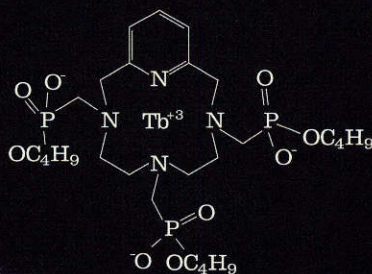


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VISTAS

TEXAS TECH RESEARCH. WINTER 2001 VOLUME 9 NO. 1



ILLUMINATING A DEADLY DISEASE

VISTAS

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editor's note

WINTER 2001 VOLUME 9 NO. 1

THE ENTIRE STAFF OF VISTAS: TEXAS TECH RESEARCH is honored to have earned several prestigious awards recently. The cover for the Fall 1999 issue was selected to appear in *Print's Regional Design Annual 2000*. *Print, America's Graphic Design Magazine*, selected VISTAS as an entry representing the best design, illustration and photography being produced throughout the United States and was selected among nearly 32,000 entries.

The Council for the Advancement and Support of Education (CASE) on the national level has awarded VISTAS with two 2000 Circle of Excellence Awards for magazine publishing improvement and for visual design in print.

Additionally, VISTAS was named among the three finalists for best magazine for the 2000 Katie Awards, given annually by the Press Club of Dallas.

Our mission is to highlight some of the extremely important research and creative activities conducted by the talented faculty at Texas Tech University and Texas Tech University Health Sciences Center. If you as readers have comments or story suggestions, please contact me via e-mail at vistas@ttu.edu. And, you can find VISTAS on-line at www.texastech.edu/vistas.

— Kippira D. Hopper, Editor

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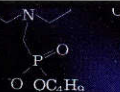
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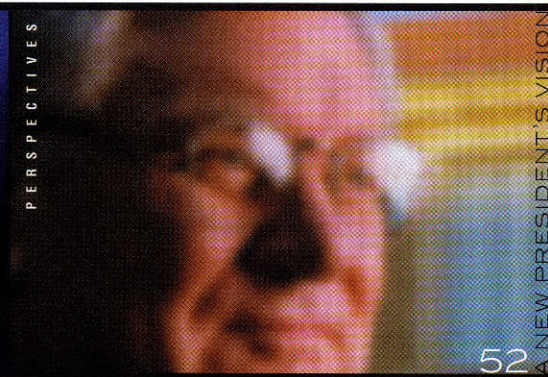
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finding

the funds for research can be difficult for many academic researchers, but chemistry and physics professors at Texas universities have an advantage through the Welch Foundation, which currently supports the work of 24 professors at Texas Tech University.

Since its founding in 1954, the Welch Foundation has helped support chemistry research at 27 Texas universities and colleges. The estate of Robert Alonzo Welch established the foundation. Welch, who was born in South Carolina, came to Texas at the age of 14. He became interested in the oil and sulfur business. In 1952, at the age of 88, Welch died and left an estate of \$25 million, which was to be used to create the foundation.

The Welch Foundation supports numerous educational programs including the research grants. The foundation has sponsored 39 university chairs in chemistry and related sciences. It funds departmental grants, which encourage students at smaller universities and colleges to continue to study chemistry at the graduate level. Through the Texas Interscholastic League Foundation, the Welch Foundation annually awards scholarships to Texas high school students studying chemistry. The foundation also sponsors a lecture tour to Texas colleges and universities. The lecture program showcases superior scientists in the chemistry field. Each year scientists from around the world attend the two-day Welch Conference in Houston on Chemical Research. The Robert A. Welch Award is presented each year to scientists who have made significant and positive research contributions. The award is one of the highest scientific prizes in the world.

Henry Shine, Ph.D., Texas Tech Paul Whitfield Horn professor of chemistry and biochemistry, has the second oldest Welch grant in the state. The oldest grant, by six months, belongs to a professor emeritus at the University of Texas in Austin. Shine has had part of his research funded by the Welch Foundation since 1955. He has been doing research in various aspects of mechanistic organic chemistry. Shine is currently working with cation radicals, which are intermediates in numerous chemical and biochemical processes.

"My Welch grant has given me the freedom to do research entirely of my own devising," Shine said. "It has kept me to high standards of fundamental research. If I failed to meet those standards, the renewals of my grant would not have been forthcoming. The Welch Foundation has made it possible for me to make a contribution to the growth of the Department of Chemistry and Biochemistry, and thus, of Texas Tech."

Shine also said funding by the Welch Foundation has allowed him to support the research of graduate, post-doctoral fellows and some undergraduate students.

"They in turn have gone out into the world of chemistry and medicine to use the training garnered with Welch Foundation support," he said.

Wilse Robinson, Ph.D., professor of chemistry and biochemistry, physics and Welch Chair at Texas Tech, prior to his death in September 2000, had his research funded by the foundation since 1976. He was working on formulating a molecular-

level description of liquid water, research that could be used in biological studies.

"Holding the Welch Chair in chemistry at Texas Tech has allowed me to continue my very active research program long past the time I would have been forced into retirement at other universities," he said prior to his death. Robinson said the grants the Welch Foundation award are very important. "They allow research programs to be carried on without the usual interruptions caused by funding shortages," he said. "In this way, important research results can be produced that will lead to later applications and eventually to government funding."

Stefan Estreicher, Ph.D., Paul Whitfield Horn professor of physics at Texas Tech, has had research funded by the Welch Foundation since 1988. He currently studies the dynamics of native defects and impurities in crystalline semiconductors such as silicon.

"I am very grateful for the Welch Foundation," he said. "The grants attract many top researchers to Texas universities."

Estreicher said the foundation invites professors to apply for Welch grants. Once a grant is awarded, research is funded for three years. When the funding period is through, the grantee may then apply for a renewal.

In addition to Shine, Robinson, and Estreicher, Texas Tech's current grant recipients are: Richard Bartsch, Ph.D., a Paul Whitfield Horn professor and department chairperson of chemistry and biochemistry; David Birney, Ph.D., associate professor of chemistry and biochemistry; Darryl Bornhop, Ph.D., associate professor of chemistry and biochemistry; Kelvin Cheng, Ph.D., professor of physics; Gregory Gellene, Ph.D., professor of chemistry and biochemistry; Thomas Gibson, Ph.D., associate professor of physics; Wallace Glab, Ph.D., associate professor of physics; Allan Headley, Ph.D., associate dean for research at the Graduate School; Robert Holwerda, Ph.D., professor of chemistry and biochemistry; and David Knaff, Ph.D., Paul Whitfield Horn professor of chemistry and biochemistry.

Other recipients are: Carol Korzeniewski, Ph.D., associate professor of chemistry and biochemistry; Guigen Li, Ph.D., assistant professor of chemistry and biochemistry; Roger Lichti, Ph.D., professor of physics; John Marx, Ph.D., associate professor of chemistry and biochemistry; David Nes, Ph.D., professor of chemistry and biochemistry; Paul Pare, Ph.D., assistant professor of chemistry and biochemistry; Edward Quitevis, Ph.D., professor of chemistry and biochemistry; Richard Redington, Ph.D., professor of chemistry and biochemistry; Max Roundhill, Ph.D., professor of chemistry and biochemistry; Robert Shaw, Ph.D., assistant professor of chemistry and biochemistry; and Bruce Whittlesey, Ph.D., associate professor of chemistry and biochemistry.

Texas Tech chemistry and physics researchers are putting the Welch Foundation funds to important use — keeping Texas ahead in important scientific research. ←

WALK THIS WAY





TASOS KARAKOSTAS, M.S.

taking

a walk on a state-of-the-art platform will allow Texas Tech University Health Sciences Center researchers to closely study movement disorders ranging from arthritis to multiple sclerosis.

The Texas Tech School of Allied Health has launched a Gait/Motion Analysis Laboratory within the Department of Rehabilitation Sciences, providing a platform for research and enhanced teaching, as well as offering an important clinical service for West Texas, said Paul P. Brooke Jr., Ph.D., dean of the School of Allied Health.

Students from all schools at the Health Sciences Center will gain valuable clinical experience from the gait laboratory, said H.H. Merrifield, Ph.D., chairperson of the Department of Rehabilitation Sciences and associate dean for the School of Allied Health.

"We see this lab as serving three valuable functions," Merrifield said. "It will provide service, educational training and research opportunities. "We believe it is a win-win situation for everyone. In the past, patients have had to travel to Dallas or San Antonio for this type of assessment. Now people all over West Texas can make the relatively short trip to Lubbock."

Preliminary testing in the lab began in mid-September 2000. Tasos Karakostas, M.S., who is completing his doctorate in biomechanical engineering from Ohio State University, and Merrifield will serve as directors of the lab.

The Gait/Motion Analysis Laboratory will feature instrumentation to objectively evaluate movement patterns such as walking, reaching and standing. Gait analysis can be used to assist medical decisions involving treatment and interventions for various pathological conditions in children,

adults and the aging population. Typical conditions evaluated by a gait lab include stroke, cerebral palsy, head injury, joint injuries or abnormalities, Parkinson's disease, multiple sports applications and falling among the aging population.

"By evaluating the way people walk or move, we can determine objectively the type of intervention needed, such as surgery and/or rehabilitation," Karakostas said.

Monitoring the position of the body in space with light-reflective markers and video cameras, observing muscle activity via electromyography and calculating ground reaction forces allow researchers to analyze coordination, movement disorders and other abnormalities.

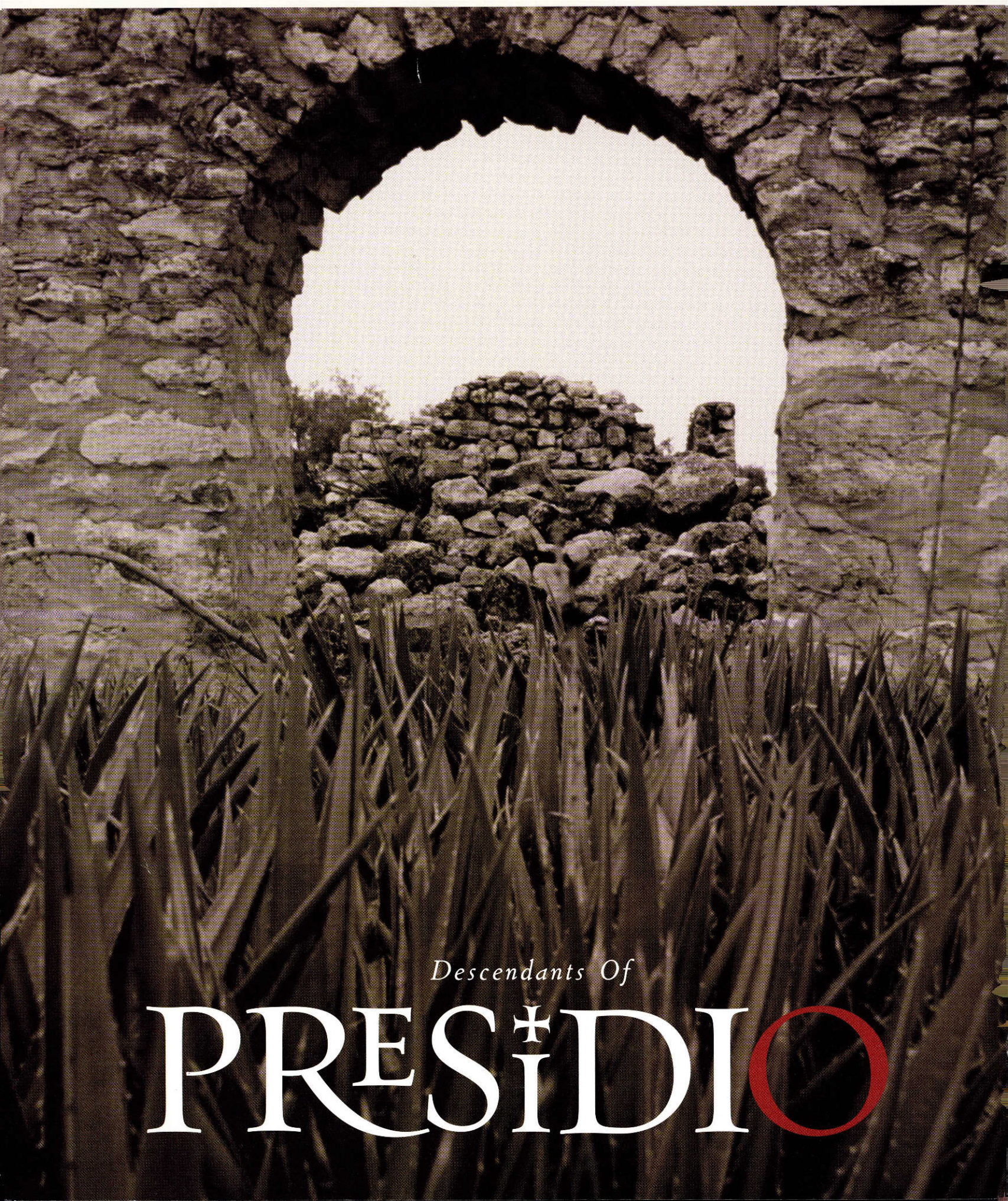
"This allows us to determine the load or weight distribution, and the impact on joints," Karakostas said.

The lab also will use foot pressure analysis to fit shoes for individuals with diabetes. Researchers map where the most pressure is being exerted on the foot when walking or standing, and special inserts then can be made to provide additional support where needed.

Another service provided will be golf analysis, which will monitor the golfer's stance and swing. "This analysis will focus on injury prevention rather than improving performance," Karakostas said. "That is true of most all the analysis this lab provides. We want to try to prevent injury, to not allow a movement pattern to become a pathological condition."

Karakostas said by extensively mapping and monitoring seemingly simple movements, many injuries can be prevented and abnormalities corrected.

"People think walking and standing are simple," he said. "But in reality, both are extremely complex." ←



Descendants Of

PRESIDIO

what

is buried at Presidio San Luis de las Amarillas, later called Real Presidio de San Sabá, offers clues to a fascinating history of the clash of cultures on the Texas frontier in the 1700s. During a Texas Tech University archeological excavation, several seventh-generation descendants of that conflict between Spaniards and Native Americans came together to see for themselves the sacred site of their ancestors' encounter with one another.

During the summer of 2000, Grant Hall, Ph.D., associate professor of anthropology at Texas Tech, led his 10th archeological field school at Presidio San Sabá. Hall and his 22 students surveyed the military post that was established by the Spaniards in 1757 along the banks of the San Sabá River near present-day Menard in the Hill Country of Texas, built to protect a mission four miles down river.

The presidio and the Mission Santa Cruz de San Sabá were constructed as an attempt to pacify the Lipan Apaches who had been troublesome to the Spaniards in the unsettled region. Within 10 months of its settlement, in 1758, a force of more than 2,000 Comanches, Tejas, Bidais and Tonkawas attacked the mission. The Native Americans killed two of the Catholic priests and six other Spaniards before completely burning down all of the mission's structures. In the violent episode, 17 Native Americans also were killed. In 1994, Hall and other researchers discovered the site of what had been called the "missing mission of Texas" in an alfalfa field outside Menard (See "The Mission of Juan Leal," *VISTAS*, Spring 1994). The researchers say a predominant theory about the assault maintains that the Comanches and their band of allies were retaliating against the Apaches and believed the Spaniards were protecting their longtime enemies.

Both the presidio and the mission sites are especially important because the presidio was the largest in Texas and served as a base for exploration of the surrounding unknown territory. The Spaniards believed that valuable mineral deposits lay in the hills along the nearby Llano River. The establishment of the mission and the presidio were the farthest north the Spanish ventured in Central Texas, due to the strength of the Comanche in that direction. King Charles III ordered the presidio closed in his decree of reorganization of the frontier in 1772. The massacre at the mission on the San Sabá and the subsequent Spanish defeat in a retaliatory expedition at the Red River marked the end to Spain's dreams of conquest and conversion on their northern frontier in the New World.

"Presidio San Sabá is the only Spanish Colonial-era fort on the Texas Forts Trail and has a lot more color and drama to it than a lot of other Texas forts do. These people were literally on the frontier, deep in Apache and Comanche territory. The Spanish had closed down missions and forts

in East Texas and were retreating to this presidio. A lot of the equipment and personnel that were in East Texas came back to San Sabá, so we've got fascinating material. We have found an amalgam of cooking ware and personal possessions that those people had," Hall said.

An inventory of what Hall and his students have found so far includes a stone maul, used for pounding; gun flints, used to make the spark for a musket; a knife blade; musket balls; a horse bit and bridle parts made of iron; shards of Majolica; a small ceramic cross; animal bones; an arrowpoint made of glass; a lead seal to mark a shipment of goods; and a metal decoration for the wooden part of a musket.

Hall hopes for further investigation and eventual reconstruction of the presidio. The Works Progress Administration restored the crumbling remains of the presidio in 1936, though not exactly to the specifications of the original structure. After more than 60 years, the WPA buildings have themselves now fallen into partial ruin. Future Texas Tech field schools will be focused on further excavation of the site. Hall said the students, who camped for five weeks in primitive sites on a private ranch on the San Sabá River, not only learned archeological knowledge, skills, methods and techniques, they also gained self-confidence from living in a camp with one another.

Contributing to important archeological scholarship, Hall and his students also were privileged to witness an historical meeting of seventh-generation descendants of the Spaniards and Lipan Apaches. Mark Wolf, an architect from San Antonio who was involved previously in the discovery of the mission, is related to a Spaniard named Juan Leal who survived the massacre and who was a civilian servant for Father Alonso Giraldo de Terreros, one of the priests killed at the mission. An interest in the site and history itself reunited Wolf and another descendant of the massacre, Juan Terreros, currently the minister for cultural affairs for the Embassy of Spain in Washington, D.C. Terreros is related to Father Terreros and to Don Pedro Romero de Terreros, the industrialist from Mexico City who funded the establishment of the mission. Daniel Castro Romero, a Lipan Apache representative, also visited the site, bringing an ancient peace pipe with him to honor the occasion.

The excavation and the meeting of the descendants was very symbolic, Castro Romero said. "We're all looking forward to the day where the true history of this area will come to light. The excavation adds to the richness of our people. It brings a lot of happiness to us and to our people, knowing that things are coming full circle. Today we had a combination of seven generations of representatives of the Spanish and the Lipans." ◀

a chance to play



what

we do in our leisure time is often what sets us apart from each other. Extracurricular activities are often more than just a way to pass time; they are a reflection of our personalities and our interests. People choose activities that are meaningful to them, based on their own needs and desires. Those who choose to become occupational therapists are choosing a career in which they help people of all ages to realize the importance of using their free time constructively.

These activities are much more important in children, where play is associated with the development of such skills as motor, cognitive and psychosocial skills. If for some reason, such as a physical disability, children are not able to participate in play with other children who are their own age, these skills can be more difficult to develop, says Judi Day, B.S.O.T., an instructor of occupational therapy in the School of Allied Health at the Texas Tech University Health Sciences Center. Day worked with students in the program on a project to modify and/or develop playgrounds for children with disabilities.

"This study addressed the area of play for kids and their development within the play," Day said. "If a child in a wheelchair is able to access a playground, he or she is more likely to develop even the most basic of skills, such as balance, that other children can develop while playing on a playground."

Senior occupational therapy students from the Lubbock, Amarillo and Odessa medical campuses participated in the project which began with community-based research and a needs assessment in each of the communities. The focus of the community project is to integrate disabled individuals with non-disabled individuals, which enhances the lives of persons with disabilities through role modeling of non-disabled peers. Additionally, non-disabled children learn from children with disabilities by learning to appreciate differences in others by being able to play together.

The students at the Texas Tech Medical Center in Amarillo collaborated with the Boy Scouts of America and Camp Don Harrington's C.O.P.E. (Challenging Outdoor Personal Experience) Ropes Course on updating the existing ropes course in Amarillo to be adapted for use by disabled children. The students spent two days on the course learning team-building skills and going through the obstacle course. They also experienced simulated disabilities throughout each of the activities. The necessary equipment for the update of the

course would include wheelchair harnesses, pulleys, ropes and helmets.

"The Boy Scouts of America requested continued collaboration with the occupational therapy students for their expert input on the course," Day said.

Students at the Texas Tech Medical Center in Odessa discovered an existing playground in the community that was in need of updating. The playground, which is adjacent to the Permian Basin Rehabilitation Center, was not in use due to the poor condition of the equipment. The students met with representatives from the rehabilitation center to complete a preliminary needs assessment, which included researching the various diagnoses treated at the center to determine what types of equipment would most adequately fit the needs of the facility. The diagnoses treated at the facility include cerebral palsy, Down's syndrome, muscular dystrophy, autism and spina bifida.

"Representatives for the Permian Basin Rehabilitation Center are proceeding with plans to seek funding for construction of the project with continued input from occupational therapy students," Day said.

The students in Lubbock found a community need for a new playground that would be built adjacent to their client's existing hippotherapy business, Turff Therapy. Hippotherapy involves using horseback riding as therapy for people with disabilities. The playground would serve the young clients and their family members while waiting for and during hippotherapy sessions. Partial funding for the project has been secured and some of the playground elements already have been constructed. Turff Therapy owner Judy Overturff said she expects to secure additional funding and will continue to work with Texas Tech occupational therapy students for their input.

According to Day, occupational therapy students will continue to work within the communities they live in and try to fulfill certain needs of these communities. While this particular project was conducted by undergraduate students, eventually students seeking their master's degrees in occupational therapy also will participate and conduct more in-depth studies.

"All children need an environment in which they can develop sensory, motor, psychosocial and social skills," Day said. "With the adaptive playground equipment, disabled children may have the same advantages as other children in mastering and practicing these skills." ←



the magic touch

crisp

and cool cotton sheets on a hot summer night. Warm flannel shirts on a below-freezing winter morning. A fine linen shirt paired with a favorite silk tie. Each with its own unique feel against the skin. But choosing higher quality sheets, or determining if that fine shirt really is worth the price has, up until now, been left to methods which, at best, are extremely subjective. Seshadri S. "Ram" Ramkumar, Ph.D., a researcher at Texas Tech University's International Textile Center is changing that with the touch of a finger.

Ramkumar has developed an objective quality evaluation method that uses an artificial polymeric finger, which could revolutionize the way fabric quality is measured. Polymers, which can be either natural or synthetic, include materials such as polyester and nylon. The particular polymer used in Ramkumar's project is a kind of rubber that has some flexibility. The finger simulates the way fabric is felt with the human hand, but also assigns a standard measurement to each fabric, a system that is faster and certainly more accurate than using human touch or other established industry methods.

The quality of fabric, or "hand" as it is known in the textile industry, is still best measured by the running of fabric between finger and thumb. Hand has long been a time-consuming and costly test for manufacturers. Fabric testing methods, such as the Kawabata Evaluation System for Fabrics (KES-F) and the Fabric Assurance by Simple Testing (FAST) method measure hand-related properties, but are still too expensive, cumbersome and time-consuming.

"When a consumer goes into a store, they may rub a jacket or sweater between their fingers to decide its quality. The problem is the finger test is not very accurate," Ramkumar said. "The idea is to create some kind of industry-wide rating system for fabric, similar to the one currently used with cotton fiber. That way, consumers will know whether garments made of two fabrics that feel completely different are of similar quality."

Ramkumar initiated the project while at the School of Textile Industries, University of Leeds, England. He began by collaborating with David Wood, Ph.D., and Kathryn Fox, M.S. Dentistry, of the Division of Restorative Dentistry, Leeds Dental Institute, to create the original prototype of the artificial finger, which ultimately measures the frictional properties of fabric.

Ramkumar's artificial finger has been molded into the shape and size of an average human finger, and looks and feels like a real finger on the tip. It is made of a rubber-like material called polysiloxane. The finger is the integral part of a machine that simulates human touch. Ramkumar has tested textures of paper towels, medical and hygienic cloths and even baby diapers.

Ramkumar explained that, for example, a baby cannot say whether a cloth diaper feels good. Having a rating system would assess a value to the fabric.

"You may say a certain cotton fiber is not good," he said. "One fiber has X quality and another has Y quality, but it may make very little difference in the finished fabric. Now we can say this fabric has this value. Period."

As innovative as the system is, it appears to be a relatively simple process. "The polymeric finger, which is rubbed over the fabric, sends an electronic signal to the system, which is used to measure hand during production," Ramkumar said. "Specifically, I just place the material on a small platform. The pulley creates a to-and-fro motion. The polymeric finger touches the fabric where the nerve endings meet in a human finger. The finger simulates what a human finger would feel."

The machine assigns a number that rates the quality of the material. The lower the number, the better the quality, Ramkumar said. The numbers are in Pascal, which is a pressure unit.

Continuing his research at Texas Tech's International Textile Center, Ramkumar must further prove his system over a wider range of materials and gather supporting data. Work has begun on patenting the system.

"My next task will be to construct a smaller prototype, which will be easier to commercialize," Ramkumar said. "Right now the machinery is too cumbersome for routine use by manufacturers."

Ramkumar believes other industries also will benefit from the research. He says the artificial finger research also has implications for the medical field for creams and lotions, as well as the cosmetics industry in terms of how products feel to the skin.

Ramkumar's pioneering research has been cited in many textile journals such as *Textile World*, *Textile Horizons*, *America's Textiles International* and *A.T.A. Journal*, an Asian journal on textiles and apparel. He recently received the Chartered Physicist Award from the Institute of Physics in London. In July 2000, he was invited to speak at the Harvard School of Public Health and to present posters at the prestigious Frontiers of Science "Gordon" Conference on tribology, which broadly covers the field of friction and draws on knowledge from the fields of physics, chemistry, metallurgy and engineering. Additionally, Ramkumar received the Fiber Society's Graduate Student Original Research Paper Award in 1998 for his innovative work on the hand evaluation of fabrics.

With the patent for the artificial finger and rating process nearing completion, Ramkumar and Texas Tech's International Textile Center are again on the cutting — or measuring — edge of textile and fabric industry technology. All with the touch of a finger. ←

two

Texas Tech University Health Sciences Center researchers are investigating yet another area in which quitting smoking can greatly improve health, particularly for African-Americans.

Texas Tech School of Medicine faculty members Donald Wesson, M.D., and Jan Simoni, D.V.M., Ph.D., are studying the connection between smoking and kidney failure and have been awarded a grant for their proposal, "Smoking Cessation and the Risk of Diabetes-Related Kidney Disease in African-Americans."

"The study at Texas Tech will focus particularly, but not exclusively, on African-Americans because this population group has a higher risk for diabetes-related kidney failure," said Wesson, chairman of the Department of Internal Medicine.

The Texas Higher Education Coordinating Board awarded the grant for fiscal year 2000 and 2001 under the Minority Health Research and Education Grant Program. The program was established by the 76th Legislature with proceeds from the Texas tobacco lawsuit settlement. Proposals were selected for funding based on peer reviews and legislative intent to support health research and educational programs that address minority health issues.

Wesson and Simoni, research assistant professor in the Department of Surgery, hope to determine whether smoking cessation specifically reduces an individual's risk for developing diabetes-related kidney failure. The two scientists have collaborated on several research projects since 1995. "Up to now, Dr. Wesson and I have studied 600 patients together," said Simoni, who will focus in particular on analytical aspects of this study. "The research will employ the most advanced laboratory techniques which were developed and perfected in our laboratory."

Wesson points out that advances in treating kidney disease have been slow in coming. "Scientific studies show that smoking cessation improves many aspects of our health," he said. "While strides have been made in decreasing the incidence of some types of cardiovascular disease, that has not happened with kidney failure."

Cardiovascular disease describes diseases that are caused by abnormalities in blood vessels of the body. The most common diseases in this category are heart attack and stroke that are caused by diseased blood vessels in the heart and brain, respectively. Medical science has produced strategies that have successfully reduced the incidence of these two diseases in recent years.

Kidney failure is caused by diseased blood vessels in this organ, making

it a form of cardiovascular disease. Yet contrary to heart attack and stroke, the incidence of kidney failure continues to increase, Wesson said. Individuals who progress to complete kidney failure require replacement therapy in the form of kidney dialysis or kidney transplant to continue to live.

"Medical scientists do not fully understand why the strategies that have successfully reduced the incidence of heart attack and stroke, including improved diet and better blood pressure control, have not also decreased the incidence of kidney failure," Wesson said. "Because medical researchers at Texas Tech Health Sciences Center have shown that cigarette smoking worsens the risk of kidney failure in some individuals already at risk for it, they decided to explore if smoking cessation reduces the risk of kidney failure."

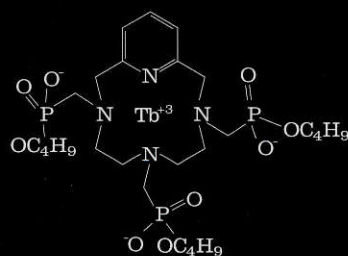
Diabetes is the single biggest cause of complete kidney failure in the United States, Wesson said. And African-Americans with diabetes are more likely to develop complete kidney failure than are diabetics from other U.S. population groups.

"Cigarette smoking increases the chance of developing diabetes-related kidney disease," Wesson said. "In other words, if you're diabetic and you smoke, you have a greater chance of developing kidney disease than if you're diabetic and you don't smoke."

"If smoking cessation does reduce the risk for kidney failure, health care providers would then have another effective way to reduce a diabetic's chances to develop complete kidney failure," Wesson said. "This would not only help these patients avoid the sickness and other problems that accompany kidney failure, but would also avoid the tremendous expense associated with all forms of kidney replacement therapy."

However, smoking cessation is not easy. Nicotine is one of the most addictive substances there is and patients who smoke have a very difficult time trying to stop. Individuals who will participate as study subjects will undergo very aggressive smoking cessation measures that include using effective drugs combined with counseling, Wesson said.

"It's a win-win situation for individual diabetic smokers who participate in this study," Wesson said. "If smoking cessation does indeed decrease the risk of kidney failure, we would have identified an additional effective strategy to avoid the devastating effects of complete kidney failure. If smoking cessation does not reduce this risk, many of the participating patients will have successfully stopped smoking and will enjoy the many associated health benefits that have already been proven." ←

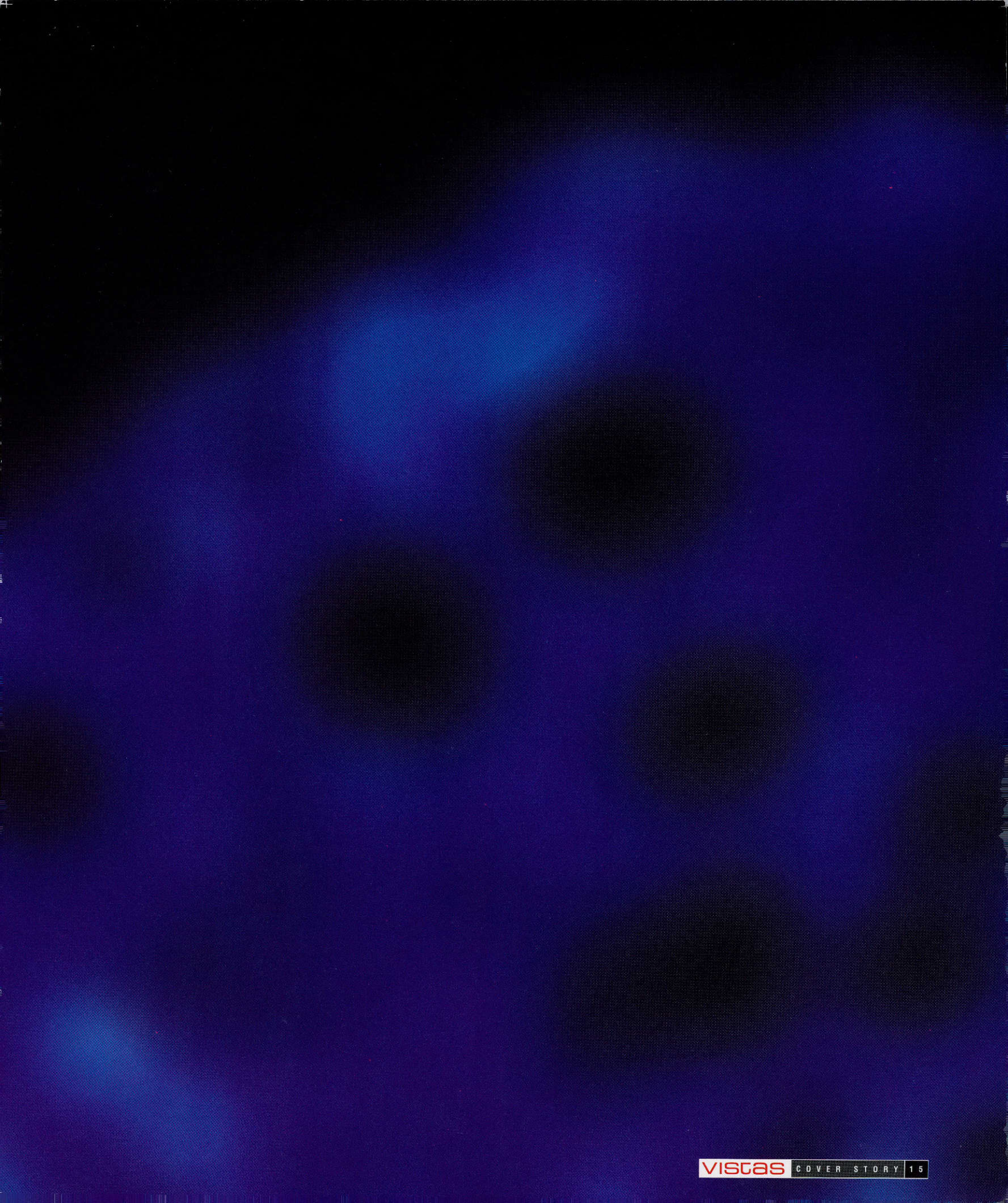


ILLUMINATING A DEADLY DISEASE

A CHEMIST'S GROUND-BREAKING CANCER DETECTION RESEARCH HAS THE MEDICAL WORLD SEEING THINGS IN A NEW LIGHT.

STORY BY JOSH MURRAY : PHOTOS BY ARTIE LIMMER : IMAGES COURTESY JOHN M.M. GRIFFIN

EARLY-STAGE CANCER OR A
COLONIC ADENOMIA FROM A
SPRAGUE DAWLEY RAT





DARRYL J. BORNHOP, PH.D.

SOME WOULD SAY

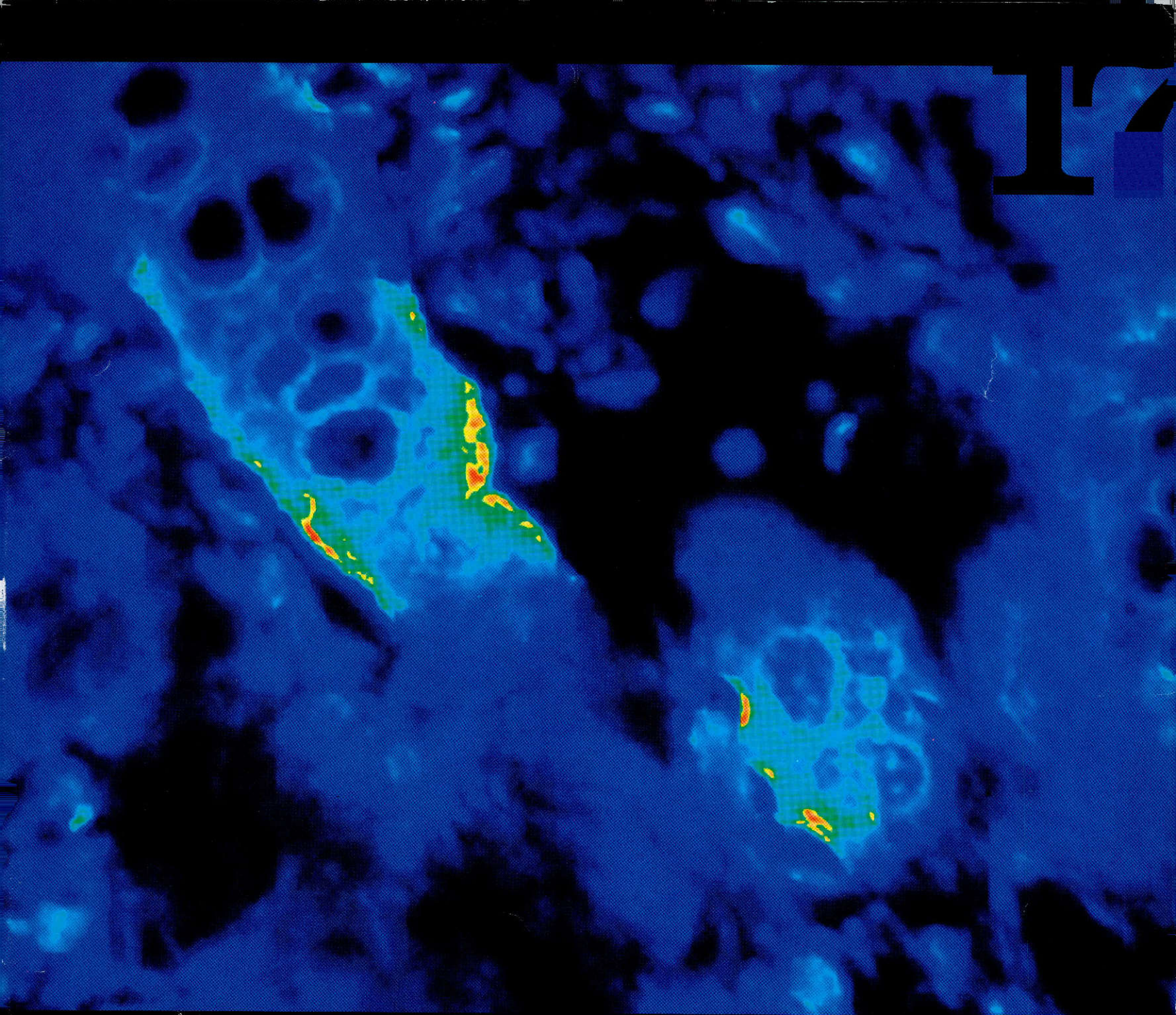
detecting a disease has never been easier, and much of the progress is due to a better design of the instruments. They are quicker, and they are more accurate. But at Texas Tech University, a chemist is taking detection of colon cancer one step further. In fact, he has, in his own way, illuminated cancerous cells so that they cannot be missed.

Darryl J. Bornhop, Ph.D., associate professor of chemistry at Texas Tech, and his team of researchers from Texas Tech, Texas Tech University Health Sciences Center, the Southwest Cancer Center and the Dow Chemical Company, have worked diligently over the last six years to develop Tb-PCTMB, the chemical highlighter. Each researcher has a unique background. Each brings a certain level of expertise into the lab.

"This is typical of modern biomedical science. You bring in people with a number of different backgrounds because the problem is very complex. So you frequently end up with chemists, engineers, biologists and geneticists all working together," said Barbara C. Pence, Ph.D., associate vice president for research at the Texas Tech University Health Sciences Center. "It is just a modern way of doing things."

But still in this modern world of modern science, colorectal cancer is not easy to detect. In fact, people often do not recognize the symptoms – a change in bowel habits, unusual rectal bleeding, abdominal pain or fatigue. And even worse, the cancer may go unnoticed for up to 10 years before the lesions become visible to the eye.

"Cancer is considerably treatable if it's found in the early stages," said Bornhop.



Today, medical practitioners use several methods to detect **cancerous** tissue in the colon. The fecal occult test is a simple procedure to detect traces of blood in the stool. It can be done in doctors' offices or even in private homes and sent to a laboratory for testing. The sigmoidoscopy, a 10-minute procedure, is typically done as an outpatient procedure and screens the lower part of the colon. And the colonoscopy, the most effective method, examines the entire length, almost five feet, of the colon. During this procedure, physicians try to identify potential **cancers** through changes in the color of the tissue, increased blood vessels and the presence of abnormal growths, known as polyps, in the colon. All of this is seen by physicians under normal white light at the end of the colonoscope.

Colon **cancer** is such a silent killer that 57,000 Americans will die from colorectal **cancer** this year, and more than 37,000 of those deaths would be preventable through early detection. And early

detection and modern science is what Bornhop is taking one step further.

"When the tissue transforms into **cancer** cells, its visual properties are slow to change. Once visualization occurs with white light, it gets easier to see, but by that time, it's not just a splash of cells, it's a tumor," said Bornhop.

It is the splash of cells – in the early stages – which Tb-PCTMB has shown to detect in laboratory animals.

This chemical marker is similar to those chemicals used for magnetic resonance imaging (MRI). Tb-PCTMB rapidly associates with diseased tissue and unlike some dyes used in other procedures, it cannot be washed off. The researchers have determined that the non-toxic blue fluorescent color is easily detectable. In fact, it has a great deal of tissue specificity when administered topically. The fluorescence of the chemical attaches to **cancerous** cells to make them clearly visible.

Bornhop said Tb-PCTMB is somewhat like a porphyrin complex. Porphyrins



are compounds that occur naturally in the body, and in cancerous tissues, there is a higher concentration. In the past, scientists have developed agents to stimulate the production of porphyrins to selectively kill cancer cells. This state-of-the-art chemical research is not exactly a lifelong project of Bornhop's. It is, however, the blend of two careers.

Before coming to Texas Tech in 1994, Bornhop worked in the medical device industry for three years. He was familiar with visualization technology that allowed physicians to examine almost any part of a patient's body – knees, the heart, arms, ankles, the colon – through in-cavity microsurgery.

In his first semester as a faculty member at Texas Tech, he sat in on a lecture given by Garry Kiefer from the Dow Chemical Company. The lecture, Bornhop said, was about the chemical synthesis. At the end of the lecture, Kiefer showed a picture of a piece of bone that was glowing in a blue-green

color. Bornhop said a "light" went on for him. The "light" for him was sight-directed chemistry.

"I saw the correlation of early detection and making a chemical associate with or attach to a specific target site," said Bornhop.

In this case, the target site was cancer cells.

After the lecture, he talked to Kiefer and showed him Texas Tech's micro-endoscopy technology. The next day, Bornhop flew to Houston to present his research on fluorescence endoscopy at the Dow Chemical Company.

"Fluorescence is the most recently developed detection application," said Kiefer, who is the research leader in pharmaceutical development at Dow Chemical. "It's our hope to be able to detect cancer lesions before they become visible to the naked eye."

Soon after, Bornhop secured grants from the Whitaker Foundation, the

COLON CANCER IS
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Texas Tech University Research Enhancement Fund and the Dow Chemical Company. Pence offered him laboratory space at the Texas Tech Health Sciences Center.

"I know nothing about the development of chemical compounds. I know how to grow cells, and I know how to study DNA, and I know how to diagnose cancer, but I haven't worked with imaging agents," said Pence. "He's discovered a system to detect the fluorescence from this compound. I had the animal models."

The collaboration began.

The best approach, the researchers decided, was two-pronged. First, they would test cell cultures and then conduct tests in animal models during this pre-clinical development phase.

The cell cultures were used to test the basics of Tb-PCTMB. The researchers

were looking to see if the compound would get inside the cell, its lighting capabilities and the appropriate dose ranges. When the researchers were satisfied with the results, they moved on. It was time to experiment with the animal models.

Before animal testing was done, Pence said a Health Sciences Center committee had to weigh the risks and benefits.

"The potential benefits for human medicine is of enough value to support the testing," said Pence. "Many human diseases would not be as treatable today and children would not be immunized without animal testing."

In the laboratory, approved by the Institutional Animal Care and Use Committee, 16 Sprague Dawley rats were injected with a carcinogen, dimethyl hydrozene (DMH) and fed a high-fat, meat-based diet. After 10 weeks, Tb-PCTMB was put to test.



Using a small endoscope, a lighted instrument to view the inside of the colon, Bornhop applied the aqueous solution of the fluorescent compound followed by a saline rinse.

"This is an imaging technique that works best when applied topically," said Bornhop. "In this case, it was a blue-green marker. We then used a fluorescent light source to visualize the chemical on the tissue."

Results from the investigations indicating specificity for detecting colon cancer, particularly the early development of abnormal tissue, was better than 85 percent. Today, the tests continue and include expanded studies for colon cancer and other oral diseases such as oral cancer. A Phase I human clinical trial is expected soon.

Bornhop's discovery could not have come at a better time. In the last 20 to 30 years, only some strides have been made in the treatment of cancer,

especially colorectal cancer, said Pence. The big chance for reducing the number of people dying is to prevent cancer or detect cancer in the very early stages, she added.

"It is still too early to know how this testing will fair in humans, but if it is developed safely, it is better than what we have now," said Pence.

And now the testing will move into the next stages of development. Pence said the Food and Drug Administration is always concerned about two things — safety and efficacy.

Before it reaches humans, Tb-PCTMB will go through three clinical trials to determine if it is safe, if it works, and how it stands up against the current standard methods of testing. Time will tell.

But if all goes as Bornhop has planned, early detection may take on a new look, so to speak. A fluorescent, hard-to-miss look. ←



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HOPWOOD

THE 1996 COURT CASE, **HOPWOOD V. TEXAS**, HAS CHANGED THE WAY OUR STATE
WILL LOOK AT EDUCATION AND MINORITY ISSUES FOREVER. > **NOW**

TEXT W. FRANK NEWTON, J.D., LL. P., ILLUSTRATION SCOTT C. DADICH

The case, which was filed in 1992 by Cheryl Hopwood and others, claimed they, as applicants, were improperly excluded from entering the University of Texas Law School because of their race. The plaintiffs are Anglo.

Because Hopwood has forced our state to search for other means of diversifying student populations, we are quite literally facing the question of "Where will Texas be in the 21st century?" Will it have an educated public with economic strength, or will it have an uneducated public, with attendant economic depression?

Hopwood currently is back before the 5th Circuit Court and there undoubtedly will be attempts to take the case to the United States Supreme Court. Despite being in the national spotlight, Hopwood is a state issue and applies only to Texas. However, it applies to all Texas schools. Because the decision applies to any institution that accepts federal money, it applies to both public and private schools. Institutions are not able to admit or provide scholarship support based on ethnicity or race. What that means is that many of the more capable minority students are offered scholarships in the other 49 states, but cannot be offered scholarships in Texas based on those criteria.

One lesson Texas has learned since Hopwood was that while Affirmative Action programs worked to boost minority enrollments, they also tended to mask part of the problem. That is, our African-American students and our Latina/Latino students are more likely to drop out of school in junior high and not graduate from high school, or not go to college. Because by 2025 the majority of citizens in Texas will be either Black or Hispanic, Texas must find a way to educate, including on a professional level, those students. If we do not, the average educational level of our citizens will be lower than that of the United States as a whole.

Another discovery we have made is that economic increases and educational increases go hand-in-hand. Using the legal profession as an example, the ratio of lawyers to the general population in Texas is one lawyer to every 354 citizens. In some areas of the state, however, such as in South Texas and in the border regions, El Paso and San Antonio and farther south, the ratio is 1 to 750. But we can't increase the income level unless we can increase the number of educated citizens, because amount of annual income is causally related to levels of education.

Hopwood has created brain drain for the very professional students that Texas needs most. Texas has too few minority lawyers, both African-American and Latino/Latina, and they are the ones we lose. Although some of them have chosen to come back after attending school out of state, *most* lawyers and doctors practice in the part of the country where they attend professional school. Most students who go to school in Texas came from Texas and will practice in Texas because of factors such as job placement, the fact that bar examinations are given on a statewide basis, and the fact that most law school colleagues will locate in Texas. Indeed, at state-supported law schools, the Legislature has mandated that at least 85 percent of the students admitted in any given year *must* be from Texas.

What this means is the most important potential students are Texas students, and Hopwood prevents us from admitting or offering scholarships based on race or ethnicity. There is, perhaps, a partial solution to the problem.

One solution would be legislation for programs at state-supported law schools that will address some of the brain drain problems. One proposal is a plan that would take students who come from those underserved areas or who go to school in those underserved areas, and give them two advantages.

First, under special programs, they would be considered for admission to law school after 90 hours, or three years of college instead of four. Once they complete the first year of law school, their hours from the first year would count as electives for completing their bachelor's degree at their undergraduate institution. In law school, they would be on full scholarship. But they would agree, after graduation, to serve at least three years, in broadly defined public service jobs in those underserved areas. They would work toward actually helping Texans access the legal system.

Many of those young lawyers are likely to stay in those areas, advancing the educational level and enhancing the economy. This plan could very well help stop the lost opportunities for some of our brightest and best students, as well as supply a reason for some of them to stay in school and progress to a professional career in their home state.

Whatever the outcome of any final Hopwood decision might be, we must be successful in finding ways to keep all students in our school system, both in public schools and at the university level. We must develop strategies that effectively target underserved areas. Those measures will increase the educational level and the economic potential of underserved areas, and Texas will be ahead. ←

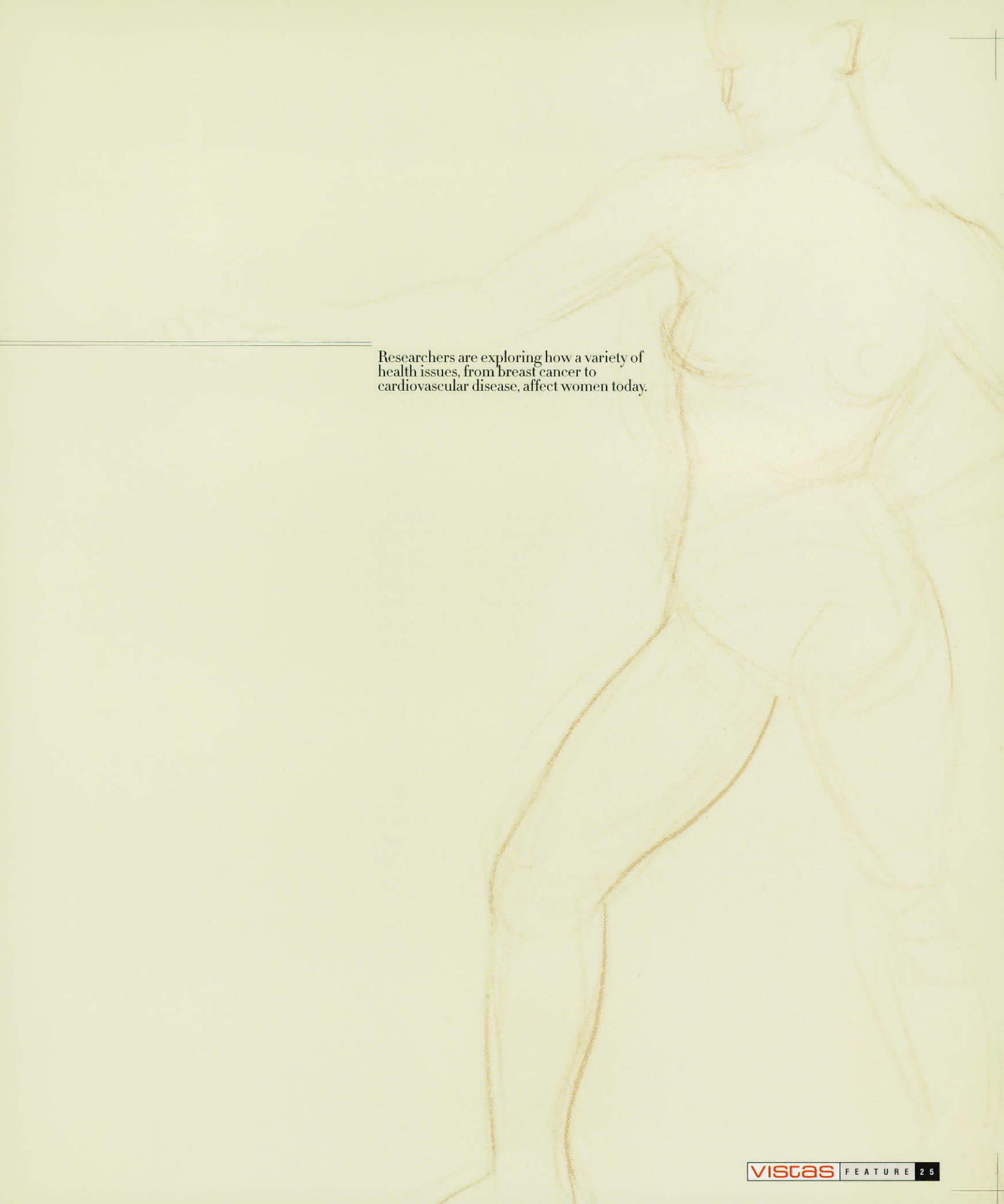
EDITOR'S NOTE: W. FRANK NEWTON, J.D., LL. P., IS DEAN OF THE TEXAS TECH UNIVERSITY SCHOOL OF LAW. WHILE *VISTAS* WAS IN THE PRINTING PROCESS, THE 5TH CIRCUIT COURT OF APPEALS ON DEC. 21, 2000, LIFTED AN INJUNCTION BARRING RACE-BASED ADMISSIONS AT TEXAS PUBLIC UNIVERSITIES AND SENT THE CASE BACK FOR FURTHER HEARINGS. THE FEDERAL APPEALS COURT RULED THAT THE INJUNCTION GOES AGAINST A 1978 U.S. SUPREME COURT DECISION.

understanding

WOMEN'S HEALTH



by Erin Ritter and Michael Hughes
DRAWINGS BY RYDER RICHARDS



Researchers are exploring how a variety of health issues, from breast cancer to cardiovascular disease, affect women today.



S

uzanne Lindsey, Ph.D., was just entering her 30s when her mother died after battling endometrial cancer for nearly a decade. That event spurred a significant life change for Lindsey, who went back to college and now dedicates her career to cancer research.

She is a member of one of four research teams at Texas Tech University Health Sciences Center's schools of medicine and pharmacy in Amarillo that recently were awarded grants by the newly formed Women's Health Research Institute of Amarillo to study health issues that may affect women differently than men.

Lindsey, an assistant professor in the Department of Pharmaceutical Sciences at the Texas Tech School of Pharmacy, received a grant to study how metastatic cancers are signaled to spread from localized tumors to much more deadly malignancies growing throughout the body.

She and her research partner, Rusty Robinson, M.D., will study how activated proto-oncogenes signal ovarian cancer-specific cells to spread. A proto-oncogene is a normal cellular gene that is altered to become an active oncogene, that is, a gene capable of converting normal cells into cancer cells. Robinson is a gynecologic oncologist at the Harrington Cancer Center and an associate professor of obstetrics and gynecology at the School of Medicine at Amarillo.

Lindsey said she shares the vision of the Women's Health Research Institute's four founders: Steven Berk, M.D., regional dean of the Texas Tech School of Medicine at Amarillo; Arthur Nelson, Ph.D., dean of Texas Tech's School of Pharmacy in Amarillo; Joel Kupersmith, M.D., dean of the Texas Tech School of Medicine; and Moody L. Chisholm, chief executive officer of Northwest Texas Healthcare System in Amarillo.

"Having investigators from all of these institutions working together really strengthens our opportunity to become an important national center for research in women's health," Berk said. "One of the reasons we chose women's health as this focus for the School of Medicine's research was that we already had a good deal of expertise in women's health research on the campus."

Berk's hope is that the funded projects will result in abstracts, publications and possibly peer-review grants. He said attracting additional faculty whose interest is women's health is an important aspect of the research institute.

"We already have attracted two outstanding new faculty members whose careers have been in women's health research," he said. "Mark Arredondo, M.D., who is already here, was head of the breast cancer program at the Medical College of Ohio in Toledo. Joaquin Santolaya, M.D., has expertise in genetics and maternal fetal medicine, and he will be here this fall. These are examples of two individuals who are nationally known in women's health research and who were attracted to the Amarillo Medical Center partly because we have a Women's Health Research Institute."

Lindsey said she hopes eventually to devise a test allowing oncologists to study excised tumors to determine if the cancer already has spread elsewhere throughout the body. "Then you would have an idea whether or not to treat with something that would impair their migration."

Lindsey said she and Robinson eventually would like to help develop a method to block genetic messengers from broadcasting the signal for cancer to spread. Already, she has isolated two such genes that trigger cancer metastasis, but she has yet to name them.

She said the genes become active and induce other genes to trigger cancer migration. "A lot of things have to occur before a cell can break away from its cellmates and traipse along to the blood supply or to other tissues," Lindsey said.

Lindsey said her research could apply to 80 percent of the metastatic cancers: breast cancer, colon cancer, prostate cancer, squamous cell carcinoma, ovarian cancer, endometrial cancer and uterine cancer.

All this from a high-school-dropout-turned-business-major who didn't decide she wanted to be a molecular biologist until her 30s.

"As a child, I loved science," she said. "But I dropped out of high school and started working for AT&T and then was a business major in college. When my mother died of cancer, it really spurred my interest. So, at the age of 37, I went back to school and did a full science undergraduate degree and a Ph.D. I think a lot of times people are pushed a little bit further when a loved one suffers from a certain disease."

An accident and an observation played a part in other researchers' interests in finding particular solutions to women's health problems. Thomas Myles, M.D., assistant professor of obstetrics and gynecology and director of maternal-fetal medicine at the School of Medicine in Amarillo, received a Women's Health Research Institute grant to study a new test that may help doctors diagnose gestational diabetes earlier in pregnancy.

Myles said gestational diabetes causes women a number of complications, including pre-term labor, high blood pressure, still birth, excessive fluid and large babies, and therefore, a resulting increase in the incidence of Cesarean-sections.



Women who develop diabetes during pregnancy have a 60 percent increased risk of developing full-blown diabetes later in life. Early diagnosis and treatment seem to reduce those risks, however techniques for early diagnosis are somewhat limited, Myles said.

"In general, diabetes is diagnosed at 24 or 28 weeks. But we'd like to be able to pick up gestational diabetes at less than 12 weeks so we could begin treatment much earlier," Myles said.

Standard procedure to diagnose gestational diabetes is glucose testing at 24 to 28 weeks.

Myles and his research partners, obstetrics/gynecology Professor Dan Castracane, Ph.D., and obstetrics/gynecology Chief Resident Amy Sarver, M.D., will test for insulin levels and the protein Inhibin A early in pregnancy on women who are at high risk for gestational diabetes.

"The hope is, that with the addition of insulin levels and Inhibin A levels, that we'll be able to make the diagnosis earlier," he said. "The preliminary evidence for Inhibin A seems to indicate that patients who go on to develop gestational diabetes do not have the same increase in Inhibin A levels that we see in a person who does not develop diabetes."

Insulin is a hormone produced by the pancreas to regulate blood sugar levels. Although Myles said women normally could become resistant to insulin during pregnancy, however women in danger from gestational diabetes may become resistant earlier. The researchers therefore will be testing insulin levels during the first trimester of pregnancy.

Inhibin A is a protein that's produced during pregnancy. And women who develop gestational diabetes seem to produce less of it. They have less of a peak in the level of Inhibin A during the first trimester of pregnancy, between eight and 10 weeks of gestation, Castracane said.

Castracane discovered the potential link between Inhibin A and diabetes by accident. He was studying a link between Down's Syndrome and Inhibin A levels, when a couple of patients who did not have the normal Inhibin A peak went on to develop gestational diabetes.

"The question is, is this something that's normal, or did it just happen with these few patients?" Myles wonders aloud. "Accidents happen. That's the way a lot of drugs are discovered in the first place and also the way off-label uses are found for medication."

The long-term effects of a common birth control method and cardiovascular risks in reproductive-age women are the interest of another researcher. John Jennings, M.D., received a Women's Health Research Institute grant to study the possible effects of the widely used birth control method, Depo Provera, on cardiovascular health in women as young as 16 to women in their 30s or 40s. Women throughout the world are using Depo Provera, but doctors still are learning about possible health risks related to this synthetic hormone, progesterone, said Jennings, regional chairperson of the Department of Obstetrics and Gynecology at the School of Medicine in Amarillo.

"The goal is to see whether a widely used medication like Depo Provera has a potential for long-term ill effects that previously were unrecognized in the hundreds of thousands of women who used it," Jennings said.

Jennings is collaborating on the study with Michael Hensley, M.D., instructor in the Department of Obstetrics and Gynecology. Jennings said some indicators show that there are differences in types of progesterone, synthetic and natural, and their effects on the cardiovascular system. These results have come from recent literature, primarily looking at postmenopausal women, and the use of different progestins, groups of hormones secreted by the corpus luteum and placenta, which induce the formation of a secretory endometrium.

"We want to study the effects of commonly used progestins on vascular reactivity (how blood vessels react) in young women. The Depo Provera, medroxyprogesterone acetate, (a type of progestin) has been approved for contraceptive use. It is widely used, yet no one really knows what the effect of that use might have on vascular reactivity," Jennings said.

Cardiovascular reactivity can be measured by ultrasound techniques and by a microvascular Doppler technique, an ultrasonic technique used to measure cardiovascular blood flow. The hardening of the arteries of cardiovascular disease begins early in life, even though the disease does not manifest in a cardiac event or a stroke until years later. Jennings said the pilot study that he and Hensley are conducting will compare three groups of women – one group receiving

nothing, one group receiving natural progesterone, and the final group receiving synthetic progesterone. In the beginning, five women will be in each part of the study. Jennings expects the research to continue for several years.

He said some progestins cause a rise in conditions that cause inflammatory reaction in vessels that could create the conditions that result in heart attacks and strokes.

Depo Provera has been used for years for contraception and to control menstrual cycles. The researchers will look at the events that may start the process of heart disease early and measure and compare. For example, if researchers see that a woman who takes a medroxyprogesterone acetate has remarkably narrowed vessels and decreased blood flow to extremities compared to another woman who is taking a different type of progesterone or nothing at all, then the researchers will have a good indication that other adverse cardiovascular events may occur over a longer period of time.

The possible positive link between the hormone estrogen and Alzheimer's disease is what interests researcher James Stoll, Ph.D. He always has been intrigued by neuroscience. This curiosity led him to study the effects of Alzheimer's disease both at the National Institute on Aging in Bethesda, Md., and at the Texas Tech School of Pharmacy in Amarillo where he is an assistant professor of pharmaceutical sciences.

Stoll recently was awarded a grant from the Women's Health Research Institute to discover how estrogen may protect the brain from Alzheimer's, a disorder that gradually destroys a person's ability to reason, remember, imagine and learn, especially in older individuals.

In the United States, more than 4 million people have Alzheimer's disease, and women have a higher risk factor than men who do and who are the same age. Stoll's hypothesis is that estrogen acts to stimulate basal forebrain cholinergic neurons, and the activity of the high affinity choline transporter which transports choline from fluid outside cells that will be used to make acetylcholine, a neurotransmitter involved in learning and memory. Basal forebrain cholinergic neurons are severely diminished in the brains of Alzheimer's patients.

Once inside the cells, a second enzyme that controls the production of acetylcholine, choline acetyltransferase, uses the choline to make acetylcholine.

Estrogen can function in a different role than its conventional role as a sex, or reproductive, hormone. Stoll said the tie-in is that the risk of Alzheimer's disease appears to be greater in women with low postmenopausal estrogen level. He said it is possible that the low estrogen levels keep the basal forebrain neurons from carrying out their function.

"The important thing is that the transporter is the slow step in this process so by speeding up the transporter or by making more transporter, we can make more acetylcholine," Stoll said. "Speeding up choline acetyltransferase is not as effective because it already works faster. What we are going to do is test the hypothesis that estrogen stimulates the transporter."

Estrogen increases the synthesis of proteins. Stoll said the hormone also could increase the amount of transporter present in those cells. This will be easy to test, once and if, the hypothesis is proven.

Epidemiological evidence shows postmenopausal women with lower estrogen levels have a greater risk of developing Alzheimer's disease. Women who are on estrogen replacement therapy have a lesser risk of developing Alzheimer's disease.

"It appears in some form or fashion that estrogen is important in preventing Alzheimer's disease from occurring," Stoll said. "This grant is about testing one hypothesis of a biological mechanism through which estrogen is working."

If Stoll proves his hypothesis, he will be providing a reason for estrogen replacement therapy in postmenopausal women. The research also would identify new targets for treating Alzheimer's. Finally, understanding estrogen's mechanism of action allows drugs to be designed that mimic its therapeutic effects but do not have the undesirable side effects.

"Hopefully down the line we can harness those mechanisms to help regulate the activity in Alzheimer's patients," Stoll said.

Berk said he is pleased that the first group of Women's Health Research Institute grants included collaboration between the schools of medicine and pharmacy in Amarillo, but he hopes future grants also will include collaborating faculty from local undergraduate institutions that are represented on the institute's board and those at Amarillo College and West Texas A&M University.

The Women's Health Research Institute will bring the Texas Tech School of Medicine, the School of Pharmacy, Northwest Texas Hospital and the undergraduate schools together to develop research in all areas of women's health, Berk said. "Having investigators from all of these institutions working together really strengthens our opportunity to become an important national center for research in women's health."

The National Institute of Health now has a women's research division, and at least 10 other women's research institutes exist in the United States, including two in Texas, the Women's Health Research Institute in Amarillo and the Center for Women's Health at Baylor, he said. "There aren't many others in the western part of the United States. There may not be other medical schools where women's health is the focus of their research," he said. "Most of the academic medical centers that have women's health research institutes may have 10 other research institutes as well. Therefore Texas Tech is unique in choosing the focus of its research at this campus."



"SOME PEOPLE, WHEN THEY THINK OF WOMEN'S HEALTH, THINK OF ISSUES OF PREGNANCY, AND THAT IS VERY IMPORTANT. SOME WILL THINK OF DISEASES SPECIFIC TO WOMEN, AND THOSE ARE VERY IMPORTANT," BERK SAID. "BUT ALSO EQUALLY IMPORTANT ARE ISSUES OF HEART DISEASE IN WOMEN, STROKE IN WOMEN AND HYPERTENSION IN WOMEN AND HOW THEY MAY BE A LITTLE BIT DIFFERENT. WE NEED A NEW UNDERSTANDING OF SOME OF THOSE ISSUES SPECIFICALLY AS THEY RELATE TO WOMEN." ◀



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THESELENIUMSOLUTION

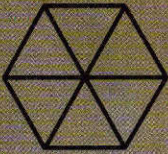


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BY COURTNEY KRIEWALD PHOTOS BY ARTIE LIMMER

Have you ever watched a pot of water boil? Despite the cliché, there is actually a lot going on. As the water heats up, tiny bubbles begin to rise to the top, a signal that the water is close to boiling point.

Well, just as water sends signals that something is about to happen, there are lots of signals that a health crisis in Bangladesh is about to hit boiling point — and Julian Spallholz is trying to stop it.

Spallholz, Ph.D., a biochemist and professor of education and nutrition at Texas Tech University, is working to help solve the problem of arsenic contamination in the drinking water of Bangladesh. Although countries all over the world, including the United States, Canada, Mexico, the United Kingdom and Australia, face the problem of arsenic contamination on a limited basis, no where is it presently known to be more severe and affecting more people than in Bangladesh.

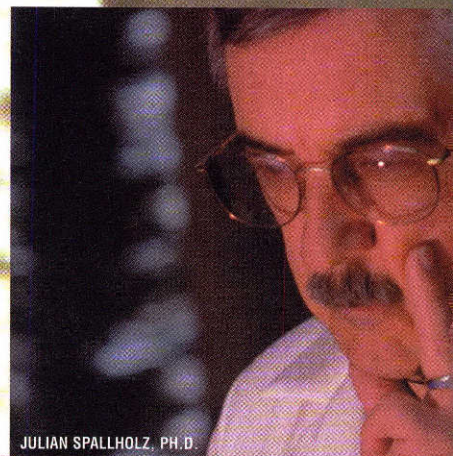
Bangladesh is a country in southern Asia bordered by India, Burma and the Bay of Bengal. The country, about the size of Wisconsin (144,000 square kilometers), has a population of approximately 127 million, making Bangladesh the most densely populated country in the world (approximately 883 people per square kilometer, compared to

approximately 28 people per square kilometer in the United States).

Bangladesh, also one of the world's poorest countries, has a history of problematic drinking water. Because 230 rivers cut across the country, one would think that surface water would be the best option for clean drinking water. However, during the country's monsoon season when the entire country is flooded, the surface water becomes contaminated with industrial waste from factories, as well as human and animal waste. Consumption of the contaminated surface water results in a wide variety of diseases, including cholera and dysentery, which is especially detrimental to children.

The high number of deaths from water-borne diseases, especially the high infant mortality rate, spurred the government of Bangladesh and international agencies, such as the World Bank and the United Nations International Children's Fund (UNICEF), to take measures to provide the Bangladeshi people with biologically non-contaminated drinking water.

Beginning in the late 1970s and continuing into the 1980s, the Bangladeshi government and the international agencies worked to provide



JULIAN SPALLHOLZ, PH.D.

clean drinking water by tapping into underground aquifers by drilling tube wells. Initially, the government of Bangladesh installed approximately 4 million tube wells, but then private citizens began installing their own. It is estimated that another 7 million tube wells were privately drilled, bringing the estimated number of tube wells in Bangladesh to 11 million.

The campaign to wean people away from drinking surface water was so successful it was estimated that 97 percent of the population had safe drinking water from tube wells. Furthermore, cases of water-borne diseases began to decline, according to the Harvard Arsenic Web site project (phys4.harvard.edu/~wilson/arsenic_project_introduction.html).

However, the solution to one health problem, the tube wells, wound up causing another health problem — arsenic poisoning. Naturally occurring mineral deposits of arsenic were hidden beneath the surface soil of the numerous river deltas. When the tube wells were installed, many of the wells tapped into the arsenic deposits, thus contaminating the well water supply.

Arsenicosis, or arsenic poisoning, causes a break up of the skin known as keratosis and alternating layers of dark and light pigmentation

— hyperpigmentation and hypopigmentation, respectively — on the hands and feet. Skin pigmentation occurs only after several years of low level exposure to arsenic. After a dozen years of exposure, skin cancers may begin to appear. Following 20 to 30 years of exposure, cancers of the lungs, bladder, kidneys and liver are likely.

A survey completed in 1999 of 500 villages, sponsored by the government of Bangladesh and conducted by the Dhaka Community Hospital, tested 62,782 tube wells for arsenic. Fifty-two percent of the wells tested positive. However, the 500 villages surveyed are only 0.6 percent of the total number of villages in Bangladesh.

With 97 percent of the Bangladeshi population drinking from tube wells and with an estimated 50 percent of the wells contaminated with toxic levels of arsenic, the anticipated health crisis is enormous, potentially affecting 80 million people. And now, as Julian Spallholz can attest to, there are signals rising to the top, indicating the health crisis is near boiling point.

A recent Dhaka Community Hospital survey found 2,327 patients with visible signs of arsenicosis. There were another 459,833 villagers who

"I'M SITTING THERE HEARING ABOUT THIS ARSENIC PROBLEM AND

drank from contaminated wells who did not yet show signs of arsenic poisoning. But it takes years for the symptoms of arsenicosis to appear. Again, with almost the entire population relying on tube wells for clean water, a large-scale health crisis appears unavoidable.

Spallholz became involved in solving the problem of arsenic poisoning in Bangladesh by voluntarily plunging himself into the problem after watching a PBS documentary on the country of Bangladesh and the issue of arsenic poisoning in February 1999.

"I'm sitting there hearing about this arsenic problem and I said to myself, 'That shouldn't be a problem,'" Spallholz said.

Spallholz believed that he knew of a solution to the problem because for most of his career, he has studied the element selenium, a critical trace element primarily associated with animal protein. One of the things he learned from his 34 years of research is that selenium, in the right proportion, counteracts the effects of arsenic.

"In poor, rural areas, the biggest problem other than just getting enough calories is just getting enough high-quality protein," Spallholz said. "Knowing about the geology, high rainfall, acidic soils and a likely

lousy protein diet in rural Bangladesh, where the arsenicosis was occurring, I suspected that many of these people have a very low selenium intake."

Spallholz was so confident in his knowledge that he immediately began contacting the agencies involved to get them to listen to his idea.

"I started to call around and e-mail people, just trying to get anyone to listen to me so that we could help these people," Spallholz said.

Spallholz knew that time was critical, but he found it difficult to get anyone to listen to him.

"The first cases of human arsenicosis occurred in 1993, but the wells were drilled in the 1980s," Spallholz said. "I knew that with such a large population, the problem could be massive."

Nearly seven months after he first saw the PBS documentary, Spallholz found someone willing to entertain his idea and who could help him. After contacting a private donor who was interested in funding his research, Spallholz — assisted by Mallory Boylan, Ph.D., associate professor of nutrition at Texas Tech, and Suzanne Henderson, a graduate student in the department of nutrition — began developing an animal



SAID TO MYSELF, 'THAT SHOULDN'T BE A PROBLEM'.

model on the relationship between arsenic toxicity in water, just like in Bangladesh, and adding selenium to the diet.

What he has discovered to date leads Spallholz to believe that providing the Bangladeshi people with a nutritional supplement containing selenium to counteract the effects of the arsenic-contaminated drinking water could help remedy the problem of low-level arsenic ingestion. He believes that a supplement is feasible as well as inexpensive.

Spallholz presented his proposal for a selenium supplement at the Third International Conference on Arsenic in Bangladesh in May 2000 in Dhaka, Bangladesh. He continues to work with the international agencies involved about the possibilities of providing the people of Bangladesh a supplement containing selenium.

But Spallholz sees nutritional supplements as a short-term solution. He believes the ideal solution would be a recyclable filter that removes arsenic at the well head. The filter-bound arsenic could then be removed from the filter and used for commercial purposes, including pressurized wood treatments, defoliating cotton and in electronics.

"Arsenic has a huge commercial value, and if there was a recyclable filter, Bangladesh could use the arsenic to provide much-needed income to the country," Spallholz said. "The sales from the arsenic for commercial uses could pay for the remediation of the water."

Although Spallholz has yet to do any work on developing an arsenic filter, he has helped develop the technology for the use of selenium.

So as the problem of arsenic poisoning nears its boiling point, Julian Spallholz is working furiously to find the right balance of selenium to stop the effects of arsenic toxicity from drinking water. He is enthusiastic and hopeful about his work and expects soon that he will be able to help turn the heat off of a potentially massive health crisis in an already impoverished place. ←

The Navajo Indians believed that mice were the bearers of illness. Folklore says the Navajo elders predicted healthy young men would become sick and die throughout generations with an illness that came with the rains. In 1993 there were many unexplained deaths among young Native Americans in the Four Corners area of the United States. Researchers would eventually give the illness a name, Hantavirus Cardiopulmonary Syndrome (HCPS).

TEXT BY SUZANNA CISNEROS MARTINEZ ●
PHOTOS BY ARTIE LIMMER ●

A close-up photograph of a brown mouse's head, showing its eye, ear, and whiskers. The mouse is looking towards the right. The text "AIRBORNE" is overlaid in white, bold, sans-serif capital letters across the middle of the image, with the letter "O" positioned directly over the mouse's eye.

AIRBORNE



The 1993 outbreak came to the normally semi-arid region of the Four Corners, the only point in the United States where four states — Utah, New Mexico, Colorado, and Arizona — share a common border. The preceding year, El Niño's weather pattern brought uncommon rains to the area, causing the rodent populations to explode because of an extra supply of piñon nuts, the primary food of *Peromyscus maniculatus*, the deer mouse.

Researchers say the virus that causes Hantavirus Cardiopulmonary Syndrome is carried by rodents such as the deer mouse. The increase of infected rodents exposed the victims, many of which were of the Navajo Nation, to the rodent droppings. During the 1993 outbreak, 13 deaths were confirmed as due to Hantavirus Cardiopulmonary Syndrome (HCPS).

Hantavirus Cardiopulmonary Syndrome is used to describe one of two diseases caused by the many strains of Hantavirus. Since the 1993 outbreak, HCPS had been found in more than half of the states in the United States. Although it recently has been recognized in North America, Hantavirus was given its name back during the Korean War. Researchers had named a virus that caused the Hemorrhagic Fever after the Hantaan River in Korea, which ran through the region where the virus was most prevalent.

Texas Tech University Health Sciences Center's David Waagner, M.D., associate professor of pediatrics, says the biology of the Hantavirus is interesting in the sense that the disease is different in various parts of the world. 'Old World' Hantaviruses in Europe and Asia predominantly cause kidney disease and bleeding. It's a very different illness from Hantavirus Cardiopulmonary Syndrome, which is caused by the 'New World' Hantaviruses," he says.

The patient may present with mild flu-like symptoms, headaches, mild aches and pains, vomiting, fatigue, fever and some diarrhea. Researchers know that the virus seldom targets the old or young. "We don't know why, but Hantavirus predominantly targets healthy individuals, not the very young or the elderly," says Waagner. "This is unusual because one would expect infants to have a higher risk of exposure. Likewise, one would expect the elderly to have more severe disease with underlying baseline pulmonary disease. Yet, this has not been observed."

Waagner notes that a 45 percent fatality rate exists in the reported cases of Hantavirus. Through May of 2000, a total of 250 Hantavirus Cardiopulmonary Syndrome cases were reported in the United States. Although most of the cases affected Navajo Indians in the 1993 outbreak, Hantavirus Cardiopulmonary Syndrome can strike anyone.

American Indians account for 20 percent of the cases, African-Americans for 2 percent, Asians for 1 percent, Hispanics for 10 percent and Anglos account for 77 percent of all cases. The Centers for Disease Control and Prevention states that 60 percent of reported cases have been male and 40 percent female.

Waagner is quick to point out that the virus is acquired through exposure to aerosolization, or the dispersal of fine particles in the air, of infected rodent droppings and not by person-to-person contact. "In North America, there haven't been any confirmed cases of person-to-person transmission," says Waagner. "However in South America, there have been a few cases which are suspicious for person-to-person transmission."

After someone is exposed to the infected rodents, symptoms appear one to five weeks later. The illness begins with symptoms that resemble the common cold. Patients with Hantavirus Cardiopulmonary Syndrome rapidly develop pneumonia, shortness of breath and respiratory distress.

"We have a basic supportive care that we use for an illness that's called ARDS, acute respiratory distress syndrome, and that is a syndrome that can be due to a wide variety of different causes, Hantavirus being one of them," says Michael Romano, M.D., associate professor of pediatrics at Texas Tech Health Sciences Center.

"The virus causes the lungs to fail, and we use a mechanical ventilator and oxygen to support those patients," says Romano.

Texas Tech researchers may have found one way to save Hantavirus victims from death. In 1996, 16-year-old Heath Henderson made a trip with his family from Merkel, a small town in West Texas, to Lubbock to attend a Texas Tech Red Raider football game. After struggling with a fever and other pains and aches for a week, Heath's condition became worse, and he was taken to the emergency room at University Medical Center. Two days later, his condition deteriorated.

Doctors from the Texas Tech Medical Center worked to find the solution to his condition. Doctors Robert Rosenberg, Waagner and Romano determined that Henderson potentially had been exposed to Hantavirus. What they did next would be the first in the treatment of Hantavirus Cardiopulmonary Syndrome.

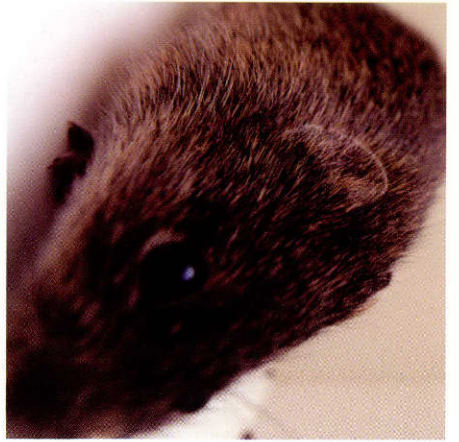
"Although Heath was the first pediatric patient in our region to present with Hantavirus, his symptoms, X-ray findings and laboratory results were very similar to those described in the initial outbreak in New Mexico," said Waagner.

"Patients with Hantavirus usually have very leaky blood vessels with fluid leaking out of the blood vessels into the lungs. Therefore, their blood is rather concentrated," says Waagner. "Hantavirus patients typically have blood hematocrits of 45 percent or greater. Heath was brought in at 51 to 52 percent, and that was our red flag."

"We were seeing a young, healthy adult who 16 hours after admission, complained of severe shortness of breath, with respiratory rates ranging from 40 to 50 breaths a minute," says Romano. "And if our suspicion of Hantavirus was correct, we knew Heath's conditions could easily become fatal."

After the traditional procedures had been tried, the doctors offered a new experimental study to treat Heath which would save his life. "He qualified for using nitric oxide on the basis of an investigational protocol, that I had in place," said Rosenberg. "He therefore qualified because of the severity of the illness."

Rosenberg says that nitric oxide is not normally a treatment for hantavirus. "Nitric oxide is a therapy for



El Niño's weather pattern brought uncommon rains to the Four Corners region, causing the rodent populations to explode.



People can protect themselves from contracting Hantavirus. If a person is in an enclosed area, like a closet or an attic or storage shed, and sees evidence of mice droppings, then there are a couple of things one should do in order to clean up.



- :Wear a good filter mask, such as a painter's mask;
- :Use a bleach solution in a spray bottle to spray the area down, letting it set for a few hours before cleaning it out;
- :Avoid putting the particles in the air, for example by sweeping the area with a broom;
- :If you find live mice, dead mice or signs of mice, like droppings in the area, spray the area with a bleach solution, then using gloves, pick up the carcass with a plastic bag turning it inside out. Seal the bag and even double the bag before disposing of the carcass.



pulmonary hypertension, which can be a complication of Hantavirus Cardiopulmonary Syndrome, as well as many other disorders," explains Rosenberg. "Nitric oxide is used for example on newborns who experience pulmonary hypertension, and in patients with certain heart conditions."

Nitric oxide is a chemical that our bodies use to regulate blood pressure and is produced in a variety of cells. The relevant cells in this case are those that line blood vessels and produce nitric oxide. "When it's locally available, it causes the blood vessel muscles to relax, and the blood vessel gets larger making it easier for blood to get through the vessel, by lowering the resistance," says Rosenberg.

"We delivered extra nitric oxide if you will, through the gas that the ventilator gives to the patients. We mix it with oxygen, give it through the lungs and it diffuses into the blood stream," adds Rosenberg. "And as it affects those blood vessels, it causes them to relax."

Rosenberg says the illness produces a situation where the blood vessels are not normal in the way they are regulating blood pressure in the lungs. The blood pressure tends to be too high. The nitric oxide interacts with the muscle cells and the blood vessels causing them to relax so that the blood pressure goes down.

"That's the theory as to why it should work. It makes it easier to get blood through the lungs and allows the heart to do less work to get the blood through the lungs," says Rosenberg. "We have other medications that cause blood vessels to relax, given intravenously. The problem is that those chemicals will indiscriminately cause blood vessels to relax all through the body, causing the patient's blood pressure to fall."

The small capillaries in the lungs adjust blood flow to various parts of the lung based on oxygen levels in the lung. As oxygen levels fall, blood flow is decreased. In this way, the lung does not "waste" blood going to areas where it can't pick up oxygen. The unique aspect of nitric oxide is that it is given by inhalation. In this way, only blood vessels to areas of the lung that are receiving oxygen open up. Nitric oxide has a very short half-life, so it breaks down before causing low blood pressure in the rest of the body.

The majority of patients who die with Hantavirus Cardiopulmonary Syndrome usually die within 48 hours of the onset of the severe respiratory illness. Waagner says most survivors of Hantavirus Cardiopulmonary Syndrome have little long-term after-effects. If the patient survives, they usually return to normal activity with little residual problems," says Waagner. "Aggressive supportive care during this time is critical for a good outcome. In Heath's case, he went back to playing high school football."

Doctors Romano, Rosenberg and Waagner agree that Hantavirus is difficult to study. "Overall, it is a relatively rare disease, and most cases are clustered in a few geographic regions," says Romano.

"All of them are younger. That's why Dr. Rosenberg has done a recent collaboration with investigators in New Mexico, comparing our two cases with some of their cases and other cases from other parts of the country to combine data," says Romano.


Doctors warn individuals not to be frightened if they are exposed to mice. The chances of contracting Hantavirus are slim. "Almost all cases occur indoors in an area with rodents' droppings that are aerosolized typically by sweeping," says Waagner.

In Heath Henderson's case, doctors suspect that he was exposed by infected animals found in a closet used to store the family's hunting equipment. "A dead mouse and rodent droppings had been seen in the store room. Heath had a hunting vest that was somewhat dusty, and he shook it vigorously to air it out," says Waagner. "We postulate that might be the exposure, but we don't know for certain. The Texas Department of Health confirmed that rodents trapped in the immediate area tested positive for the virus."

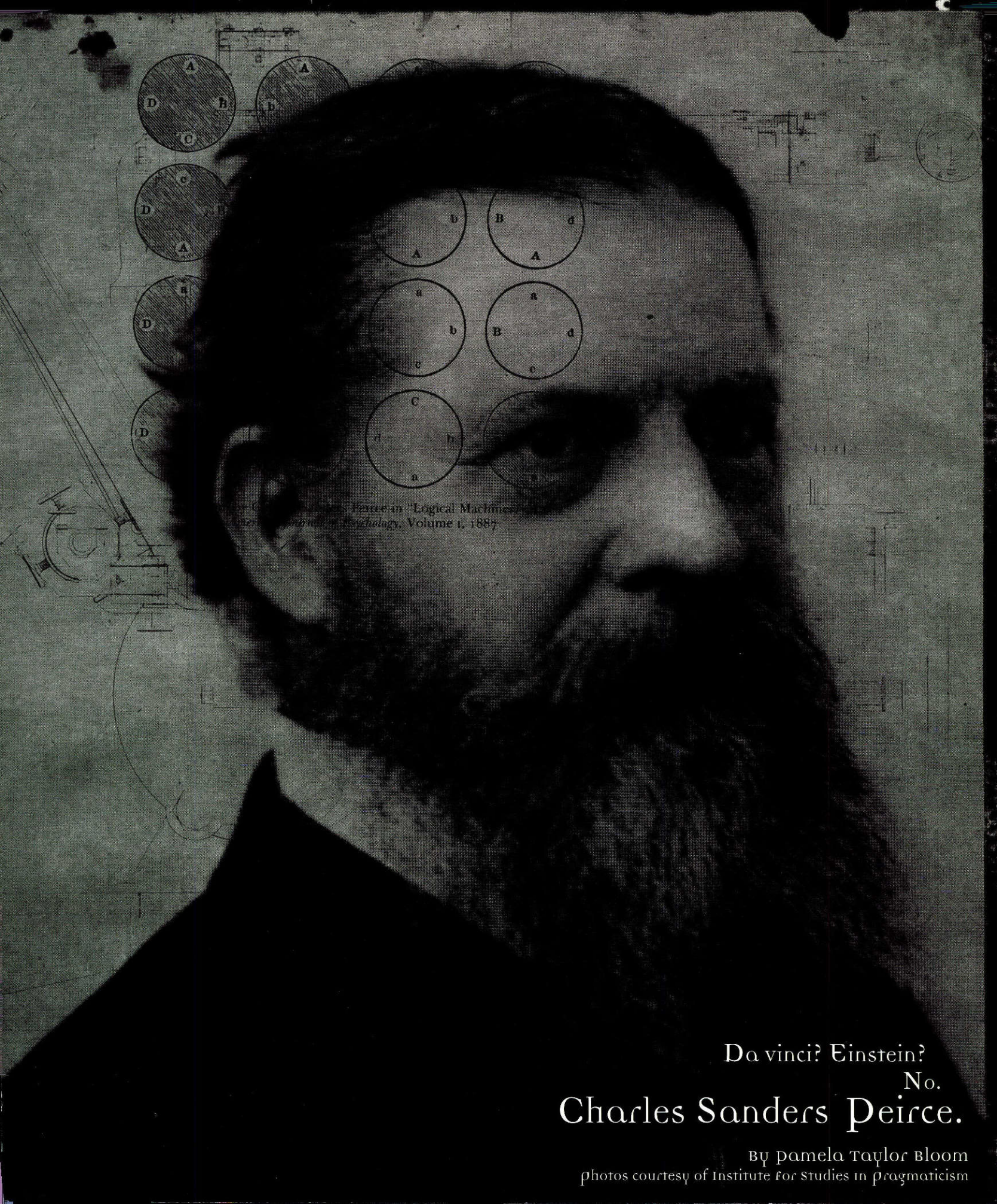
The Texas Tech Health Sciences Center doctors add that research is being done to see if anything else can be done for patients with Hantavirus. "There is a protocol testing a potential drug for the Hantavirus Cardiopulmonary Syndrome," says Rosenberg. "But we are still looking at three or four years of testing to see if it works."

But for now patients like Henderson are happy to have a medical center like that at Texas Tech in the West Texas community. "At the time Heath received nitric oxide therapy, this was the only center within 250 to 350 miles that had this technology available," says Romano. "If he were not at Texas Tech, he would not have been able to access this therapy and perhaps may not have survived. This is a perfect example of what an academic medical center like Texas Tech offers to the community." ←





Genius



Charles Sanders Peirce in "Logical Machines"
Journal of Psychology, Volume 1, 1887

Da vinci? Einstein?
No.
Charles Sanders Peirce.

By Pamela Taylor Bloom
photos courtesy of Institute for Studies in Pragmatism

Fig.1. Fig.2. Fig.3. Fig.4. Fig.5. Fig.6. Fig.7. Fig.8. Fig.9. Fig.10. Fig.11. Fig.12. Fig.13.

This is the story of a *genius* ahead of his time — a man who envisioned technology before it existed, understood the nexus of art and science, and will continue to affect science and technology well into the 21ST century.

Da Vinci? Einstein? No. Charles Sanders Peirce.

The Institute for Studies in Pragmatism at Texas Tech University is devoted to the study of the little-known Peirce (1839-1914), a true interdisciplinary whose research influences fields as disparate as military science, psychiatry, physics and philosophy nearly a century after his death.

"The study of logic, in the widest sense of the word, is the one short phrase that best describes his life work," according to Scott Cunningham, B.A., assistant director for operations at the institute.

In 1865, Peirce founded the distinctive American school of philosophy known as Pragmatism, based on the fact that all scientific disciplines share certain principles of logic and method. According to Kenneth Ketner, Ph.D., Horn professor, Peirce interdisciplinary professor and director of the institute, until 1898 the discipline stayed within a circle of friends that included philosopher and psychologist William James and educational reformer John Dewey. That year, James gave a lecture in Berkeley, Calif., called "Philosophical Conceptions and Practical Results," and the philosophy spread like an intellectual wildfire. Around 1903, Peirce became discouraged that others were changing his approach, so he modified the name for his original ideas to "Pragmatism."

"A word," he said, "that is too ugly to be kidnapped."

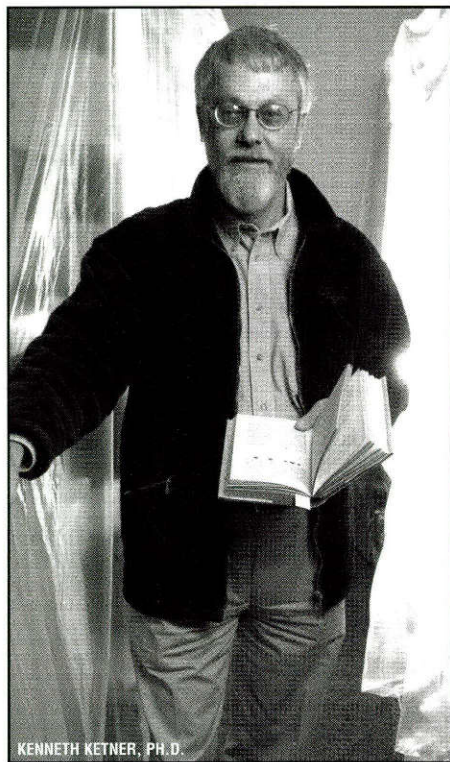
According to Cunningham, Peirce had a long-running professional life as a laboratory physicist with the U.S. Coast and Geodetic Survey, where he was in charge of their gravity survey, a responsibility that took him and his laboratory across the United States and around the world, earning an international scientific reputation. Fellow physicists have described his value of the constant for the force of gravity as the best one attained during the 19th century.

For this project, Peirce used what Cunningham called "the Cadillac of pendulum rigs at the time." At one point, Peirce realized that his early pendulum apparatus was in error on a measurement; he examined the apparatus and found a flaw in the tripod supporting the meter-long pendulum.

"He then redesigned it to fix the problem," said Cunningham, "and sent his design to Repsold, the German manufacturer of the pendulum, resulting in a redesign that was called the Peirce pendulum."

Peirce was devoted to the study of logic since before his college days at Harvard, where his father Benjamin was Perkins professor of astronomy and mathematics. According to Ketner, Peirce is ranked among the top three or four of the great logicians of all time.

"Perhaps only Aristotle, the ancient founder of the subject, can equal Peirce," Ketner said, "in that both were highly qualified scientists who brought their scientific inclinations and



experiences to the work."

Logic has come to be equated with mathematical logic, and in this respect Peirce was one of the architects of contemporary formal logic, the logic that has made contemporary computing possible. But Peirce's understanding of logic was broader than mathematical logic alone. Throughout his life, he consistently worked on what he called the logic of science, a study of the nature and functioning of the methods used throughout science, and thus was a founder of the study of scientific methodology.

"Many of his insights and methods are now routine within any activity in which a laboratory frame of mind is found," Ketner said.

In recognition of his accomplishments in

the logic of science, Peirce was made a member of the National Academy of Sciences in 1877. Other members include engineer Alexander Dallas Bache, a founding member, and physicist Albert Einstein, elected in 1922.

Peirce was also the major inventor of the logic of relations. According to Ketner, among a number of spectacular results Peirce achieved in this area, the most important is known as Peirce's Reduction Principle. This law illustrates that it is impossible to construct a genuine triadic relation — a fact about three items — using only dyadic relations, which are facts about two items. An example of an attempt to construct triads from dyads is found in recent psychology. B. F. Skinner and other behaviorists proposed to construct a theory of human intelligence using only stimulus/response sequences, which are basically dyadic relations of a causal nature. Intelligence, on the other hand, contains a number of triadic relations, especially the transmitter-message-receiver triadic relation as found in communication processes, which are clear subsets of intelligent activities.

"Peirce's Principle shows that Skinner's plan to construct an account of intelligence from stimulus/response phenomena cannot succeed on logical grounds alone," Ketner said.

Peirce's Principle has important applications in a number of areas, particularly for engineering of intelligent control systems. According to Ketner, this is true because, until recently, strategies for constructing intelligent devices within computer science have been based on an exclusive reliance on algorithms that are, in effect, long strings of dyadic relations.

"As long as artificial intelligence researchers limit themselves to those resources only," he said, "Peirce's Principle shows that they will not be able to construct genuine triadic relations of the kind found in fully intelligent activity."

Ketner also believes that use of Peirce's work within physics research is about to happen at a significant level, and that aspects of Peirce's Logic of Relations will affect "some very interesting matters within quantum mechanics."

According to Ketner, Peirce left diagrams in his papers for a logic that will illustrate how to build better computers.

"It's been sitting there as if buried in a time capsule," Ketner said. "Indeed, Peirce actually designed an electrical computing circuit. He

didn't work out all aspects of the computer as we know it, but he developed some of the fundamentals. An essay published in *The Princeton University Library Chronicle* (Volume 45, Spring 1984, Number 3, pages 186-224) makes a strong case that Peirce was a founder of modern computing and artificial intelligence research."

In the 1880s, Allan Marquand, who had been Peirce's student at the Johns Hopkins University, developed one of the earliest mechanical computing devices. Later, Marquand commissioned Peirce to design an electrical computing circuit. In an earlier letter to Marquand, Peirce proposed what is likely the first electrical analog of logic: switches in series used to represent sentences joined as conjunctive, or conjoining, statements, and switches in parallel used to represent sentences joined as disjunctive, or separate, statements.

"By this method," Ketner said, "if we have two simple sentences, 'Albert is handsome,' abbreviated as A, plus 'Betty is beautiful,' abbreviated as B, then we can represent the sentence 'A and B' by two switches A B in series.

"In such a series circuit, current will pass only if both switches are closed, and current will not pass if either or both of switches A B are open. This is directly analogous to the situation with the sentence 'A and B,' in that the whole compound sentence is true only if both A B are independently true, and the whole is false if either or both of the sentences A B are false.

"A similar situation is found with 'either A or B' and switches in parallel. However, in this case the compound sentence is false only when both individual sentences are false, because in the case of parallel switches, current does not flow only in the case that both switches are open."

This insight, which Peirce presented in 1886, has become one of the foundations of current computing machines, but with the function of mechanical switches being realized in transistors.

The circuit that Peirce designed for Marquand survives in the Marquand Papers at Princeton.

"It adds a number of interesting functions," said Ketner, "including a basic form of electrical memory and an operating system. The machine was never built, but through a careful examination of the function of its circuits, one can see that it would be capable of solving useful problems in basic logic."

Peirce's inventions were not limited to hardware. He also made a number of contributions to theoretical and software-related topics.

Perhaps the most spectacular, according to Ketner, is his prior independent discovery of a positive-mode version of the famous Limitation Principle published by Turing in the 1930s.

"Stated mathematically," Ketner said, "Turing discovered that there are numbers that a mechanistic system of algorithms — a Turing Machine — cannot compute. This means that there is a range of activities that can otherwise be accomplished, but which a computer constructed only with dyadic resources cannot perform."

Around 1900, Peirce showed that deductive reasoning, instead of being a singular type of reasoning as had been assumed, was in reality two related forms of reasoning, which he called



GENTRY HARRIS, M.D.

Corollarial reasoning and Theorematic reasoning. Corollarial reasoning is found in a deduction reached through a system of logical diagrammatization, where the premisses of an argument are entered and the conclusion is present immediately with no other action being required. Theorematic reasoning results in a deduction reached through a system of logical diagrammatization in which a diagram of the premisses of an argument does not immediately contain the conclusion, and requires one or more additional hypothetically generated items in order to obtain the conclusion in a sound way.

"The interesting thing to note about the latter form of deduction is that an active and original step — a creatively generated hypothesis on the part of the thinker — is

required," Ketner said. "Peirce then noticed that both forms of deduction are required to accomplish all forms of mathematical reasoning."

After 1892, when Peirce was no longer employed by the U.S. Coast and Geodetic Survey, he took up residence at his homestead in Milford, Penn., in order to concentrate on the study of logic.

To gain income, he took on engineering consulting jobs, one of them for George Morrison, the world-famous builder of major bridges. Peirce computed the loads for some of Morrison's bridge projects, including the George Washington Bridge connecting Manhattan to New York.

Peirce, an insomniac who survived on as little as five hours of sleep each night, also worked on a number of chemical engineering projects, including one scheme to produce illuminating gas for public lighting.

Throughout his life, he focused on producing a method for teaching logic to beginners, one that would be particularly appropriate for visual display. He was, according to Cunningham, successful in this attempt, and produced an efficient visual logical system, as well as many of the principles needed to use this system effectively within an educational setting.

According to Clyde Hendrick, Ph.D., the institute's associate director and a Horn professor of psychology, military scientists are increasingly interested in Peirce's work as a means to condense information-heavy technology for human comprehension.

"This has a number of applications," he said, "primarily in the area of information analysis. For example, the array of instruments and lights that aviators or astronauts use continue to become increasingly complex, and Peirce's work has implications for better ways to analyze and process information.

"An engineer from Lockheed, who visited the institute, mentioned that the weapons of the future will carry a hundred-fold more information," said Hendrick, "so the need will increase dramatically to find methods of analysis that can overcome human limitations in information-processing."

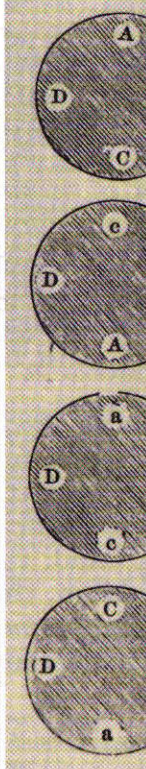
The institute was founded in 1971, when then-Vice President for Research Arlo Childs, Ph.D., requested faculty proposals for research centers and institutes. Because of the promising possibilities for interdisciplinary collaborations, Ketner and then Chairperson of Philosophy Charles Hardwick, Ph.D., proposed an institute centered on the work of Charles Sanders Peirce. The proposal was accepted. Hardwick subsequently became vice president for academic affairs.

"We were in an old frame building at the

Handwritten notes and diagrams on the left margin, including a vertical diagram with rectangular blocks and labels like 'Fig. 10' and 'b'.



CHARLES S. PEIRCE - standing, cane, in Berlin (vard 3 1/4 x 5) Widener 1643, folder 5, green album



Diag

PLG

Handwritten notes at the bottom right, including 'y w' and a small diagram.

time," Ketner said, "and the swamp coolers in the ceiling had been taken out, leaving a big hole in the middle of the roof. Well, one day there was a big West Texas dust storm, and God was on our side: there was a nice little coating of dust over all the valuable papers. I said, 'Quick; call Hardwick! Big disaster; get over here!' He took one look and said, 'OK, you're going into the library.'"

According to its constitutional document, the institute reports directly to the dean of the College of Arts and Sciences, but coordinates with the dean of libraries. The institute director is the designated curator of the collection, while any holdings that are catalogued are the property of the library, in the status of a special collection.

The Texas Tech institute is one of three university-based facilities in the country with holdings on Peirce. Peirce's widow transported the original Peirce papers, about 80,000 sheets, to Harvard at his death. In 1974, a team of Texas Tech scholars working at Harvard developed an annotated master copy on archival paper to serve as the foundation for detailed study of Peirce's unpublished work. This copy is housed in the Texas Tech institute.

About 1976, with help from the institute, a second project was started at Indiana University in Indianapolis, to focus on completing an edition of Peirce's papers. It has been estimated this task will require 100 volumes. Indiana purchased two copies of the Texas Tech master copy and is using these to prepare its edition, now into volume six.

"So," Ketner said, "we're the proud parent of that center."

With clusters of Peirce scholars located in Brazil, Columbia, England, France, Germany, Holland and Spain, academic interest in Peirce is now worldwide. The institute frequently hosts scholars from other countries and institutions and was the backbone for two international congresses, one held in Amsterdam in 1976 and another at Harvard in 1989, jointly organized by Texas Tech and Harvard on the occasion of the 150th anniversary of Peirce's birth.

In August, the institute received a remarkable gift from Gentry Harris, M.D., of Greenbrae, Calif., who contacted the institute after reading an edition of Ketner's long exchange of letters with medical pathologist and novelist Walker Percy, published in "A Thief of Peirce," (University Press of Mississippi Jackson, 1995) and Ketner's biography of Peirce, "His Glassy Essence," (Vanderbilt University Press, 1998).

Since 1955, Harris assembled a collection that includes 300 volumes of materials on or closely related to Peirce; 3,000 volumes of research on psychiatry, psychology,

mathematics, logic, natural science and natural history; and more than 20 completed but unpublished papers on Peirce-related topics. According to Cunningham, the gift doubled the institute's holdings in amount and in scope overnight.

"It turned out that not only had Dr. Harris studied Peirce on his own, he'd done quite a scholarly job," said Cunningham, who flew to California in 1999 to catalogue the collection.

Harris was also a 30-year friend of Percy, himself a student of Peirce, who had worked with Harris at the National Institutes of Mental Health on a five-year psychiatric project. Harris included significant research materials compiled with Percy, as well as their 30-year correspondence, in the gift to the institute. These papers include diagrams based on Peirce's semeiotic rationale for understanding psychiatric disorders, particularly schizophrenia, along with transcripts of family counseling sessions and Percy's evaluations.

"So the opportunities for interdisciplinary study will now include psychiatric illnesses," Ketner said. "This is remarkably original work, and scholars have not yet seen it."

One of Harris's early projects was front-line battlefield psychiatric research on soldiers suffering Post-Traumatic Stress Disorder during the Korean War; this work has been published on the U.S. military history Web site. And, in the early 1970s, when there was interest from law enforcement in the profiling of terrorists, Harris was involved in seminal research in this field. The collection includes these documents, as well as a revised, updated and unpublished version of his original papers on Post-Traumatic Stress Disorder.

"The beauty of it," said Ketner, "is that the collection has Peirce at the center. He influenced a considerable part of Walker Percy's book and essay writing, and influenced Harris as well, illustrating again the interdisciplinary use of Peirce's basic insights in logic and methodology."

The Gentry Harris Collection will be maintained as a separate collection within the institute's holdings.

While an emphasis in Peirce Studies is presently offered through the graduate school's interdisciplinary master's degree program, the future development of Peirce Studies as an academic discipline is central to the mission of the institute.

"Our goal is to become a degree-granting institute," said Hendrick, who served as graduate dean for 11 years, "with Peirce professorships in arts and humanities, social and behavioral sciences, and sciences and engineering."

The team of researchers, curators and

writers who make up the staff of the institute are involved in research that reflects the scholarly range of Peirce's work. Ketner currently is writing the next volume of Peirce's biography, and Hendrick is pursuing a project on the notion of community as it developed through the 19th and 20th centuries, and what he calls the "loss of certainty" that began to surface in the middle of the 19th century over the weakening absolutism of science and religion.

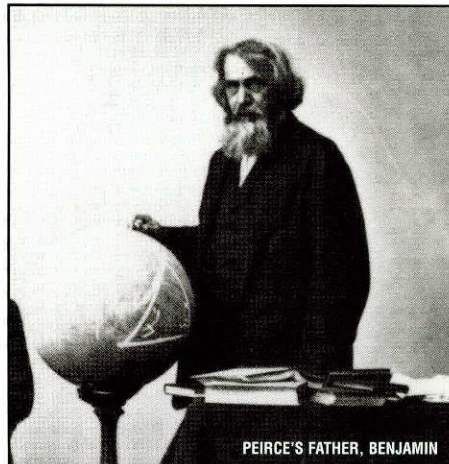
Cunningham is pursuing research on an aspect of Peircian logic that has implications squarely in concerns of the 21st century. While teaching at Hunt Elementary School in the Lubbock Independent School District, he conducted an informal study with two groups of fifth and sixth graders, using Peirce's graphical logic system as a means for focusing on the reasoning process.

"They all received the same instruction," he said, "except that one group was given Peirce's graphs."

The behavior problems of students in that group dropped from 20 percent to zero, while Texas Assessment of Academic Skills scores increased by 10 to 12 percent. He is currently pursuing grant funding to conduct a formal study, which he hopes will result in widespread use of Peirce's graphs in the schools.

"There is clearly something the graphs teach that enhances self-control," he said. "And they clearly taught the kids how to read a question, understand and process a question, look at answers, and see the relations."

"Peirce's work has implications for so many disciplines, almost from astronomy to zoology," said Hendrick. "The mining and development of his ideas is very important. I believe that the impact of his work will still be felt in the next two centuries. He truly was a man ahead of his time." ←



PEIRCE'S FATHER, BENJAMIN





a DEADLY COMBINATION

STORY BY MELODY RAGLAND, ILLUSTRATIONS BY T.J. TUCKER

During the past two decades, the use of dietary and herbal supplements has increased dramatically. Currently 29,000 herbal supplements are available for sale over-the-counter in the United States. With the increase of consumption of these products, the majority of people using these products fail to tell their health care providers what they are taking, which could prove to be a fatal mistake.

Alan Kaye, M.D., Ph.D, professor and chairperson of the Department of Anesthesiology at the Texas Tech University Health Sciences Center, recently found that one in three patients use a dietary or herbal supplement. In his survey, of those patients who admitted to taking a supplement, 70 percent failed to tell their doctor they were taking a nutraceutical. Nutraceuticals include all herbal medications, medicinal foods and vitamins.

Kaye's purpose in doing the research was to create awareness among patients and doctors that a number of these nutraceuticals are known to cause drug interactions and serious health problems. Some problems include variations in blood pressure, increased bleeding tendencies and herb-anesthetic interactions.

"We know about some documented interactions, but what are the interactions we don't know about?" Kaye said. "No one is telling their

doctor what they are on. Patients need to tell their doctor what they're taking, and they need to work with them. If the doctor is not willing to read, learn and be educated on the subject, maybe they need another doctor." With the availability of information on the Internet, he said patients also could educate themselves about herbal supplements.

For Kaye's study, members of the anesthesiology staff and residents at Texas Tech University Health Sciences Center evaluated patients. After patients were given a pre-anesthetic evaluation, a simple survey was administered. The survey listed 12 different nutraceuticals and the patients were asked to circle all that applied. The surveys were given over a period of five months to 1,017 different patients. Some were discarded because they were incomplete. Of the remaining 755 valid surveys, Kaye found that of the patients who admitted to taking a nutraceutical, 90 percent of the patients were using vitamins, 43 percent garlic extracts, 32 percent ginkgo biloba, 30 percent St. John's Wort, 18 percent ma huang, 12 percent echinacea, 10 percent aloe, 8 percent cascara and 3 percent licorice.

Kaye's research indicated that most of the herbs being taken by patients surveyed could cause drug interactions or alter bleeding time, which can increase the risk of bleeding during surgery. The herbs not only

can have an interaction with anesthetics, but also can have adverse effects.

According to Kaye's pulmonary and cardiovascular laboratory studies, garlic derivatives can cause a dose-dependent decrease in mean arterial and pulmonary vascular pressure. It may also cause bad breath, prolong bleeding time and cause low blood pressure. If taken, ginkgo biloba can cause platelet dysfunction, increase bleeding during surgery, and it may decrease the effectiveness of intravenous barbiturates. St. John's Wort can cause dry mouth, dizziness, constipation and nausea. Kaye also said if St. John's Wort is taken with certain anti-depressants, it could cause a lethal interaction. Ma huang or ephedra, can cause hypertension, stroke, myocardial infarction, cardiomyopathy, cardiac arrhythmias or sudden death. Combining echinacea with anesthetic may increase barbiturate toxicity and can cause unpleasant taste sensation, tachyphylaxis, or potential liver toxicity. Currently, Kaye's laboratory is studying the effects of ma huang.

"Our statistics make sense because people who come to the operating room all have a problem," Kaye said. "That's why they are in the hospital or need certain surgeries. So you would think we have just a little bit more nutraceutical use than the general population."

Kaye believes the No. 1 way to prevent potential dangers related to herbal medicines and induced drug interactions is communication. He said doctors also need to familiarize themselves with all the herbs currently available. He said patients do not need to be afraid of telling their doctors every medication they use.

According to Charles Seifert, Pharm.D., Texas Tech professor of pharmacy practice and regional dean for Lubbock programs, the Food and Drug Administration does not have to approve nutraceuticals for sale.

"Normal pharmaceuticals have to be approved safe and effective," he said. "Herbal and dietary supplements fall under the food category. The Food and Drug Administration steps in when herbals are shown to be dangerous."

Herbal supplements are protected by the 1994 Dietary Supplement Health and Education Act. According to the Food and Drug Administration's Web site, the agency defines a dietary supplement as a product (other than tobacco) that is intended to supplement the diet that bears or contains one or more of the following dietary ingredients: a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by humans to supplement the diet by increasing the total daily intake, or a concentrate, metabolite, constituent, extract or combinations of these ingredients.

The Food and Drug Administration also considers the following a dietary supplement: if the supplement is intended for ingestion in pill, capsule, tablet or liquid form.

A dietary supplement is not represented for use as a conventional food or as the sole item of a meal or diet. Supplements must be labeled as a "dietary supplement." The Dietary Supplement Health and Education Act includes products such as an approved new drug, certified antibiotic, or licensed biologic that was marketed as a dietary supplement or food before approval, certification, or license as a supplement (unless the Secretary of Health and Human Services waives this provision).

The act also states that herbal manufacturers cannot claim their product prevents, mitigates, treats or cures a specific disease (unless approved under the drug provisions of the Federal Food, Drug and Cosmetic Act).

As far as labeling, supplements containing herbal and botanical ingredients must state what part of the plant from which the ingredient is derived.

Both Kaye and Seifert agree that herbal and dietary products may have some benefit, but the problem is that not enough research has been done on them. "We need to do more and more studies to show whether or not herbals work," Kaye said.

"We need to sort out which agents are therapeutic, which are not and which are dangerous."

Seifert said that because products do not have to be approved by Food and Drug Administration, some products might have other additives in their ingredients. "You never know what you are getting," he said.

Kaye said there are hundreds of documented deaths across the United States due to complications with herbal supplements. He also said there are many lethal interactions that are not documented. Ma huang, a component in Metabolife, has reportedly caused 58 deaths and 900 cases of adverse affects in the past few years. He said since ma huang is often an ingredient in weight loss pills, medical professionals are very worried about that particular herb.

"We think herbals are drugs. They are drugs," he said. "Some herbals have good effects, some have no effects, and some of them have bad effects. We are not being judgmental and saying these are bad. What we think is that the Food and Drug Administration should standardize and ensure purity to protect society. I'm not against them. I just want them to be looked at under the same standards as any other medications."

Seifert said people who choose to take herbs are looking to self-cure. Kaye said some patients believe traditional medicine will not cure their illnesses, but herbals will. He also said because herbals are available almost everywhere, patients believe herbals are more convenient and cheaper than traditional medications.

"If you are sick, seek medical attention," Seifert said. "Just because an herb worked for your neighbor doesn't mean it will work for you. Everyone is different. There need to be studies to find the benefits and dangers."

He said one of the reasons the Food and Drug Administration has yet to standardize supplements is due to the political pressure from lobbyists, manufacturers and the general public. "The marketing and advertising for these products is misleading and deceptive," Seifert said.

According to Seifert, there is no clear-cut guide to how much dosage of an herb actually has to be in the supplement. This means, some people may not be taking an herb with enough active ingredients. For example, he said what makes garlic lower some people's blood cholesterol is the smell component. There are garlic products for sale over-the-counter that say "odor free."

According to Seifert, if someone is taking an "odor free" garlic tablet, it is probably not doing what it says it does.

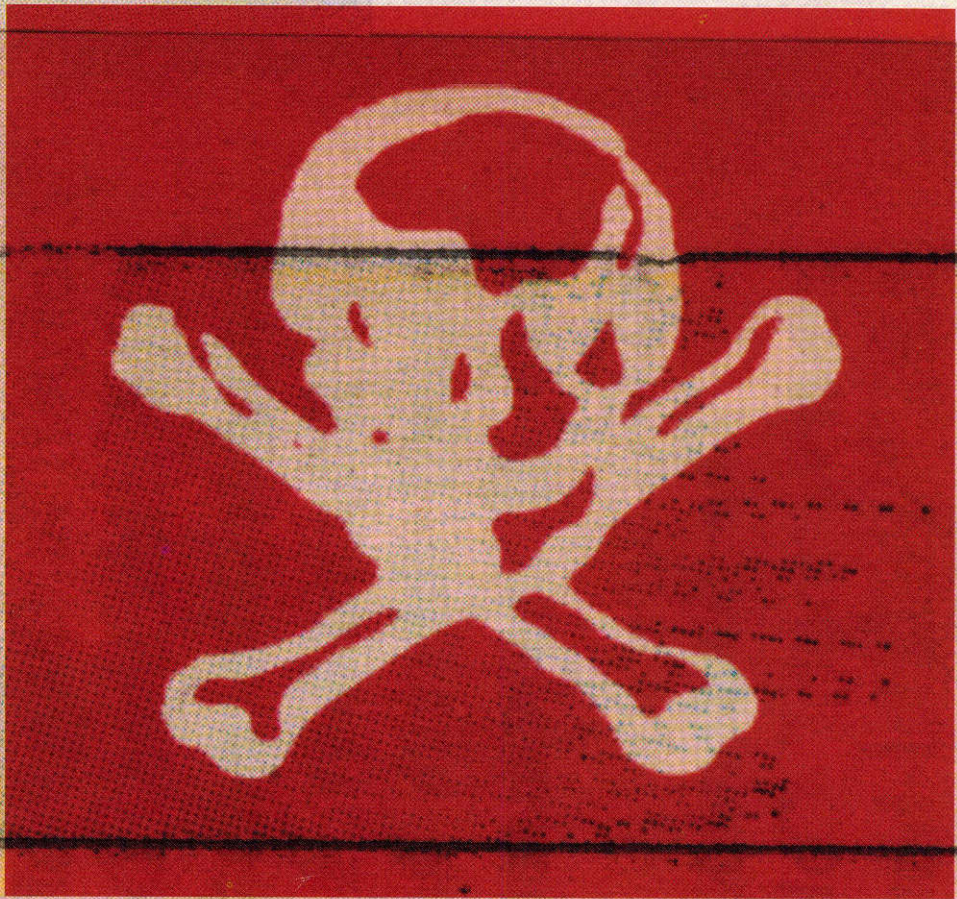
Kaye said it is important that the benefits and risks of herbal supplements be taught in medical education. According to Kaye, the American Society of Anesthesiology recommends anyone going for elective surgery should discontinue all herbal products two to three weeks prior to their surgery.

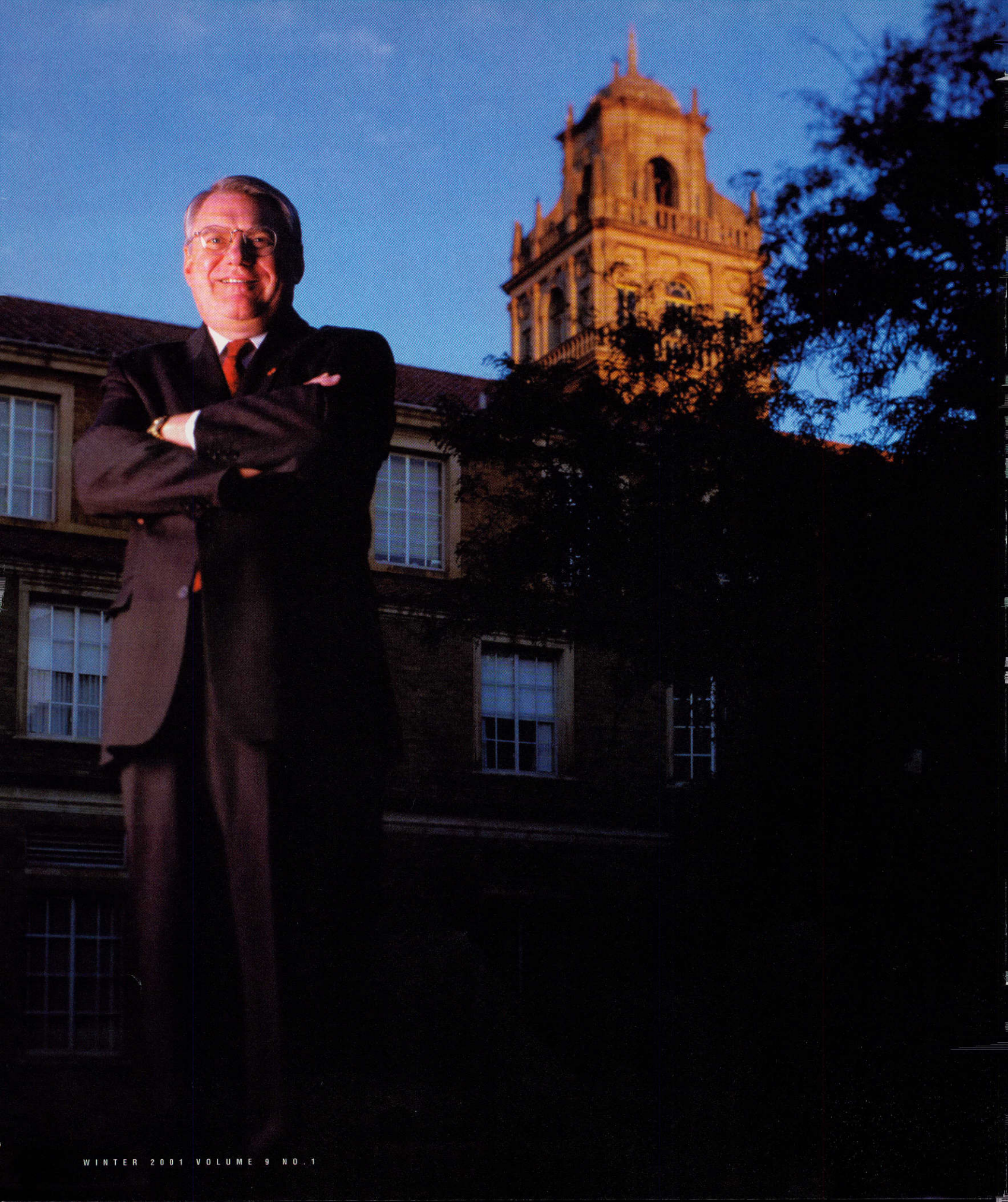
"That's pretty simple," he said. "That way all of the herbals will leave the patients' systems before their surgical procedures." ←

“The marketing and advertising for these products is misleading and deceptive.”

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FOR MORE INFORMATION ABOUT THE DIETARY SUPPLEMENT HEALTH AND EDUCATION ACT OF 1994, SEE THE FOOD AND DRUG ADMINISTRATION'S WEB SITE, [HTTP://VM.CFSAN.FDA.GOV/~DMS/](http://vm.cfsan.fda.gov/~dms/).





A NEW PRESIDENT'S VISION

BY DAVID J. SCHMIDLY, PH.D.

I assume the office of president of Texas Tech University with a great sense of pride and humility. I begin this job, the highlight of my professional career, understanding how much I owe to my parents, my wife and family, and my mentors for the opportunities they have all helped me realize. As a Texas Tech graduate and the son of a Levelland cotton farmer, I am especially honored to become the first native of the South Plains to serve this great university as president.

Texas Tech has an outstanding combination of assets. We are the most comprehensive institution in the state, with K-12 public education on our campus, and 269 degree programs at the bachelor's, master's, and doctoral levels. We are the only institution in Texas where you can enter kindergarten, graduate with a medical or law degree, and never leave Lubbock. We have a Law School, a branch campus in Junction, membership in the Big 12 Conference (one of the top athletic conferences in the country), museums and historic sites, and a great location in a region of great people. Our cupboard is not empty; it is rich, full of tradition and ripe for success. Now, as we enter the 21st century, we need to build off of this legacy and develop even higher aspirations. We have a special window of opportunity today to revitalize our efforts and move in new and more prominent directions.

We will face many challenges in the months and years ahead, but I see five that will be especially important.

The first is access and diversity. Given the changing state demography and the gaps in educational attainment, we must recruit and graduate a more diverse student body from Texas Tech. To do this, we will need a more diverse administration, faculty and student body. There can be no excuses for failure to progress in this crucial area, and we will make none.

A second challenge is scholarly achievement. Research and research education are keys to our national prominence. But in stressing this area we must pursue student-centered strategies, like our Honors College, and we must fully integrate the arts and humanities in our efforts because they contribute to the goal of understanding ourselves and our place in the world. We must afford our students the opportunity for an international education. The world is rapidly becoming a global village and our students must be prepared for this.

A third challenge is engagement. We must maintain a deep commitment to active involvement with society as part of our fundamental mission. We

must continue our heritage of providing civil service and volunteerism, just as we must enhance access to culture and the arts for the entire state.

The fourth challenge is communications technology. The information highway is the great equalizer for diverse communities around the country, as it is around the world. The potential of enhanced communications technology to link American communities to each other and to the world is enormous. We must be able to offer new technology to our constituents if we are to be successful in serving our students and the state.

The fifth challenge is to exploit partnerships and collaboration. Collaboration is a powerful way of leveraging resources. We must partner with other universities in Texas and around the nation just as we must partner with the private sector throughout the country and the world.

Ambition and vision are great, but of little value unless accompanied by a good strategy. So effective planning and decision-making will be crucial to our future success. At Texas Tech, a positive attitude and a sound plan for the future can go a long way. We need to be upbeat and positive. We need to be thankful for what we have as we solidify a strong plan for the future.

All of us must recognize that change will be essential if we are to be successful in the future. If we are not willing to change, we risk waking up one of these days and finding out we have an Edsel on our hands — a nice, very expensive antique.

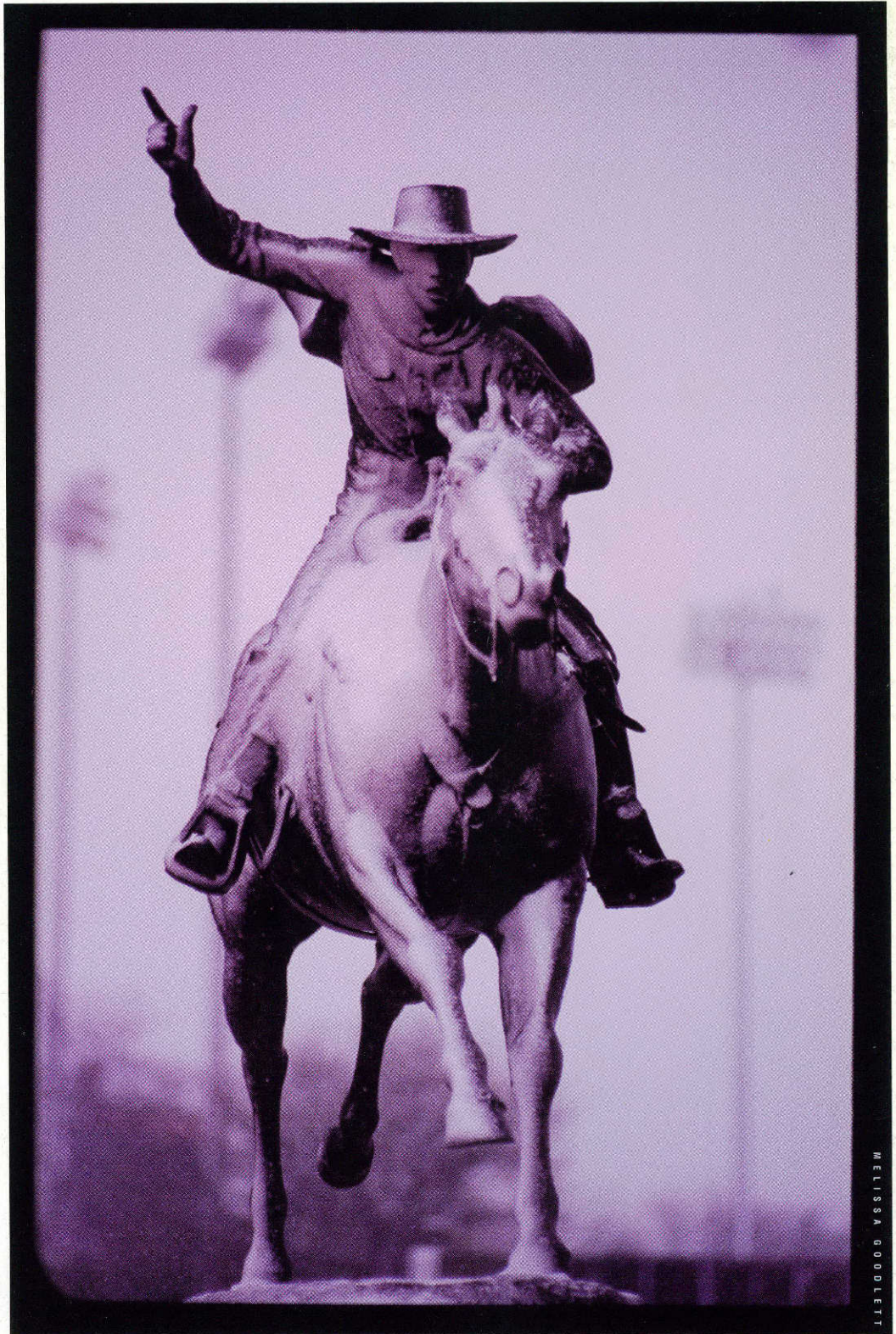
Albert Einstein once said: "Everything has changed but our ways of thinking, and if these do not change, we drift toward unparalleled catastrophe." The only thing constant about the future is that it will continue to change. If there is one thing that you cannot and should not do, it is to stay the same. The status quo simply won't move us into this century in an acceptable form in an ever-shrinking, competitive, complex and diverse world. As Will Rogers said, "Even if you are on the right track, you'll get run over if you just sit there."

My pledge is that we will not just sit here at Texas Tech. We will get about the business of "doing." Let this be our time to achieve and stake our claim to prominence. There is much we can do by working together, supporting one another, and by embracing change that will move us forward. I look forward to providing the leadership that will make this possible. ←

DAVID J. SCHMIDLY, PH.D., BECAME THE 13TH PRESIDENT OF TEXAS TECH UNIVERSITY ON AUG. 1, 2000. HE SERVED PREVIOUSLY AS VICE PRESIDENT FOR RESEARCH, GRADUATE STUDIES AND TECHNOLOGY TRANSFER AT TEXAS TECH.

VISTAS CAMPUS SCENES

An early snow covers the newly unveiled bronze sculpture depicting one of Texas Tech's most honored and recognized traditions, the Masked Rider. The one-and-a-quarter-life-sized monument of the mascot is located south of the Frazier Alumni Pavilion on the Texas Tech campus. The monument pays tribute to all of the former and future Masked Riders representing Texas Tech.



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