VISTAS

TEXAS TECH RESEARCH

Fall 1996

Fresh Air for Sick Buildings

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Fall 1996 Vol. 6 No. 1

Each issue of **Vistas: Texas Tech Research** (Library of Congress ISSN 1055-9159) reflects the goals, techniques, results and drama of research and creativity at Texas Tech. The magazine describes only a few of the many scholarly activities conducted at Texas Tech University and at Texas Tech University Health Sciences Center.

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ABOUT THE COVERS

Front — Researchers are searching for ways to vent contaminants from indoor environments. Maladies such as runny noses, watery eyes, scratchy throats, headaches, nausea, fatigue, decreased attention span, allergies and, sometimes, fatal asthma attacks can strike the occupants of "sick buildings." The culprits of the health problems generally are improper designs; inadequate heating, ventilating and air conditioning systems; chemical problems with building materials; and microbes. (See cover story Page 8.) (Photo by Artie Limmer)

Inside Front — Artist Glenna Goodacre is passionate about the virtue of public art endeavors. She is the creator of the Vietnam Women's Memorial, the heroic bronze in Washington, D.C., that honors the American women of the Vietnam War. Texas Tech University recognized the Lubbock native's contributions recently by bestowing upon her an honorary doctorate. She is with her sculpture, "Tug O' War," outside the Texas Tech Museum. (See feature Page 28.) (Photo by Artie Limmer)

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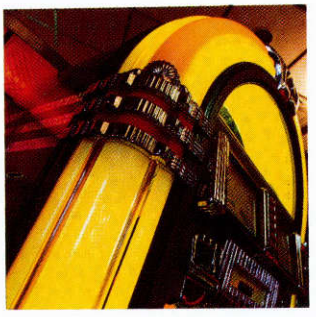

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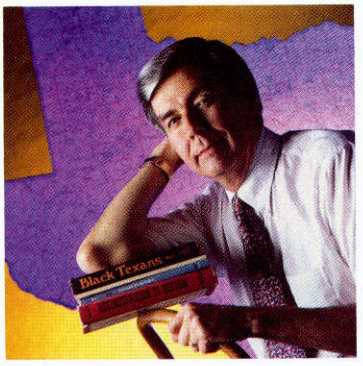

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The Road to Anywhere: Paved with Ash

Coal. Every week power plants across Texas burn coal to generate electricity producing a mountain of fly ash as a by-product. A rough estimate indicates that nationally, 50 million tons of fly ash are generated every year, yet only about 15 to 20 percent of this is being used beneficially. The remaining 80 to 85 percent of the ash must be buried in landfills. That equals enough fly ash to fill 16,000 acre-feet of landfill space.

For years the ash has been buried in landfills around the Panhandle. However, now the fly ash is being used as a base material in the construction of city streets and parking lots. By recycling the leftovers of coal, construction crews are building roads without the need of hauling in expensive road base aggregates. And power plants are saving money because they don't have to bury the ash.

Researchers in Texas Tech University's department of civil engineering are working with the Texas Department of Transportation (TxDOT) to develop standards for the use of hydrated fly ash as a roadbase material in the building of state road projects. A research team made up of Phil Nash, senior researcher; P.W. Jayawickrama, Ph.D., assistant professor; John Borrelli, Ph.D., professor; and S.P. Senadheera, research associate, has been evaluating the strength and durability characteristics of the hydrated fly ash to determine how it should be used and whether it can hold up over time.

Based on these test results, the researchers have concluded that hydrated fly ash meets the necessary strength requirements as outlined by TxDOT. However, observations on durability are inconclusive because the material has not been used on many highway projects. In the past, fly ash has been used on an experimental basis in the construction of parking lots and service roads and currently is being used as a roadbase in the reconstruction of a farm-to-market road near Canyon.

In the construction of parking lots and service roads, the use of hydrated fly ash has been successful. Texas Tech researchers have found that the material can provide very satisfactory service in the long run. In fact, parking lots built in the Amarillo area with hydrated fly ash have lasted more than 15 years.

"Historically this material has been sold to oil companies to be used for oil field roads," said Jayawickrama. "It has performed very satisfactorily, but what we need to do is find the optimum water content and curing time."

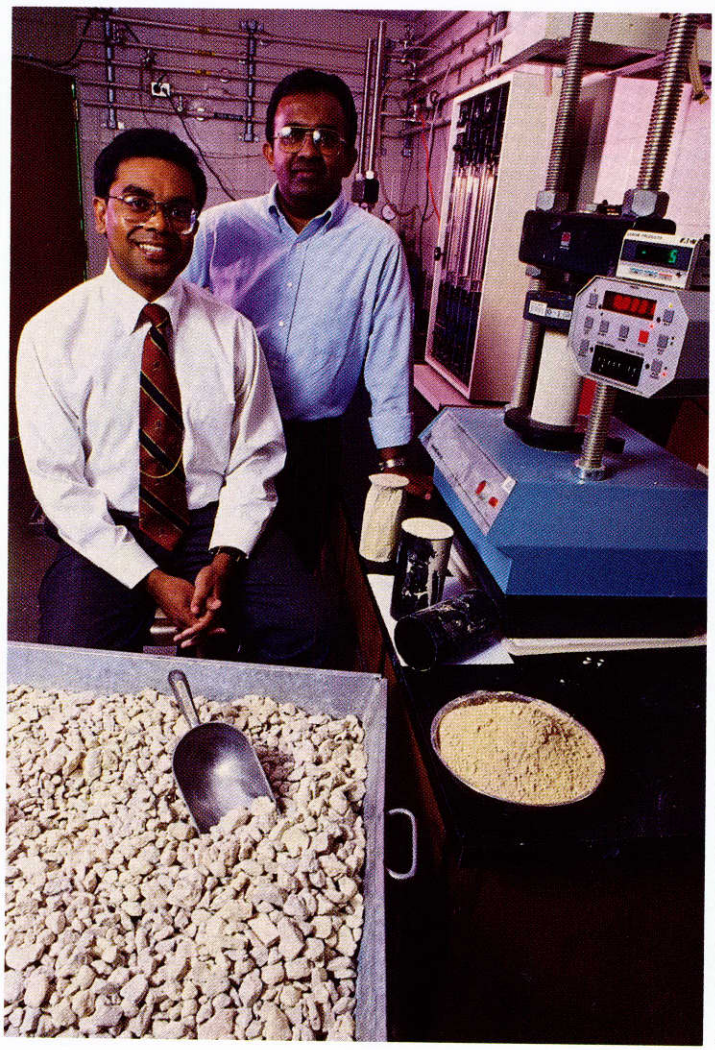
Before the fly ash can be used as an aggregate base it must go through a number of steps of preparation called hydration. First, the ash is collected at the power plant and taken to a large pit where it is mixed with water. After three to eight weeks of curing, the soupy ash hardens due to chemical hydration, much like concrete becomes hard after drying. However once the fly ash has hardened, it is mined and prepared for use as a construction aggregate.

At the construction site the fly ash undergoes more hydration. During construction of a road or parking lot, the hydrated fly ash is placed in layers and is compacted. During this process more water is added to the fly ash aggregate causing it to rehydrate and gain further strength.

Texas Tech researchers are seeking to learn how much moisture is required during initial hydration to achieve the highest strength and density. In other words, engineers need to know how much water should be mixed with the fly ash to achieve the best road base. In laboratory tests a 20 percent hydration moisture content has provided the best compressive strength.

"We know that the process that takes place in fly ash is very similar to Portland cement," said Senadheera. "With added moisture, fly ash forms certain compounds that give it certain strength characteristics."

Hydrated fly ash does present an occasional problem. Researchers have found that



Mark Mamawal

Researchers are investigating the use of a by-product of burned coal, fly ash, as a roadbase material. Two civil engineering faculty members working with the Texas Department of Transportation are P.W. Jayawickrama (left) and S.P. Senadheera.

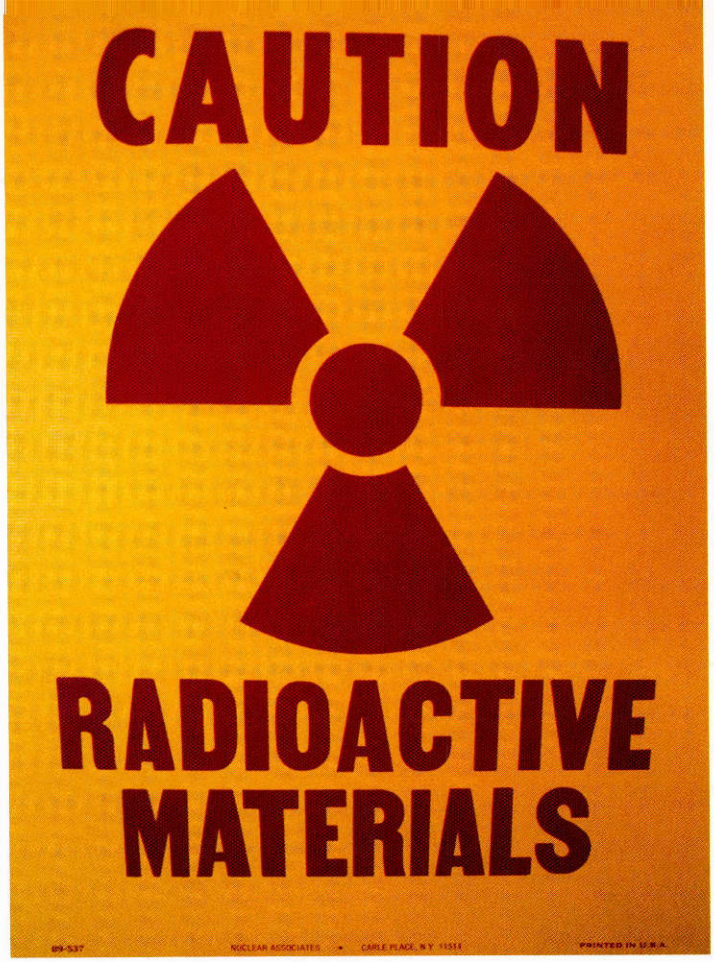
during hydration a white crystal-like structure can form on the surface of the ash. The chemical makeup of this crystal is still unknown, but researchers speculate it causes problems when the ash is used as a roadbase material. In the field, researchers have found that occasionally fly ash fails to bond with the asphalt aggregates used on top of the ash in road building. Researchers now believe the white crystals may prevent the ash from providing a tight bond with the asphalt.

"Fly ash is very sensitive to exposure elements and we need to know how to control the humidity," said Senadheera. "Some of the problems we have seen in seal coats indicates a lack of bonding. However if you keep the fly ash moist enough you can eliminate many problems."

Because the research is aimed at encouraging the use of a new roadbase material, the researchers have created a videotape to help educate engineers and contractors on the use of the recycled ash. The videotape and the final results of the Texas Tech study have been sent to TxDOT for review by other engineers in Texas and across the nation. Funding for the project was made possible by TxDOT and the Texas Natural Resource Conservation Commission.

Overall, researchers say their findings are very preliminary. They still want to learn how and why the fly ash hydrates and hardens. The answer to this question could lead to further applications of the material, or at the very least, improve how civil engineers use this new-found construction material.

— Michael Sommermeyer



Artie Limmer

Radioactive Fallout

"After five decades of frantically creating enough plutonium to build more bombs and missiles than the Soviet Union, the United States government finds itself with no plan for long-term disposal of the deadly substance. With a half-life approaching 25,000 years, the unwanted plutonium will certainly be the most enduring legacy of the Cold War."

—Dallas Morning News, July 19, 1992

Researchers across Texas are laboring for a solution to the aging problem of how to safely store and utilize plutonium during times of peace. Scholars at Texas Tech University are collaborating with peers from the University of Texas and Texas A&M University to educate a society of Cold War veterans about plutonium, its possible uses and its impact on the environment.

Plutonium is a radioactive element created within nuclear reactors by irradiating natural uranium with neutrons. The element, a fundamental building block of weapons capable of leveling entire cities, is stored on the High Plains of Texas at the Pantex nuclear weapons facility.

Pantex, located in Carson County near Amarillo, has been shrouded in mystery since its inception as a conventional weapons factory during World War II. Later, during the Cold War, the plant developed into the final assembly point for all nuclear weapons produced in the United States. As icy relations between the United States and the Soviet Union melted, Pantex workers began shifting their efforts to the dismantlement of nuclear arms. Currently, employees of Pantex disassemble all U.S. nuclear arms and store the weapons' plutonium pits at the facility.

Though change is often painstakingly slow, the cloak-and-dagger temperament surrounding nuclear technology is softening. Marie Gentry, Ph.D., and Zane Curry, Ph.D., Texas Tech researchers within the College of Human Sciences, have been engaged by the Amarillo National

Resource Center for Plutonium (ANRCP) to develop a preliminary design for a permanent Science Information and Resource Center as related to Pantex.

The science/information center is a component of a larger undertaking funded by the ANRCP through the U.S. Department of Energy (DOE). The overall project is a $49 million endeavor launched to assist Pantex and DOE officials in the discovery of adequate means for the temporary storage and disposition of plutonium.

The venture is divided into three areas of research, bringing together scholars from a medley of academic disciplines from the three major Texas universities. Educators, nuclear specialists, environmentalists, engineers, interior designers and communications specialists are among the interdisciplinary team members. Each project includes researchers from at least two of the universities. Texas Tech is responsible for communication, education and training elements, while the University of Texas is responsible for environmental studies and Texas A&M will direct nuclear research.

Phillip Nash, M.S., project coordinator for communication, education and training, said Texas Tech will develop information from Pantex and the ANRCP to present to the public. Nash, a research associate in the College of Engineering, said about $170,000 has been earmarked in fiscal year 1996 to determine the viability of a science/information center.

According to Gentry and Curry, the programming, or pre-design, stage is a crucial step toward the construction of an effective center.

"Because a science/information center must meet functional requirements, such as providing adequate space for interactive displays or creating an environment conducive to learning, as well as address the needs of individuals utilizing the facility, such a facility should be planned thoughtfully," Gentry said. Both Gentry and Curry have toured similar facilities in Texas, New Mexico and Tennessee to study the positive and negative characteristics of like centers.

"The majority of the programming will be background research," said Gentry, associate professor of merchandising, environmental design and consumer economics. Part of Gentry and Curry's pre-design goals is to identify potential locations for the center. The science/information center could be placed in an existing facility or constructed at a site in or near Amarillo.

"We were solicited to offer recommendations, based upon extensive research, about what characteristics the center should have to best serve the center's employees as well as visitors. We are simply researching the possibilities," said Curry, assistant professor of merchandising, environmental design and consumer economics.

If created, the facility will house scientific and historic information about plutonium, material about Pantex, as well as details about possible future strategies for the use and disposal of plutonium. The researchers said individuals visiting the facility also may be given the opportunity to express their opinions about the best alternative uses for the stored plutonium pits, the display and exhibit content as well as demonstrations and programs.

"The facility could house much of the research and analysis associated with plutonium," said Gentry.

The researchers said they conceptualize the science/information center as a hub for science and math education for students in kindergarten through age 16 as well as for their parents. In addition, the individual components could be broken down and transported to other sites for use.

"It's also very possible that the permanent center will provide a type of distance education. Thus, a classroom of students in Tahoka can log on to a computer system within the center and actually have a demonstration, a lecture or a look at individual displays," Curry said.

The pre-design process also will include establishing partnerships with other Amarillo entities, including the Don Harrington Discovery Center and Mason and Hanger Co. to develop portable exhibits which could be used for collecting data. The Don Harrington Discovery Center gives visitors an opportunity to interact with exhibits while learning about math and science. Mason and Hanger provides Pantex with contract workers who oversee the daily operations of the facility.

Gentry and Curry recently collaborated with personnel from Mason and Hanger and the ANRCP to prepare a transportable exhibit. A similar unit originally was developed by personnel of the Bradbury Science Center in Los Alamos, N.M., for the Savannah River plant in Aiken, S.C., another DOE site. The display included panels describing the use and storage of plutonium, a section about Pantex and interactive exhibits. One exhibit allowed participants to perceive the weight of plutonium by holding tungsten in their hands. Tungsten, weighing approximately as much as plutonium, is two and a half times heavier than steel and six times heavier than aluminum, Gentry said.

The exhibit also offered an opinion poll for gathering data about the exhibit and the public's perceptions about plutonium. Analysis of the data collected from transportable exhibits, like the one used at the information fair, will help researchers and officials determine the location, user characteristics, message and design of the permanent facility.

Neither Gentry, Curry nor their academic peers are spokespersons for Pantex nor the DOE, Curry said. He and other members of the Texas Tech faculty are trying to raise the public's level of awareness and education about the historic use and possible future applications of plutonium, he said. By eliminating the mystery around plutonium the public then can make informed decisions about what to do with the substance, he added.

Perhaps investigators one day will lay to rest fears of environmental holocausts and worldwide destruction caused by the hammering of a nuclear trigger. Future generations may no longer fear plutonium and its wrath, but instead develop a healthy respect for its power, by viewing nuclear weapons, the facilities in which they were produced and the bunkers in which their parts now are housed as components of an obsolete war machine. The world finally may thaw from a lengthy Cold War and the threat of a nuclear winter.

— Charles Griffin

Drafting a Master's Plan

Texas Tech University's College of Architecture has taken a new direction in education. The college has introduced a five-year professional master's of architecture degree. The move puts Texas Tech above competing architectural programs nationwide.

According to Associate Dean Jim White, Texas Tech's new program is unlike any other in the nation.

"There are several universities among the approximately 104 accredited programs in the United States that offer the 'four plus two' program. Students complete the four-year program then continue for an additional two years in graduate school to earn a master's degree in architecture," he explained.

Now at Texas Tech, students can earn a master's degree in architecture in five years by completing more accelerated courses during their last year and a half. Under the old degree program at Texas Tech, most students obtained a bachelor's degree in architecture at the end of a five-year period.

The move to introduce the new program has been an initiative within the college since the National Architecture Accrediting Board gave its endorsement last fall. The new program does not represent a radical departure from the traditional curriculum, however it enhances the degree with a new standard of professionalism and will better assist the graduates of the college in their careers, White said. The new degree will mean not only additional classroom preparation for architecture graduates, but it also will give students more opportunities to hone their skills through supplementary projects and other venues.

"The primary reasons for introducing this opportunity is to give appropriate value to the effort, time and credit hours required to complete a professional degree in architecture," White said.

Representatives of the College of Architecture reviewed its programs and compared it to other programs in colleges across the Texas Tech campus, according to White. In most cases, he said, the number of classroom hours required to earn a degree in architecture was equal to a master's degree in other programs.

"In offering a professional master's degree, the courses at the graduate level would have in-depth research components. Studio-based design education at upper levels requires complex research and problem-solving abilities and communication skills beyond those typically necessary at the undergraduate level," White said.

"In this new program, then, the students will be required to complete a written design program with an in-depth research component and a final comprehensive design project. They will demonstrate their ability to integrate all of the components required in the design and construction of a building," he said.

The new program consists of two parts. The first is on the undergraduate level and requires students to complete 131 hours generally in seven fall or spring semesters and one summer session before applying for admission to the professional graduate level.

Acceptance into the graduate level involves evaluation of a combination of criteria including a portfolio review, minimum 3.0 cumulative grade point average, minimum 800 graduate record examination combined score and admission to the university's graduate school, White said.

Students must take an additional 43 hours at the graduate level to earn the master's degree in architecture. The graduate level courses take three semesters to complete. Students who do not advance to the graduate level can complete an additional year and graduate with a non-professional bachelor of science in architecture degree and may apply to the existing architectural master's program upon graduation.

"These students still might want to be involved in the architecture profession through some other component such as construction or facilities management," he said.

Students who already have graduated with a bachelor's degree in architecture and want to return to complete the master's program can enroll in the college's post-professional degree program, White said. With this degree, a master of science in architecture, students can specialize in historic preservation, architecture-special topics, community design, appropriate technology and housing, and architecture for health.

In addition to its new master's degree program, the College of Architecture also provides several dual-degree programs with the colleges of engineering and business administration.

Each of these degree programs takes six years to complete. Students can earn a master of architecture and bachelor of civil engineering degree with 221 hours; a master of architecture and bachelor of business administration degree with 212 hours; or a master of architecture and master of business administration degree with 212 hours.

About 60 to 70 students will enter the new master's program this fall, according to White.

"Employers today are looking at the quality of students and their knowledge base rather than the nomenclature of the degree," White said. "Our goal is to make our graduates more attractive than the competition."

— Myrna Whitehead

Artie Limmer

Associate Dean Jim White says Texas Tech's new College of Architecture five-year professional master's degree program is unlike any other in the nation.

Texas Tech's Launch into the 21st Century

By John T. Montford, J.D.

Artie Limmer

Chancellor John T. Montford, J.D., (center) is working with Donald Haragan, Ph.D., (left) president of the university, and David Smith, M.D., president of the health sciences center, to set a course for the future of Texas Tech.

My first two months as chancellor of Texas Tech University and Texas Tech University Health Sciences Center have been a most challenging and rewarding experience. The faculty and administration of these institutions have worked with me to evaluate our current situation and set a course for the future. When the Texas Tech Board of Regents announced my appointment as chancellor in August, I remarked that Texas Tech was on the launch pad and our future was bright. We now have ignition, and I predict that Texas Tech will project itself into the 21st century as one of the most exciting institutions of higher education with a blueprint for sustained success.

Since its founding in 1923, Texas Tech has enjoyed dynamic leadership. From the early vision of Paul Horn to the later growth achieved under the leadership of Grover Murray, Lauro Cavazos, Robert Lawless and Donald Haragan, Texas Tech has prospered and has achieved the characteristics of greatness for a statewide institution. I am fortunate to have this solid foundation of leadership to build on in my tenure as the first chancellor of Texas Tech. As Sir Isaac Newton once observed, "We stand on the shoulders of giants" who guide us into the future.

My first challenge at Texas Tech was the selection of a president for Texas Tech University and for the Texas Tech University Health Sciences Center. These institutions now have in place two outstanding leaders in Donald Haragan, Ph.D., president of Texas Tech University, and David Smith, M.D., president of Texas Tech University Health Sciences Center.

Don Haragan has an outstanding tenure of service to Texas Tech beginning 27 years ago as a faculty member and continuing to his most recent post as interim president. This new chapter in his partnership with the university no doubt will continue his sterling

record of performance and leadership. David Smith is a dynamic individual and an outstanding academician. His vision will lead the health sciences center to a new prominence. His role as Texas Commissioner of Health over the past four years has brought significant and positive recognition to health initiatives in Texas. His efforts on behalf of rural health care and his emphasis on children's health and issues of public health in my view make him the best possible selection in the nation to serve as president of Texas Tech University Health Sciences Center.

My intention is that the presidents of these two institutions will operate with great latitude and develop their own internal strategies for achieving outstanding academic success. At the same time, I plan to work closely with Dr. Haragan and Dr. Smith to ensure the needs of both institutions are met as we remain on a steady course for the future.

I see my role as chancellor of Texas Tech focused in several specific areas. For the past two months my focus has been on fund raising. I expect that emphasis to continue throughout my tenure at Texas Tech because I believe that the growth of our endowment is the single most important challenge for Texas Tech at this time. In addition, I will take a major role in governmental affairs, guiding Texas Tech through the upcoming legislative session. I also will place significant emphasis on the marketing of Texas Tech with a goal to attract and retain top notch faculty and students. Finally, my goal is to improve efficiencies in the shared services of Texas Tech University and Texas Tech University Health Sciences Center. I plan to enhance information resources on both campuses and develop both a financial plan and a strategic plan for Texas Tech that will take us into the 21st century. I plan to establish a close working relationship with the faculty, the students and the communities that we serve.

Regardless of how successful our marketing, governmental relations and fund raising may be, we also must review the essence of these institutions — our academic programs. In these times of declining resources, we must strive to achieve a level of operations in all our programs that is not only successful but also lean and efficient. Perhaps more than any other factor involving our academic and administrative programs, we must stress that we will be a "user-friendly" campus. All we do at Texas Tech must support a learning and research atmosphere which flourishes.

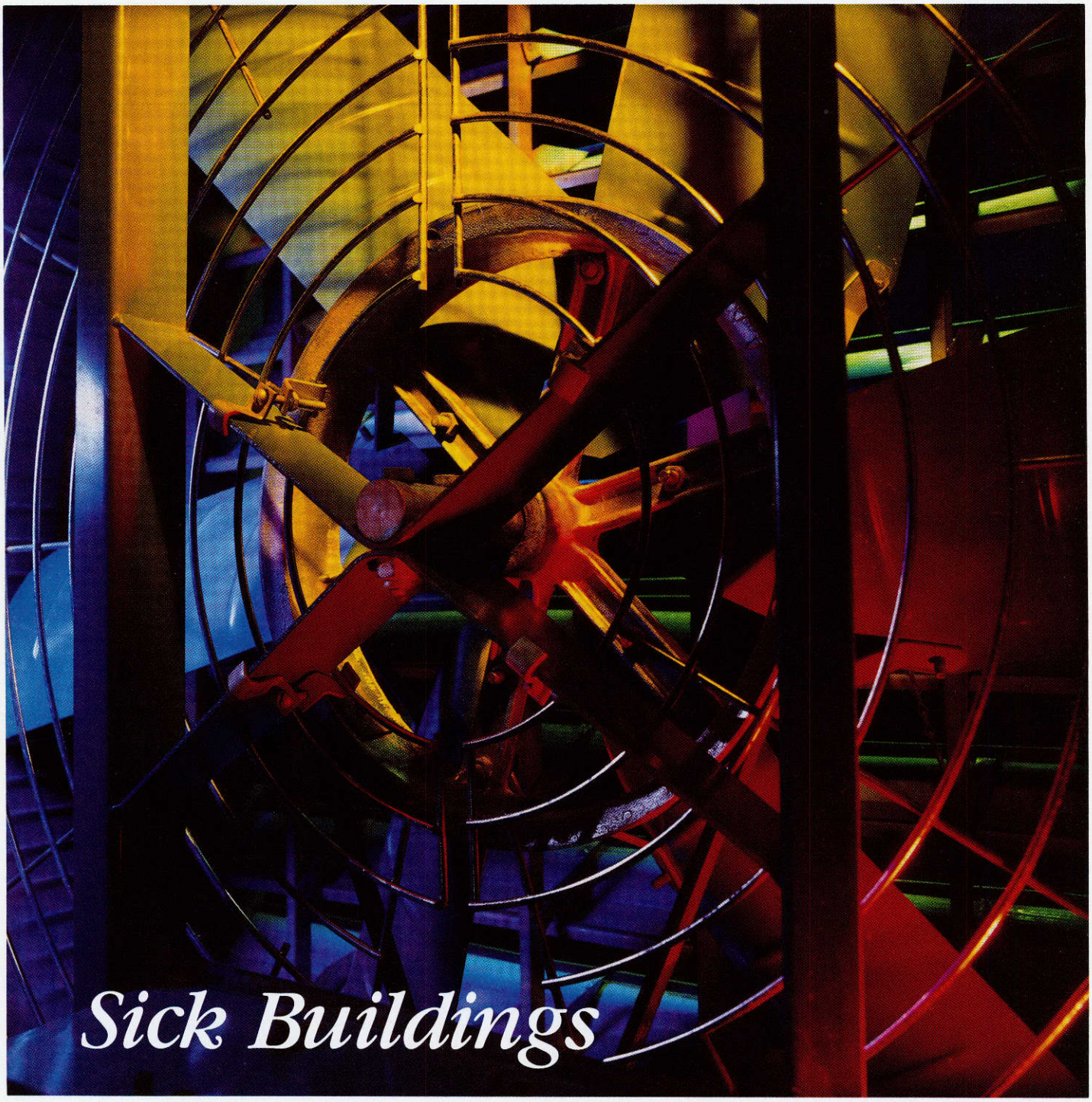
I look forward to working with Drs. Haragan and Smith on the recruitment of top students for Texas Tech. Exemplary students, of course, are vital to our future success. In order to attract top undergraduate students from high schools throughout Texas and superior graduate and professional students from throughout the nation, we must be ever mindful of the need to increase the number of scholarships and fellowships available for our students. As federal and state budgets for higher education are reduced, we must be ready to ensure that deserving students can attend our university and graduate with respectable financial assistance.

In addition to attracting excellent students, we also must recruit and retain elite faculty. Texas Tech can be a center for teaching and research that attracts both established faculty members and new faculty members with promising futures. To do this we also must substantially increase our numbers of chairs and professorships. An increase in faculty salaries is essential at Texas Tech, not only because our faculty deserves a pay increase, but also because increased salaries will help with faculty recruitment and retention.

The pride that Debbie and I feel in being asked to serve these great institutions is indeed overwhelming. We see this as the significant challenge of our lives and look forward to a close association with the Texas Tech family now and in the future. I applaud the readers of **Vistas** for your active participation and the support of Texas Tech. I hope that you will join me on the launch pad as we soar into the exciting 21st century at Texas Tech.

John T. Montford, J.D., is the first chancellor of Texas Tech University and Texas Tech University Health Sciences Center.

"Regardless of how successful our marketing, governmental relations and fund raising may be, we also must review the essence of these institutions — our academic programs."



The Indoors that Augment Our Ills

By Preston Lewis

Buildings — like people — must breathe. But when they can't, it is the people instead of the buildings that get sick.

Runny noses, watery eyes, scratchy throats, headaches, nausea, fatigue, decreased attention span, allergies and, in some rare instances, fatal asthma attacks can strike the occupants of those buildings.

Those maladies are the result of what has become known as "sick building" syndrome (SBS). The impact a building could have on people's health was brought dramatically to the public's attention in Philadelphia in 1976 with a fatal outbreak of what became known as Legionnaires' disease. The disease killed 29 participants at an American Legion convention.

Legionnaires' disease is classified as a building-related illness, or BRI, which means the causes are known and the disease can be clinically diagnosed. Though SBS is more difficult to diagnose, it could affect up to 33 percent of the non-residential buildings in the country, according to the World Health Organization and the Environmental Protection Agency.

Because SBS's causes are a complex combination of building design, materials and maintenance further complicated by fungal and biochemical factors, indoor air quality may well be one of the most serious — and least understood — health problems facing industrialized nations.

"The problem with indoor air quality stems from the Mideast Oil Embargo in the mid-1970s," said Texas Tech University Health Sciences Center Physiology Professor James J. McGrath, Ph.D. "The government decided we needed to conserve energy, and one of the goals was to tighten up buildings and make them more energy efficient."

As a result old buildings were insulated, windows sealed and every crack caulked and filled so heated or cooled air — depending on the season — wouldn't escape. New buildings were designed with energy conservation in mind. They were built with nonfunctioning windows, with synthetic insulation materials and with other energy conserving features that locked energy — and contaminants — inside.

Certain organisms appear every time researchers find a building that has "sick building syndrome," says David C. Straus, noting that investigators are trying to establish whether a relationship exists between the organisms and the maladies that affect the building's occupants.

New and retrofitted buildings could no longer breathe or vent contaminants as easily as they could when open windows were as accepted as 32-cent-a-gallon gasoline.

"It's sort of like an old-time farm family of six taking a once-a-week bath on Saturday night and everybody using the same bath water," McGrath said. "We're using the same dirty air over and over and over again."

Kenneth V. Easterwood, vice president for the Dallas-based indoor air quality firm QIC Systems, puts it another way.

"We're creating a new environment inside these buildings and they are becoming test tubes," he said. "And we're living and working inside these test tubes."

McGrath and other Texas Tech researchers, both at the university and health sciences center, became involved in indoor quality issues after being contacted by Easterwood, a Texas Tech architecture alumnus, and H.W. Holder, president of QIC.

"When we got involved in indoor air quality issues," Holder said, "we thought it was primarily an engineering problem. It's much more than that.

"We began to realize that only a major university and health sciences center like Texas Tech would have the variety of expertise needed to address the problem. Our goal is to solve the problem at the cause rather than simply address the symptoms."

This realization led to the public/private partnership between QIC and Texas Tech, which today has four laboratories involved in indoor air quality research.

However subtle the causes of SBS, McGrath said the problem is avoidable if buildings are designed properly, if they are used as they were originally designed, if they are equipped with an adequate heating, ventilating and air conditioning (HVAC) system and if the HVAC system is properly maintained.

"Virtually none of those conditions exists in buildings as they are used today," McGrath said. "Buildings are regularly modified and renovated or their use has changed over time. Governmental agencies are very bad about taking over a building and packing two or three times the number of people inside than it was originally designed for."

Beyond those issues two additional problems enter into the SBS equation: building materials and microbes.

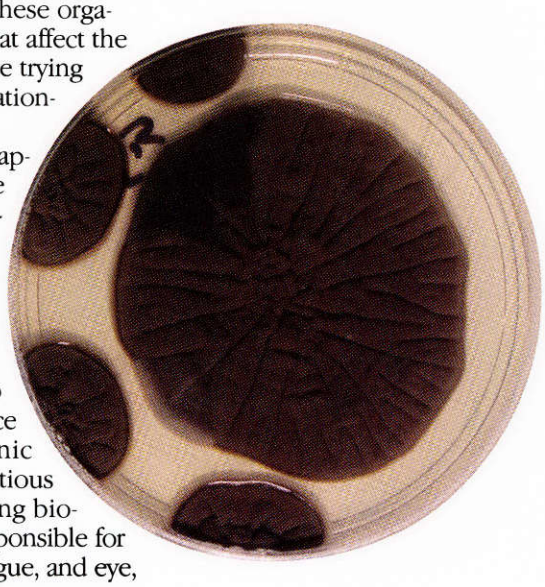
Horn Professor Purnendu K. Dasgupta, Ph.D., of chemistry and biochemistry who has a $138,000 grant through the State Advanced Technology Research program to investigate indoor air quality, said, "You can classify these problems as either chemical or biological in nature. Because chemical processes are used to produce so many building materials ranging from paint to plastics and from carpeting to adhesives, there is a certain level of chemical contamination in most new buildings."

Because these materials — carpeting, wall trim, ceiling tiles, insulation, paint, etc. — are synthetics, they will emit gasses that can cause headaches, nausea and other ill effects in some people. In essence, the "new" smell in a brand new building actually can be hazardous to some.

However, if building materials are properly selected, the composite levels of these chemicals can be managed. In some cases engineers have even attempted to "cure" the problem buildings by turning up the heating system abnormally high to "bake out" the gasses.

Things are not nearly so simple for biological agents or microbes, said David C. Straus, Ph.D., professor of microbiology at the Texas Tech University Health Sciences Center.

"Every time that we find a building that has what is commonly referred to as sick building syndrome, certain organisms appear," Straus said, "but there's no proof that there's a causal effect between the presence of these organisms and the maladies that affect the building's occupants. We're trying to establish if there's a relationship."



The three main players appear to be members of the genera ***Penicillium, Aspergillus*** and ***Cladosporium.*** These fungi are invariably present in indoor air, Straus said, but the ratio at which they are present appears important. This trio of fungal genera can produce a variety of volatile organic compounds (VOCs), infectious particles and other irritating bioaerosols which may be responsible for the headaches, nausea, fatigue, and eye,

variables not only include the multiple combinations of fungal species but also the individual reactions of the people who live or work in a building.

For example Glenn Hill, an associate professor of architecture at Texas Tech, noted, "There are some people who may react and some who don't. It is just like some people are allergic to something and others are not."

McGrath said, "For a number of reasons people vary in their sensitivity to different chemical and biological agents. Physiologically, they just do and we can't tell you why beyond that. The second thing is that people at different stages of a life cycle vary in susceptibility. The very young, the very old, pregnant women, people with AIDS and people undergoing organ transplants all may have suppressed immune systems so they are extremely sensitive to various chemicals and biological aerosols in a building. Consequently, we have a target population that varies and a building that varies, complicating the issue further."

As an architect, Hill must be concerned about designing a building that maintains a proper balance between energy efficiency and proper ventilation. Because the two are not mutually exclusive, cost often becomes the determining factor in the design decisions. Also, the standards for the industry are changing as the impact of indoor air pollutants on personal health is identified.

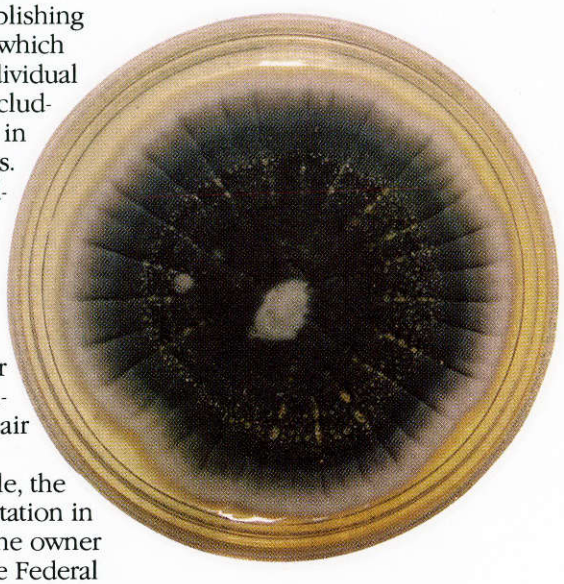
"Now scientists and architects are realizing the pollutants indoors may be affecting health and there is debate about updating building codes to increase the cubic feet of fresh air per person per hour," Hill said.

The problem is succinctly stated by McGrath.

"There are no standards for indoor air quality," he said. "If we were outside breathing the same air as we are inside, the air quality would be regulated. Indoors, you become completely dependent upon the HVAC system."

"As in most cases, cost becomes an issue," Hill said. "Without clear, distinct data, it is difficult to change the codes and some people won't do things unless they are forced by code to do it. So, I think one of the biggest problems of design is to make clients and the people who build buildings aware that the potential for a problem is there."

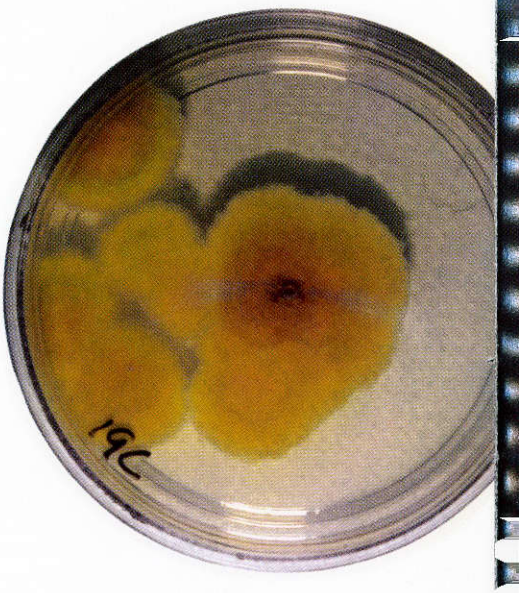
QIC and Texas Tech are beginning to link building conditions to health effects as well as identify traditional practices and procedures employed by architects and engineers which can lead to problem situations. QIC is also engaged with clients in establishing indoor air quality programs which involve all aspects of the individual client's corporate culture, including the design criteria used in new and renovated buildings.



Additional factors are leading other architects, engineers and builders to reconsider the issue of indoor air quality. First, the legal liability may force some to re-evaluate. And second, worker productivity issues may convince others to take indoor air quality into account.

This past April, for example, the U.S. Department of Transportation in Washington requested that the owner of a building it leased for the Federal Railroad Administration (FRA) spend $5 million to relocate employees and overhaul the building's HVAC system.

The building was identified as a problem after 60 out of some 5,500 workers blamed the building's air for nausea, headaches and sore throats. Subsequent investigation showed high levels of hydrocarbons, a by-product of fungi, and carbon dioxide. A month later a more detailed study of the building identified the toxigenic fungus ***Stachybotrys chartarum*** in the air, but had been unable to identify its source. ***Stachybotrys chartarum*** produces substances that can irritate the skin and mucous membranes, interfere with body metabolism and reduce resistance to infections.



The FRA office is only the latest in a spate of indoor air quality problems affecting public buildings. The Polk County Courthouse in Bartow, Fla., for instance, was built in 1987 for $37 million. The building was plagued with so severe a microbial infestation that it was estimated to cost another $30 million to fix.

Also in Florida, Lamary Elementary School in Pinellas County had so much mold contamination on walls, books and furniture, that more than 800 students had to be moved out of the new building.

More than half the workers in the newly built DuPage County, Ill., Courthouse experienced symptoms associated with SBS after the facility

nose and throat irritations which strike occupants of many so-called "sick" buildings.

To thrive, these fungi and other microorganisms require nutrients, which are found in almost any building material, as well as a temperate environment and, most importantly, water. Consequently, sick buildings generally are more common in humid areas than in arid and semi-arid regions. Even so, microorganisms are found in the dust, carpeting and wall surfaces of all buildings. So while an HVAC drain pan may create an inviting environment for bacteria, high relative humidities can quench the thirst of fungi in the dust, carpeting and walls.

"Any air conditioned building has the potential to be a problem because you have moisture condensing on the cooling coils and the typical system cannot deal with excessive moisture loads in buildings," said QIC's Easterwood. "To complicate matters further, many materials are brought into a building with high moisture content which is then trapped in the building."

Once a fungal colony establishes itself in a building, the fungus itself, its spores and its biochemical byproducts, or volatile organic compounds such as solvents like hexane or ethanol, which are both neurotoxins, can be spread throughout a building by the air handler.

To date the individual VOCs which cause a specific symptom have not yet been correlated. Straus and Dennis Shelly, Ph.D., in the Texas Tech chemistry department, are initiating one of the first studies in the United States to attempt to make such a correlation.

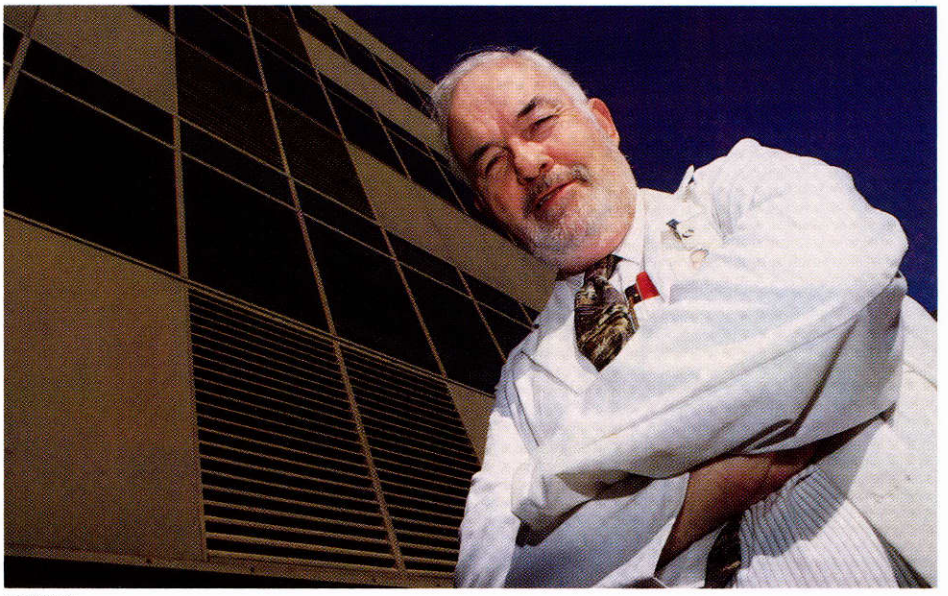
After taking fungal samples from suspect buildings, Straus and his colleagues — technician William Wong and graduate student Danny Cooley, both of microbiology, and Cynthia A. Jumper, M.D., in the department of medicine — culture the fungi and introduce them and their byproducts into air chambers where they can be maintained at levels comparable to the building where they were sampled. Then mice can be placed in the chambers for periods comparable to an eight-hour work day for an extended period. At the end of that time, the test animals are sacrificed to determine if the exposure has contaminated their lungs.

"This is the first experiment that will try to show a direct link between sick building syndrome and the presence of these organisms," Straus said. "Nobody knows the connection between these organisms and sick building syndrome though there are a lot of theories. Certainly one possibility is that you get an allergic reaction — almost like hay fever — from inhaling these fungi over time. Continual exposure to these organisms may cause your lungs to mount an immune response that causes problems. Or possibly the material from these fungi may be directly damaging. Once again, we don't know."

The unknown is common in the study of indoor air quality because the

"It's sort of like an old-time farm family of six taking a once-a-week bath on Saturday night and everybody using the same bath water. We're using the same dirty air over and over and over again."

The problem with indoor air quality stems from the Mideast Oil Embargo in the mid-1970s, says James J. McGrath.



Artie Limmer

opened. It had to be evacuated for a major and costly renovation.

The legal precedent for indoor air quality liability was set earlier this decade when five plaintiffs received $950,000 in damages after claiming that office building owners and managers were responsible for improper renovations which caused them to suffer respiratory and neurological disorders. Ironically, the suspect building was the Washington headquarters of the Environmental Protection Agency, the very agency that had estimated more than 30 percent of the office buildings in the country have significant problems associated with their HVAC systems.

A second legal case, styled Call V. Prudential, then determined that designers and contractors of the HVAC system in a suspect building could be held liable under strict liability theory. The judge ruled, in effect, that the HVAC system could be viewed as a product and those who designed and installed a defective "product" could be held liable for damages.

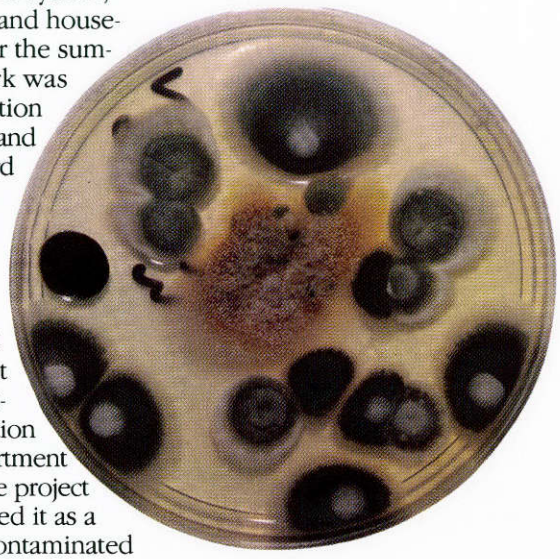
The safest way to deal with the health issues and the possible liability issues, said McGrath, is for management to take complaints seriously.

"Too often management goes into denial and that's unfortunate because it only prolongs the problem and the potential for liability," McGrath said. "The next step is to bring in professionals who can address the myriad factors which could be contributing to a problem."

As an illustration, McGrath used Tom Green Elementary School in Kyle, Texas, as a best-case scenario. The 60,000-square-foot facility was built in 1985 for $2.6 million, but its occupants had experienced ongoing problems with headaches, upper respiratory infections, teary eyes and allergies, all symptoms associated with sick building syndrome.

The school district turned to QIC for help. With technical assistance from McGrath and Straus who took microbial samples, QIC identified the problem as excessive moisture in the crawl spaces beneath the building. Earlier attempts to dry out the crawl spaces had actually forced molds into air, walls and ceiling tiles of offices and classrooms, where the fungi continued to thrive.

QIC developed a program to address the problem at all levels. In addition to the engineering aspects, the plan also included components to work with the district to develop multi-lingual communications with the staff, students and parents. QIC then implemented a decontamination process prior to the end of summer to lessen the immediate health risks to the occupants. To solve the problem, the plan addressed the entire concept of the HVAC system, energy savings strategies and housekeeping procedures. Over the summer the renovation work was completed and a certification was issued jointly by QIC and the Technical Review Board staffed by experts at Texas Tech.



Since the certification, complaints have dropped from 22 per month to one in two years. Straus and Jumper continue to meet with school officials to discuss the ongoing certification program. The Texas Department of Health, interested in the project from the outset, has viewed it as a model for dealing with contaminated environments. In fact, TDH has expressed an interest in utilizing the Texas Tech IAQ Laboratory as a resource.

"It was expensive, yes," McGrath said, "but not nearly as expensive as building a new school."

Joddie Witte, superintendent of the Hays Consolidated Independent School District in Kyle, said, "This is a success story. We have received numerous positive comments from parents and staff concerning the new quality environment of the building."

The improved environment was healthier and alleviated the complaints which previously had been plaguing students and teachers at Tom Green School, he said.

For QIC President Holder, Tom Green Elementary is one of a growing number of success stories for his firm. Ultimately, he hopes the certification program which QIC and TTUHSC has developed will become the standard for dealing with contaminated buildings. With the success of Tom Green and subsequent certified buildings, QIC hopes to develop its certification program into a sort of Good Housekeeping Seal of Approval that can become a standard nationwide.

When that day comes, a lot of people will be able to breathe easier on the job. □

"This is the first experiment that will try to show a direct link between sick building syndrome and the presence of these organisms."

Poise Among the Arts

By Steve Kauffman

Photos by Joey Hernandez

When students leave Texas Tech University's fine arts doctoral program with degree in hand, they walk off campus to be college professors, theater center or museum directors and symphony managers. But perhaps, most importantly, these graduates go on to be some of the most knowledgeably well-rounded professionals in the arts work force.

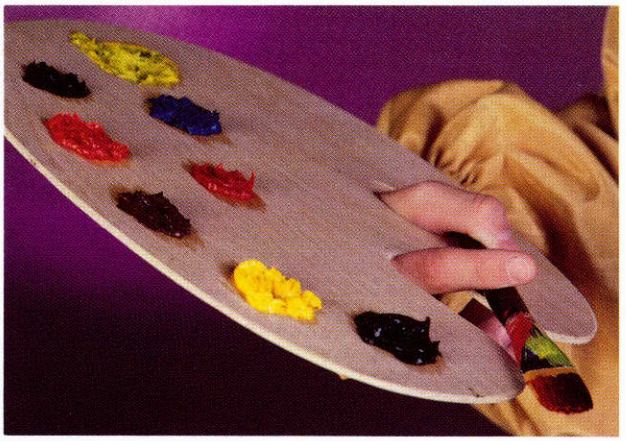
A prime example of this new type of renaissance artist is John Stinespring, Ph.D., not only Texas Tech art professor but also a graduate of the program.

"What we in this program are looking at is the broad aesthetic overview — looking at a specific art in the context of its place within the arts," Stinespring said of the importance of an interdisciplinary approach. "And more specifically, people interested in administrative roles need to be more conversant with what goes on within the overall interworkings of the arts."

Stinespring, now a doctoral educator and member of the program's overseeing Fine Arts Doctoral Committee,

"What we in this program are looking at is the broad aesthetic overview — looking at a specific art in the context of its place within the arts."

—John Stinespring



came to Texas Tech with a broad interest in fine arts in addition to his discipline. The cooperative approach already was familiar to him. He previously had taught several years in a high school as part of an interdisciplinary humanities team that included music, art, theater and dance.

An accomplished musician as well as artist, Stinespring has remained active in local music since completing his graduate studies and joining the Texas Tech faculty, auditioning and securing a spot as bassoonist with the Lubbock Symphony Orchestra, a position he still holds.

"The program has a successful formula, unique in its flexibility that lets the student develop a credible major base of study in a specialized field combined with a broad arts overview that opens that person up to a lot of opportunities," Stinespring said.

The comprehensive knowledge base through art, theater, music and philosophy classes is the goal of Texas Tech's fine arts doctoral program. With a cooperative arts teaching approach, the curriculum sets the degree apart from any other doctoral arts program in the United States, according to Texas Tech administrators.

"Actually, I believe that the truly interdisciplinary design of our fine arts doctoral program is unique in the world," said Graduate School Dean Tom Langford, Ph.D., chairperson of the governing Fine Arts Doctoral Committee for the past 15 years. Serving in various capacities in the graduate school administration since 1968, Langford was among the creators of the fine arts doctoral degree program approved by the Texas Higher Education Coordinating Board in 1972.

Before that time, the three areas of the arts only offered master's degrees for graduate students, although the art and music departments both were in the process of garnering administrative support for separate doctoral programs.

According to Langford, then-Graduate School Dean Lawrence L. Graves was concerned about the limited market for two new specialized arts doctoral degrees but brought up the idea of a cooperative arts doctoral program. In 1970, Langford as interim dean of the Graduate School appointed a feasibility committee to look into pioneering an interdisciplinary program drawing upon the collective strengths from the three arts departments.

"The committee was fully supportive of the idea, but all three of the major departments had to buy into the doctoral program or the whole thing was a no-go," Langford said.

Theater Professor Richard Weaver, Ph.D., came to Texas Tech to head the theater program in the fall of 1972 just as the Coordinating Board was in the process of approving the doctoral program. He said the dedication and cooperation among the faculty members at Texas Tech has been a key to the success and growth of the program since its start.

Weaver, who returned to teaching after 22 years of heading the theater program, said he knows of one other university trying to create a program from Texas Tech's model. He actually helped a Florida university design its fine arts program, but the program was discontinued before it accepted its first students.

"It fizzled immediately after it was approved," Weaver said. "The faculty did not support the program and were not really interested in it; they were more interested in the traditional Ph.D. program."

As specified in 1972, the Texas Tech program still is run with joint leadership from the School of Music and the departments of art and theater. The Fine Arts Doctoral Committee, chaired by a Graduate School representative, is comprised of the chairperson and graduate adviser from the School of Music and from the departments of art and theater as well as the chairperson of the philosophy department.

Fine arts doctoral students select a minimum of 30 hours of their 62-credit-hour degree program from one of the arts, a typical arts doctoral program. However, they also are required to complete a 21-credit-hour core of classes that includes six credits in administration and perspectives courses from each of the two remaining arts areas. The core also includes six hours of philosophy/aesthetics in addition to a three-hour fine arts course titled "Interdisciplinary Perspectives in the Fine Arts."

The program was reviewed, under the auspices of the Texas Higher Education Coordinating Board, in the early 1980s by a panel of national experts in arts education. According to Langford, the panel's written review praised the program and suggested its interdisciplinary approach should be a model for other universities.

"The panel members were at first skeptical, but in their final report recommended that the program receive priority support from the Coordinating Board and be regarded as a model for other universities across the nation," Langford said. "The panel realized that what we basically do with this program is develop strong advocates for the arts as a whole."

Texas Tech graduates are people who

"Texas Tech graduates are people who are well-versed in a variety of aspects in art, theater and music, and that knowledge makes them better and more capable leaders in the arts field."

—Tom Langford

are well-versed in a variety of aspects in art, theater and music, Langford said, and that knowledge makes them better and more capable leaders in the arts field.

As stated in a 1982 article co-authored by Langford: "It is frequently acknowledged that the future of the arts and their impact on society in general depend on the recognition that the arts are one in their benefits to humankind, in their need for public support, and in their claim to a significant place in all formal educational curricula. Although there will always be a place for highly specialized study at the graduate level in each area of the arts, the field also has an urgent need for the development of leadership that will reflect awareness of the mutual problems and the impact on society of all the arts."

The article also champions the need at the college, community, state and national levels for informed and well-trained leaders with broad understanding of the current place and future significance of the arts in public life who can work to fulfill the potential envisaged by such federal break-throughs as the establishment of the National Endowment for the Arts.

With the now-increasingly hostile federal budgeting wars in which humanities programs like the NEA are being starved, current Theater Department Chairperson Norman Bert, Ph.D., sees the role of arts advocate as more important than ever and Texas Tech's program as the training ground for proponents of federal arts funding, public support and free artistic expression.

"In today's society, the funding problems and political environment is producing a growing need and importance for a national interest and awareness in the arts," said Bert, noting that advocates with a broad arts knowledge like that developed at Texas Tech are best equipped to foster that national support.

School of Music Director Wayne Bailey, D.M.A., who arrived at Texas Tech in 1995, agrees that the program produces people who are artists and who have "knowledge about the arts in big terms." He said that doctoral students preparing to be teachers are offered training and experience that also has become vital in the classroom.

Bailey notes that, with traditional graduate education designed to be increasingly focused, a doctoral student in music might not even be studying music but rather a very specific area of music.

"That's good for tenure and promotion but not necessarily good for teaching the classes," he said. "Professors are asked on a daily basis to relate one art form to another, and that is difficult to do with traditional training."

Bailey also said the interdisciplinary arts knowledge is something that most readily needs to come from a teacher's college preparation.

"Full-time music professors, for example, often can't take the time to learn everything about art history or acting. They don't have a lot of time to study other art forms on the job," Bailey said.

Still, Bailey sees this particular interdisciplinary degree as something that can never and will never replace the traditional doctoral program focused on a particular area of the arts in history or criticism.

"And the interdisciplinary program shouldn't replace the traditional doctoral degree. It is not the degree for everyone. It takes a special kind of student," Bailey said.

Weaver agrees that Texas Tech graduates have found their niche mainly in teaching, and many now are academic department chairs at colleges and universities.

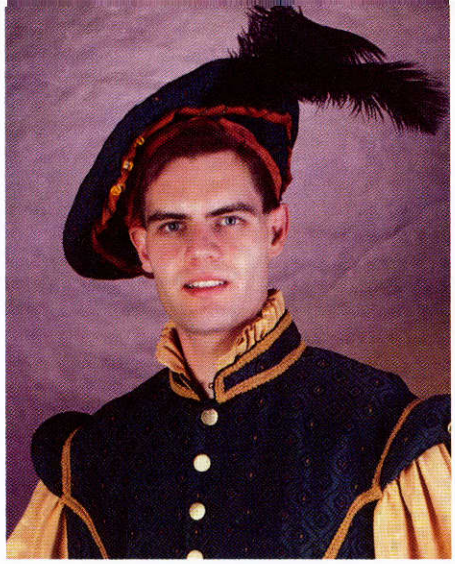
"We did some research and found that most of the other doctoral programs in America were actually training people in history or criticism. But when they got their first jobs, they were expected to teach acting, directing and direct productions," Weaver said. "What we do is teach them acting, directing, and we also throw in management training."

The clash between this type of hands-on training and traditional research-oriented doctoral programs has been a point of contention for arts educators and professionals for years, according to Music Professor Wayne Hobbs, Ph.D.

"The division of scholar vs. practitioner has been a point of tension in arts professionals for years," said Hobbs, who served on the Fine Arts Doctoral Committee as director of the School of Music from 1987 until he returned to full-time teaching at the end of 1994.

At Yale University, widely respected for its arts training, the division is manifest physically in the buildings the two sides occupy. According to Hobbs, Yale has a department of music for undergraduates and graduate students in musicology while the separate school of music is devoted entirely to graduate student training in performance and composition.

Hobbs, referring to the difference as "creative tension," said that the remedy, while not changing anyone's opinion, is for the artists on both sides of the debate to develop a



"The nature of art itself is changing with multimedia presentations, performance art and computer technology."

—Melody Weiler

respect for the other side.

"We manage to coexist rather nicely here," Hobbs said of Texas Tech, adding that the arts faculty as well as the doctoral students appreciate the interrelationship of the arts.

Bert, who has been theater department chair since the start of the 1995-96 academic year, agrees that the traditional doctoral degree still is useful, primarily in preparing for history or criticism. He said the interdisciplinary education is of most benefit to future college educators who plan to head up programs and to arts center or arts commission directors.

"There is a definite need for administrators who know about the full range of the arts. One reason is the cultural shift today, brought on by artists and audience members, where we tend to blur the distinctions and boundaries between different art forms. Performance art, with its blend of art and theater, has become the Post-Modern art form," Bert said, noting that even now-popular music videos are a form of group performance art.

"Looking at the national state of the arts right now, this fine arts doctoral program is sort of a happy accident," Bert said. "It has been here for 25 years just waiting for culture to catch up."

Art Department Chairperson Melody Weiler, M.F.A., said these interdisciplinary programs are becoming an integral part of art education as the "layering" of the arts becomes increasingly more prevalent among working artists.

"The nature of art itself is changing with multimedia presentations, performance art and computer technology presentations," Weiler said. "With collaborative presentations, the challenge is that one form does not become just a backdrop for another art form. It requires a tremendous amount of dedication and training to work in other arts."

The program also builds a mutual respect or "empathy" for professionals in other art forms, Weiler said.

That mutualism spawned a well-received production this past spring that may be the model for future cooperative productions among the three arts areas.

"Ucross Junction" was presented in March as an original theater production, co-authored by Bert and playwright Madeline Martin with music improvised and performed by music faculty member Lisa Rogers. The event was well-attended, and faculty as well as students praised the cooperative efforts required to produce the show.

The play centered on two characters at the opening of an art exhibit. The production actually was staged in an art department gallery with a painting and ceramic exhibit in place. The percussion music was added during the final rehearsals as the final layer of the work.

"The production was designed to show the interplay between the characters, the art, the music and the audience members themselves," said Bert. He noted that the two actors roamed through the audience members, many of whom had to stand throughout the gallery because the amount of seating purposely was limited to encourage audience interaction. Also, a painter, Marjorie Arnett, a fine arts doctoral candidate in art, started each performance with a blank canvas and ended the evening with a finished work inspired by the production.

Music School Director Bailey called the production a success in terms of attendance and fulfillment of purpose.

"We were extremely pleased with the interaction and the public's reception. It was not the typical concert or theater event," he said.

More mutual arts events and projects are likely to be produced in the future, all three program heads agreed. That type of collaboration among the arts departments and faculty is something chairs of the arts areas see as key to expanding the visibility of interdisciplinary activities and the cooperative experience — and supply-demand marketability — of students in the doctoral program.

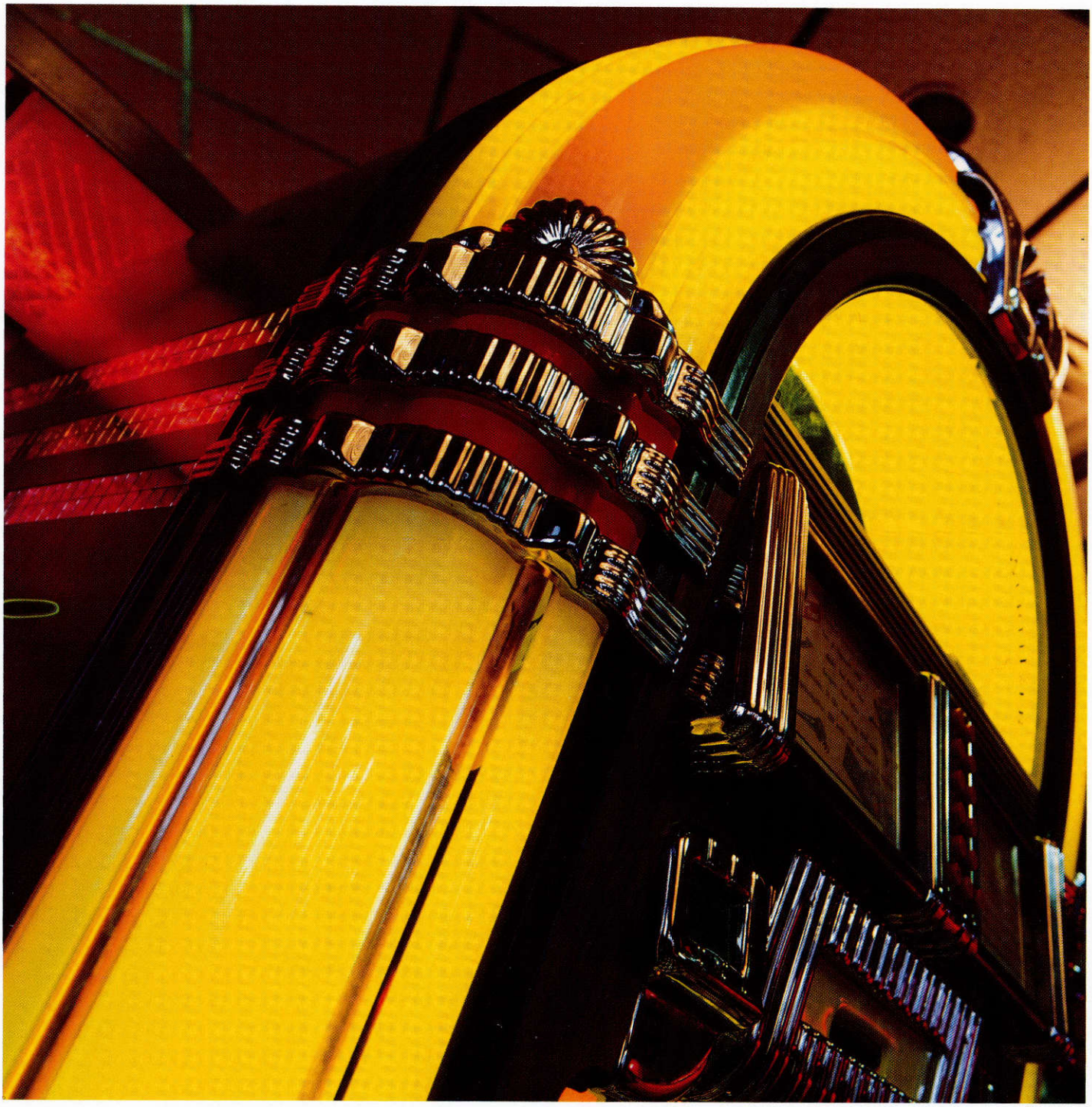
Stinespring said, "When I was in the job market, I had one school that had trouble understanding my interdisciplinary degree, but the rest knew it was something they were looking for."

The program, according to Langford, has a near 100 percent placement rate for graduates with all of them working at some position related to their field.

At state and regional United States theater conferences this year, Bert also has seen the first-hand effect of Texas Tech's program on the arts work force.

"I was amazed at the number of people who said 'I am a graduate of your program.' It seemed like every other person among these theater arts professionals had gone through our program," Bert said.

The widespread placement of fine arts graduates is destined to continue with Texas Tech making its presence known in fine arts venues throughout the nation and the world. As evidence of the program's far-reaching reputation, the fall 1996 class of 20 incoming doctoral candidates includes 10 students from U.S. states outside Texas and five more students who are coming to Texas Tech from Austria, Japan, Mexico and Venezuela. □



Spinning a New Image

By Sandra Pulley

Photos by Artie Limmer

The Fonz knew how to fix Wurlitzers.

Each week on the hit sitcom "Happy Days" he elbowed the temperamental jukebox in Al's Diner until it spun out the latest '50s hits.

Glenn Roberson, M.D., could be called the Fonz of teleradiology. But in his jukebox, selection A-13 isn't "Love Me Tender," it's the chest X-ray of a patient needing critical medical information. And while the Fonz wrestles with comical crises, Roberson is working on a more serious dilemma — giving rural patients access to modern medical care.

Roberson and his team of specialists are putting together a computer system that will receive radiology test results from rural hospitals across the nation.

"This equipment will allow rural physicians to draw on experts in nearly every field of radiology within minutes, as opposed to the average delay of several days," Roberson said.

After these images are imported, they will be stored in a central carousel, allowing the films to be downloaded to individual terminals when needed.

"When completed, it will work like a CD jukebox," explained Roberson, the chairperson of the department of radiology at Texas Tech University Health Sciences Center. "Physically, it is similar to the old Wurlitzer. We will store images on disks and the computer will mechanically select the requested disk from storage and play it. Of course, all this is transparent to the computer operator."

In a world accustomed to high-speed, high-memory personal computers, storing CDs may sound easy, but Roberson pointed out that saving about 50 large images could fill the hard disk drive space of a normal office computer and render it unusable. Just one X-ray is one to 10 megabytes of information.

The average computer on the market now can store 850 megabytes of information, an amount that must include the software needed to run the system.

"The memory requirements to store images are just astronomical," Roberson said.

But by using this "jukebox" system, doctors will be able to access the CD bank without overtaxing their computers, and the CDs will be readily accessible from each terminal. When the system is completed in a couple of years, Roberson hopes to elbow it into storing about half a million images a year, including ones sent to him from area clinics.

Roberson is working on a teleradiology computer system, giving rural patients access to modern medical care.

Other agencies, like the Social Security Administration and large banks, also maintain this kind of computerized storage system, but they get more bang for their storage buck because the data they store is text.

"You can get a lot more text on a disk than you can images," Roberson said.

This is the problem Sunanda Mitra, Ph.D., professor in Texas Tech's department of electrical engineering, has been trying to solve for years. Mitra is researching how to compact images and still leave them readable — a technique called compression.

This technique will combine the simplicity of the bobby socks generation jukebox with the latest computer wizardry.

"It is like taking a painting and peeling away all but 1 percent of the paint," Roberson said. "It is difficult to still see the image. If we have the computer fill in the missing parts, though, we will greatly reduce the amount of memory needed."

To do this, Mitra is designing computers that mimic the way the human eye

sees. Instead of requiring all of an image to produce a clear picture, these computers will use patterns to piece together a usable image. In the same way, the human eye and brain use certain clues to reproduce an image quickly.

"We know that we can crunch images down, but that does not mean that they are always usable," Roberson said.

In addition to being clear, these images also need to be transmitted quickly, Roberson said. Speed is the second problem Roberson's team is overcoming as teleradiology becomes a reality in vast West Texas.

"As we try to transport an image we need to be concerned about the quality of the transmission lines," he said. "This is analogous to needing a faster modem to get information off the Internet in a timely manner."

And if the transmissions are too slow, they render even the most up-to-date equipment useless.

"It is like trying to soup up a '57 Chevy with the engine from an early model Ford. You can't run the car because the engine isn't fast enough."

This time will become critical as doctors transmit more images from remote locations. Currently, the health sciences center receives patient films daily from a clinic in Hale Center. "Right now a chest film takes from one to two minutes to transmit from Hale Center 50 miles away. That's OK for our purposes," he said. "But as we transmit from more locations, we'll want faster connections."

To shorten the time, the health sciences center will depend on high-tech telecommunications lines that are becoming more available for non-military uses. Since the end of the Cold War, many such products originally designed for the military have been introduced into the private sector.

The fastest lines available in West Texas are fiber optic, which can transmit images more than 50 miles in one to two seconds.

The only problem with using these better lines is adaptability. Because the lines are not designed for teleradiology, special adapters have to be created to accommodate the medical equipment.

"Otherwise, it is like being in Europe and not having the adapter for any electronic appliances. They simply will not work. Or it is like having a telephone with no phone jack."

Because fiber optic cables are costly and available on a limited basis, the radiology department has been working with two other types of lines, the T-1 line and the 56-K line.

The 56-K line, which has 1/24th the capability of the T-1 line, currently is being used in Hale Center. But Roberson said the more expensive T-1 is needed when transmitting from far away locations.

"As the distances get longer, you have to go with the faster line. Otherwise the speed really cuts down on your capacity to work."

In conjunction with HealthNet, Texas Tech's telecommunications network,

the radiology department now can use the faster T-1 line from Alpine, which is 330 miles away from Lubbock's medical hub. This kind of technology could also one day connect the veterans hospitals in Amarillo and Big Spring to Lubbock.

These connections would make consultations by three of the area's four neuroradiologists available to veterans, without the patients ever leaving the hospitals.

"Currently, the person has to get in a car and drive up here. There is just not enough volume for the hospitals to keep specialists in every field.

"But to provide the level of care these veterans deserve, you really need specialists."

In radiology, each specialty complements a specialty in another field.

For example, a coronary radiologist would read tests for heart specialists in internal medicine.

Another radiology specialist would help in pulmonary cases.

These specialists and the equipment they require can quickly become expensive for smaller hospitals, but Roberson pointed out that medical schools and their teaching hospitals are specialist-rich. Each hospital that offers a radiology residency is required to staff radiologists in all specialties so that residents can pass their boards.

"If, for instance, the Veterans Administration contracted with us for specialty services, they would only pay on an as-needed basis. This is a lot cheaper than hiring a specialist, and it is better for the patients who do not have to leave town for consultations."

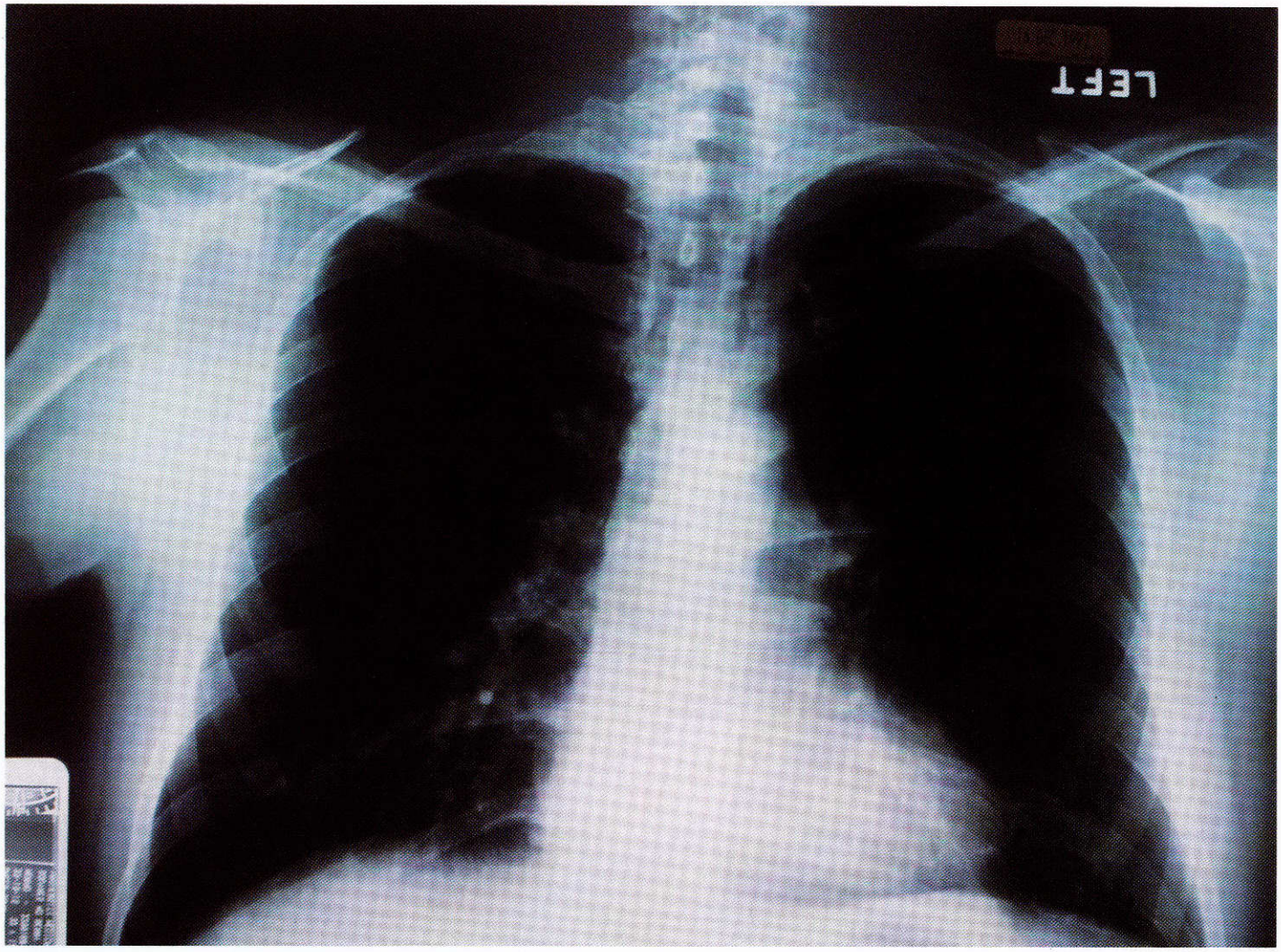
This same concept applies to rural towns.

"You can't have a specialist in Big Spring. It does not make economical sense. On the other hand, these little hospitals are remote enough that they cannot support specialists, and yet their patients cannot always afford to travel two hours for medical care."

In most small towns with hospitals a neurologist visits once a week.

"That is like getting the newspaper a week late," he said. "These people need medical care. They are deprived. They need help. As an institution, it is our mission to help these rural patients."

A rural network of health care, Roberson said, not only will



help those in need, but it also will sustain the health sciences center during the managed care era. As specialty care becomes more expensive and general practitioners become more important in health care delivery, he expects that rural doctors will refer patients to large medical centers for specialty work.

This new attitude about health care differs greatly from the way medicine has been delivered since the turn of the century, Roberson said. He divides modern medical history into three phases.

During the charitable era, which began at the turn of the century and lasted through World War II, hospitals largely sought to fulfill their sense of community responsibility. During the '50s, the hospital was transformed into a highly technological enterprise funded largely by federal and state programs such as Medicaid and Medicare.

In the 1990s, managed care and increased competition among hospitals are molding the face of health care.

"Health care is moving to control costs by utilizing general practitioners more," Roberson said. "Yet at the same time Americans demand more specialized care. This is the irony of the current system.

"I can be just as effective here as I am in the field. I deal with images. An image is an image."

With features like zoom, brightness and contrast, radiologists can view films on computer as easily as they could in person before.

Despite potential economic benefits, hospital radiology departments are wary about becoming totally automated, Roberson said. Only one-third of America's hospitals have an automated radiology information system. Fewer still are developing the equipment, like the "jukebox" to store large electronic images permanently.

"Computers and telecommunications are ways to cut costs without cutting the quality of care."

Although the quality of care provided by teleradiology is immeasurable, the costs can drive hospitals away. T-1 lines can run up to $4,000 a month to maintain.

"The faster lines are not cheap," he said.

Neither are the systems designed to cull information off of these lines. Because the computer industry is changing rapidly, Roberson hired Yao-Yang Shieh, Ph.D., in March 1994 to play medical McGyver for his equipment. Shieh, whose background is in defense contracting, is putting together a system that is both state-of-the-art and adaptable.

"Computer imaging science came out of the space program and defense," Roberson said. "Defense contractors are in the business of systems integration. They gather together pre-existing equipment to do a task.

"We are bringing this technology out of space and defense and into medicine."

But because telecommunications systems specifically designed for teleradiology are rare, Roberson said, they are also expensive.

"It is simple economics. The more people that can buy a product, the more the unit costs go down. But it is astronomically expensive to have a customized project completed. If you are paying to customize, the meter is running."

By having Shieh in-house, the radiology department not only saves money, it also gets computers specifically designed for its needs.

"Big companies are locked into a tremendous amount of long-term research and development, meaning they can't turn projects around quickly," Roberson said. "There are multiple levels of committees, of funding, of marketing. By the time the product gets on the market, it is obsolete.

"We are designing systems that you will not even be able to buy for three or four years."

By designing the new system in modules, the radiology department will be able to simply pop out outdated equipment and replace it with newer versions.

"That way we are not locked into the old systems. We do not have to replace the whole thing when a better piece of equipment comes out. Computers are progressing so rapidly that if you are not at the forefront, you are dead."

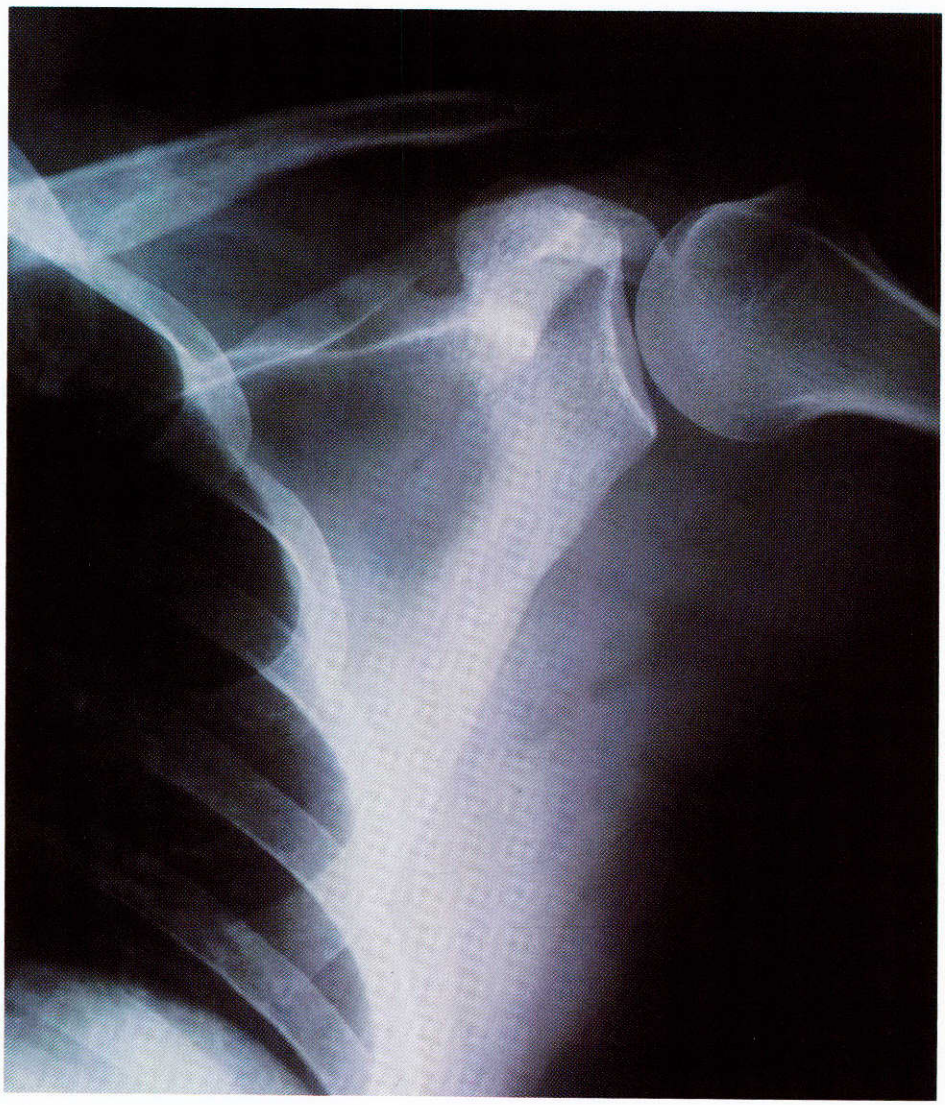
By offering a versatile system, Roberson and Shieh hope to be able to mold their system to the financial means of the rural hospitals. They also are seeking grants and special funding arrangements to further reduce the costs for these hospitals.

"By focusing on cost-containment, we may break the only barrier left to teleradiology — the price tag," Roberson said.

As one of the only centers in the nation developing teleradiology equipment, the Texas Tech University Health Sciences Center is ensuring itself a place in the forefront, he added.

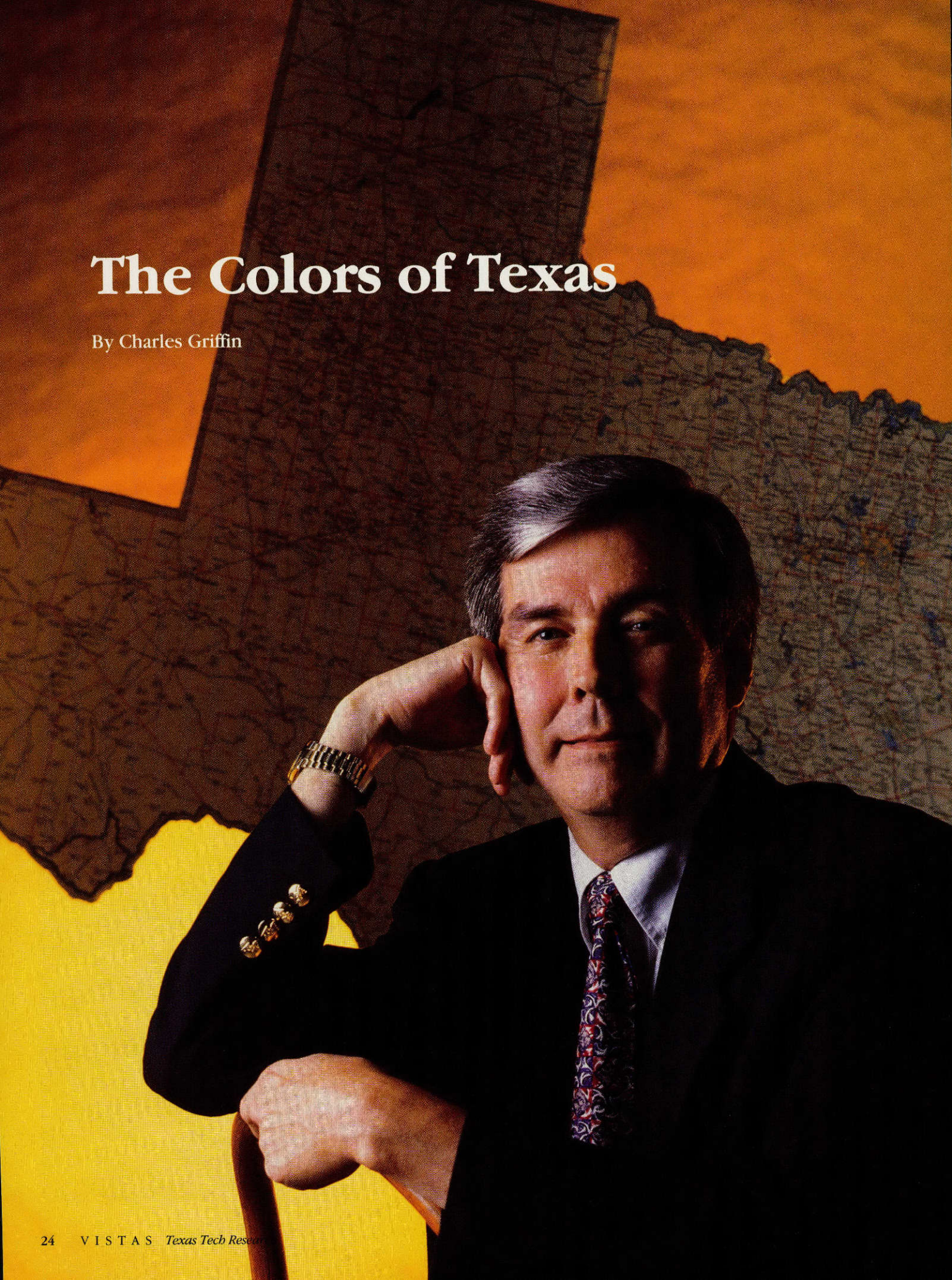
But unlike the Fonz, who only needed a leather jacket and a shiny motorcycle to stay cool, the Fonz of teleradiology knows the next few years will be a constant battle to stay on that cutting edge. □

"By focusing on cost-containment, we may break the only barrier left to teleradiology — the price tag."



The Colors of Texas

By Charles Griffin



As an impressionable child during times of segregation, Alwyn Barr looked beyond the blacks and whites of a color-coded world. Living in Austin, Barr transcended color lines established by a dominant white culture via his mother who taught him the values of embracing diversity and imparting understanding.

Barr's mother, an active member of the Methodist church, served on the board of Huston-Tillotson, a college for blacks during segregation. As a board member she met with black educators, doctors and lawyers, providing young Barr with a kaleidoscopic view of African-Americans.

From his rearing, Alwyn Barr, Ph.D., now a professor of history at Texas Tech University, has seized an appreciation for the unsung hero and has integrated that respect with his love for history. In turn, he has shared his views and knowledge with others, influencing present and future historians as well as numerous Texas history books.

"My friends growing up in Austin saw mainly working-class African-Americans, but I saw middle-class people, individuals dressed in suits. I believe that the exposure instilled in me a more diverse image of African-Americans, much more so than my peers had during times of segregation," he said.

While satisfying a childhood interest in the Civil War, Barr was exposed to two other facets of American history, which later would become an integral part of his research and teachings.

"I think many people with an interest in American history start with a specific area of attention and then it broadens. My interests began with a curiosity regarding the Civil War and expanded to include the history of the South and African-American history because of their close relationship to the Civil War," he said.

Barr received his bachelor's, master's and doctoral degrees in history from the University of Texas in 1959, 1961 and 1966, respectively. "When I was in graduate school in the late 1960s there really were not many courses on African-American history. However, there was a great deal of black history within courses on the history of the South and the Civil War," he said.

Alwyn Barr is curious about the Civil War, the American South and African-Americans.

Armed with an expansive understanding of the Civil War and Southern history, coupled with a sampling of black history, Barr embarked on his career as one of Texas' most notable historians and educators. He began his career at Purdue University where he introduced that university's first black history course.

"That was in the late '60s, at a time when many universities did not have courses in African-American history, although there was an interest in the courses because of social changes taking place," he said. "It turned out, that within Purdue's history department, I was the person who probably knew the most about the subject," Barr said.

After teaching at Purdue for three years as an assistant professor, Barr came to Texas Tech in 1969 as an associate professor. Quickly becoming an integral part of the history department, Barr again established a university's first black history course, and he continued teaching courses in the history of the South, the Civil War and Reconstruction. He has continued to concentrate on the same subject matters in his research.

As an established historian Barr has authored four books, all of which have received wide acceptance by his peers. His works include "Polignac's Texas Brigade," "Reconstruction to Reform: Texas Politics 1876-1906," "Black Texans: A History of Negroes in Texas 1528-1971," and "Texans in Revolt: The Battle for San Antonio 1835."

"I think when a historian writes about something, he or she hopes to have something new to say. Something that has not been written about, that is different or provides a new insight, is always going to be one of the attractive possibilities in picking topics," Barr said.

"Polignac's Texas Brigade," published in 1964, is titled for a French officer who commanded in a Texas brigade of the Confederate Army. Polignac's brigade consisted of an unusual group of men, Barr explained.

"The tendency in writing about the Civil War is to write about victories of a particular unit or officer. This brigade was made up of units, in some cases, that had begun as cavalry and were dismounted and converted to infantry. They were not very happy about that," Barr said.

"Polignac's brigade is different; the soldiers do not fit the stereotypes that we have about the Civil War in terms of great enthusiasm," Barr said. However, he noted, the men of Polignac's brigade fought several battles and showed a reasonable amount of courage and ability.

"Writing about this group attracted me because they were virtually unknown, and because they represent a diverse and unusual background that allowed me to explore the Civil War from a different point of view," he said.

Barr's second book, "Reconstruction to Reform: Texas Politics 1876-1906," was published in 1971. Barr said he wrote the book because he believed no indepth study of Texas politics had ever been conducted for that time period. Within the text, Barr closely examines catalysts to political change, such as social and economic pressures. More specifically, "Reconstruction to Reform" discusses interactions among various ethnic groups and the roles they played in bringing about the evolution of politics in Texas.

"Most of the textbooks about Texas history refer to the book and it is cited as the primary study for that period," Barr said.

In the same vein, "Black Texans" was the first attempt to examine the general history of African-Americans in Texas. "Black Texans," Barr's third book, also has widely influenced the way history textbooks are written in Texas.

In part "Black Texans" is an effort to explain the link between the social changes that occurred during the Civil Rights movement with other historical events. Barr said that he intended to give readers a general history that would shed light on the changes and the problems that African-Americans faced and how they tried to deal with those problems.

"'Black Texans' really is a general history. It covers everything from African-Americans who were with the Spanish exploring expeditions in the 1500s all

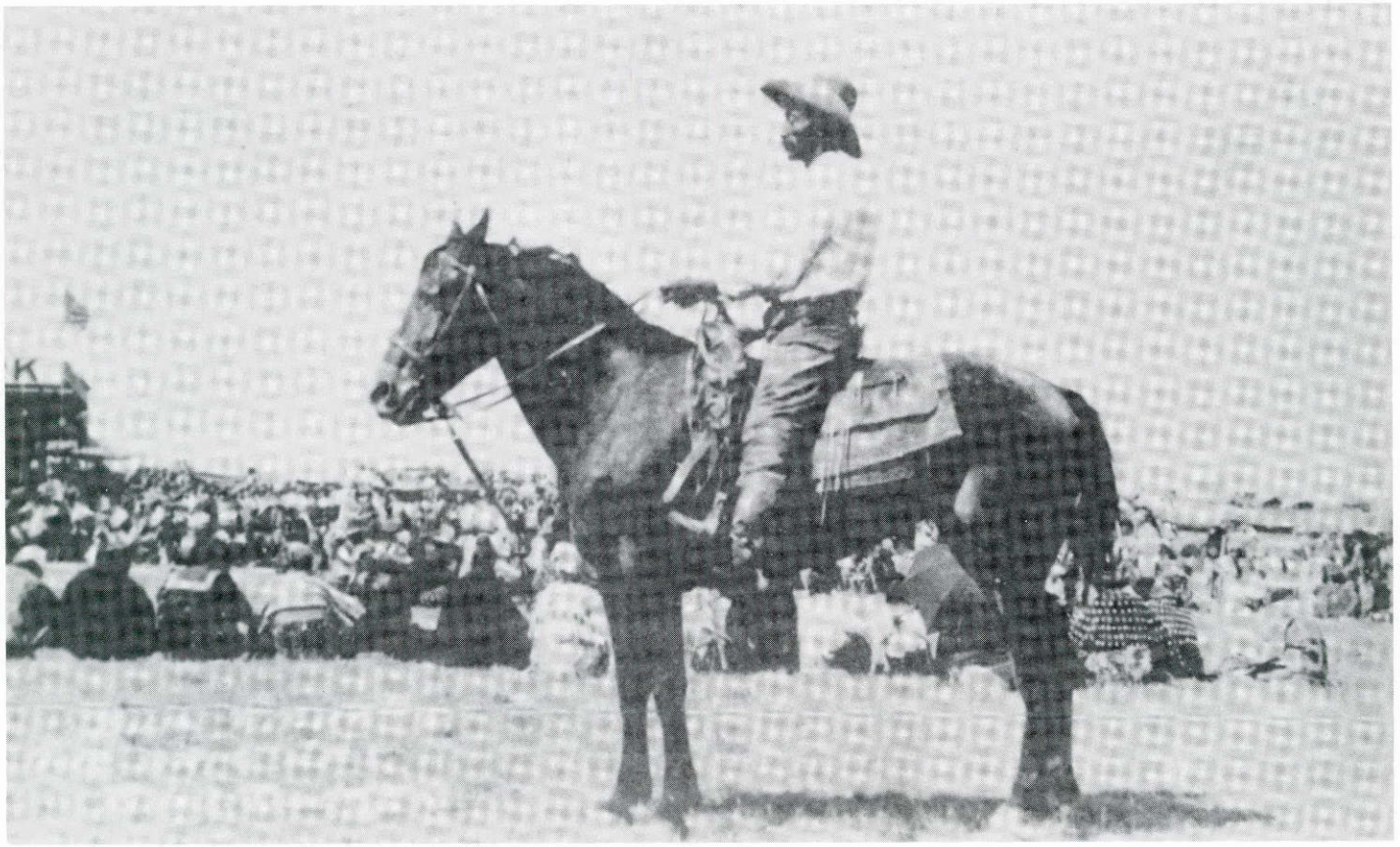


Photo courtesy of Southwest Collection

An early photograph of Bill Pickett, a pioneering black cowboy, is included in Barr's book, "Black Texans: A History of Negroes in Texas 1528-1971."

the way up to around 1970," he said.

According to Barr in "Black Texans," African-Americans arrived in Texas with Spanish explorers about 400 years ago. Thus, African-Americans arrived in Texas before the first Anglo-American population immigrating west settled in the area.

"In some cases, blacks may have been slaves of Spanish explorers. Slavery existed in Mexico under Spanish rule, which also included Texas. However, there are other cases where blacks gained their freedom and played greater roles in the Spanish expeditions," Barr said.

Specifically, in "Black Texans" Barr relates the life of "Estevan," the earliest known African-American in Texas. Estevan, a member of a shipwrecked expedition, came to Texas in 1528 as a slave of a Spanish officer. However, as the party's numbers dwindled, Estevan, who mastered Native American languages better than other members of the expedition, played a critical role as a communicator with Native Americans. Eventually, Estevan became an interpreter and scout for at least one other expedition before he was killed by Native Americans.

Other chapters are dedicated to the examination of free blacks prior to the Civil War and other African-Americans who impacted society until 1970. "Black Texans," originally published in 1973, is expected to be republished in the near future. The new edition will include a short chapter covering 1970 to 1995. As in previous chapters, Barr plans to examine the topics of politics, legal status, economics, education and social life of African-Americans.

Barr's most recent book, "Texans in Revolt," was published in 1990 and details one of many battles that took place during the Texas Revolution. The battle for San Antonio which occurred during the months of November and December of 1835, set the stage for the battle at the Alamo.

"The battle of the Alamo has been written about over and over again, but no one has ever written anything as long as a book about the battle for San Antonio. Yet, the battle was obviously of great importance — if Texans had not captured San Antonio, then there would not have been a battle at the Alamo," he said.

"Texans in Revolt" gives a balanced perspective of both the Mexican and Texas armies, describing the armies' officers and soldiers and their goals, Barr said. He noted that most people have misconceptions about the size of the Mexican and Texas armies. According to Barr, the Texas army was probably larger than many people realize, while the Mexican army was probably not as large as most people believe.

"What was especially interesting about the Texas army in this battle was that the army itself was very democratic. The soldiers elected their officers and came and went as they wanted to," Barr said. "I suspect that it was very difficult to be a commander in the Texas army because of the army's democratic nature."

Barr presents the battle for San Antonio in various stages including the accumulation of soldiers, the advances

by the Texas army, and the final pitched battle for the town. He said a great deal of the information in "Texans in Revolt" originated from letters written by officers and personal memoirs of soldiers from both the Texas and Mexican armies.

As a historian and an educator who disseminates information for consumption by others, Barr tries to accomplish several objectives within his books and courses. The primary objective is simply to help individuals understand the events and the people involved.

When teaching a course, Barr tries to expose students to all viewpoints of an issue. "If I am teaching the history of the South I try to help my students understand the relationships between Southerners and the rest of the world," he said.

In teaching a course on the Civil War, he said he tries to relate the views of each side, focusing on how particular attitudes developed, what people where trying to accomplish and why they clashed with one another.

In his African-American history course, Barr emphasizes the early period of segregation and the uses of various forms of discrimination to give his students an understanding of why the Civil Rights movement emerged.

According to Barr, many historians hope to impact the ways that certain historical events are interpreted and written about. "Overall I hope that I have contributed to a better understanding of history and have introduced some new ideas, information and analyses. When you are cited in textbooks and in other studies, it's reassuring," he said.

Each of Barr's books has garnered respect and notability as evidenced through numerous citations and awards. "Reconstruction to Reform" received in 1971 the Coral Horton Tullis Memorial Prize for the most important contribution to Texas history from the Texas State Historical Association. Other book awards include the L.R. Bryan Jr. Award from the Texas Gulf Coast Historical Association in 1964 for "Polignac's Brigade," and an award from the San Antonio Conservation Society in 1990 for "Texans in Revolt."

One of Barr's personal accomplishments was becoming the director of Texas Tech's Ethnic Studies Program in 1970 and later serving three non-consecutive terms. Ethnic Studies is an interdisciplinary minor that seeks to increase understanding of the nature and development of race relations and stimulate a greater sense of dignity for minority students. Instrumental in the program's development, Barr received the Sigma Delta Chi award in 1971 for his contributions to the program.

Other notable achievements include his receipt of the President's Excellence in Teaching Award from Texas Tech in 1986 and the President's Academic Achievement Award in 1991.

Barr also was recognized by a legislative resolution sponsored by Texas Rep. Helen Giddings in 1993. The resolution praising Barr states, "Dr. Barr has significantly raised awareness of the role played by African-Americans in shaping Texas' history. His contribution has profoundly benefited his native state and the nation at large. . . . be it resolved, that the House of Representatives of the 73rd Texas Legislature hereby honors Alwyn Barr for his outstanding contributions to the study of the history of African-Americans in Texas."

Considering all of his tributes, Barr suggests that perhaps his greatest fulfillment comes from his work as a teacher and mentor. He has directed 20 graduate dissertations, most of which have been related to black history, Southern history or the Civil War.

"It has been an enjoyable experience for me to direct the work. There have been some very good students who have published books, and some have become significant historians in their own right. Some of them have gone on to win awards for their books, and many of them are teaching at smaller colleges and universities around the state," Barr said.

Preferring to be one of the unsung heroes he frequently writes about, Barr — with great humility — believes that his contributions to education should be measured by the success of his students — a new generation of historians who also may look beyond the black and white accounts of bygone scholars in search of an unexplored perspective from a colorful past. □

"Dr. Barr has significantly raised awareness of the role played by African-Americans in shaping Texas' history. His contribution has profoundly benefited his native state and the nation at large. ..."

Artie Limmer

Glenna Goodacre's Defining Moments

By Kippra D. Hopper

While most of us have been taught not to touch pieces of art, Glenna Goodacre leans on the large sculpture. "The children's eyes need to be cleaned," she says, rubbing away the dirt blown in from the adjacent cotton field. Goodacre is embracing her own bronze, a piece outside the Texas Tech Museum that depicts children at play, called "Tug O' War."

The artist is being photographed with her sculpture on a May morning before she receives an honorary doctorate from Texas Tech University. Just as important this day, Goodacre is giving the keynote address to more than 2,000 graduating students. She is nervous, but she has braved a larger crowd.

An estimated 35,000 individuals attended the dedication of Goodacre's sculpture, the Vietnam Women's Memorial, on both a somber and healing Veterans Day, Nov. 11, 1993, near "The Wall" in Washington, D.C. Thousands more viewed the sculpture on the way to its final destination throughout a 28-city, 8,000-mile whistle-stop tour that included Lubbock, Goodacre's birthplace and home for many years.

The heroic bronze monument honoring the American women of the Vietnam War is the most distinguished public sculpture produced so far by Goodacre during her 25 years working in the genre. The realization of the work is most remarkable when one considers both the lifelong journey of the artist and the travails of producing public art.

"The biggest turning point in my four years of a liberal arts education at Colorado College came when my sculpture professor told me I should never sculpt, and I received a D in sculpture," Goodacre explains. "His discouragement was so profound, I never considered sculpting for 10 years. I've always resented that one man had such a profound influence on my career, but perhaps the following 10 years of painting and drawing made my transition to sculpture a natural progression."

Continuing her training at the Art Students League in New York, Goodacre was determined to be a professional and recognized artist — despite demands of a family and discrimination toward women in art.

"Though my paintings always sold regionally, I entered the various New York shows to be judged by the Eastern Art Establishment. My work was invariably rejected. Skeptically, I tried sculpture," she says, noting the subject of her first three-dimensional portrait bust was anthropologist Curry Holden, still displayed in the rotunda of Holden Hall at Texas Tech. Goodacre's determination finally began yielding her awards from the National Academy of Design — as a sculptor.

Recognizing that gender has imparted other obstacles in her career, Goodacre remembers, "My biggest dealer would always say of my work, 'Not bad for a girl.' Another gallery owner wouldn't buy a painting with a female signature, so I began signing just 'G. Goodacre,' and sales improved. Also many of my subjects are women and children, automatically secondary material for art. I was often invited to art shows as the token woman, an equal opportunist."

For Goodacre, the Vietnam Women's Memorial has tendered the most admiration in her calling, yet the project also may have presented the greatest frustration she will encounter in a public work. The fourth sculptor to submit a design for the Vietnam Women's Memorial Project, Goodacre had to satisfy three governmental committees

Kippra D. Hopper

Top: Goodacre stands with "He Is They Are." Bottom and opposite page: Visitors leave sacred objects at the dedication of "The Vietnam Women's Memorial."

Kippra D. Hopper

in three years before her work finally was approved. "That was the hard part. One committee brought in another artist to try to redo the composition. I've never had that happen before. I had no control over it. It was the committee's vote."

However, as one would expect of Goodacre, she kept most in mind both the honored women of the memorial and those who had fought 11 years to see the completion of the project. Diane Carlson Evans, R.N., who served in Vietnam, first conceived the idea of the memorial in 1983. "Three sculptures were rejected until my design came along. I was definitely working with a larger group in this project. The sculpture was my design, but it was for the women who served in Vietnam," Goodacre says.

Tenacity rendered to Goodacre the gift of experiencing gratitude and healing — a catharsis — from thousands of individuals whose lives were changed by the Vietnam War. Approximately 11,500 American military women served in Vietnam during the war; nearly all volunteered. Those women in turn helped many of the 350,000 soldiers who were wounded. Sometimes they were the last comfort for the more than 58,000 individuals who died.

Kippra D. Hopper

"There will never be another sculpture of mine that evokes as much emotion. It is certainly the highlight of my life."

"The dedication ceremony was incredible, with the masses of people and so many crying. They all wanted to say something to me. They couldn't talk, so they'd hug me, and I'd pat them, like a mother does. They could just say, 'Thank you,'" Goodacre says. "It was amazing. I'll remember those people the most. Even the men were so pleased for the women to be memorialized too. All the women had stories, and it was a healing process for them to have the monument.

"There will never be another sculpture of mine that evokes as much emotion. It is certainly the highlight of my life," says the 55-year-old artist.

The Vietnam Women's Memorial Project and other works of public art, by nature, invite discourse — and criticism. "The media critics have not always been kind," Goodacre admits. "The **Los Angeles Times** and the **Washington Post** critics soundly denounced the Vietnam Women's Memorial. After I recovered from the shock, I realized that these were only two opinions among the literally thousands of accolades. The gratitude of the veterans far overshadowed the critics." Poignantly, she then remembers the sacred articles placed at the memorial: letters, photographs, berets and helmets, MIA bracelets, purple heart medals, poems, a wedding ring . . . a funeral flag.

Unpretentious and certain, Goodacre is passionate about the virtue of such public art endeavors. "The people I did the sculpture for are who matter. It's there on the Mall, and when we're all dead and gone and our great grandchildren are old, it's still going to be there. From my small corner of the world, I like to do public sculpture that people can identify with, art that's personal."

Since her first trip to Europe in 1956 when she observed Michelangelo's sculptures, and during six subsequent visits, Goodacre has nurtured her love for the subject of people.

"The obvious reason I love to go to Europe is that art is everywhere. I love public art simply because I love seeing it," she says. "I'm intrigued by people, so I think others are too. I'm interested in the composition, the pose, the gesture, the overall effect. I work for the image to draw people in so that they want to look closer, think about it, stop, study it and remember it because we're that type of animal. We're curious."

From her own spirited nature, Goodacre extends herself and her work, always from the tradition of figurative sculpture. In the permanent medium of bronze, she manifests an appreciation of the old masters, her "dead heroes," such as Michelangelo, Rodin, Bernini and Carpeaux.

"I've met or studied all the people I've sculpted, and I've learned from them — I've tried to absorb their greatness, their struggles, their successes and failures."

"To be influenced and humbled by the old masters is very important to me, but the influences are not a past tense thing," she explains. "I was in Cairo recently, and I loved seeing the Egyptian art. I think I've done some pretty good sized pieces, but I haven't. When you see a 60-foot Ramses that was done in 3000 B.C., it's awesome. It opened my eyes to a stereotyped figure and the way they were placed. All those figures meant something, they were all an illustration to the people of the time. If the man was the pharaoh, they made him big and did him over and over.

"My point is that in any profession, you should continue to grow. With each piece I do, I learn something, and I hope I progress. With my sculpture, I redo a child's eyes 15 times until I get them just right. It's an ongoing process. When does an artist stop learning?"

Education oftentimes calls for meditation, an examination of what one has reached. Last year the Museum of Texas Tech exhibited the collective works of the first 25 years of artistic growth for Goodacre in a retrospective of 160 sculptures.

At no other time had so many pieces by Goodacre been assembled in one exhibition. Her work is in public, corporate and museum collections throughout the United States and in many other countries. She has shown her sculptures throughout the world and has won awards from such organizations as the National Sculpture Society, Allied Artists of America, and the National Academy of Design in New York City. Her public works include the Walk of Texas Heroes at Sea World in San Antonio, "Philosopher's Rock" in Austin and the Texas Instruments founders in Dallas.

Point out to Goodacre that her work generally represents four themes — Native Americans, children, monuments and portraits — and she gently asserts that each of those superficial categories pertain to people.

"I do figurative portraits. They are realistic figures, and I've done that all my life. I've never varied. I like people, and I sculpt them as I see them. I look for different ethnic types to keep it interesting and to see variations," she says.

"Each person I've sculpted has hopefully added to my character — from the innocent children to the military figures, scientists and historians. The women who served during the Vietnam era were forgotten heroes. Their stories were horrifying but their courage admirable," she says. "I've met or studied all the people I've sculpted, and I've learned from them — I've tried to absorb their greatness, their struggles, their successes and failures."

As for the next 25 years, Goodacre says she will continue to live in the artist community of Santa Fe, N.M., her home since 1983, working with her three-person staff, sculpting who and what she chooses.

"I'm now in the position of not having to accept all commissions. My time is my own. I don't feel so pressured," she says. "I am not a starving artist — that is a great measure of success."

Leaving the Museum, Goodacre pauses to contemplate her fortune and the honorary degree she is accepting. She ponders her earlier tribute of the dedication of the Vietnam Women's Memorial. The night before that ceremony, she wanted one last, quiet moment with her sculpture. But even at midnight, people were there holding candles in the dark — touching what Glenna Goodacre has given them. □

A Loss of Words

By Carole J. Young, M.S.

For a growing number of people, the use of electronic technology has become an integral component of the workplace, if not life in general. From the point of view of an academic publisher, computer technology has made certain aspects of publishing more efficient, less costly, and more expedient, but there is a hidden cost that may not become apparent for years.

This cost is the loss of information in the process of writing and publishing. Ironically, the advent of word processing, which makes the process of writing easier, also is obliterating the record of how that piece was written.

As recently as 10 years ago, the majority of manuscripts that were submitted to the Texas Tech University Press were produced on a typewriter, a few were handwritten, and even fewer were produced with a word processing program on a computer. The basic process by which the manuscript was converted into a book had changed little from the beginning of the century.

Once a manuscript was selected for publication, having passed through the scholarly review and revision stage, it was copyedited, queried and returned to the author for approval. Corrections and comments were marked on the manuscript and new material and rewritten paragraphs were attached to the original. The manuscript then was marked for the typesetter. The typesetter re-keyed the entire manuscript and produced a text in a continuous form, called a galley.

The galley was returned to the press and the author to check for any typographical errors. Corrected galleys then were returned to the typesetter to break this continuous text into book-length pages, called page proofs. These proofs were checked by the press and author, corrections marked, and pages returned to the typesetter to produce second page proofs. These proofs made the same loop as before. The pages then were ready to be sent to the printer. The printer photographed these pages to create plates from which the book is printed. All proofs and marked up manuscripts were retained by the press for about a year after the book was published and later returned to the author.

Joey Hernandez

Escalating costs impelled many presses to find ways to become more efficient. One of the first significant cost-saving methods employed was to provide the typesetter with electronic files, thereby saving the time and expense of re-keying a manuscript. This process also cuts down on the number of typographical errors, which means further savings in later stages. Within five years, Texas Tech University Press made the transition to requiring all manuscripts be submitted both as an electronic file and a paper copy.

We are not alone in this transition. Most university presses now require authors to submit manuscripts on disk and most copy editing and production marking is done electronically. Many presses are doing their own typesetting, and some have even made the leap to sending electronic files directly to the printer, eliminating yet another step in the process. All of these changes to the traditional procedure save us both time and labor expense.

Where is information being lost? A record is not being retained of the way the manuscript has changed from

"The details give direct insight into the process of writing, and this information is in jeopardy of becoming lost."

when it was originally written to when it is finally published. Or at best the record is incomplete. Why then should we be concerned about this loss?

One of the journals published by the Texas Tech University Press is **Conradiana**. The journal articles are all related to Joseph Conrad (other authors of similar stature have journals devoted to their study). Among the topics covered in recent articles are an examination of the influence of romanticism in Conrad's works, his use of various literary devices, and a discussion of the connection between Conrad and Henry James. Articles germane to this discussion are those that examine and compare not only the various stages of a manuscript, but also different editions of the same work.

By examining various drafts of a manuscript, scholars can observe the evolution of a work and gain some understanding of how Conrad wrote. For example, marginal notes can clarify Conrad's intent, show the influence of an earlier critic, or indicate why a specific alteration was made. A comparison of the manuscript, proofs and editions can show whether a change was a typographical error or whether Conrad made the change intentionally and when. This is vital information for scholars studying Conrad or other authors. But it extends further; by studying the process we begin to understand the methodology of writing, in turn making us better writers.

Under the old system, copyeditor and author's changes to a manuscript and typesetting errors were easily identifiable. Places where the editor and copy editor disagreed were recorded, with the author's justification for why a particular change was not appropriate being noted directly on the manuscript. This sort of record is invaluable for scholars studying these authors. The details give direct insight into the process of writing, and this information is in jeopardy of becoming lost.

Copyediting programs allow us to imbed footnoted queries to the author, make certain changes (for example, correct spelling mistakes) without ever pointing them out to the author, and indicate where more substantial changes have occurred. At Texas Tech University Press we generate a paper copy for the author to read and proof at this point, but other presses send the copyedited electronic files back to the author to input changes. When the author returns the copy, the copy editor reviews any changes or corrections and hits the "accept" button and the revision automatically replaces the original. If the author disagrees and the copy editor accepts the author's reasons, the revision is not accepted and is automatically deleted. Queries are deleted as they are answered. In some instances the entire process can happen electronically via e-mail and no paper copy exists.

Some changes to the manuscript still are tracked in page proofs because the changes tend to be more costly. Changes requested by the author other than typographical errors in page proof are typically charged to the author and thus a fairly close record of those charges are kept. Few of our authors however request any of the original material (except for illustrative material) or proofs be returned to them after the book is published. If the author does not want old text returned, we recycle anything we can. Although most of these changes in the procedure help to speed up the publishing process as well as save money (in postage, paper and labor costs) and are more efficient, the documentation of how the manuscript evolved is becoming lost.

I do not advocate that we return to the traditional methods of book publishing. Without doubt the changes to the process have allowed presses to be more efficient and far more cost effective. But it is also true that this has come at a cost that may not become apparent for years. Many university presses publish first-time authors, and who among us can predict who may be the next Conrad or Faulkner or Austen early in their careers? At a recent gathering of representatives of university presses I asked several directors and editors about this situation. As scholarly publishers we recognize the problem and deplore the loss of any information. The scholarly community and the presses must take care to preserve the writing and editing process by recording the changes we make within text. Sometimes, even the minutia lends the greatest knowledge. □

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Inside Back Cover — A stainless steel globe, 12 feet in diameter, symbolizes the mission of the new Texas Tech University International Cultural Center. The center, which houses the Office of International Affairs, will serve as a focal point and central location for international activities for the university and the city of Lubbock. The globe, one of only four in existence, was funded through a $92,000 gift from the Lubbock Osteopathic Fund Inc. (Photo by Artie Limmer)

Back Cover — John T. Montford, J.D., and his wife, Debbie, became the first family of Texas Tech University and Texas Tech University Health Sciences Center when he assumed the chancellorship on Aug. 20. Montford, longtime Texas senator, was selected by the Texas Tech Board of Regents as the first chancellor of the institutions to begin a new era of positioning Texas Tech for world-class stature in the 21st century. (See viewpoint Page 6.) (Photo by Artie Limmer)

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