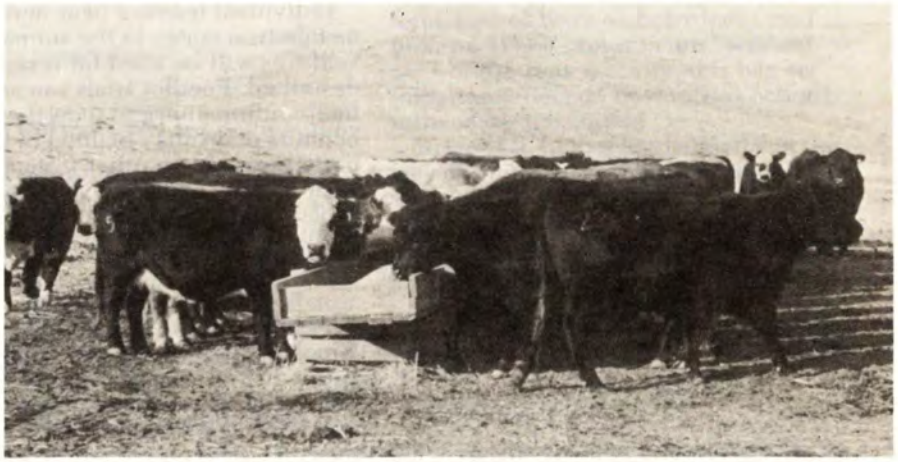
Previous research at Brookings indicated that aspen might have a place as a roughage in growing and finishing rations. For example, average daily gains of 2.68 lbs for a 36% aspen-soy growing ration mix compared with 1.26 lbs daily gain from a comparative 93% alfalfa ration. No researcher maintains that aspen will replace conventional forages, but its potential now is known as a possible ration component in emergency situations.

A harvestable crop

One question is frequently asked: what about the source of aspen. A Forest Service inventory shows that South Dakota has about 28,000 acres of pure aspen stands not being harvested for any commercial use. Other adjoining states have more than 3 million acres of aspen trees for potential harvest for feed or fiber. Aspen is one of the most widespread of trees. Estimates indicate that an acre of mature aspen could produce enough fiber to make up half of a ration for 50 head of cattle for a year.

South Dakota aspen stands are mainly mature trees 60 years old or older and may be lost if not regenerated by harvesting or burning. The South Dakota

Game, Fish, and Parks Department originally contacted the Agricultural Experiment Station waste fiber research project when mature aspen trees were cut in the Black Hills. Regeneration from roots of the trees would provide improved wildlife habitat, especially for ruffed grouse. SDGF&P sought a use for the cut aspen trees in the experiments.



Calling a halt to pine needle abortion

Other Black Hills trees have a far more unpleasant role in ruminant nutrition.

Pine needle abortion results when cows graze the pine needles in foothill pastures. Young are aborted, and infection in the cow results in loss of reproductive potential.

Severe losses have often been reported.

Added facilities of the Animal Science Department are expected to help solve the riddle of pine needle abortion because animals can be contained in quarters suitable for controlled studies.

Thus far, the fractions within the needles possessing the abortive factor have been isolated, and many sub-fractions containing more specific chemicals have also been separated for biological studies with small animals.

At least one major pharmaceutical company is closely monitoring this research.

A complete research project combines feedlot and individual-pen studies

Feedlot Nutrition

L. B. Embry
Ruminant Nutrition

Performance in the feedlot is the ultimate test in nutrition experiments.

Comparison may include source and level of nutrients, type of rations preparation, additives, implant treatments, and management systems. Measures of performance include rate of gain, feed intake, feed efficiency and effects on carcass characteristics.

Digestion trials, balance trials, and individual feeding trials, requiring close monitoring of feed or nutrient intake on an individual basis, are designed to find out what use an animal makes of the nutrients in the ration. In this type of research, it may be necessary to collect feces and urine to determine difference in intake and outgo of nutrients. Rumen contents and blood may be sampled to determine type of fermentation taking place and absorption of the nutrients. These procedures may require not only data on individual feed intake but also data relating to changes in time the animal consumed the feed.

Individual feeding pens and metabolism crates in the animal science facilities will be used for research as described. Feedlot trials can serve as final confirmation and show the practical benefits of results obtained in the more basic research. In other instances, the basic studies will serve as followups, to explain the basis of responses obtained in the feedlot.

Feedlot facilities

Feedlot facilities on the main station at Brookings are comprised of 52 pens for cattle and 48 pens for sheep. The pens are designed for up to 10 head of cattle and 12 head of sheep. Cattle experiments are generally conducted with 6 to 8 head per pen and sheep experiments with 8 to 10 head. In each case, treatments are generally replicated three or four times.

Bulls, heifers, and steers

This project was initated to compare performance of bulls and heifers and to determine effects of castration of bulls and spaying of heifers. Response to hormone or hormone-like products—diethystilbestrol (DES), melengestrol acetate (MGA), zeranol, Synovex-H and Synovex-S—were studied.

Current research in this area is involved with feedlot performance of the Hei-Gro uterine device and Synovex-H each alone and in combination as compared to a nontreated control. Studies will be made by this group on the effects of treatments on estrus cycles and development of the reproductive tract as determined upon slaughter of the animals.

Protein utilization

The need for supplemental protein depends upon stage of growing and finishing and the type of ration. Protein requirement as percent of the ration decreases as the animals grow and fatten. Many common finishing rations composed of a high percentage of corn grain show little, if any, response to protein supplementation, especially when the roughage portion is alfalfa hay or haylage. On the other hand, low quality, low-protein roughage may reduce total protein content of the ration to the point when supplemental protein is needed.

Considerable emphasis has been devoted to studies with urea under various dietary conditions. Cattle and sheep unaccustomed to urea show reduced weight gains for periods of a few weeks, generally 2 to 4, when first offered urea. After becoming adapted to urea, performance has been about equal to animals fed soybean meal when rations contain liberal amounts of grain or corn silage.

Research has been devoted to studying ways whereby the reduced performance might be eliminated or minimized. Feeding no urea during initial feedlot adaptation followed by a urea supplement appears advisable especially for young animals subjected to stress of weaning and shipping. Lower levels of urea during initial adaptation appears to reduce the problem.

Current research is involved with effects of previous nutrition on response to urea supplementation.

Rumen fermentation

Research in this area has been concerned with ways to improve feed utilization. Emphasis for the past 3 years has been with monensin (Rumensin).

Rumensin generally results in an improvement in feed efficiency of 10 to 15% with high roughage and high grain rations. There is a reduction of about the same order in feed consumption with essentially no effect on weight gain. Evidence is inconclusive at present as to effect on protein requirements and utilization of nonprotein nitrogen.

Feed preparation and storage

Our research has shown that grinding or rolling of corn grain does not improve feedlot performance in comparison to whole grain when finishing cattle are fed rations with 80% or more corn. At lower levels of corn, there was generally some benefit from processing the corn.

High moisture corn was generally equal to, or slightly better, than dry corn on basis of feed efficiency. High moisture corn appeared to have more advantage over dry corn when fed with higher roughage rations and with haylage in comparison to hay.

Current research is devoted to feeding value of oat forage fed as hay or haylage and the value of processing oats fed at various levels in the ration.

Single-Animal Nutrition

Metabolism crates and modern labs enable scientists to close on basic nutrition problems

While there are many aspects to livestock feeding, the diet itself is of prime concern to several folks who work in the nutrition labs of the Animal Science Department.

Feedlot performance of cattle and sheep is usually measured in terms of rate of gain or pounds of feed required to make a pound of gain. Why certain rations, feed additives, or certain management techniques make feedlot performance fluctuate is of primary concern to the men and women who make up this part of the Agricultural Experiment Station staff.

Richard Luther, professor of animal science, says that the new facilities are especially suited to handling the much more sophisticated problems faced by South Dakota livestock feeders today.

While studies in the past have been concerned primarily with group feeding of animals, there is a growing interest in how these things affect individual animals. The new facilities are well equipped to utilize this approach.

All in one place

Pens of tubular steel in the new facility can hold 8 head of cattle and 16 sheep on fully slatted floors. Animals can be put in a stanchion and restrained for periodic sampling of blood and rumen contents.

Feed consumed or undigested feed residues excreted by the animal can be easily collected and analyzed in the same building. Samples are taken immediately to a nearby chemical laboratory for processing and storage. Through this procedure the quality and content of materials fed is compared with excreted material to determine how digestible the nutrients are in the ration consumed.

This capability becomes much more important as scientists delve deeper into the basic nutrition questions: How does an animal make use of a specific feed, an additive, or a drug, and what happens to these ingredients and to the animal as it works its way through the digestive process. How do these things affect digestibility? What are the biochemical and physiological effects, and how do they affect the health and well being of the animal?

Answers to such questions require complex tests and sophisticated equipment.

A protozoa "washout"

A typical example of the type of study that Luther and his colleagues are talking about is one involving the digestion of high-energy feeds. Research has shown that high-energy feeds and finely ground diets pass rapidly through the alimentary tract of cattle and sheep—so rapidly, in fact, that they take the tiny one-celled protozoa out of the digestive cavity at a rate faster than they can be reproduced.

Protozoa are absolutely essential to the feed breakdown process. They play a role in the formation of fatty acids and ammonia, which are involved in the first stage end products leading to the formation of body carbohydrates and protein. When protozoa are "washed out" of the rumen cavity, this has an important effect on how feed is actually utilized by the animal.

In fact, Dr. Luther has learned that the lack of protozoa can alter the amount of short-chain fatty acids, lactic acid, ammonia nitrogen, and rumen pH levels. Even the nitrogen balance and blood urea nitrogen levels are affected.

So scientists continue to study protozoa populations in the rumen of cattle when they are fed various levels of

roughage and concentrate. These studies may have a dramatic effect on future feeding recommendations.

Vitamin A

Another high-interest area of study concerns vitamin A utilization. Feeding trials have been conducted at the James River Valley Research and Extension Center at Redfield. In addition to the traditional data such as rate of gain and feed intake, samples of blood were taken periodically and liver tissue was collected at slaughter time and analyzed in the laboratories. A similar experiment was conducted on vitamin A depleted sheep.

This work showed that methods of administering vitamin A could be evaluated more precisely by looking at vitamin A levels in circulating blood and at storage levels of vitamin A in the liver than by simply checking feedlot performance.

The capability of the animal science nutrition laboratories plays a major role in providing analytical support for such studies.

Teaching

You have read about animal research that could change your lives. There's another program of the Animal Science Department that is just as important.

That's people—the students who have had classes with and worked in the labs beside nearly all of the researcher-teachers whose work is reported in this magazine.

Over half of these young people take their animal science knowledge with them into careers as farm or ranch operators or managers.

That's the finding of a survey among graduates who completed their bachelor of science degrees at SDSU August 1975, December 1975, and May 1976.

Of 55 animal science graduates, 25 (46%) returned to farms and ranches—mostly family operations. Another 4 (7%) accepted management positions in livestock operations. Almost 13% went into agribusiness—banking, livestock feeds and chemicals, and sale representatives for seed corn companies.

Public agency positions attracted 9% to the Bureau of Indian Affairs, Farmer's Home Administration, Federal Meat Grading Service, and the Cooperative Extension Service.

Seven percent became teachers, while 5% entered graduate study in animal science. Only two graduates were still considering opportunities at the time survey responses were summarized.

Current graduates will have similar opportunities. The demand for animal science graduates will remain strong, says J. W. McCartey, coordinator of the undergraduate program.

Swine

Temperatures and drafts, which seriously affect accuracy of weanling research, can be controlled

Rick Wahlstrom
Swine Nutrition

When he's growing up, an average young pig is watched over by his owner and maybe the farm cat and a flock of sparrows.

But hundreds of people checked out the first little pigs to be put into the pens in the new Animal Science building. An experiment was in progress even before the building was dedicated and the tours of the facility began.

Promising picture for Spear oats

This first experiment was a study of the value of different levels of high-protein Spear oats in diets for early weaned pigs weighing approximately 18 lbs. The diets were equalized in lysine content, as this is the amino acid most deficient in cereal grains. Spear oats contains about .65% lysine and corn only .25%. Using Spear allows a reduction in the amount of soybean meal or other protein supplement needed in the ration.

All levels of oats up to 50% look very promising, although the final data have not been cleared. Those little pigs are now out in lots, and a new group is under scrutiny.

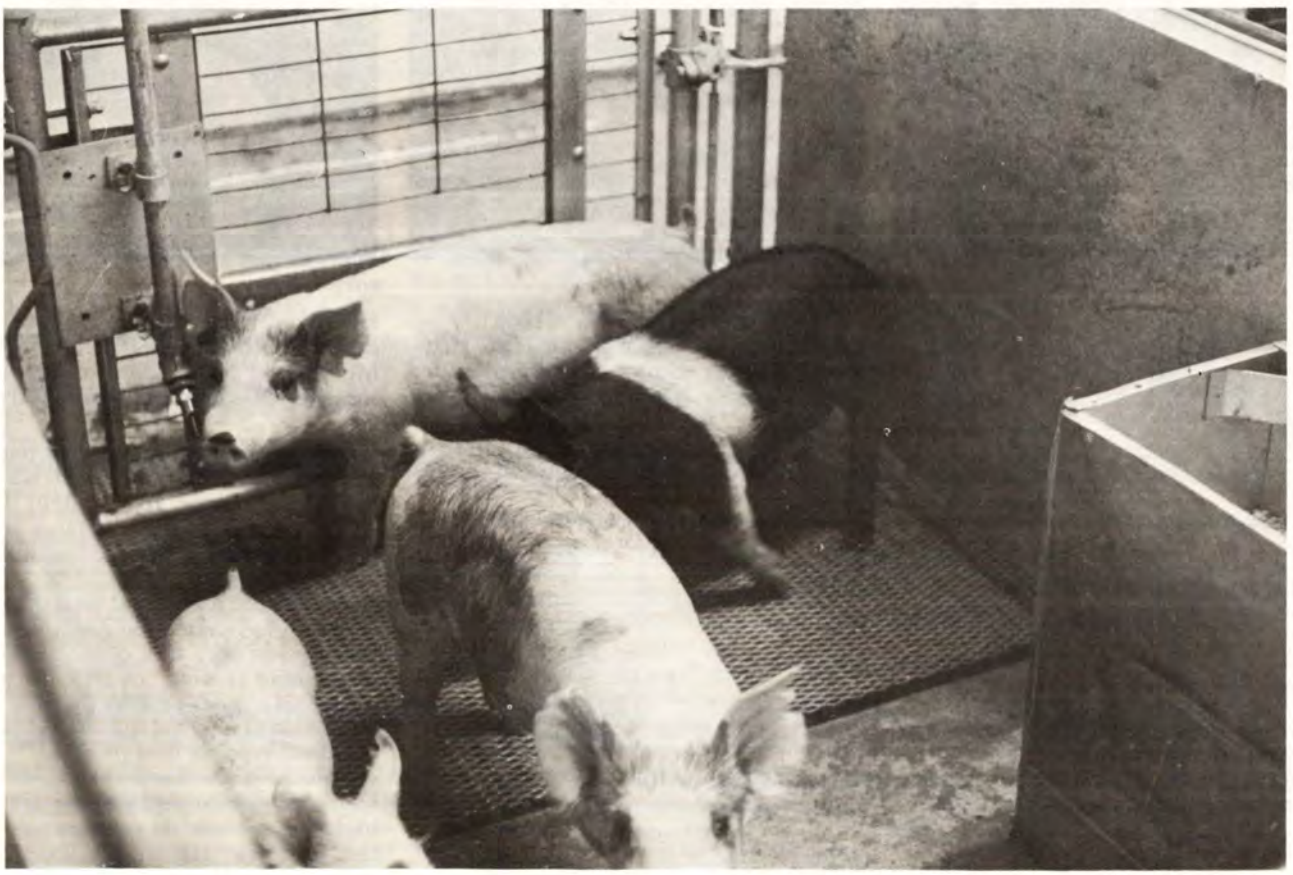
Before this, we couldn't study young pigs so exactly. They are extremely susceptible to temperatures and drafts, but the new facilities control these variations. This means that our research will be more reliable and useful for the producer.

It will also be possible to start pigs on experiment at an earlier age and study the effect of very early weaning and the nutritional requirements of pigs at these early ages when fed dry diets.

Rations of older pigs also on trial

Feeding of the sow to regulate gains during gestation is being studied under different feeding management systems. Gilts and sows are being hand-fed limited quantities of normal gestation rations (corn-soybean meal-mineral rations) and compared to self-feeding a ration consisting of only alfalfa pellets and a free-choice mineral supplement. Comparisons of the energy requirements of gilts and sows, and the value of a chelated iron supplement in brood sow diets are other experiments in progress.

The growing-finishing pig is being used to study the effect of different protein levels fed during early growth and the compensatory growth obtained when adequate protein is fed later. Research is also being conducted on the protein quality of various feed ingredients, particularly alternate feed sources which might be satisfactory for



optimum pig performance on a more economical basis. Feed sources that have been or are being investigated are blood meal, high lysine corns, and high protein oats. Other experiments with growing-finishing pigs are concerned with the effectiveness of various feed additives as growth promotants.

Digestion and metabolism trials will also be conducted to study how feed ingredients and various nutrients affect pig performance. It will be possible to conduct more basic research to determine why certain substances cause different pig responses.

862

Newer corns can cut protein supplement needs

A pig will make a hog of himself over corn, it's said.

It's true that corn has long been considered one of the best feeds that can be included in swine diets. It is an excellent energy source; the pig, of course, finds it tasty; but it isn't enough to live on.

The main fault of corn is that it contains protein of a poor quality that won't support normal growth unless fed with adequate protein supplement. A deficiency of the amino acids lysine and tryptophan (building blocks of protein) is responsible for the poor protein quality of corn grain.

Some newer corn varieties are 50 to 100% higher in these two amino acids. SDSU researchers R. C. Wahlstrom and G. W. Libal are conducting research with high-lysine varieties to determine their value for pigs, using corn with the mutant genes "opaque-2" and "double mutant" (a combination of opaque-2 and floury-2 genes).

High-lysine corn to cut feed costs

In experiments with early weaned pigs weighing approximately 20 lbs, they found no difference in performance when 18% protein diets were fed. However, if the protein content of the diet was reduced to 16%, pigs fed the high-lysine corn gained faster and required less feed than those fed normal corn.

In fact, the performance of pigs fed 16% protein high-lysine corn was equal to that of pigs fed 18% protein diets.

Similar results were obtained with heavier weanling pigs using diets of 14 and 16% protein.

Wahlstrom and Libal said their research indicates that feeding pigs high-lysine corn that contains 0.4% lysine could reduce by 25% the amount of soybean meal or 40% protein supplement needed in swine diets. One hundred pounds less protein supplement are needed in each ton of feed and can be replaced by 100 lbs of high-lysine corn. At present prices, the feed cost per ton would be about $8 less.

Poultry

For years we've assumed growers need 16% protein in their diets

C. Wendell Carlson
Leader, Poultry Research

A single project at the poultry unit could save the South Dakota poultry industry about a quarter of a million dollars a year in feed costs and at the same time free about 960 tons of protein for other uses.

Over the years, a 16% protein ration has been accepted as the requirement for a grower diet for layers. Work at the poultry research unit has shown that 12% protein is adequate for raising egg production pullets from 10 to 20 weeks of age.

A 12% protein diet of 50% corn, 30% oats, 10% alfalfa, 4% soybean meal, and the balance of minerals and vitamins cut the cost of the ration about $10 per ton on the feed bill for the 10-week period.

The savings could amount to about a quarter of a million dollars when based on four million layers raised in the state.

The low protein in the grower diet doesn't affect egg production. Layers grown on the low-protein diet laid and lived just as well in the laying house as birds raised on high-protein diets.

One of the problems encountered using a low-protein diet has been cannibalism, but this was brought under control through the use of the oats and alfalfa meal.

Feed costs are 70% of total production costs

Rising production costs and lower average returns per dozen eggs during 1976 have reduced the South Dakota poultryman's return to labor and management by better than one-half, compared to the previous year.

Extension poultryman Phillip Plumart cites figures from a 5-year summary of SDSU's computer flock record program. Cooperative flockowners submit their operating and fixed cost figures along with their income data to the program during a 12-month period.

The summary showed a substantial reduction in return to labor and management from 11.40 cents a dozen in 1975 to 5.31 cents a dozen in 1976. The reduction came from a 3.06 cent a dozen increase in total production costs and a 3.03 cent a dozen decrease in average income.

Feed costs the main reason

The increased production costs were caused by two major factors. One-third of the increase came from increased pullet costs, while rising feed costs accounted for the other two-thirds of the increase.

Initial pullet costs increased 16 cents during the last 12-month data period and 26 cents over the 5-year total period. Salvage value of old hens—used in chicken soup and pot pies—increased 5 cents from 18 to 23 cents over the last year. Subtract the 23-cent salvage value and a 6-cent charge for insurance and interest, and you get a net pullet cost of $1.79 for 1976, an 11-cent increase from 1975.

During 1971-72, feed costs accounted for 56% of the total cost of production. The 1975-76 data period showed feed costs at 70% of total production costs.

Fixed costs have actually gone down from 2.40 to 1.55 cents per dozen during the last 5 years. This is probably due to less depreciation now being charged to flocks as the buildings and equipment increase in age.

The 5-year summary indicated a slight increase in flock sizes, from 8,581 to 9,409 birds per flock. The poultryman's return to labor and management varied from a negative 0.63 cents per dozen in 1971-72 to a high of 13.74 cents per dozen in 1973-74, back down to 5.31 cents per dozen in 1975-76.

Because of its immensity, and because it feeds our livestock, it's one of our most valuable resources

Rangeland

Steve Waller
Range Management

Rangeland—not much more than endless and uninteresting grass to the uninformed interstate tourist.

But where he stops for the night, and back home, that grass may be ultimately served up to him on his dinner plate as red meat.

More than half of South Dakota's land area is rangeland. It is one of our most valuable resources. Livestock grazing is its largest single use, which is why the new animal science building contains range management labs.

Rangeland, of course, has other uses—for prairie hay production, wildlife habitat, water storage, and watershed protection. With care, these other uses can be coordinated with livestock production for increased benefit to the individual operator and society.

"Take half, leave half"

The drought has emphasized the necessity of proper management of rangeland. The additional stress of drought coupled with overgrazing magnifies the results of inadequate grazing management.

The rule of thumb that we emphasize is to "take half and leave half."

The half that is left is not wasted; it provides an adequate base for forage production the following year.

Grazing research at the Range and Livestock Experiment Station, Cottonwood (75 miles east of Rapid City) has evaluated the benefits of proper use and of range condition. These are long-term studies started in 1942.

During the drought year of 1976, summer pastures were grazed June 1—Aug 30 with Hereford x Angus yearling steers. Pastures in fair range condition were stocked at .33 Animal Unit Months per acre (AUM's/A or 2.1A/steer month), while those in low excellent range condition were stocked at .42 AUM's/A (or 1.67 A/steer month). Average daily gain per steer for the summer grazing period was 1.4 lbs for both pastures grazed at proper use.

Results indicated that pastures in fair range condition are much more productive when grazed for proper use, especially in dry years, than when overutilized. Pastures in fair range condition are less productive of steer gain than those in low excellent range condition, especially during drought.

Searching for a speedy diagnosis

The pressing problem which has not yet been overcome is how to quantitate range productivity. We need a rapid and comprehensive way to analyze range and its nutritional value.

This system could be used to measure the results of experiments more quickly and economically, thus permitting more research to be accomplished per dollar invested. It could allow better prediction of total forage production, optimum season of use, proper stocking rate, metabolizable energy removed by grazing animals, grazing animal production, and net return.

This kind of system for measuring the response of range to various treatments is absolutely necessary for reaching optimum net ranch income and optimum use of public lands. It is one of the first problems that will be worked out in the new laboratories.

The improved facilities supplement our rather crude field labs at Cottonwood and the West River Research and Extension Center at Rapid City. The new lab will permit more detailed study of forage production and nutritional value, and the laboratory evaluation of factors influencing range productivity. There will be some facilities to evaluate ground level and aerial photography.

The range management program will benefit from the operating room for the preparation of animals with esophageal and rumen fistulas, from the metabolism room, feed preparation room, and the improved facilities for chemical analyses and meat evaluation.

Reproduction

One more pig doesn't sound like much. But see what it can do

Lowell Slyter
Reproductive Physiology

One more pig weaned per litter would bring an additional $16 million into the South Dakota economy. A 5% increase in the state's calf crop would add approximately $12 million. A 20% increase in the number of lambs weaned would generate approximately $3.8 million.

These figures are only sales revenue at weaning at the farm level and do not include related increases as a result of more sales.

Average national statistics reveal that about 7.15 pigs are weaned per farrowing, 80 to 90 calves born per 100 cows, and 95 lambs saved per 100 ewes.

Other studies show that as high as 50% of all potential gametes produced by the female after reaching puberty fail to become young weaned animals. Reproductive efficiency of farm animals is low in terms of live animals marketed per female in the breeding herd.

How much profit, then, has the producer lost? How much feed has he forked or shoveled to breeding stock which isn't breeding?

The major objective of this section is to increase the reproductive efficiency of farm animals. That involves such aspects as the number of females in estrus, ovulation rate, conception rate, embryonic mortality, and fetal and postnatal death.

Births by the clock

One way to increase reproductive efficiency is to time the birth.

This benefits the operator several ways—from getting a full night's sleep without missing a delivery and perhaps losing the young or even the mother to picking up early signs of trouble in his herd because he's more closely working with it. He can plan and concentrate his labor for specific times of high-frequency delivery.

A high percentage of beef cows and sheep will respond to hormone injection to induce parturition, our trials have shown. However, the cows tend to retain placentas as a side effect of the treatment.

The new Animal Science facility will allow us to investigate the physiological mode of action on a more precise basis. We may be able to clear up this problem. Now we can house large animals under conditions where we can obtain frequent or continuous observations.

We also currently are investigating several factors that affect puberty and lifetime productivity of ewe lambs. The new experimental surgery laboratory provides us the capability to monitor ovulation rate and blood hormone levels as well as the usual field data (lambing percent, etc.) which we normally obtain.

The reproductive physiology laboratory will expand both the undergraduate and graduate teaching programs. For example, we now have adequate storage facilities for slaughterhouse specimens to aid in teaching the reproductive anatomy of the reproductive system (male and female) of beef, sheep, swine and horses. This is an important aid in instructing artificial insemination, pregnancy testing, etc.

Confinement Sheep

Changes in lamb rations, limit feeding ewes will give even greater profits next time around

Lowell Slyter
Reproductive Physiology, and
Herley Miller,
Extension sheep specialist

There's profit to be made in raising lambs.

SDSU animal science researchers from both the Agricultural Experiment Station and the Cooperative Extension Service have been working with a commercially managed feeding unit to demonstrate the merits and profitability of a modified confinement system in western South Dakota.

The demonstration on a commercial feeding operation (Cheyenne Feeders, Edgemont, managed and partly owned by Robert Cator) combined various successful research techniques and management practices on approximately 1000 head of ewes in a situation where there was almost unlimited housing (old army buildings) on several thousand acres of land.

Other factors were predator-proof fencing around the perimeter and personnel with experience and interest in sheep production.

Objectives of the project were to: (1) determine production level expected, utilizing a relatively large flock under commercial management; (2) determine the manpower required for a sheep enterprise of this nature; and (3) determine the capital required for animals and the expected return from a well-managed sheep enterprise.

139% lamb crop marketed

What the project demonstrated was that, indeed, sheep can be profitable in South Dakota. Return to investment, after taking out feed, labor, medicine and shearing costs, was just under $9,000.

A labor charge of $9,500 was allowed for four men alternating 12-hour shifts during a 46-day lambing period. One man was figured on a 70% basis for 11 months. Under a family situation consisting of a husband-and-wife team, the $9,500 is one of the expenditures th could be added to the return.

Feed was purchased, so actual feed costs were represented. Other management practices could increase that profit picture.

Of the 986 aged Western whitefaced ewes that were exposed to rams in late September of 1975, 910 lambed, representing a 92% lambing rate. That was lower than normally would be expected, but they were old ewes of which 81 died during the year.

Using aged ewes is a departure from the practice in western South Dakota where most sheep are normally run on range. This requires strong, healthy sheep with good teeth, so ewes 5 or 6 years old are sold to eastern South Dakota producers where lambs are produced in more sheltered conditions on grain or silage rations.

A 143% lamb crop was alive at 48 hrs after birth. Sixty of the surviving 1,299 lambs were raised as orphans. A 139% lamb crop (1,266 lambs) was marketed.

The death loss in the ewes was mainly due to age. No losses were attributed to predators due to the confinement lambing and lamb feeding and a completely fenced pasture.

Less beet pulp, more protein

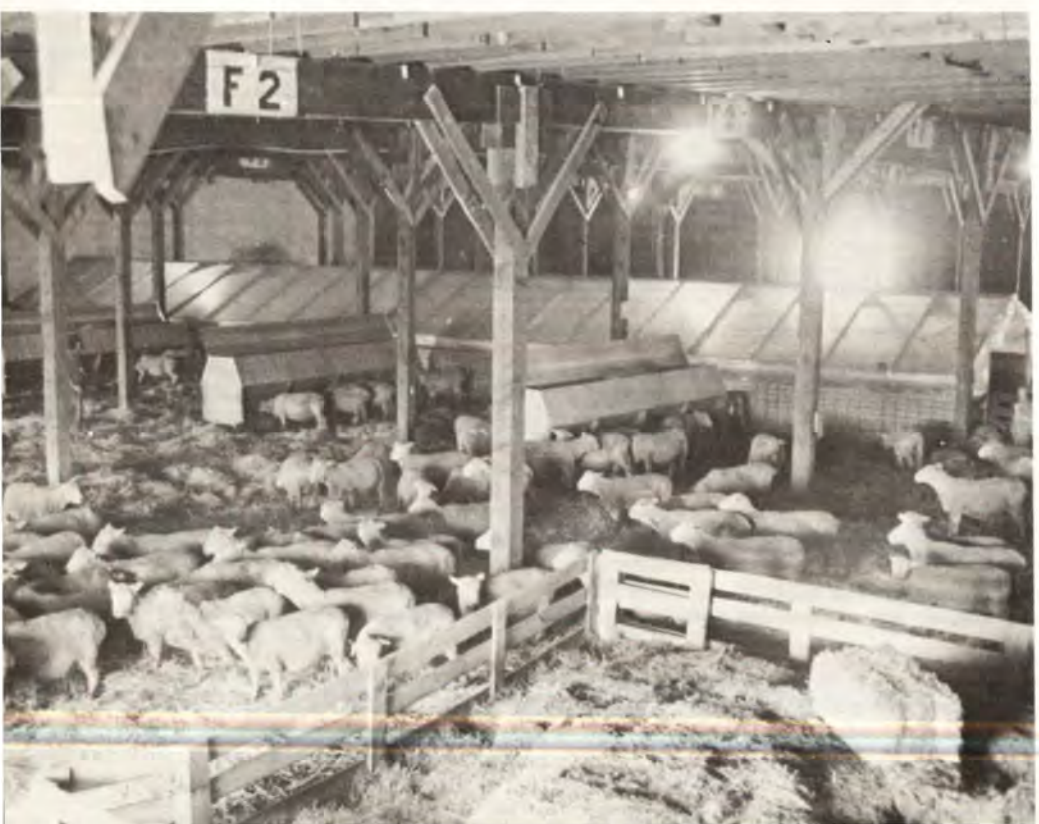
Lambs were marketed at 84 lbs, lows weights than was expected. Considerably more profit could have been realized if the lambs had weighed an additional 10 to 20 lbs more. The low market weight likely was due to a low protein ration and to high levels of beet pulp, especially in the creep feed (which decreased the consumption of the ration).

There would likely have been more profit through limit feeding the ewes. Feed costs of the ewes also would have been considerably less if the ewes would have been flushed just one month prior to breeding, as recommended instead of continued on grain feeding during the gestation period.

Major problems recognized by Dr. Cator in the operation were with marketing systems and market fluctuations. They also were not able to adapt to a limited hay and grain feeding system in confinement.

This year, however, several changes will be made in a continuation of the demonstration. Ewes will be given adequate bunk space and will be limit-fed grain and ground hay with a dump truck instead of self-feeders. This should represent a considerable savin in feed consumption by the ewes.

Lamb rations also will be changed. Beet pulp will not be fed in creep rations, and protein content will be increased during the early feeding period.



The lambs were marketed at an average selling price of $49.64 per hundred weight with an average price per lamb of $41.80. Ewes were shorn 2 wks before lambing with a wool clip of 12.6 lbs per ewe and sold at 60 cents per lb grease price.

Feed for the ewes, flushed starting Sept. 5, 1975, with ½ lb of corn per day per ewe, represented the largest single cost for the year. This level of grain was fed during the entire gestation period. The ewes were brought into the sheds and maintained until weaning, receiving dehydrated alfalfa, corn, molasses, and beet pulp ration containing a high level of salt to control consumption in self feeders.

The average feed consumption during this time was about 6 lbs of feed per ewe per day. Hay was hand fed. The ewes consumed 658,340 lbs of total feed while in the sheds (this also includes the corn fed during the flushing and gestation period) for a total cost of $29,902.31.

Lambs had access to a 13% protein creep ration starting when they were about one wk of age. The creep ration was 23.25% oats, 5% corn, 25% dehydrated alfalfa, 40% beet pulp, and 6.75% of a commercial 32% protein supplement. The lambs were finished on a series of rations starting at 12.5% protein, decreasing to 10% protein when marketed.

Lambs consumed an average of 2.01 lbs of ration per day from the time they were started on creep until marketing. Average daily gains for this period were ⅓ lb. Lamb feed costs were $14,517.88, medicine was $355.70, and shearing costs were $838.10.

Sheep can make money where other stock can't

Sheep, man's earliest domesticated animal, are adaptable to all parts of South Dakota.

They are economically produced in the range flocks in western South Dakota and in the farm flocks of eastern South Dakota. This wide range of adaptability is primarily due to their simple ration of pasture and grain, low investment in animals and equipment, and the demand for meat and wool.

South Dakota, at 686,000 head in 1976, presently ranks fifth in the United States in the number of sheep and lambs. Last year there were 66,000 lambs on feed, which ranked our state 11th in this category, according to the SD Crop and Livestock Reporting Service.

County Extension agents in at least five counties hard hit by drought and a cattle selloff have been encouraging farmers to improve their cash flow picture by increasing sheep production.

A survey circulated in Hyde, Hand, Sully, Hughes, and Faulk counties showed interest in sheep production was high.

In Hyde County, 13 respondents presently not raising sheep requested 2,300 head of ewes. Four producers wanted 450 additional ewes. This would show an increase in sheep numbers for Hyde County of about 33%.

An increase in ewe numbers of just 5% statewide would represent an increase in lamb receipts of about $1.5 million.

In addition to lamb receipts, additional ewes would also increase wool production.

During the 1975-76 production year when some livestock enterprises were losing money, a sheep enterprise was still quite profitable.

For example, when a 125% lamb crop is marketed, the producer can expect a minimum net profit of about $11 per ewe under present market conditions. Boosting the lambing percentage kicks the net profit picture up rapidly.

Meat Science

Here's where the consumer and his needs are linked with research and production

Bill Costello
Meat Research

The meats lab of the Animal Science Department is one of the bridges between the consumer public and the livestock producer.

That consumer contact is more than the Friday meat sales. It's also taste panels, where consumers test various meat products and tell us which they like best. It's teaching—home economics students, homemakers, FFA students, and our own majors.

It's research in slaughtering, chilling, cutting, curing, and storage.

Two-way exchange

South Dakota benefits more from meat research than most states. Because what we learn from meat research benefits not only the consumer. It gets back to the producer, too.

Our animal nutritionists and geneticists can help livestock growers achieve more efficient animal production when pounds of edible meat produced and/or meat palatability evaluations are included in research interpretations. The resulting efficiency in production benefits the state's economy. The increased flavor and acceptability of meat cuts also help consumers' pocketbooks.

"Meat science" is relatively new in agricultural terminology. Historically, the meat product data collected by animal researchers represented a measure of treatment effectiveness much the same as final live weight, height at withers, or total feed consumed. Meats data was one of several indicators of genetic improvement, feed additive effectiveness, increased reproductive efficiency, or response to environmental differences.

It is still all that. But, during the present generation, meat science has expanded to include investigations of meat chemical composition, muscle and meat anatomy, and muscle function or physiology as they relate to meat characteristics. Meat science today includes studies on protein and fat formation and their control mechanisms in animal tissues.

Basic meat anatomy, chemistry, and physiology are presently being used not only to provide end-point data for livestock production research, but also to help consumers more effectively use meat animal proteins, increase flexibility in meat distribution, and give greater satisfaction and convenience for all meat consumers.

The carcass and product data collection in support of projects throughout the Animal Science Department is continuing, as in the past. The new facility also allows us to try some different things.

Finding "tough" meat

One of them is a rapid tenderness screening technique for beef carcasses.

Even in a lot of carcasses graded "choice," one or two will be tough. If the packer could guarantee that all carcasses in a particular lot were of the same tenderness, he could market them under a premium price.

Our approach to this problem is a modification of the shear technique.

"Pre-chewed" steaks and roasts

Another area of research activity is meat cuts fabricated from flaked meat.

Flaked tuna you're familiar with. There's even flaked chicken. You have also been eating flaked beef in some of the large fast-service hamburger chains across the country.

Flaking is a method of breaking down meats that have previously been utilized only as ground meats and sausage products. This means that the lower value cuts can be raw material for the production of fabricated steaks and roasts.

You could compare the flaking machine to something like a super grinder. It's capable of throwing out flakes of meat no more than 1/32 of an inch thick. "Throwing" because the method is centrifugal—which keeps bone chips from going through the knives.

The resulting product is nearly "pre-chewed," but it has the bite and mouth feel of intact meat. Fat and almost any other additive can be put in to enhance the product.

The technique is being used, but there are some problems we are working on. One is distortion during cooking. We are also looking at other variables in the cooked product.

Some people may object to the sameness in these fabricated items. But the method will increase the overall return from meat animals and thus be more economical for both producer and consumer, it will increase the variety of meat items for the shopper; and most important, it will provide greater eating pleasure for the consumer.

The new meat science facility was designed to provide space for processing and laboratory equipment. New research activity will stress processing and packaging of meat products. Consumer demands continue to stress convenience, quick preparation, and variety. Through processing research, the value of less popular meat items can be increased.

Beef Breeding

Partnership between researchers and producers has built a progressive livestock industry

Chris Dinkel
Beef Cattle Breeding

The beef cattle breeding-management section has a long history of working closely with the South Dakota cow-calf producer. Together they have shaped the beef industry.

Production records

In the late 1940's and early 1950's the SD Livestock Production Records Association came into being with department members providing an important part of the stimulus. Notable among these was Henry Holzman, who continued to influence the development of the organization over the years until he was followed by Del Dearborn, Joe Minyard and Mick Crandall. Dearborn is now the dean of the College of Agriculture and Biological Sciences at SDSU. Minyard and Crandall are Extension livestock specialists at Rapid City.

In the early to mid-1950's the bull leasing program of the Experiment Station was initiated by Chris Dinkel who was soon joined by Minyard. This developed into a statewide demonstration project in which research data were gathered. At the same time producers had available local demonstration projects which influenced them in appreciating the value of weaning and yearling performance records and their use in selecting replacement stock.

This project developed in the late 1950's into a sizable postweaning evaluation when the Agricultural Experiment Station started buying sample sire groups at weaning to be fed out at the main station in Brookings.

From 1958 to 1968 approximately 60,000 calves were weighed at weaning in producer herds throughout South Dakota and some 1,200 calves fed and slaughtered. This project provided postweaning growth and carcass data which could be used as demonstrations back in the county by Extension agents. The figures were also used nationally to lead the beef industry in the direction of increased efficiency of production and leaner, more desirable carcasses.

Grass tetany studies

In the early 1960's, Dearborn and Minyard conducted studies on grass tetany that were carried out entirely with producer owned cattle. This work produced results that are essentially 100% effective and are used nationwide. Prior to this discovery, losses had been as high as 10 to 20% of the cows in some herds in the hardest hit southwest corner of the state.

Crossbreeding work

In the late 1960's and early 1970's staff members and producers began crossbreeding to increase efficiency of production in commercial herds. Simumate, the computerized crossbreeding simulator, helped match the crossbreeding system and the breeds involved to the management and feeding practices of the individual cow-calf unit in order that high producing cattle are not used in marginal operations where their production potential will not be supported. This area is backed up with research projects directed by Gene Deutscher at Cottonwood, Deutscher and Dinkel at Antelope, and Mike Brown and Dinkel at Brookings.

At the Antelope Range Livestock Station the Simmental x Hereford and Angus x Hereford two breed rotation crosses are being compared to the straightbred Hereford as systems of beef production. The first three calf crops involving only the Simmental x Hereford and straight Hereford indicated an 80-lb advantage at weaning to the crossbred system.

Efficiency studies

In the late 1960's producers sold foundation stock to the Experiment Station to establish a study of efficiency of the beef cow.

Herds of straightbred Angus, straightbred Charolais, and the reciprocal crosses of the two breeds were established and a program of individual feeding of cow and calf was inaugurated. The consumption of the cow from weaning to weaning and of the calf from birth to slaughter enables the evaluation of the feed required to produce a pound of calf at weaning and the feed required to produce a pound of retail cut.

From this the industry has learned that big cows produce enough extra pounds of calf to offset their increased

maintenance requirement. Thus, cow weight does not influence feed required to produce a pound of calf at weaning.

This work has also established that the commonly used ratio of calf weight to cow weight is not the optimum measure of efficiency. Prediction equations for estimating efficiency to weaning have been developed.

Drylot calf creep feeding vs no creep

Over a 6-year period, creep-fed calves raised under drylot management were significantly heavier than non-creep calves at weaning by 105 lbs. This advantage also carried over through the feedlot with heavier slaughter weights, heavier carcass weights, and higher carcass grades.

Sire effects on calf production

A 3-year comparison of calf production of Angus-Hereford crossbred cows bred to either Angus, Hereford, or Charolais bulls showed that Charolais sired calves were significantly heavier at birth and at weaning and gained faster in the feedlot which resulted in heavier slaughter and carcass weights. Angus and Hereford sired calves had similar production through weaning, feedlot, and slaughter.

Calf production under pasture and drylot

A 6-year study comparing calf production under native pasture vs drylot management showed that pasture management produced heavier calf weaning weights at less cost than drylot management. Percent calf crop weaned was similar between the two management systems.

Nutrition level of replacement heifers

Four research trials on 550 replacement heifer calves have shown that a high nutrition level during the first winter after weaning will allow heifers to exhibit estrus earlier and conceive earlier with a higher conception rate than lower levels of nutrition.

Calf production from these heifers/cows is being followed over a 5-year period to determine effects on total productivity.

Calving difficulty in 2-year-olds

Calf birth weight and the size of the heifer's birth canal (internal pelvic area) are the two most important factors affecting calving difficulty, shows a study on 650 2-year-old heifers of various breeding.

Breeding yearling heifers to bulls which produce small calves at birth and selecting replacement heifers for large pelvic size are methods for reducing calving difficulty.

Calf production of crossbred cows

First-year results of a 5-year study comparing the calf production of Simmental-Angus to Hereford-Angus cows showed a 64-lb advantage in adjusted calf weaning weight for the S-A cows with no difference in percent calf crop weaned between the groups.

Effects of flushing on conception rate

Preliminary results of another study show no major effect on conception rate by feeding a high-energy cake to cows 30 days before breeding and 20 days during the breeding season when cows are on good spring pasture.

New copper study

A study of possible copper deficiencies involving private herds has been initiated in the northwest corner of the state under the direction of Deutscher, Jim Johnson, agronomist, James H. Bailey, and Royce Emerick. Bailey is Extension veterinarian, and Emerick is a biochemist.

The first year's results were varied, with some indications of possible deficiencies under certain conditions.

Another recent area of study involves growth promoting implants with Minyard, Crandall and Brown conducting the studies in several private herds. Results are still to come.

Early weaning

Bill McCone at the Brookings Station has studied early weaning of calves and has recently completed an experiment evaluating the effect of feeding MHA to lactating beef cows.

Paul Kohler has a longtime history of cooperative research with producers in the area of controlling insects (principally horn flies, lice, and grubs) that affect livestock. This work originated self-applicating devices including back rubbers and dust bags for horn fly control. New treatments and products continue to applied in this fashion. This study first demonstrated the pour-on and insecticide in feed or mineral treatments for grub control.

"The section is proud of their past accomplishments and particularly the record of working with the producer in achieving a more efficient production system. Production efficiency will receive high priority as will continued cooperation with the producer," says Dr. Harold Tuma, head of the Animal Science Department.

Biochem

Direct service to citizens, assistance to other scientists, animal and human health are their chief concerns

Eugene Whitehead
Professor, Station Biochemistry

Last summer drought ravaged South Dakota farmers and ranchers sent over 1,000 corn and forage samples to SDSU to be analyzed for nitrate levels. About 6% of those samples turned out to be high enough in nitrate that if the feed was used alone it could have caused sickness or death to animals. Of course, reports were sent back to producers in all cases.

Important work—you bet!

Yet those samples made up only about one-tenth of the analytical work performed last year by a small group of workers now housed in the new animal science complex. Together these people make up what is called the biochemistry section of the Chemistry Department (which is actually housed elsewhere on campus).

Much of what this group of scientists and support people is doing is of direct help to the livestock industry, but they also serve many other departments on campus and a variety of subject matter areas.

For example, they handle analytical requests required for the state-wide meat inspection program directed by the Livestock Sanitary Board. They analyze for heavy metals, strychnine, arsenic, copper, and related elements for the Veterinary Diagnostic Laboratory at SDSU. They diagnose certain aspects of problems related to mineral nutrition and metabolism and run checks for mercury toxicity.

Four people handle the task of providing analytical services for citizens of the state and for university departments: Andrew Halverson, Larry Novotny, Nancy Thiex, and Biruta Zarins. Part-time help is used to meet fluctuating work loads.

In addition, the biochemistry section handles six other research project areas:

Mercury in the environment

Studies were initiated because of the large amount of this material that has been released into certain streams from past mining operations.

Work so far shows that pheasants (which normally eat seeds) seldom exceed a level of .05 ppm (parts per million) mercury in the liver, kidney, or muscle. Meanwhile, fish eating birds usually exhibit much higher amounts, with cormorants averaging .64 ppm in the whole body and higher levels in the liver and kidney. R. J. Emerick is in charge of this project.

Mineral nutrition and metabolism in livestock

This joint project between biochemistry and animal science started out with the goal of finding the causes of a common feedlot disease of cattle and sheep called "urinary calculi." Losses that once reached 5 to 10% in many feedlots have been virtually eliminated.

The "stones" (urinary calculi) found in the urinary tracts of feedlot animals were found to be composed of calcium, magnesium, and ammonium phosphates. We know now that urinary phosphorus concentrations can be reduced to levels that will not form stones if phosphorus intake is reduced and a calcium to phosphorus ratio is maintained of about 2:1.

Additional protection can be achieved if animals are fed acid-forming salts, including ammonium chloride and calcium chloride, to counteract alkaline urine.

Recently attention has been turned to another problem called ruminal acidosis

in sheep and cattle. This condition is usually associated with a rapid change from high-roughage to high-concentrate diets, such as that experienced when changing from background feeding to the finishing phase of cattle feeding.

We have found that a gradual changeover in diet plus the use of buffering materials in the diet during the changeover period has reduced death losses. Emerick, chemistry, and L. B. Embry of the animal science staff are project leaders.

Winter hardiness of barley

This is a basic research project that is being conducted in cooperation with the plant science staff. D. G. Kenefick, who holds a joint appointment in the two departments, is project leader, and Eugene Whitehead assists.

Through this project we are learning more about those factors that are responsible for winter hardiness in the barley plant.

If these secrets can be uncovered, it may be possible for plant breeders to combine certain characteristics in new varieties that will make them adaptable to more areas of South Dakota.

Zinc and corn

The same two men are working on the role of zinc in growth regulation of corn. In this study we are trying to determine how zinc affects something called tryptophan synthesis. It is possible that the production of this naturally occurring amino acid, which is essential to the nutrition of animals, is being altered in certain inbred corn lines which show signs of "zinc deficiency."

PCB's

The physiological effects of polychlorinated biphenyls (PCB's) on animals is a project under the direction of Yvonne Greichus with assistance by Barbara Amman. Bird and animal tissues are checked for traces of PCB's; these chemicals do not break down readily in the environment. An evaluation is also being made of the effects of PCB's on brain tissues of certain animals.

Selenium

Across the country the biochemists at SDSU are well known for work done on what was once called "alkali disease" in farm animals. That project was initiated in 1929. Studies on various aspects of the problem have been continued over the years.

After 4 years of work it was learned that the problem was caused by selenium, an element that occurs naturally in certain types of soils. Plants absorb and concentrate the element. Animals eat the affected plants and develop typical signs of poisoning. Livestock will exhibit symptoms such as cracked hooves, loss of hair, emaciation, and poor reproduction performance. In poultry the most obvious sign is decreased hatchability of eggs due to malformed embryos.

Current studies are aimed at learning more about the precise relationship between geology and available selenium in soils. Biochemists here have found that linseed oil meal and arsenic will counteract selenium poisoning. Those findings have not helped range cattle producers much, but they do provide clues that may lead to other discoveries that will be useful for alleviating this perplexing problem.

During the past 20 years research work in this and other countries has not only established the fact that selenium is toxic or death producing, but it has shown that low levels of selenium are absolutely essential to the animal diet. It is now an authorized additive for certain feeds and it was work by biochemists and poultry scientists at our experiment station that helped make this possible.

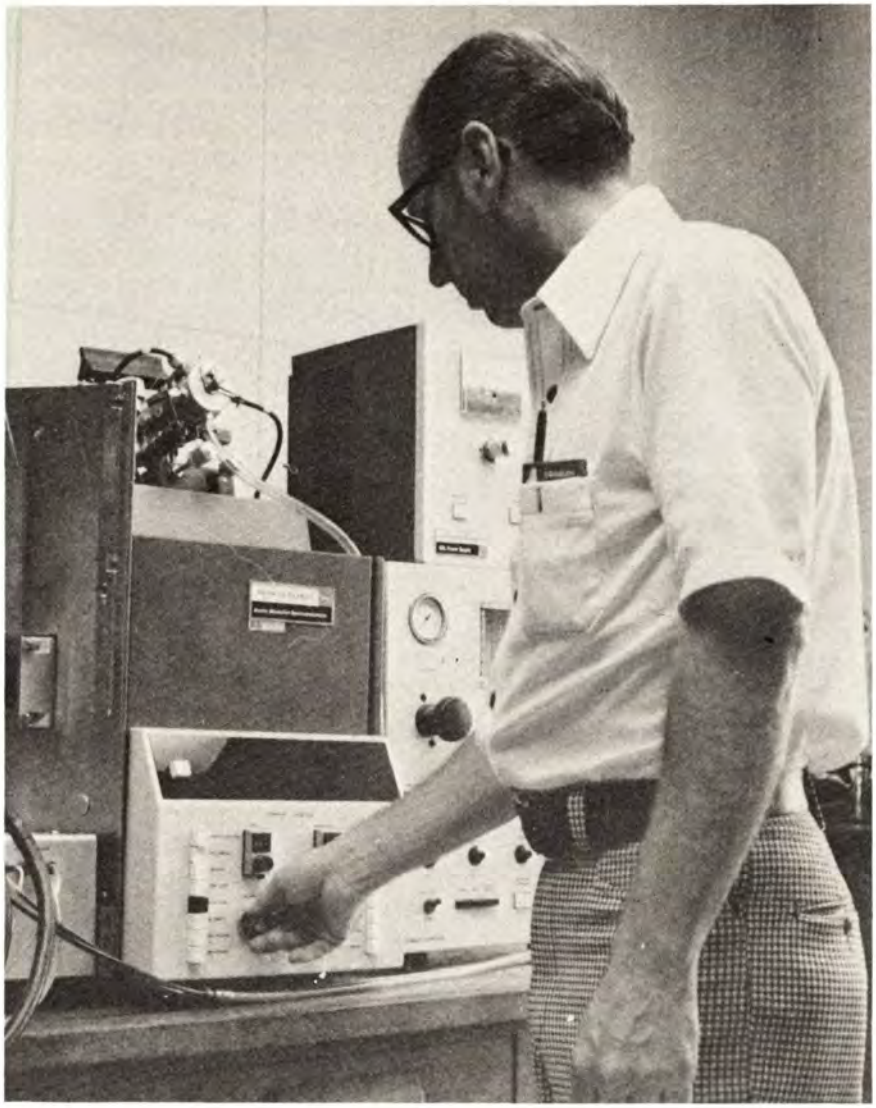
Present research is aimed at uncovering better methods of analysis for this element. One method developed here has been used by many other laboratories. By using rats, one key step in the process by which the animal body detoxifies selenium has been found. With the cooperation of poultry scientists, additional information on the manner in which tissues actually handle selenium is being developed. Slow but steady progress is being made on this problem

Whether man needs selenium has not been established, but it could play an important role in the human diet. New EPA standards for public water supplies have presented us with a need to survey selenium content in our state water supplies. Previously it had been assumed that South Dakota water sources contain levels below the maximum allowed, but recent data suggest that this may not be the case.

Much more work needs to be done on this problem. Current studies involve Oscar Olson, Ivan Palmer, A. W. Halverson (all in biochemistry) and C. W. Carlson (animal science); they are assisted by Deborah Pravacek.

While most of the analytical and research work conducted by our biochemists is very important to the livestock industry, it is obvious that much of the work has implications for improving environment and human health as well.

Whether they realize it or not, probably every South Dakotan has benefited either directly or indirectly from the work performed by this small staff of men and women within the Agricultural Experiment Station.



Publications off the press

The Agricultural Experiment Station and the Cooperative Extension Service distribute a large variety of publications to South Dakota citizens. Your county Extension office will have copies for you. These publications list the new subjects between August 1, 1976, and May 5, 1977.

FS 525A Chemical Weed control in Small Grains 1977
FS 525B Chemical Weed Control in Soybeans 1977
FS 525C Chemical Weed Control in Corn 1977
FS 525D Chemical Weed Control in Sorghum 1977
FS 652 Weed Control in Sunflowers
FS 655 Do You Really Want to Remove Crop Residue?
FS 656 Pheasants and Farming in South Dakota
FS 657 Constitutional Amendments—Perhaps You've Just Begun
FS 660 Pesticide Applicator - Training and Certification
FS 661 Shade Trees to Replace the Elm
FS 662 Small Grains for Forage
FS 663 Beef Referendum

EC 713 Alternative Policies for Preserving Lands for Agricultural Use
EC 715 South Dakota Constitutional Amendments
EC 717 Strengthening South Dakota's Tourist Industry

EMC 707 Protecting Trees from Animal and Bird Damage
EMC 712 Establishing Campsite Rental Rates Through Management Figures
EMC 726 Crepe Makers
EMC 727 Appliances - Slow Cookers
EMC 728 Appliances - Major Appliances
EMC 729 Microwave Oven Selection
EMC 730 Appliances - Irons
EMC 731 Appliances - Automatic Drip Coffee Makers
EMC 732 Appliances - Blenders
EMC 733 Appliances - Hair Care
EMC 734 Stalled But Safe
EMC 738 Creative Gifts
EMC 739 Sorghum Varieties and Hybrids

B 642 Grass Species and Variety Performance in South Dakota
B 644 Noodles . . . Naturally!
B 645 How an Oat Plant Develops
B 646 Crafty Carp Cookery
B 648 Bounty from the Bin

C 216 1976 Grain Sorghum Performance Trials
C 217 1976 Corn Performance Trials

AES 15 A Study of Parks and Recreation in South Dakota

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