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South Dakota Farm and Home Research

South Dakota State University

South Dakota Farm & Home

RESEARCH

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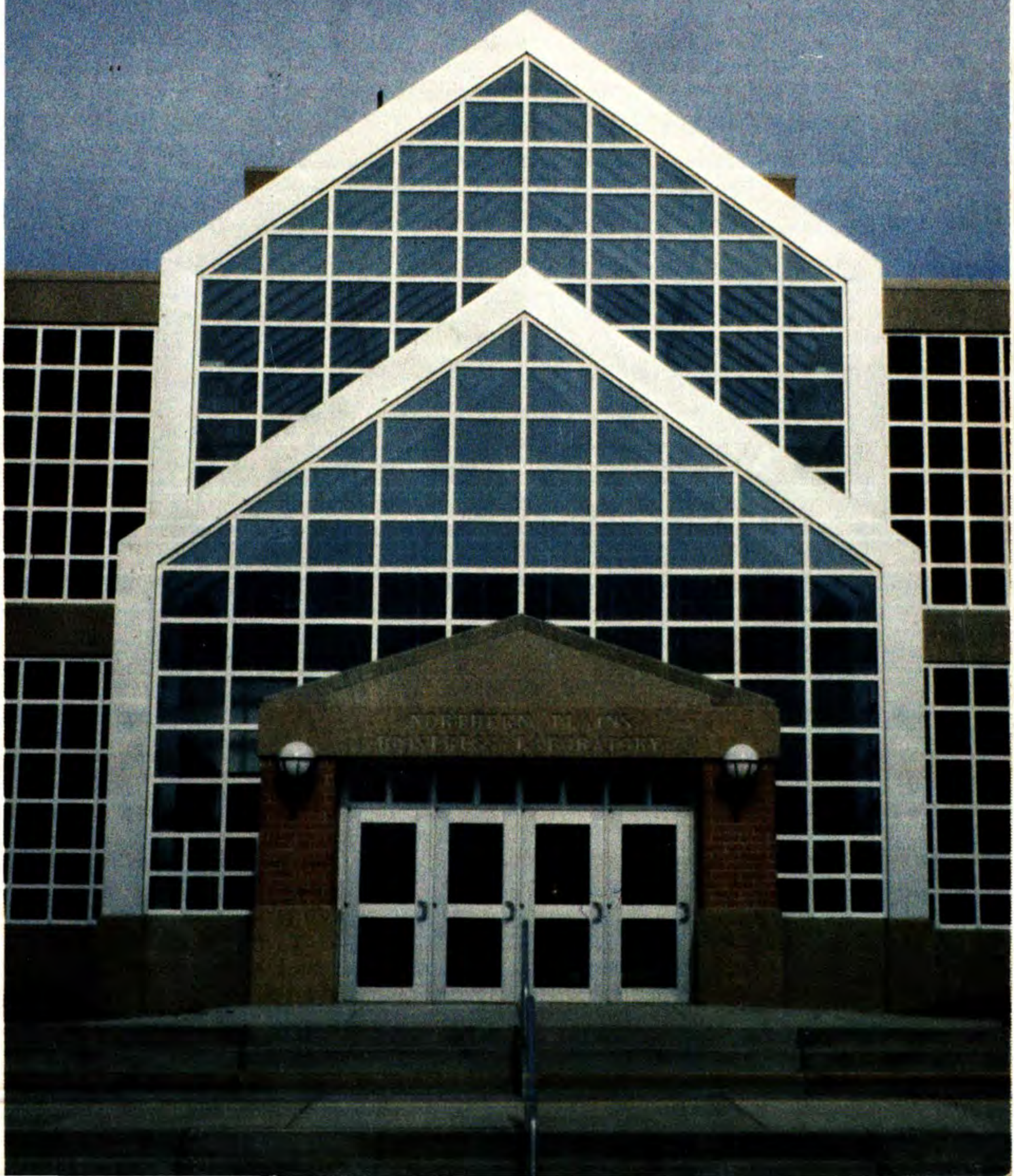

SDSU

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Scientists unpack boxes and set up equipment in the newly completed Northern Plains Biostress Laboratory. Some research projects have already begun in the new state-of-the-art laboratories. Projects that were once difficult for scientists to even contemplate will now be possible, thanks to the new facility.

photos: Gary Peterson and Ag Communications

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Welcome from SDSU's President

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Welcome to our Friends:

Just over 2 years ago we welcomed you to the ground breaking ceremonies for the Northern Plains Biostress Laboratory. And now, this fall, we welcome you to the dedication of a superb facility, fully equipped and furnished and ready to serve South Dakota and the region.

What we are dedicating, however, is more than a fine new facility. Today we are rededicating ourselves to our land-grant mission, the serving of students and citizens through instruction, research, and Extension. This laboratory and its associated programs mark our recommitment to high-quality undergraduate and graduate programs, to competitive research in areas important to South Dakota and our neighboring states, and to nationally recognized Extension efforts specifically directed to provide beneficial information to clients in our region.

We have waited for this event for over 14 years, and we are proud! This well-equipped facility includes laboratory, classroom, and office space for plant scientists and biologists and houses our Horticulture, Forestry, Landscape and Parks and Wildlife and Fisheries Sciences departments.

But even more important, this laboratory supports new agricultural technologies that help crops, livestock, and humans cope with environmental and biological stress, sustain soil productivity and assure profitable agriculture, preserve sufficient water supplies for the region, and guarantee a healthful environment for all life, including humans.

Thank you for joining us in this great celebration! Thank you, also, for helping us achieve this great goal. Thank you, even more, for helping us serve more effectively in the great tradition of land-grant universities.

Cordially,

Robert T. Wagner
President

photo: Virginia Coudron

Robert T. Wagner

Scientists at SDSU have been devoted to alleviating stress for over 100 years says Dean David Bryant. The addition of the NPBL will give current and future researchers a greater base of knowledge in combating environmental and biological stresses in South Dakota.

Dean's comments

Standing at the door to the future

Dean David A. Bryant
College of Agriculture and Biological Sciences

We stand at the door to the future as we dedicate the Northern Plains Biostress Laboratory. But inside the NPBL door is also the past—the "Dakota 1883" pediment that once capped the entrance to the very first building at SDSU. "Dakota," rising above the lobby of the NPBL, reminds us that what we do now in this new structure is built on the work of those who have preceded us at this fine land-grant institution. It reminds us that this University, this College, this building exist to serve you—to improve your farming and ranching operations, to improve your quality of life.

The NPBL confirms our commitment—to build on past successes and to go confidently into the future. But we stand in the present. How will this building serve us now?

It gives us space, so critically needed. It gives us tools, the latest and finest now available. It gives us, most importantly, "bioconnections." These are the opportunities that evolve when we can bring scientists from widely different disciplines together in one building where they can make the connections between, say, electron microscopy and test plot yield, protein chemistry and swine health, between the classical response to stress in cells with similar responses in tissue systems, organisms, and humans.

It gives us the opportunity to make fresh and original scientific breakthroughs, which happen when people from different scientific backgrounds examine a problem together. Why do we need these bioconnections? Because biostress is a fact of life in South Dakota. Since biostress disrupts life, we must alleviate biostress.

Biostress includes drought, floods, blizzards, insects, soil erosion, and a host of other environmental and biological impacts, catastrophic or subtle, statewide or home-sized in scope. Biostress affects humans, plants, and animals.

This year alone, we've seen many catastrophic biostresses, chief of which has been flooding in the eastern counties. On a daily basis are the biostresses we barely blink at: thistles springing up in a pasture because it's too wet to get in and fight them, washboard roads and bridges out, late—and poor—harvests. In South Dakota, biostress is the norm.

The objectives of the NPBL represent a collaborative approach never used before in the area of biostress. The objectives—as appropriate today as in 1883 but even more compelling—are:

- Finding new technologies that cope with environmental and biological stresses of major crops and animals.
- Sustaining soil productivity through farming practices that control erosion and minimize nutrient depletion.
- Protecting our water so that it meets quantity and quality standards for personal, agricultural, industrial, municipal, and recreational uses.
- Revitalizing rural South Dakota through the development of human and natural resources.
- Providing a healthful environment for humans.

Can one building and the people in it accomplish a reduction in biostress? The answer is an unqualified "yes." I can tell you why I feel so confident about this.

We have a standard to live up to. Our scientists devoted themselves to alleviating stress from the very first year the Station became an entity, 1887. The first biostress they mentioned was wind; it severely damaged the campus trees that had been imported from the banks of the Mississippi River.

Since then the standard has led us on. We have made key discoveries in every corner of the state relating to environmental or biological stresses in crops, livestock, and humans. Our research stations scattered about South Dakota attack, and often conquer, biostress where it occurs. The NPBL will provide a greater base of knowledge to these stations and to you, for you will be shown how to directly apply many of these new findings to your own operations.

The key to the NPBL is people. We have high quality faculty already at SDSU and we are already attracting valuable people to South Dakota on the strength of the biostress-research opportunities we are creating. We have students who now have a more challenging education ahead of them. And we have the many good people of South Dakota to serve and who will give us their comments and guidance.

The NPBL will succeed because of the commitment of these people. We were able to gain support for the new lab from political and agricultural leaders and commodity groups across South Dakota and the region because they saw what we had done in the past. They were already familiar with what we could do. They possess a vision of both agriculture and the future. When we asked them for support, they were with us 100 percent.

The NPBL represents our past, our shared vision of the future, and our commitment to serve you. We are proud to present to the citizens of South Dakota its new Northern Plains Biostress Laboratory. ❑

photo: Duane Hanson

Director's comments

Making the connections

Dr. Ray Moore
Agricultural Experiment Station

We have a fine new building on the SDSU campus. Five years ago when we announced our intention to build it we were just coming out of a drought. Now, when the Northern Plains Biostress Lab is completed, we are experiencing the aftermath of flood.

What's the connection between a building—just bricks and mortar—and drought and flood? People are the connection. And a different slant we are taking with agricultural research.

Some of those people are our Experiment station scientists, Extension specialists, and the students who have moved into the NPBL. You will see no new faces among the staff. We didn't hire new faculty to fill the building; we needed the room and the new equipment to let our present staff do a better job of helping you get through floods, drought, and the everyday biostresses that go with living in South Dakota. The rest of the people involved are you, your families, and neighbors. What happens with our expanded program in this building affects us all.

photo: Duane Hanson

"There are five 'centers' in the biostress concept." says Experiment Station Director Ray Moore. "They are genetics and plant breeding; animal stess; natural resources/native germplasm; water quality/wetlands; and cellular and molecular biology."

When we broke ground for the NPBL, it had already gone through a long germination period.

Nearly 20 years ago the Horticulture/Forestry faculty, led by their department head at that time Dr. Ronald Peterson, provided plans for a building to replace their very old, overcrowded facility. With support from garden clubs and nurserymen, they achieved their first goal—two greenhouses and a headhouse that includes a classroom and some laboratory and office space. The effort continued but needed more public support.

The Wildlife and Fisheries Department was also housed in old, inadequate quarters. It seemed appropriate to put the two building programs together. The grassroots support certainly increased but still wasn't enough to bring about the necessary funding. Meanwhile, the Biology Department was crowded into limited space on third floor of Ag Hall and the Plant Science Department was similarly squeezed onto second floor and two other locations on campus.

It was time for a good, long, hard look at our overall College space needs.

And we knew that the future would demand more multi-disciplinary research from us. There would be tremendous efficiency generated if staff members could be located next to each other to share equipment and, more importantly, share ideas and "brainstorms."

So we started to talk about a new program, a shift in objectives, a concept as well as a building. The idea caught fire, especially when federal funds through USDA became available to support construction of ag research facilities. The state legislature approved funding for half the total cost of $12.6 million, providing the federal government supplied the other half.

USDA sent an evaluation team to the campus to study the feasibility of the project. The team liked our concept and gave it solid support but suggested the impact of the project would reach far beyond our state borders.

Our idea was growing beyond our expectations! The new building, in finally becoming reality, becomes not just a home for any one or two departments. Instead, it signifies a concept, a redirection in priorities and resource allocation.

But only a redirection. We at the Agricultural Experiment Station have always worked to lessen stress, any condition that keeps the life of living organisms—humans, plants, animals—from achieving their true potential. That's why we have field stations—to find and evaluate and alleviate stresses in particular localities. That isn't enough. We need the connections, to find out how Stress 1 affects Stress 2, to find out if the remedy for Stress 1 also affects Stress 2 or if it even causes Stress 3. Unless our scientists can work in teams and pool their knowledge, we don't stand much of a chance of making those connections. The NPBL will facilitate those connections.

"Stress" is incredibly complicated. There are layers of stress, and responses to it from single cells, tissues, organs, and the individual, whether plant, animal, or person.

There is a response to stress even beyond the individual. How did your community handle the flood this summer? With just one response? Or, because the stresses were multiple, with food from your own pantries, extra clothing, help in rolling up rugs and evacuating, money donations? Then was the stress over when the water went down? Not by a long shot.

That's only one illustration. Stress is multiple, and the effort to control it must also be multiple. To make that point, "stress" had to be part of the building's name. Then, to emphasize the link between "stress" and living things, "bio-" was joined to "stress." "Northern Plains" denotes the regionalism of our work.

We were given strong support by Dr. Roald Lund, Dean of the College of Agriculture at North Dakota State University. His enthusiasm for the project prompted the endorsement by the late Senator Quentin Burdick of North Dakota, who was chairman of the Senate Appropriations Committee at the time. We are very appreciative of the efforts of Senator Burdick and his staff and of Congressman Jamie Whitten of Mississippi who was chairman of the House Appropriations Committee. Senators Daschle and Pressler and Congressman Johnson made innumerable important contacts in Washington which resulted in nearly all of the federal match needed to complete this project.

The total building project isn't over. It also includes a small addition to the Veterinary Science Laboratory and to the Swine Unit.

Nor has the concept of biostress reached maturity. This spring, in anticipation of greater cooperation among scientists, we held three biosymposia on campus. Our own faculty and scientists from within the state and region met to inventory biostress research in progress and identify opportunities to form new work groups. The symposia were highly successful, and you will be seeing greater collaboration among our scientists as a result.

We know that you expect high yields from this concept of biostress research and from this building that grew from an idea planted two decades ago. We expect the same. Some ideas will ripen faster than others, but over the years the harvest will be large. Our sincere thanks to all of you who, in many different ways, supported the authorization and the funding of the Northern Plains Biostress Lab. ❑

photo: Larry Tennyson

Part of SDSU's oldest building is preserved in its newest

A remnant of the first building at South Dakota State University is now part of the newest structure on campus.

The triangular entrance pediment from Old Central, which says "Dakota 1883," has been preserved in the atrium of the Northern Plains Biostress Laboratory.

The Dakota pediment, which originally capped the west entrance of Old Central, now caps the exhibit cases in the NPBL atrium. The wood and tin pediment is 8 1/2 by 16 feet and weighs about 600 pounds.

Old Central was constructed in 1883 and 1884 as the start of the university. Construction price for the first campus building was approximately $19,750. For nearly 80 years, Central housed several college departments, served as the president's house, a dormitory, a bookstore, and a library. It was torn down in 1961 to make room for Shepard Hall.

The pediment was placed in storage where it remained for 32 years before it was restored to become part of the NPBL atrium exhibit.

John Awald, director of the South Dakota Agricultural Heritage Museum on the SDSU campus, is exhibit consultant. Awald says the Biostress Lab is an appropriate place for the Old Central pediment.

"This campus was formed by the Morrill Act as a land-grant college. The Biostress Lab carries on and continues the grand tradition of the Morrill Act to teach agriculture and related sciences." ❑

photo: Duane Hanson

Century-old quest for knowledge brought about biostress laboratory

Jerry Leslie

On Friday, September 17, 1993, the new Northern Plains Biostress Laboratory is dedicated to its new owners, the people of South Dakota. It is a building born of needs—some dating back more than a century.

The $12.6 million building on the campus of South Dakota State University is complete and occupied. Research faculty began moving in on July 29. Students sat down to their first classes in the NPBL on August 31.

As laboratory equipment was moved in and made operational, researchers resumed their on-going efforts to improve productivity by helping crops and livestock overcome stresses. But now they are using better facilities and tools.

The need for agricultural research in this country became apparent with the land rush, when the homesteaders headed west during the years of Abraham Lincoln—armed with a lot of optimism, but very little science about growing things under adversity.

SDSU, one of the land-grant universities born out of these 19th century needs, has played its part for over 110 years in securing a stable and abundant food supply for this country through improved agricultural technology.

The need to better understand and manage the complex structure of plants, animals, and humans and learn how they overcome harsh environmental and other stresses endured on the Northern Great Plains will continue into the 21st century.

As the effort to feed the nation and the world continues, so will the requirements for updated buildings, laboratory design, and laboratory equipment where scientists can carry out the work. The NPBL will meet that need into the next century.

The urgencies on the SDSU campus that ultimately led to a drive for the NPBL began in the 1970s—at least in the perspective of Ray Moore, director of the Agricultural Experiment Station at SDSU, who has been present through it all, and Ron Peterson who started the campaign.

Peterson, then head of the Horticulture-Forestry Department, in 1974 dropped in to see Duane Acker, then dean of agriculture. Peterson said the old buildings were dilapidated and would lead to loss of staff and program if not replaced. He asked for and received consent to begin requesting a show of support for a new horticulture building.

Richard Kneip was governor, and in his budget proposal for the coming legislative session were the proposed Animal and Range Sciences Building, the new Briggs Library, and remodeling of Scobey Hall.

Peterson and others began the planning process for a building and eventually approached the state Legislature. The first bill was submitted in 1978, but had difficult sledding.

Peterson said that the horticulture building had strong support from South Dakota Nurserymen's Association, the State Federation of Garden Clubs, and the State Horticulture Society, plus many others.

The proposal was split in hopes of securing funding in pieces. Phase I would construct a headhouse-greenhouse, and Phase II a classroom-laboratory building. Eventually Phase I was funded at $250,000 in 1983.

Peterson said that inflation was rampant at the time—15%, in his recollection. The appropriated money could build the headhouse but only 20% of the needed greenhouse space.

The following year, additional funds were appropriated to complete the greenhouse range.

Meanwhile, the old Horticulture Building was vacated and remodeled for the Ag Communications Department, and the old greenhouses were torn down because of their condition. Horticulture staff moved to Ag Hall and the new headhouse.

Phase II, the classroom-laboratory building, was expanded to include the Department of Wildlife and Fisheries Sciences, but it had an even more difficult time. Through the mid-1980s, various attempts and strategies were made to secure funding for the building.

photo: Jerry Leslie

The NPBL is completed now, a proud and imposing sight on the north end of the SDSU campus. Departments have moved in, labs are in operation, and students are attending classes, but people who had supported the Biostress Lab project for years found it hard to wait for their first look at the culmination of their efforts. Tours of the building during the latter stages of construction were very popular.

Eventually, in 1987, building authority for $6.3 million for a combined Horticulture-Wildlife building was signed, but funding was approved not to exceed $1.5 million. Actual funds made available were below $1 million. The next year, a further funding bill was tabled by the Joint Appropriations Committee.

That next July, David Bryant arrived on the scene as Dean of the College of Agriculture and Biological Sciences.

He soon decided to reorient the project to a biostress focus and expand the scope to include Plant Science, Biology/Microbiology, Range Science, Animal Science and Veterinary Science.

The planners involved now were Bryant, Moore, Maurice Horton, then head of the Plant Science Department; Tom Warner, then head of Horticulture-Forestry; Charles Scalet, head of Wildlife and Fisheries Sciences, and Jim Males, head of Animal and Range Sciences.

There's a story as to how the biostress reorientation came about. In 1988, Moore and new ABS Dean Bryant were returning to Brookings from Pierre. As they drove through Highmore, Moore pointed out the University's oldest research farm, the Central Research Station. Bryant asked Moore why the station had remained there so long when SDSU believed in moving its research stations around.

Moore said that this station was considered the university's "stress" station, because its location in a semi-arid region almost guaranteed that crops and livestock being tested there would be regularly exposed to environmental stresses—usually heat, drought, wind, and cold.

On a trip to the James Valley Research Station at Redfield, this time with Horton, the Plant Science Head, Horton also pointed out the stress connection at this research station.

After Bryant's first legislative session—the 1988 session—he became convinced that the horticulture-wildlife building proposal wasn't going to go beyond the $1 million appropriation.

a Biostress Laboratory. Add to that total ag industry support.

From here on, good things began happening.

In 1988, the state Legislature approved the plan, and the U.S. Congress appropriated $100,000 for a feasibility study.

In 1989, the state Legislature appropriated the remaining state funding, $5.126 million which—with the horticulture-forestry appropriation and some internal state dollars—would represent the $6.3 million state match for an equivalent amount of federal dollars.

The NPBL was on its way.

Dean Bryant, Director Moore, SDSU President Robert Wagner and everyone involved began working on the biostress lab and concept.

They took the lab proposal to commodity groups, farm groups, Ag Unity, Governor George Mickelson, and the state Legislature, achieving unanimous support in the state. Instrumental in securing approval of the state Legislature were former Sen. Mary Wagner of Brookings, former Sen. Jim Stoick of Mobridge, and Sen. Lyndell Peterson of Rapid City.

Bryant and Director Moore made an important journey to North Dakota, securing support from North Dakota State University's Ag Dean Roald Lund. Lund and Sen. Tom Daschle later became instrumental in securing support of Quentin Burdick, chairman of the U.S. Senate Ag Committee. Burdick and Sen. Larry Pressler became critical in moving it through the Senate. Congressman Tim Johnson secured critical support for the proposal in the House of Representatives.

Journeys in other directions brought support from surrounding states and land-grant universities. Needed support in Congress was also garnered by Alvin Fjeldheim of Pollock S.D. and David Bogue of Beresford S.D., SDSU's representatives on CARET, the national Council on Agricultural Research, Extension, and Teaching.

More key support came from the Cooperative States Research Service which is the USDA arm that administers funds to Agricultural Experiment Stations across the country.

photo: Jerry Leslie

It comes in many forms--excessive heat or cold, insects, disease, drought, flood, and countless others--but it's all biostress. When Dean David Bryant coined the word and developed the concept of biostress, he envisioned the research planned for the NPBL: many departments, many disciplines, but all with the common goal of dealing with the stresses on living things.

Following that 1988 legislative session, Bryant continued to think about the fact that "stress" of some kind is involved in almost all of SDSU's agricultural research, past and present, and ought to be involved in the name and mission of the building being planned.

Research of many departments which he envisioned being located in the building would have one thing in common—all would deal with stress on living things, the reasoning continued. And then came the obvious: "Bio," meaning life or living organisms or tissue, and "stress," a constraining force or influence.

"Biostress" became the new concept. The building proposal became the Northern Plains Biostress Laboratory. From then on the name was a natural, "It fit, and everyone began to appreciate that we were defining the major production problems of South Dakota," said Moore.

A significant development occurred 3 years before the name came to mind and would put the idea within reach. Congress, in its 1985 Agricultural Food Act (farm bill), had included dollars for construction of facilities. What about going after some of those federal dollars?

Bryant proposed taking the nearly $1 million in state money being held for the Horticulture-Forestry and Wildlife-Fisheries building and using it as a match for federal funding for

During a CSRS site review on the SDSU campus, CSRS officials said the laboratory was a good idea and should be expanded from a regional to a national focus. Research conducted in the building would be of value far beyond the state's boundaries.

With support now from the state Legislature, both houses of Congress, and from USDA administration, the rest is history.

Everyone "supported" the NPBL and the biostress concept. Over 4 years, the federal money came together in pieces to match the state money.

The current building was erected and fully furnished with $11.7 million, but add the research wing to the Veterinary Research and Diagnostic Lab and the Swine Grow-Finish Unit, and the sum becomes $12.6 million.

Construction on the NPBL began in 1991 after a May groundbreaking and was completed ahead of schedule. The keys were turned over to the state of South Dakota on July 24, 1993.

Construction will soon take place on the remaining biostress livestock research wing of the new Animal Disease Research and Diagnostic Laboratory plus the Animal and Range Sciences swine grow-finish research facility. These were parts of the original proposal, though not in the same building, and will be erected with the final federal installment of $875,000.


photo: Gary Peterson

The biostress concept goes beyond the confines of the NPBL itself. Construction will soon begin on the biostress livestock research wing of the new Animal Disease Research and Diagnostic Laboratory and on the Swine Grow-Finish research facility. Both of these were parts of the original proposal, though not part of the same building.

Bryant, in his many talks across the state, has emphasized that one of the most important things coming out of the NPBL effort was the broader biostress concept.

It has brought about "teamwork between the teaching, research, and Extension family as we developed the biostress concept and what it means for South Dakota and the region," Bryant told the South Dakota Crop and Pest Conference last March.

With the biostress concept, "we tried to give it more of an identity—we refer to it as our biostress program. But it really relates to most of the best of what we've been about here for more than 100 years," Bryant said.

Bryant also points to teamwork "with our faculty working with the ag industry across the state and rededicating ourselves to solving problems of the people and meeting the needs of the state as we go along toward the new century."

From now on, most research proposals coming out of the College of Agriculture and Biological Science will have a biostress emphasis.

Bryant, reflecting on the process, said, "As we worked on the idea we found that it has helped to integrate the college and university and regional university efforts.

"Anytime you can bring people together and encourage them to focus on common goals and ideas, it's always a productive thing to be involved in."

Bryant said, "This building invests in the future. It's something we're putting on the table today for our future generations.

"We feel strongly it is the right thing to do. It sets the stage for better things for our ag industry here in the state for years to come."

And Moore added that completion of the building will not mean that the ABS College goes back to business as usual.

"That's where we get married to the concept," said Moore. "We will try to carve out a new identification for the college with this concept, to focus on biostress research, to create a different image.

"To do that, we will redirect programs and some resources to this effort."

So what began 20 years ago simply as a need for a horticulture building evolved into much more. It produced a building housing all or parts of five departments that will foster cross-discipline research and team-building.

The campaign for the funds produced a rethinking of college-wide priorities and a rededication to something SDSU has done best over 110 years—biostress research. SDSU's College of Agriculture and Biological Sciences has made a commitment to serving the future needs of South Dakotans.

The names of crucial supporters will be found on a brass plaque inside the lobby. The names will include State Senators Stoick, Peterson, and Wagner; J.D. Lynd of Ag Unity; Lund from NDSU; U.S. Senators Daschle, Pressler, and Burdick; Congressman Johnson; CARET representatives Fjeldheim and Bogue; Experiment Station Director Moore; and Eugene Arnold, associate dean of academic programs who was the college representative on the building committee.

But the NPBL belongs to every South Dakotan, and many persons will rightfully feel they own a piece of it—from farmers who supported the idea within their commodity groups to the last senator who saw the need for continuing biostress research and voted "aye." ❑

Jerry Leslie is news and features writer in the Department of Agricultural Communications, SDSU.

Department head comments

Breaking the barriers

Fred Cholick
Plant Science Department

We all have different points of view when the subject of biostress comes up. South Dakotans don't whine about their troubles. But each of us eventually ends up with a personal viewpoint on biostress. It's what each of us knows best.

I want to come at biostress from four different points of view—yours, mine, a student's, and the plant's.

I believe there's no argument that you, South Dakota farmers, experience more constant biostress than anyone else in the country.

You live through biostress every growing season, from groundbreaking to binning the crop. And then you must pay off the loan, get your livestock and yourselves through the winter, and negotiate new loans in the spring. Biostress is the reality of farming and ranching in this state.

Why is South Dakota in this fix? When we study biostress from the plant's point of view we get a pretty good idea.

Our main crops are, for the most part, uncomfortable in South Dakota. We are north and west of the corn and soybean belts, south of the best spring wheat regions, north of prime winter wheat states. We are in a transition zone between all these better production areas; consequently, we can grow a lot of crops, but conditions aren't ideal for any one of them except, possibly, forages.

The stress is so great because, from the crop plant's point of view, it wouldn't be here if we hadn't brought it here and put its seed in the ground. Once there, it can't move to shade or water or shelter. From the plant's perspective, we've often placed it in an unfriendly environment—drought in 1988, too much water in 1993, too much heat in 1988, too little heat in 1992. When it can't grow, as much as scientists and farmers help it, the plant experiences biostress. And so do we.

When a "good" year comes along, the plant must contend with different biostresses. The old saying applies: "What's good for the goose is good for the gander." Favorable conditions for plant growth are also favorable conditions for most insects, diseases, and weeds. A major exception is the grasshopper. He likes it dry, so he delivers a "double whammy" on plants in a dry year.

So the plant stays there, anchored in the soil, taking up nutrients, making food in the sunshine, always trying to outrace stresses to reach physiological maturity. When it dries down, it is far from reaching its absolute potential.

What are the limits of a plant? The history of research says we don't know. We talk about theoretical yields; they are astronomical.

The grasshopper leads us to the plant scientist's point of view about biostress. We don't concentrate only on drought and ignore the grasshopper, nor do we study the grasshopper and forget the drought.

Combining biostresses, along with the plant, in one study brings us closer to real life, for biostress does not come one-at-a-time, and our management recommendations have to work on the farm and ranch. On the other hand, incorporating too much complexity into research introduces unreliability in results and incredibly complicated recommendations no farmer could use. We scientists have to walk a careful line between simplistic and complex projects.

We do need to sort out biostresses, work on them individually, combine them and see what happens, pull them apart again, and try new combinations. That is the opportunity the NPBL gives us. As plant scientists, we want to understand everything that is going on in the plant and its environment. We want to control biostress. Total control is probably not realistic, but the idea drives us on, and it is much closer to reality today in the NPBL than it was before.

Can we control biostress? For the most part, we're finding out we can.

photo: Jerry Leslie

The "land of infinite variety" means an infinite variety of biostressors, too. Farmers may find their crops suffering through drought one year, and yet the next year it may be too wet to even get in the fields. In either case additional stressors such as insects or disease may be affecting the plants as much as the weather. Researchers need to study biostresses singly and in a variety of combinations to understand how to control them best.

Control can't come too soon. The overriding goals of our department are to increase yields and stabilize crop production in South Dakota. These goals go together.

Increasing yield decreases the cost per unit produced and therefore makes our producers more competitive on the international market. But our farmers cannot afford to go through boom and bust years. So in our plant breeding, we don't waste time on a variety that has soaring yields one year and falls apart the next.

In working with diseases, we first isolate and find out what we're dealing with before we develop management strategies. In phytophthora of soybeans, for example, we're making progress with molecular markers. One of the first steps in developing varieties that resist the disease is to identify the race of the disease. In weed control, we recognize that the weed is nothing but a robber of nutrients, light, and water from the crop plant, and we're stressing environmentally sound control. In soils, we combine physics, chemistry, and the dynamics of nutrient flow. Some soils, for example, freely give up nutrients to the plant; other soils are stingy and like to hold back.

In all these areas of biostress control, the NPBL gives us greater opportunities to mix and match biostresses and plants and then devise control methods.

Students have a point of view about biostress that is all their own, and they will make the most important and long-lasting contributions to alleviating biostress of any of us. Many of our students are employed on research projects and spend a lot more time with our plant scientists than just in the classroom. We have taught them what we know, and will open more opportunities to them through the technology present in the NPBL.

With their hands-on experience, education, and imagination, they will someday unravel more of the complexities of biostress. They may become ag chemical reps, ag loan officers, graduate students, or go into production agriculture. Whatever road they pick, they will be better managers of their individual operations and natural resources because the worked and learned in the NPBL.

So now, my personal point of view. What are the limits to crop yields, to research breakthroughs we can accomplish in the NPBL, to the knowledge we can transfer to students and South Dakotans? I don't believe we have any idea of the limits.

I believe we will come closer to them—so close that we will break through barriers that biostress has put in our path. I think the NPBL will encourage us to use our imagination and our scientific expertise to the utmost.

To break down those barriers, to raise and stabilize crop yields, we have put teams into the NPBL. We have a corn team, a soybean team, and wheat team, for example, each employing the expertise of scientists from a number of areas. From the plant's point of view, that's on the right track. And it's the right track for you and me. Production agriculture will profit, and producers and consumers alike will benefit from the work we commence in the NPBL. ❑

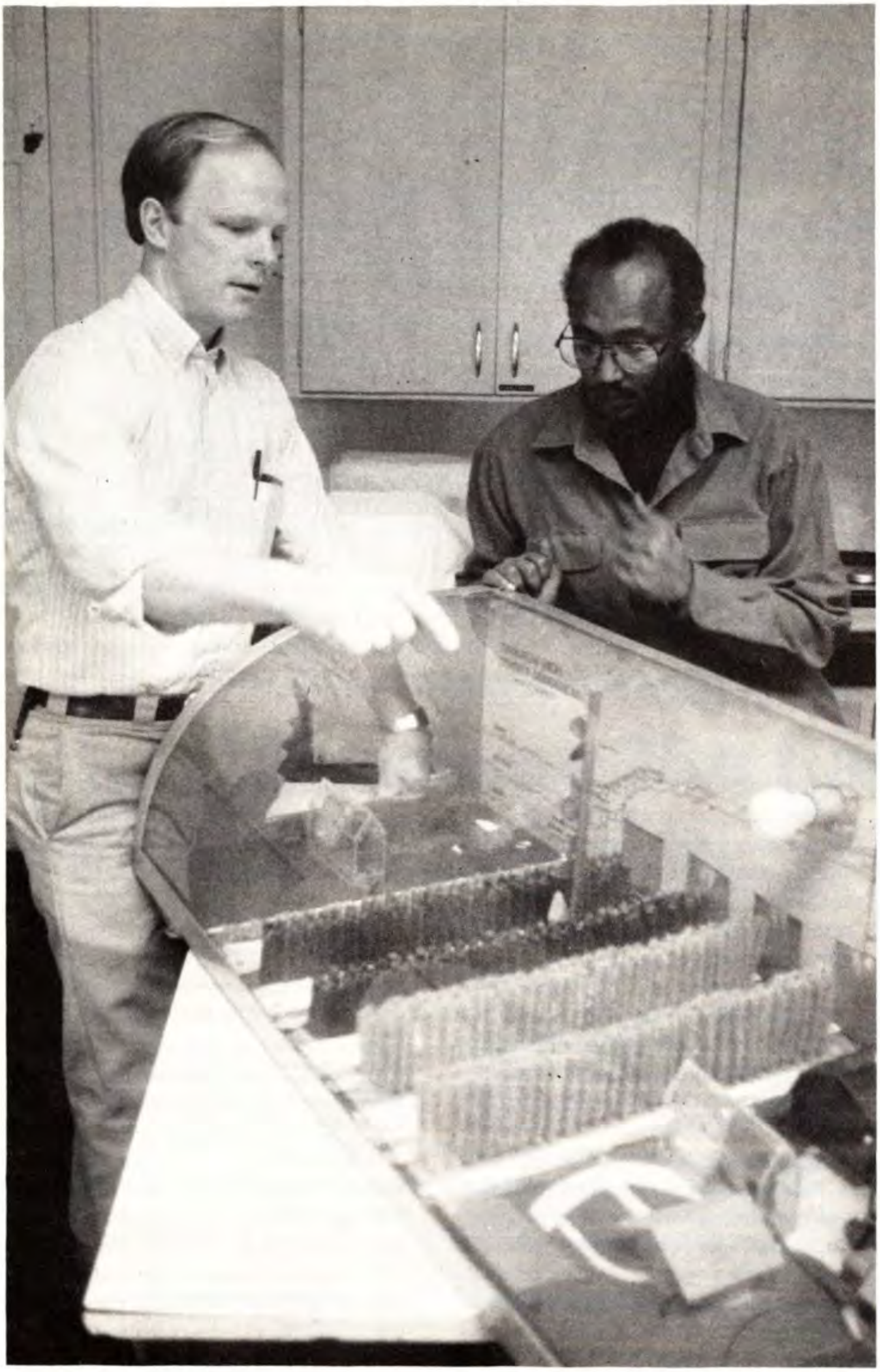


photo: M.K. McFarland

Department head comments

Accelerating success

W. Carter Johnson
Department of Horticulture, Forestry, Landscape and Parks

Our continuing challenge is to maintain a healthy landscape while also earning a living from it.

This challenge is more difficult in the Northern Great Plains because of its extreme and highly variable climate. For example, fast cycles between drought and flood lower overall agricultural productivity and cause short-term disruption of natural ecosystems.

Resilience to climatic stressors has been incorporated into our agroecosystems in many ways. These include breeding of resistant agronomic and horticultural plants, planting of windbreaks to protect crops and livestock, development of new cultural techniques to conserve soil moisture and reduce soil erosion, and introduction of exotic plants and animals pre-adapted to our weather extremes.

The Department of Horticulture, Forestry, Landscape and Parks at SDSU has played an important role in enhancing the productivity and health of our Northern Great Plains landscapes.

Dr. N.E. Hansen, famed plant explorer and former head of our department, introduced many plants from Asia, such as alfalfa, crested wheatgrass, and Harbin pear, which have proven to be economically important, well-adapted plants in our region.

More recently, departmental researchers have bred and selected new stress-resistant plant varieties. Examples include windbreak trees such as Siouxland cottonwood; fruit trees and grapes such as Gourmet and Luscious pears and Valiant grape; garden vegetables such as Super Chief and Rushmore tomatoes and Pick-me-quick pepper; and ornamental trees and shrubs such as Homestead buckeye, Nugget ninebark, and Meadowlark forsythia.

While breeding and plant selection will continue to supply us with promising plants from our nursery plots, new facilities inside in

photo: SDSU

Because we can't create mature trees overnight, laboratory tools such as wind tunnel models (left) and computer-aided design programs are essential in creating new and more effective windbreaks. Breeding stress-resistant plant varieties such as Pick-me-quick peppers (above) has long been a priority of departmental researchers. The new facilities included in the NPBL will reduce the time necessary before a new variety is ready to be released to the public.

the NPBL will enable us to expand into new stress research areas, particularly those of stress physiology and genetics. We will be able to reduce the time needed before new plants can be released to the public.

For example, the new forest genetics lab will enable us to accelerate breeding programs for Rocky Mountain juniper and eastern redcedar, which are large parts of windbreak, farmstead, and conservation plantings in the Northern Great Plains.

The new fruit research lab will allow us to conduct research on the acclimation and winter survival of woody fruit crops. Many fruit varieties that can be grown in other northern states often do not survive in our climate because of high and low temperature extremes, winter temperature fluctuations, wind, and drought. The long-term goal of this research will be to improve selection of woody fruit crops for the environment of the Northern Plains.

Our teaching mission also will be strengthened by the new facilities, particularly in the area of landscape design. This rapidly growing field of study integrates science, art, and engineering to design landscapes which are both functional and aesthetic. The NPBL includes a state-of-the-art computer-aided design laboratory in which students can more efficiently and effectively plan residential, commercial, and rural landscapes.

Even without the lab, one of our students designed the initial landscape plan for this building. And you can look to the McCrory Gardens and the South Dakota Arboretum east of the main campus as other examples of the integration of landscape design principles and horticultural research. I view them as satellite outdoor laboratories of the NPBL.

The University's Extension mission also will be strengthened by improved research and teaching capabilities in the NPBL. Many of you will benefit personally from the new information and new insights gained in the NPBL.

The benefits of the new building to our departmental programs are clear. There is an even greater long-term benefit.

Modern research problems are complex and often require knowledge beyond that of a single scientist or even department of scientists. For example, the problems of climate change and agriculture or of timber harvesting and recreation in the Black Hills can only be solved by scientists working together. The NPBL is structured to promote the formation of scientist teams to tackle tough, complex problems such as these.

So the NPBL will enable us to intensify our traditional strengths, develop new capabilities, and assemble new groups to take on the knotty scientific problems we are increasingly being asked to solve. Hundreds of people have worked on the project, but I give special credit to Dean David Bryant and Directors Ray Moore and Gene Arnold for their leadership and management of the project. Dr. Chuck Scalet and my predecessors Dr. Tom Warner and Dr. Ron Peterson deserve special credit for garnering initial support for a prototype of the NPBL. The South Dakota Nurserymen's Association, the South Dakota Golf Course Superintendents' Association, and numerous nursery businesses generously gave their money and time to landscape our new facility. ❑

Department head comments

Expanding our resources

C.G. "Chuck" Scalet
Wildlife & Fisheries Sciences Department

The Northern Plains Biostress Laboratory will address all of the on-campus teaching, research, and service needs of the Department of Wildlife and Fisheries Sciences.

Improvement in our academic component will come in the new teaching laboratories, lecture rooms, and the areas that support those activities. Our service function will be enhanced by the addition of space to provide assistance to state citizens and resource agencies. We greatly needed this extra space for those programs.

Specialized laboratory space is also provided to address the third facet of our program, that of research. The NPBL research labs make our program whole. We have always been able to address field research needs; now we can complement that with research in the lab. This will improve our overall product and will allow us to address various problems that we couldn't in the past. This will be beneficial to wildlife and fisheries resources in South Dakota.

What does biostress mean to wildlife and fisheries? Stress is the response of plants and animals to any happening that interferes with their normal states. In the Northern Great Plains, such stressors include cold, snow, erosion, wind, heat, drought, habitat destruction, hail, and many other natural or human-caused events.

Blizzards, accompanied by high winds and cold temperatures, are a fact of life in our region. Their effects on wildlife resources can be significant. Each year we pass through the blizzard season concerned about possible large-scale kills of our ring-necked pheasants. In some years, other wildlife suffers, too; you may remember that 90% of the pronghorns in South Dakota died in a late-1980s blizzard and aftermath.

We can't prevent harsh winters, but we can reduce their negative effects by better management of habitat for pheasants, pronghorns, and other wildlife.

Fisheries resources are not immune from Northern Plains stressors. Long, cold winters and marginal habitats annually decrease fisheries resources. The result is not just less fish to catch. Often, it is also a smelly, unsightly lake after a winterkill, something that has a wider impact than just on fish and fishermen.

These problems are avoidable, or certainly can be reduced, with research followed by implementation of correct management practices.

Stressors do not always kill. Stress can reduce growth rates, increase parasite and disease problems, and in numerous other ways reduce the economic and aesthetic value of wildlife and fisheries resources.

The Northern Great Plains landscape is varied and rich. Reducing the negative impacts of stressors through work we will be conducting in the NPBL will result in positive gains in a wide variety of areas. ❑

photo: SDSU

Wildlife & Fisheries Sciences has always been able to conduct solid field research, whether it be banding wood ducks with tiny radio transmitters (above) or studying fish populations in area lakes. What we've been short of is state-of-the-art laboratory facilities. The space and equipment the NPBL provides allow us to complement our field work with high quality research in the lab. It makes our program whole.

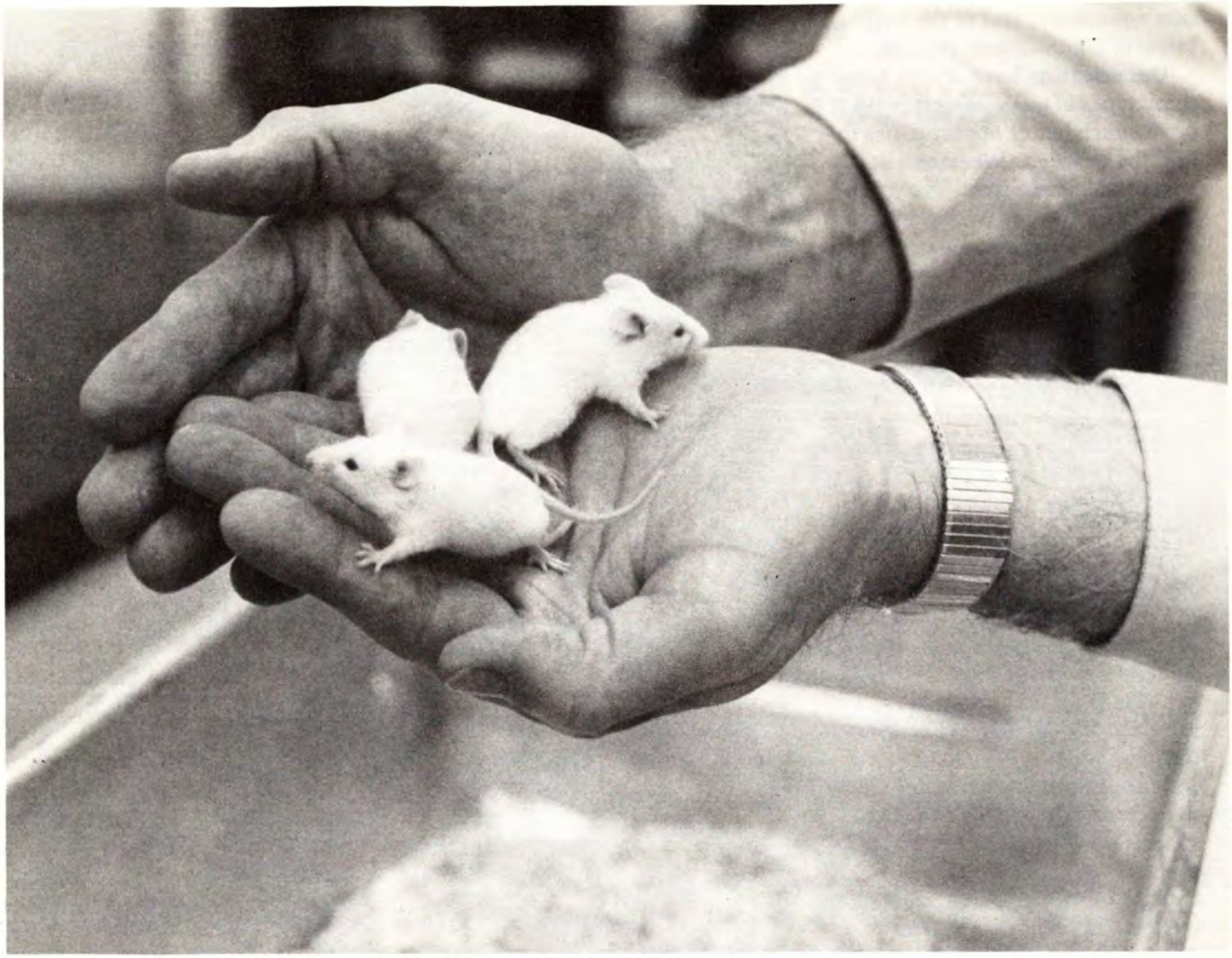


photo: Duane Hanson

Department head comments

Building bridges

Charles R. McMullen
Department of Biology & Microbiology

"Biostress" is an unfamiliar-to-new word to most of us. You can't find it in the dictionary. Every person gives it a different meaning or definition.

So why did a university build a multimillion dollar facility called the Biostress Laboratory?

Because the word perfectly describes the primary focus of our research goals from now on. "Bio" means life, and "stress" is a constraining force or influence. We will be studying the effects of constraining forces or influences on the health and agricultural productivity of living organisms.

So this laboratory is much more than a building. It is the nucleus of a unifying idea for the university and region. It is an obvious-yet-ingenious, old-yet-fresh focus for our research at this land-grant university. It is a concept whose time has clearly arrived.

I view the Department of Biology and Microbiology as a bridge between the basic and applied sciences in our college. The biological scientists moving into this special laboratory exemplify this role. They are basic and applied scientists asking important questions: How does this stress affect this organism? Why? What is happening? These are questions important to the fundamental processes of life, to production agriculture, and to the well-being of South Dakota citizens.

Our scientists have always asked these types of questions. Now they have much better opportunities to find the answers. We have a new way of doing research.

The new way is a mixing and mingling of our scientists into working groups that will meet to solve a problem and then re-form to attack another. That is probably the most exciting feature of this new building and new concept of biostress. As you move through the building you may find a molecular biologist across or down the hall from a plant breeder or soil scientist. Departmental lines are not carved in rock in this building. Scientists will move freely across artificial department lines and will be encouraged to do so.

While this is not exactly a novel idea, very few universities have been successful in promoting successful, genuine, interdisciplinary research projects. We will be. We are very fortunate to have scientists who can truly cooperate and an administrative structure that provides the atmosphere in which interdisciplinary projects can flourish. The Biostress Lab has been designed to champion this type of research project.

The Biostress Laboratory changed the nature of the Department of Biology and Microbiology even before we moved into the building.

We have recently hired several new scientists. Without the prospect of research space in the new building, it would have been extremely difficult to attract scientists of quality to SDSU. We have also been able to reassign lab space within the existing department facilities, so those not moving into the Biostress Laboratory will also benefit from it.

The new building has affected us in another way, but we can't measure how much. The building has greatly enhanced positive attitudes about the university and its dedication to excellence in research and teaching.

And in the future, it will have an even greater impact on our department, strengthening our teaching program by 1) providing greater opportunities for undergraduates to participate in hands-on research, 2) providing up-to-date facilities and housing state-of-the-art research equipment, 3) greatly enhancing our ability to compete nationally for federal and private grant funds, and 4) helping us attract high-quality students into our programs.

I have long felt that to have a long-lasting, stable agriculture in the Northern Great Plains, we must incorporate greater knowledge of fundamental biological changes into our understanding of management practices and the genetics of our crops and livestock. The NPBL will strengthen our capacity to conduct the type of research necessary to realize this goal. ❑

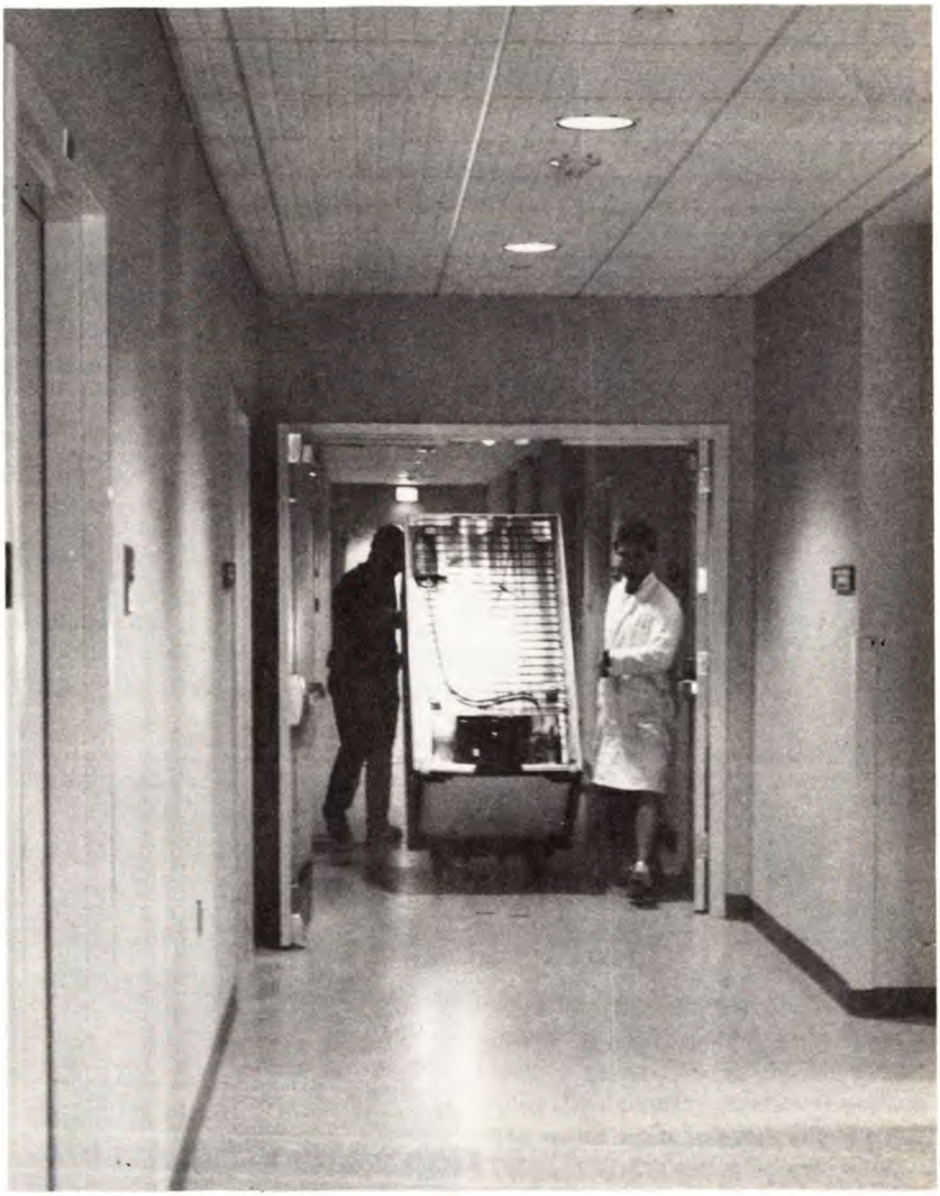


photo: Duane Hanson

Even before we began moving lab animals, equipment, and people into the new NPBL, the building was working for us. The promise of modern new facilities has enabled us to hire several top quality scientists who will help us "build bridges" between departments and disciplines with team oriented research projects.

Department head comments

Sharpening the focus

James Males
Department of Animal and Range Sciences

Biostress, whether it's temperature extremes, the effect of humidity, too little or too much water, or any other stressor, has tremendous impact on animal and grass production in the Northern Plains. It is very fitting that the center of this type of research be at South Dakota State University. Dean David Bryant and Director Ray Moore are to be congratulated on the foresight that brought this project to fruition.

Biostress has long been an integral part of research programs in the Animal and Range Sciences Department at SDSU. The effect of and management for selenium toxicity and deficiencies were determined by SDSU research. Water runoff was measured at the Cottonwood Range and Livestock Research Station. Frost-damaged green soybeans as a feed resource for cattle and swine have been evaluated. Methods to implement out-of-season lambing to produce a more uniform supply of feeder lambs were examined. The effect of grazing intensity by cattle on the productivity of native and introduced range-plant species has been measured. These are just a few examples of past research accomplishments that deal with biostressors of the Northern Plains.

photo: Ag Communications

The range science component included in the NPBL gives our range researchers some much needed laboratory support. But it does more than that. The range lab, together with the wildlife and fisheries, biology, parks, forestry, and plant sciences labs, gives SDSU a tremendous nucleus in natural resource management.

The building we are dedicating has both direct and indirect effects on the Animal and Range Sciences Department. Our range scientists will now have badly needed laboratory support for their field studies. The presence of a range laboratory in this building—in conjunction with the other programs carried on in the building—allows SDSU to focus on another center of excellence: natural resource management. With already excellent programs in range science, wildlife and fisheries, biology, parks, forestry, and plant sciences, SDSU has a tremendous nucleus in natural resource management. Bringing these groups together in the Biostress Lab allows us to further develop this center of excellence.

On the animal side the biostress concept sharpens the focus in the animal research we have been doing. Whether comparing feeding South Dakota calves in Texas vs. South Dakota, nutritional value of weather damaged feeds, housing systems for swine, range vs. farm flock production with sheep, or winter supplementation programs for brood cows, we are already doing a lot of biostress research.

The biostress concept will also result in a strengthening of the interaction of scientists at SDSU and in the Northern Plains. This will benefit all the citizens of our region.

Livestock and dairy production are major contributors to the economic viability of the Northern Plains. The Northern Plains Biostress Lab will guarantee that SDSU will continue to play a leading role in supporting the economically efficient and sustainable production of livestock and dairy, thereby assuring long-term economic viability for this region. ❑

photo: Ag Communications

Department head comments

Interaction of stress and animal health

John U. Thomson, DVM
Veterinary Science Department/Animal Disease Research and Diagnostic Laboratory

For many years, scientists have tried to find reliable measures of stress in animal production. It's extremely difficult to do in the first place. It's made even more difficult when one scientist tries to work alone on a problem. Something is bound to be missed.

The word "stress" is frequently used to sum up behavioral and physiological responses to environmental change. This is no topic one scientist working alone can master. Our approach to stress research must be multi-disciplinary, clarifying and assessing both animal behavior and physiology. Otherwise, we miss something. I could give several examples that would illustrate the difficulty that we have with our present knowledge when we try to use only behavioral change to interpret the magnitude of a response to an environmental change.

Stressors associated with the host, agent, or environment do not work in isolation. They interact to induce disease. Consider, for example, the development of a mixed infection. The main infectious diseases in intensive production units relate to body surfaces, such as enteric and respiratory tracts. Many diseases of these surfaces are frequently mixed infections.

The animal responds to acute stressors by behavioral "fight or flight" and by endocrine activations that allow for immediate change or adaptation to the environmental conditions. It is extremely difficult to pin any lowered animal production on short-term responses to stress, for these reactions generally only last seconds, minutes, or hours. But long-term responses to stress are an entirely different matter: they have tremendous importance to animal production. These include

photo: Larry Tennyson

Environmental and biological stress factors play significant roles in the health of livestock. Researchers in the Veterinary Science Department have already had significant success in tracking down the complicating factors that we suspect may have serious effects on the production, health, and welfare of farm animals. For example, Drs. David Francis and Alan Erickson (above) have discovered genetic susceptibility among some swine to one kind of baby pig scours.

responses by nervous, lymphatic, circulatory, and hormonal systems that result in hormonal change, including corticosteroids on nitrogen metabolism and growth rate of young animals and reproductive performance of older animals.

The environment plays a role in the dynamics of many diseases. Many authors have suggested that ventilation, cold, wet, heat, air quality, and other factors intensify diseases. However, most of these suggestions have come from subjective field observations. Scientifically controlled studies are needed to assist in identifying useful, cost-effective management strategies.

Fear of the handler produces such responses. It shouldn't surprise you that studies have found that the attitude of your "hired hand" toward you is highly correlated with behavior toward the animals. Competence coupled with calmness in working the animals will reduce the level of fear of humans and improve animal performance.

But even with the calmest of stockhandlers, herding, penning, and transporting animals is hardly a relaxing time. Such activity can directly produce a stress called post-capture myopathy syndrome in the animals. The result is asymmetric muscular and myocardial lesions that have been described in red deer after capturing. Behavioral and physiological responses are intermingling.

Continued stress, brought on by a number of activities, can produce protein wastage, abnormal organ function, and suppression of the immune system and anti-inflammatory response. Thus, shipping fever is associated with transportation, dehorning, castration, and winter weather. The increased incidence of malignant catarrhal fever and yersiniosis in deer during winter may be due to prolonged exposure to the stressors of cold and low nutrition.

Biological stress, no matter whether the animal is ready for market or a weanling, happens at the the physical or chemical level in the cell. For example, Dr. David Francis, professor in our department, has successfully identified the receptor protein in the intestine of pigs that interacts with the K88 antigen of *E. coli* to create disease. Identifying this type of interaction will lead to improved genetic control of sub-optimal production.

There also appears to be an interaction between bacteria and poor ventilation that leads to pneumonia in respiratory disease associated with the density of airborne bacteria. Increased incidence of bacterial pneumonia has been associated with predisposing viral infections.

The mechanisms associated with particular stressors, severity, and disease have not been identified for most diseases related to livestock production. In many cases, we are only now beginning to look in the right places for the complicating factors that we know, or suspect, have serious effects on the production, health, and welfare of farm animals. We need more basic research about animal stress response before animal agriculture in South Dakota will fulfill its true potential. We are proud to say we have made significant impacts on these problems in the recent past. We will do more, by working as a team dedicated to healthier and more productive livestock in South Dakota. ❑

photo: Duane Hanson

The NPBL: A powerful new tool in biostress research

Dr. Larry K. Tennyson

At 12:01 a.m. on July 24, the state of South Dakota became the owner of an outstanding research facility. It was then, following an intensive, 5-day long inspection, that the state accepted the keys to the $11.7 million Northern Plains Biostress Laboratory at South Dakota State University.

Ken Schmidt, SDSU utilities engineer and project coordinator, said the brand-new facility is one of the most innovative, energy efficient, and carefully planned and executed efforts he's seen in his career. Schmidt credits this to the design team, state management and inspection staff, the SDSU planning team, and many local and regional contractors and suppliers.

The primary purpose of the project was to provide modern laboratory facilities for increased research into how plants, animals, and humans can adapt to the biological stresses of living in the semi-arid region of the Northern Great Plains.

A biological stress (or "biostress") is defined as any condition that upsets the equilibrium of a living organism.

Schmidt said the overall project also provides teaching facilities as well as related additions to other buildings.

Bottom line of the effort is to improve the economic viability of the region and much of the nation and the world through stabilized and more profitable agriculture.

The lab contains 126,027 square feet. This space will house certain personnel from South Dakota State University departments including Wildlife and Fisheries Sciences; Biology/Microbiology; Animal and Range Sciences; Horticulture, Forestry, Landscape and Parks; and Plant Science.

The space also includes general classrooms, conference rooms, offices, laboratories, and areas for specialized equipment—all of which will be used jointly by these same departments.

Classrooms represent about 7% of the total assignable space in the building. Teaching laboratories, research laboratories, and 66 smaller rooms for purposes such as offices, conference rooms, and related storage, represent about 85% of the total assignable space.

The remainder of the spaceis for corridors, custodial supplies, vending, storage, receiving, restrooms, a darkroom, trash, and climate control.

Research facilities feature areas such as growth chambers, stress laboratories, specialized labs for cell culture, inoculation research laboratories, and rhizosphere study areas.

The facility serves as headquarters for five centers of excellence: genetics and plant breeding, animal stress, natural resources and native germ plasm, water quality and wetlands, and cellular and molecular biology.

Schmidt pointed out that one of its dozens of interesting features is the more than 17,000 square feet of undeveloped space in the basement level that has been left to provide for future expansion. This shell space is beyond the project requirements, and it resulted from bids which were less than the estimates and the available funding.

Schmidt also said this is no ordinary basement. Although its floor is approximately 10 feet below grade, it has remained absolutely dry despite the extreme rainfall and flood conditions that have plagued similar areas in other large buildings across the Midwest. Schmidt attributes this to a well-engineered and installed drainage system beneath the basement floor and around the basement walls.

Yet another feature is the method engineers devised to offset some of the increased utility costs for a building of this type and size.

Schmidt explained that with as many as 50 exhaust fans for laboratory areas throughout the building, energy efficiency was an even higher priority for this type of facility.

photo: Jerry Leslie

The NPBL was completed on time and within budget, and, thanks to careful planning in its design and construction, will be extremely energy-efficient for a facility of its size and type. Careful cost controls also allowed for the construction of a basement shell, which will be used to provide for future expansion.

Engineers achieved one type of energy cost savings by extending the campus steam tunnel system past the Lab to the existing Animal Science Complex. This enabled them to replace electric boilers with steam heat from the SDSU Central Heating Plant.

Doing so frees up sufficient low-cost electrical demand provided by the Western Area Power Authority, and this, in turn, allowed the lab to be built without exceeding the current campus electrical demand limits for low-cost electricity.

This modification cost $147,000, but it reduces estimated annual utility costs by about $60,000 a year. This means the investment is returned in just 2 1/2 years, and also that this engineering feature will yield a $60,000 annual savings throughout the design life of the building.

Schmidt said the building design was a team effort. Architecture and planning was by Koch Hazard Baltzer Associates, Ltd., of Sioux Falls, S.D.. Mechanical and electrical engineering was by Roby, Quintal, and Everson of Mitchell, S.D. Structural engineering was by Chester I. Quick and Associates of Sioux Falls. Civil engineering was by Stockwell Engineering of Sioux Falls.

The team also worked closely with the academic planning committee and all members of the research staff in designing each laboratory and teaching area within the facility, Schmidt said.

The design was transformed into brick and mortar by general contractor T. F. Powers of Fargo, N.D. Ventilation and air conditioning was by Baete Forseth of Sioux Falls. Plumbing, heating, and fire sprinkler construction was by Howe Heating and Plumbing of Sioux Falls. Electrical construction was by Muth Electric of Watertown, S.D. Institutional Equipment of Emmetsburg, Iowa, installed the fixed laboratory casework and furnishings.

Careful cost controls brought the building in at a low enough figure to allow not only for the basement shell space, but also for expenditures for items such as office furniture, parking lots, and even wastepaper baskets, Schmidt said.

Some cost savings also were re-invested in energy efficiency features such as high-efficiency electric motors and lighting fixtures that will pay for themselves within 10-15 years—well ahead of the design life of the building.

Cost savings also were re-invested in modifications to the design that brought the building into full compliance with the Americans with Disabilities Act—requirements that were not even in law when construction of the building was first begun.

Yet another accomplishment is that more than 90% of all appropriated monies for the building actually went for actual construction and equipment. All specialized engineering, design, inspection, and planning functions totalled less than 10%—an unusually low figure for a project of this scope, Schmidt said.

"Not only that, but the building was inspected and turned over to the state a full week ahead of the August 1 deadline established 3 years ago," Schmidt continued. "A week may not sound like much, but when you consider the problems of constructing a building such as this in the types of weather we've had since construction began, this is yet another credit to the teamwork of everyone involved." ❑

Dr. Larry Tennyson is writer and communications specialist in the Department of Agricultural Communications, SDSU.

The complexities of biostress

Dr. Larry K. Tennyson

Scientists who work at the new Northern Plains Biostress Laboratory will find ways to neutralize or even reverse some of the negative effects of heat, cold, insects, drought, and other biological stresses on animal and plant life.

That's certainly an accurate statement, but it's also a oversimplification of the complex research issues scientists will investigate in this new facility.

Examples of such research were the subject of three symposia staged in April and May as part of the overall dedication of the new laboratory.

These events helped to show the depth and scope of biostress research already being conducted at South Dakota State University. They showed how scientists in the various research disciplines can and do work together to solve complex problems. They focused attention on new avenues of research cooperation between scientists at SDSU and those stationed elsewhere in the Northern Great Plains. Finally, they also showcased the three main types of research to be undertaken: stress mechanisms, stress responses, and stress management.

One of the important areas of investigation in biostress research concerns the mechanisms by which stresses affect living organisms.

The types of research questions either being proposed or actively pursued in this area include the stress mechanisms of such diverse factors as cold weather, diet, and insects:

- A scientist in the Horticulture, Forestry, Landscape and Parks Department is searching for an easier, cheaper, quicker way to evaluate how well a woody fruit crop can stand winter stress.

Until now, this type of evaluation has been carried out by testing plants in several locations over many years.

The scientist says cold-weather hardiness is a complex issue, and much remains to be discovered about its relationship to the physiological and genetic elements of a plant. That must occur before the new method can be fully developed.

- Scientists in the Departments of Nutrition and Food Science, and Animal and Range Sciences are looking for ways to offset the effects of high-fat diets on animal circulatory systems. They first fed rats a diet containing excess quantities of fat. They then discovered that when they then added certain amounts of ground flaxseed and oatbran to the diet, the effects of high cholesterol and high amounts of saturated fats in the blood were corrected.

This finding indicates that a diet containing the correct amounts of ground flaxseed and oatbran may offer a non-medicinal method for controlling the common problem of high cholesterol in the blood.

- Aphids in cereal crops caused more than $92 million in losses during 1989 alone, so scientists inthe Biology/Microbiology Department are working with those in the Northern Grain Insects Laboratory to genetically modify wheat varieties so they can resist aphid infestations. The steps include first identifying a naturally occurring vegetable substance that inhibits aphids.

Next, the gene that accounts for the substance will be transferred to wheat. Finally, new lines of wheat would be bred from that genetically altered material.

- Understanding the mechanisms that govern susceptibility and resistance to infectious diseases in livestock is a research goal of scientists in the Department of Veterinary Science.

Selective breeding and genetic alterations are just two possible approaches. Other new approaches may make it possible to combat diseases that are dif-

photo: Ag Communications

Biostress doesn't just affect plants and animals. People involved with agriculture suffer stress connected with agricultural production, and additionally, they are exposed to stress related to aging, education, taxes, community services (or lack of them), and the availability of health and child care services.

ficult or even impossible to control through ordinary means such as antibiotics or immunization.

Part of the work now centers on finding out why, on a molecular level, certain pigs seem to inherit either susceptibility or resistance to a certain form of bacterial diarrhea.

A second avenue of research is in the investigation of the various effects that stress can have on living organisms.

• Scientists at the Water Resources Institute and the Department of Biology/Microbiology point out that not only individuals or populations of plants and animals but also whole ecosystems can suffer from stress.

One example is a lake community that has deteriorated to an "exhaustion-type" state due to chemical, biological, and/or physical stress.

Along these lines, the scientists have begun inventorying deep lakes in South Dakota to gauge their aquatic health and to identify those that are approaching a state of exhaustion where deterioration is almost impossible or very expensive to reverse.

• The effects of salt stress on agricultural productivity is an area of interest for a scientist in the Department of Plant Science.

This is an important area of investigation for the future of irrigation in the state. Early irrigation projects have resulted in severe salinity problems because the ground water was of unacceptable quality.

• Scientists in the Department of Agricultural Engineering are interested in developing instruments that can measure the effects of stress on a specific crop at any given time.

The effect of stress varies greatly depending on the stage of crop development. However, while management practices can be adjusted to accommodate part of the stress, some type of instrument is necessary to measure, monitor, and record the parameters of that crop stress for those changes to succeed to their utmost.

Solving this research problem will require the efforts of creative plant scientists as well as engineers and computer experts.

• A researcher in the Department of Economics has surveyed the types of stress that affect persons involved in agriculture, especially those in production ag and related activities.

In addition to the stress related to agricultural production, these individuals also are exposed to stress related to aging, education, taxes, community services (or the lack of them), and the availability of health and child care facilities.

Avenues of investigation needed in the area of human stress are virtually limitless.

A third biostress research pursuit lies in discovering ways to manage stress effects on plants, animals, and ecosystems.

• Scientists in the Department of Agricultural Engineering are developing a network of automatic weather stations that will provide weather data essential to much of the biostress research.

The stations collect information including air and soil temperatures, rainfall, humidity, wind speed and direction, and solar radiation. This information then is processed, archived, and distributed to research scientists as well as other persons involved in agricultural production.

• Maximizing the benefits of insecticides while minimizing their negative effects and costs is another management strategy being investigated by scientists at the Northern Grain Insects Research Laboratory adjacent to the SDSU campus.

Half of the insecticides now used on row crops are applied to corn, primarily for control of corn rootworms. However, most insecticides are applied at planting time without certain knowledge that they actually will be needed. When pest populations are high, the insecticides return a profit, but such populations occur in less than a fourth of the corn. Soil insecticides reduce pest survival by less than 50%, but that allows enough of a hatch to re-infest the field the following year.

The scientists say new technology is being developed for more accurate monitoring of pest populations and for achieving a better kill of the adult pests with chemical baits. The results are about 95% less insecticide used per acre and a degree of control of the pests that prevents re-infestation from occurring the following season.

• Persons in production ag simultaneously confront stress that includes changing market conditions, changing consumer preferences, and global environmental changes. As if that weren't enough, those in the Northern Plains also must deal with the stress of extremely variable weather patterns.

One way to minimize the effects of these stresses is to find new markets and diversify into non-traditional crops. ❑

All this raises four sets of stress management questions, according to a scientist from the Department of Geography:

What are the best crop and market opportunities for diversification? How can non-traditional crops be successfully produced and marketed? How can the agricultural infrastructure best respond to the needs of farmers and ranchers who grow non-traditional crops? And how can successful diversification efforts contribute to the growth and prosperity of rural communities?

Discovering the solutions to these management problems will require a vast interdisciplinary research effort, the scientist advises.

• Soil erosion is resulting in sediments in the Missouri River reservoirs. This represents not only a stress on soil productivity, but also on reservoir capacity. As much as 15% of Lake Lewis and Clark already is filled with such sediment.

One SDSU plant scientist now is documenting the stress resulting from erosion in reducing agronomic productivity and the secondary stress of sediment on present and future reservoir usefulness to the state.

The questions are complex, the challenge great, and the task immense. ❑

Dr. Larry Tennyson is writer and communications specialist in the Department of Agricultural Communications, SDSU.

The long battle with biostress

Dr. Larry K. Tennyson

Old Ben Franklin had it all wrong: something is more certain than death and taxes. It's biological stress.

Need proof?

Ask any farmer or rancher.

Drought, floods, blizzards, insects, tornadoes, El Nino winds, volcanic dust, urban encroachment, toxic waste, leaky fuel tanks, catastrophic inflation, wildly fluctuating markets, and other biostresses are everyday features of rural life on the Northern Great Plains.

But the impact is not limited to our region alone. All these stresses impede the production of food and fiber, and all affect the quality of all forms of life worldwide.

There couldn't be better justification for the emphasis on biostress research at South Dakota State University.

That emphasis is as old as the institution itself. The Dakota Territory Agricultural Experiment Station opened here in 1887 with a staff of five scientists.

From these simple beginnings, Experiment Station scientists have expanded their efforts to develop ways to combat biological stresses that have literally changed the world that we live in.

Here's a short sampling of their accomplishments:

By 1898, scientist N.E. Hansen had collected seeds and plants throughout the Far East in an effort to find varieties more suited to the harsh climate of the upper Midwest.

The Great War ended in 1918, and during that same year, student Edgar McFadden produced a rust-resistant spring wheat by crossbreeding—a technique scientists then considered impossible. It is estimated this discovery by itself enabled more than 25 million persons to avoid starvation worldwide.

In 1933, our scientists discovered that selenium is the cause of alkali disease in cattle. A year later, they identified the vitamin A and D requirements of dairy cattle—and this enabled milk production to double nationwide within the next 30 years.

The word 'biostress' didn't exist when the Dakota Territory Agricultural Experiment Station opened in 1887, but the five scientists on staff understood the concept. They took up the fight to control biostress from day one, and their successes have given modern biostress researchers a high standard to live up to.

photo: Ag Communications

Entomologists here collected 10,000 grasshoppers during 1936 and used them to predict the severity of grasshopper plagues.

In 1957, our scientists also discovered the cure for parakeratosis, a disease of swine. A year after that, in 1958, they also made an internationally recognized breakthrough in pioneering tissue culturing—a forerunner of today's techniques in gene manipulation.

That same year, they developed cheap, outdoor hutches for raising young dairy calves, and this virtually eliminated death by pneumonia, which previously had resulted in losses of four in every 10 calves.

In 1962 came the beginning of a 4-year effort that successfully solved a rust problem in wheat that had cost farmers more than $24 million in losses.

Trickle irrigation research in 1970 showed how to reduce water needs by 30-40% on small acreages and specialty crops.

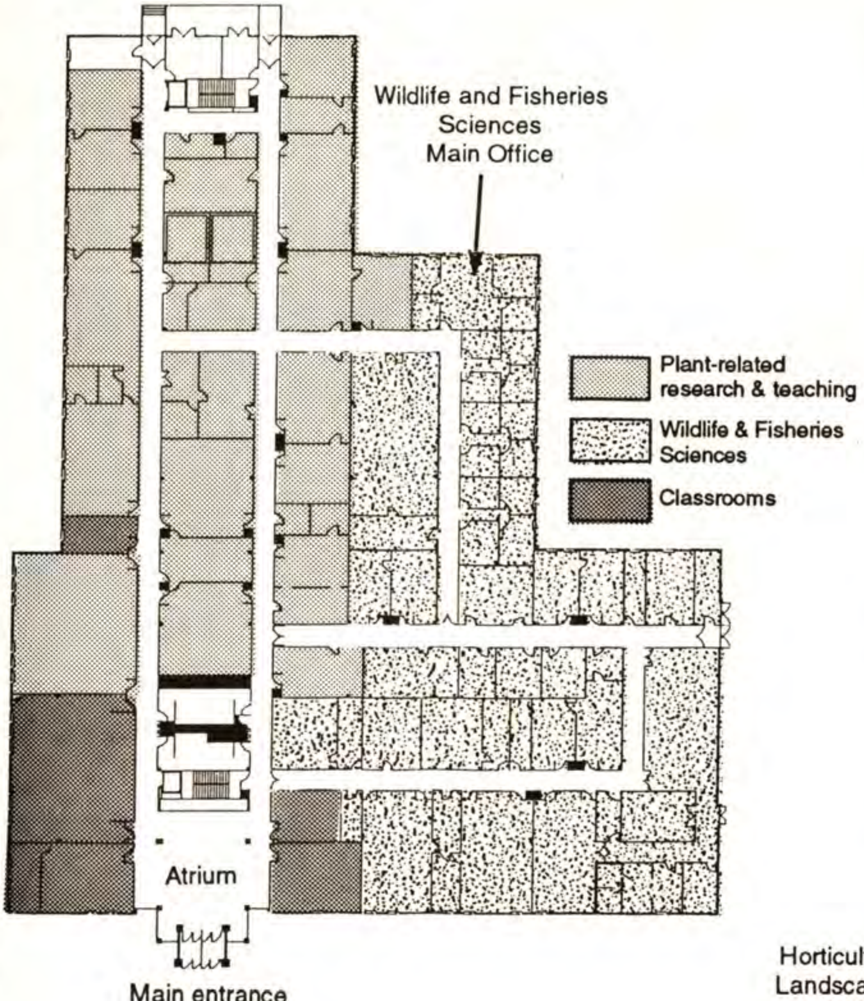
Some $25-30 million in wheat profits had disappeared because of a Hessian fly outbreak in 1978, but by 1985 our scientists already had developed and released the world's first Hessian-fly resistant wheat. This development occurred at about twice the normal rate for such a scientific undertaking.

In 1984, scientists released the first winter-hardy forsythia for the Northern Plains. Two years later, they again acquired worldwide recognition for their discovery of a bacterium that causes abortion in sheep.

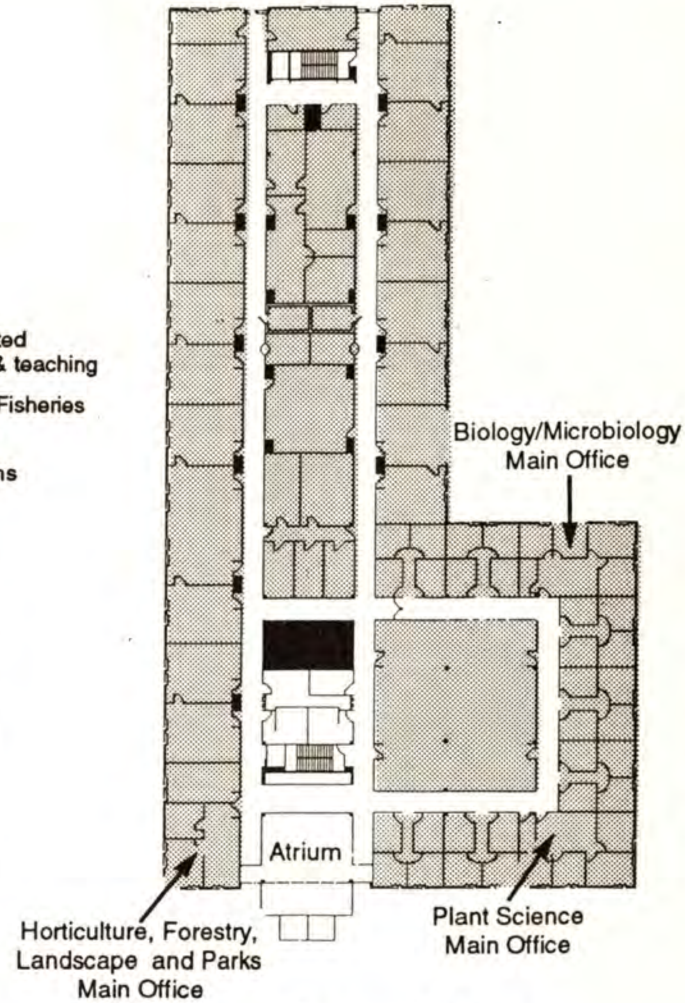
South Dakota loses half of its winter wheat yield to winter about one year out of every five. Last fall, scientists announced a major breakthrough in unlocking the secrets of freeze resistance in winter cereal grains, including wheat.

The unrelenting biological stresses of the Northern Great Plains continue, but so do these dedicated scientists in their efforts to combat those forces. And the scientists are winning. ❑

Dr. Larry Tennyson is writer and communications specialist in the Department of Agricultural Communications, SDSU.



First floor



Second floor

Getting around

A galaxy of sights greets the first-time visitor to the NPBL. First on view is the large, bright, glass-walled atrium, with its balcony, large exhibit cases, and the Dakota pediment looming high overhead. From here the visitor is presented with a choice of directions to go and things to see.

The Biostress Lab is a two-story building with a basement and a greenhouse style entry and lobby. The building houses laboratories, offices, and classrooms and has been designed to be a top-quality research and teaching facility. Horticulture, Forestry, Landscape and Parks (HFLP), Plant Science, Range Sciences, Biology/Microbiology, and Wildlife and Fisheries Sciences all have custom-designed laboratories in the Biostress Lab.

The building has been designed for flexibility. Partitions are specially made for ease of alteration. Lab cabinets can be relocated. Utility piping is overhead, allowing revision of lab layouts with minimal disruption of other labs. Easily accessible vertical chases are provided for future additions of utilities, communication wiring, or fume hoods. Accessible space above and below corridors facilitates utility repair and modification.

Forty-nine faculty and one hundred graduate students are housed in the NPBL. Seventy-eight percent of the space in the building is devoted to plant-related research in Plant Science, Biology/Microbiology, HFLP, and Range Sciences. Wildlife and Fisheries Sciences takes up 15% of the building, and classrooms take up 7%. Some of the HFLP and Wildlife and Fisheries labs also have teaching functions.

When you visit the NPBL, stop in the atrium and look over the exhibit cases. You'll also find a brochure on display with detailed floor plans and descriptions of individual laboratories and research areas. It will help you find your way around as you tour your Biostress Laboratory. ❑

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Calendar of Events

Date	Event	Person to Contact
September		
17	**Northern Plains Biostress Lab Dedication, SDSU**	**Dr. Ray Moore, College of Ag & Bio Science, SDSU**
23	Fall Tour, Dakota Lakes Research Farm, Pierre	Dwayne Beck, Farm Manager, Plant Science, SDSU
26-29	National 4-H Dairy Conference, Washington, D.C.	Kathy Reeves, West River Research & Extension Center
October		
8	Prime Promoters Banquet, Brookings	Dr. Jim Males, Animal & Range Sciences, SDSU
9	SDSU Beef Bowl	Dr. Jim Males, Animal & Range Sciences, SDSU
13-16	Western Junior Livestock Show, Rapid City	Kathy Reeves, West River Research & Extension Center
27-31	Western 4-H Round-up, Denver	Larry Tidemann, Extension Program Leader, SDSU
29-30	SD Sheep Growers Assn. Annual Mtg., Spearfish	Jeff Held, Animal & Range Sciences, SDSU
November		
11-14	North Central Regional 4-H Leaders Forum, Sioux Falls	Bob Davis, 4-H, SDSU
29-Dec 4	Area Swine Days	Bob Thaler, Animal & Range Sciences, SDSU
December		
4-8	National 4-H Congress, Chicago	Bob Davis, 4-H, SDSU
16	SDSU Beef Day, Aberdeen	Dick Pruitt, Animal & Range Sciences, SDSU