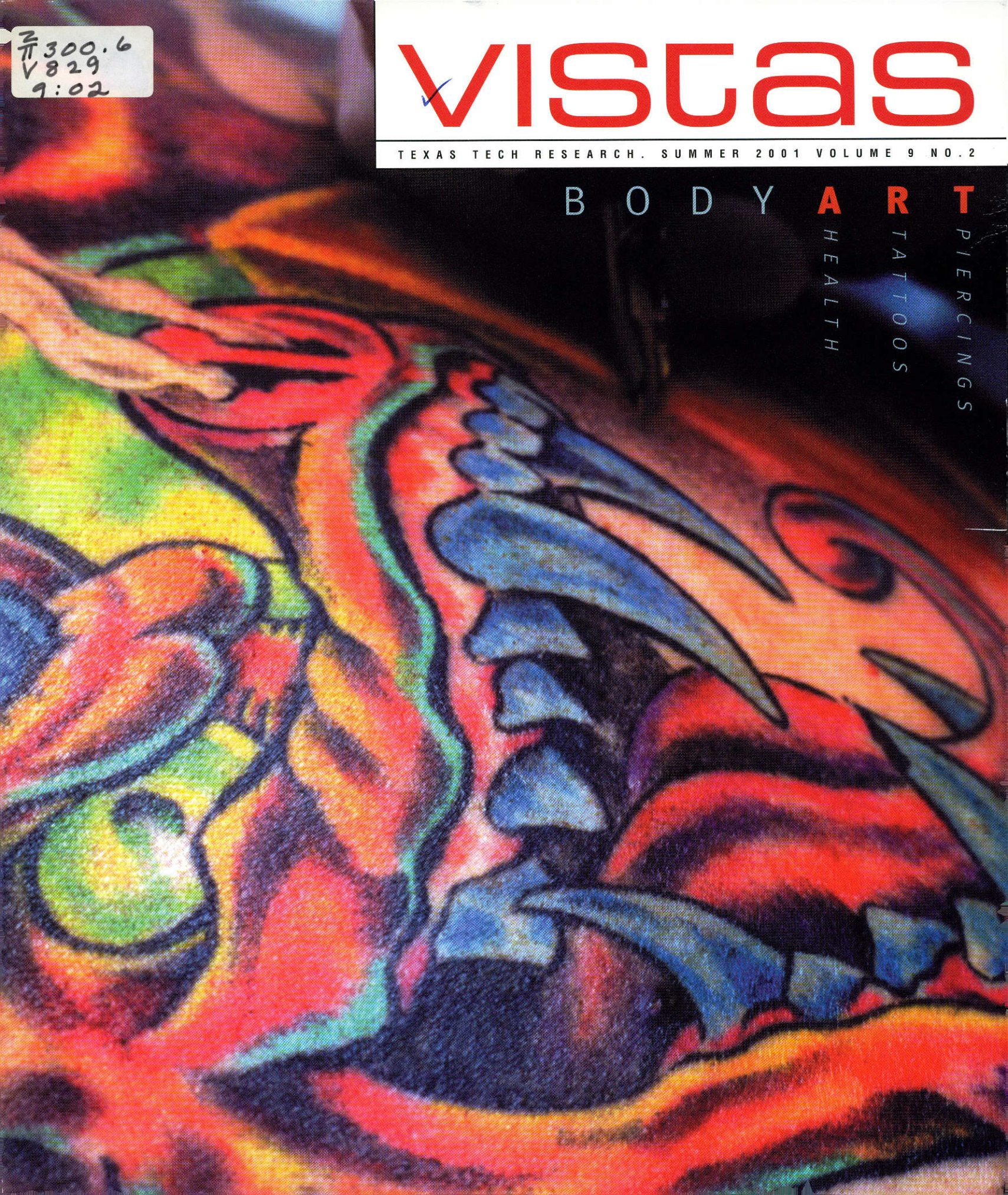


3  
π 300.6  
V 829  
9:02

# VISTAS

TEXAS TECH RESEARCH. SUMMER 2001 VOLUME 9 NO. 2

B O D Y A R T  
H E A L T H  
T A T T O O S  
P I E R C I N G S



# VISTAS

TEXAS TECH RESEARCH. SUMMER

#### CHANCELLOR

JOHN T. MONTFORD, J.D.

#### DEPUTY CHANCELLORS

JAMES L. CROWSON, LL.B.

ELIZABETH HALEY, PH.D.

#### PRESIDENT, UNIVERSITY

DAVID SCHMIDLY, PH.D.

#### PRESIDENT, HEALTH SCIENCES CENTER

DAVID R. SMITH, M.D.

#### VICE PRESIDENT FOR RESEARCH, GRADUATE STUDIES AND TECHNOLOGY TRANSFER AND DEAN OF THE GRADUATE SCHOOL,

ROBERT SWEAZY, PH.D.

#### VICE PRESIDENT FOR CLINICAL AFFAIRS AND DEAN, SCHOOL OF MEDICINE AND GRADUATE SCHOOL OF BIOMEDICAL SCIENCES, HEALTH SCIENCES CENTER

JOEL KUPERSMITH, M.D.

#### ASSOCIATE VICE PRESIDENT FOR RESEARCH, HEALTH SCIENCES CENTER

BARBARA C. PENCE, PH.D.

#### ASSISTANT VICE PRESIDENT FOR RESEARCH, UNIVERSITY

KATHLEEN HARRIS, PH.D.

#### VICE CHANCELLOR FOR NEWS AND PUBLICATIONS

CINDY RUGELEY

#### EDITOR

KIPPRA D. HOPPER

#### ART DIRECTOR/DESIGNER

T. J. TUCKER

#### DESIGNER

ALYSON KEELING

#### PHOTO EDITOR

ARTIE LIMMER

#### PHOTOGRAPHERS

JOEY HERNANDEZ

MELISSA GOODLETT

#### ILLUSTRATORS

SCOTT CORNELIUS

DIRK FOWLER

T. J. TUCKER

#### WRITERS

MARY HUDSPETH

ANGELA LOSTON

JOSH MURRAY

MELODY RAGLAND

CIRCULATION DIRECTOR

CAROL WOODARD

#### PRINTER

TRAFTON PRINTING COMPANY

MICHAEL SOMMERMEYER

JULIE TOLAND

ANDREA WATSON

LESLIE WOODARD

Each issue of **VISTAS: Texas Tech Research** (Library of Congress ISSN 1055-9159) reflects the goals, techniques, results and drama of research and creativity at Texas Tech. The magazine describes only a few of the many scholarly activities conducted at Texas Tech University and Texas Tech University Health Sciences Center. The magazine is published by the Office of News and Publications, Box 42022, Texas Tech University, Lubbock, Texas 79409-2022, (806) 742-2136. Text from **VISTAS: Texas Tech Research** may be reprinted without permission, as long as credit is given to Texas Tech. Please direct all inquiries concerning text and photography to the Office of News and Publications at the above address or e-mail to: [vistas@ttu.edu](mailto:vistas@ttu.edu). VISTAS is a member of the University Research Magazine Association. Texas Tech is committed to the principle that in no aspect of its programs shall there be differences in the treatment of persons because of race, creed, national origin, age, sex or disability, and that equal opportunity and access to facilities shall be available to all. Direct inquiries to the Office of Equal Employment Opportunity, 242 West Hall, Texas Tech University, Lubbock, Texas 79409-1073, (806) 742-3627. Persons with disabilities who may need auxiliary aids or services are requested to contact the Office of News and Publications. Copies of this publication have been distributed in compliance with the State Depository Law and are available for public use through the Texas State Publications Depository Program at the Texas State Library and other state depository libraries. © Copyright 2001 Texas Tech University [www.texastech.edu/vistas](http://www.texastech.edu/vistas)

e

editor's note

SUMMER 2001 VOLUME 9 NO. 2

#### WITH APOLOGIES TO SUZANNE LINDSEY, PH.D.,

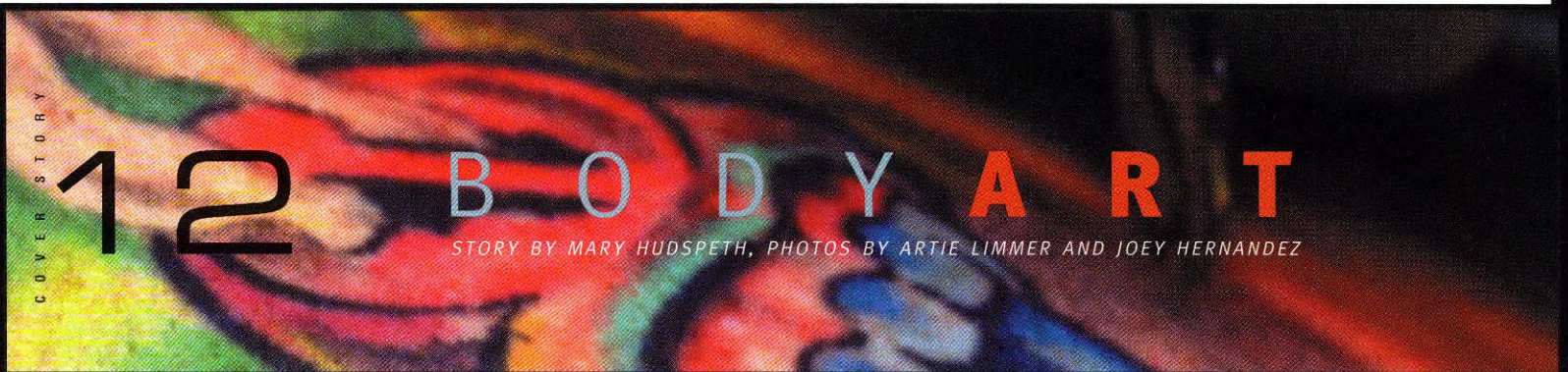
assistant professor in the Department of Pharmaceutical Sciences, VISTAS is correcting two misstatements in the "Understanding Women's Health" article in the Winter 2001, Volume 9, No. 1, issue. Lindsey is a member of one of four research teams at the Texas Tech University Health Sciences Center in Amarillo that is studying health issues that may affect women differently than men through the Women's Health Research Institute. The article was inaccurate in describing Lindsey's research and should have stated that she has isolated two genes that are upregulated by a growth factor that has been shown to be expressed in most metastatic cancers. In addition, Lindsey did not drop out of high school, as the article stated. Accuracy is very important especially in research magazines such as VISTAS, and I, as editor, regret the errors.

VISTAS: Texas Tech Research continues to garner awards. The Society of Publication Designers Inc. in New York deemed VISTAS, Spring 2000 issue, to be a Merit Winner from 7,831 submissions to SPD's 36th annual competition. Secondly, the same issue of VISTAS has been selected to appear in Print's Regional Design Annual 2001 among nearly 32,000 individual entries, representing the best design, illustration and photography being produced throughout the United States. Finally, the Council for the Advancement and Support of Education on the national level has selected VISTAS to receive a Gold Medal in the Visual Design in Print category among 263 entries.

— Kippira D. Hopper, Editor

# TEXAS

SUMMER 2001 VOLUME 9 NO. 2



COVER STORY

## 12 BODY ART

STORY BY MARY HUDSPETH, PHOTOS BY ARTIE LIMMER AND JOEY HERNANDEZ

	<b>THE BONE EXAMINER</b> Robert R. Paine, Ph.D., solves mysteries associated with forensic cases in a small, secluded room where remains of bone fragments lay scattered on wooden tables.	02		<b>AMERICAN DEATH</b> Timothy J. Floyd, J.D., who has argued before the U.S. Supreme Court, examines the death penalty system in the United States and our ideal of "Equal Justice Under Law."	20
	<b>BORDERS OF HEALTH</b> The needs of elderly people living in rural areas will be easier to address thanks to the Texas Tech 5000 survey, one of the largest surveys of health and health care accessibility ever conducted among elderly individuals.	04		<b>FROM WASTELAND TO PROMISED LAND</b> Turning one person's trash into another's treasure, researchers are turning the waste of cattle feedlots and power plant residue into a promise of economic development.	22
	<b>THE WALL STREET WOMEN</b> Business management styles differ noticeably between genders, but Linda Krefting, Ph.D., believes that the mass media perpetuates equivocal images of women executives.	06		<b>SEARCHING FOR A SUBSTITUTE</b> Creating a substitute for human blood has been an elusive dream for many years, but researchers at Texas Tech have done what others have not, by eliminating hemoglobin's intrinsic toxicity and improving its function as a universal blood substitute.	28
	<b>WIRED</b> Understanding gray matter has long been a gray area for researchers, but now researchers are using new, high-tech brain-mapping equipment to unravel the brain's mysteries.	08		<b>SPACE AGE TERRA FIRMA</b> A NASA astronaut and a colonias resident share a common need for two of the human body's necessities - fresh water and fresh vegetables. Texas Tech researchers are helping both.	34
	<b>FIRST GENERATION</b> The Ronald E. McNair Post-Baccalaureate Scholars Program provides first-generation college students from low-income families the support and opportunity to make their dreams of graduate education come true.	10		<b>NURSING US INTO THE FUTURE</b> The nursing profession, with a long history of cyclic shortages, faces another shortage in the 21st century that promises to be more complex, long lasting and will dwarf all shortages to date, says Alexia Green, RN, Ph.D.	40

Firs



**THE BONE EXAMINER**

in

a small, secluded room, remains of bone fragments lay scattered on wooden tables. Human and animal bones can be found in this laboratory alongside microscopes and other equipment used to examine bone. At first glance, this room can be easily mistaken as a typical classroom lab used by students of anthropology, but that is not its only purpose. For Robert R. Paine, Ph.D., associate professor in the Department of Sociology, Anthropology, and Social Work, this room is where he solves the mysteries associated with forensic cases, which can lead to a positive identification of the remains.

"Doing forensic work means sitting down in a lab with the bones and spending time examining them in order to figure out what the bones can reveal about the individual," Paine said.

As a forensic anthropologist, Paine investigates homicides, suicides, accidental deaths and natural deaths. When conducting an investigation, Paine said he does a specialized form of autopsy via examining the skeletal remains. Through his examinations, he is able to unlock the mystery of a puzzling death by discovering a deceased person's age, sex, height, cause of death and health status. Criminal investigators use his forensic analysis during their investigations, providing them with crucial information that often reveals who the bones represent and what may have happened to the person prior to their death. When working on a case, he works with a team of investigators that include the forensic pathologist, local law enforcement officers and other specialists.

"I think it is important to emphasize that I am only one member of an entire team of criminal investigators," he said. "I offer a piece of the puzzle which may help to solve the case."

Paine said the work can take more than a month to complete and a forensic investigation encompasses both a lab analysis and report writing. During the investigation, the analysis of the skeletal remains can take many hours while the forensic report may take several months to complete.

In one case he investigated 12 years ago, Paine said he used another area of his expertise, bone histology, to help solve a murder. This scientific procedure is used to examine bones at a microscopic level to determine their origin. The case involved a teenager who was killed by a blow to the head from a lead pipe. Once law officials examined the murder weapon, a lead pipe cane, they discovered a piece of bone inside of the pipe. The small bone fragment was sent to Paine for him to determine whether it was of human or animal origin. Through using bone histology, Paine

was able to confirm that the bone was of human origin, and the suspect was linked to the crime.

While he was attending graduate school at the University of Missouri-Columbia, Paine developed a keen interest in forensic science. By working closely with his mentor, Samuel D. Stout, Ph.D., a forensic anthropologist, Paine was exposed to forensic casework.

"The field of forensic anthropology was not well-advertised during the time when I was an undergraduate and graduate student," Paine said. "Today, I meet with students on a regular bases who have inquiries about the field of forensic anthropology. I think those questions come from reality-based television programs that show forensic scientists and medical examiners solving crimes. It takes someone who is very dedicated to science to become a forensic specialist. For myself, it involved many years of training as a graduate student in anthropology. Once students realize there is a lot of work involved with very little pay, many of them lose interest in the field."

Currently, Paine said he, along with officials of the Texas Tech University's Health Sciences Center, are working toward establishing a forensic research center for the university, the West Texas Regional Forensic Sciences Institute.

Along with his forensic work, Paine said he has an interest in using bone analysis to document health problems in past populations. In order to detect various illnesses, Paine uses paleopathology, the study of skeletal lesions seen in the burial of past cultures. He said the use of paleopathology has contributed to the discovery and history of illnesses such as osteoporosis, tuberculosis and osteoarthritis. By studying paleopathology, Paine said anthropologists are able to gain an understanding of present health conditions from studying the past.

"In doing so we have a way to predict how present lifestyles will affect our health by seeing how lifestyles affect the health of past populations. We have realized these diseases are related to the environment, behaviors and life choices," he said.

This summer, Paine is visiting Rome for six weeks as a visiting professor at the Universita La Sapienza. He intends to collect bone samples from a Roman period burial population with the purpose of doing a health assessment of the burials via histological examination of bone. The results from this project will be used to compare their health status to that of other skeletal populations with differing lifestyles. ←

**BORDERS**

**OF  
HEALTH**



# the

needs of elderly people living in rural areas is now a little easier to address thanks to a survey just completed by the Department of Health Services Research and Management at Texas Tech University Health Sciences Center.

The Texas Tech 5000 survey was one of the largest surveys of health and health care accessibility and quality ever conducted among elderly individuals. The survey is based on a random sample of 65,000 telephone listings in the 108 counties that comprise West Texas. Households were screened to identify age-eligible respondents.

"This survey and its results will help us target the rural population more effectively," said Tyrone F. Borders, Ph.D., assistant professor in the Department of Health Services Research and Management and co-author of the survey.

Respondents were questioned about health services use, satisfaction with accessibility and quality, health insurance coverage, health beliefs, health status, demographics and other health-related factors. A Spanish version was administered upon respondent request.

"We had a wonderful response," said James E. Rohrer, Ph.D., chairperson of the Department of Health Services Research and Management and co-author of the survey. "We were inundated with calls from people who wanted to be involved. People want their voices heard about the problems they face."

The survey was funded by the Administration on Aging/U.S. Department of Health and Human Services.

"There have been surveys of Hispanics that included Mexican-, Cuban- and Puerto Rican-Americans, but there's never been a survey in the Southwestern part of the United States that targeted elderly Mexican-Americans," Rohrer added. "That was a big part of this study."

One of the more startling results of the survey was that one in five respondents had not seen a doctor in the previous six months. Rohrer said the researchers controlled for various health problems to compare sub-groups. However, the statistics were still significant. "It's not likely that it's due to chance," he said. "The bottom line is we have to ask 'Is this how we want the health system to function?' Do we want

this many people to be limited in their access to health care?"

Among the results discovered from the survey were that a higher percentage of elderly Hispanics have no health insurance coverage, and of those with health insurance coverage, Medicaid is more common among Hispanics while private health insurance is more prevalent among non-Hispanic whites.

The study also revealed that a lower percentage of Hispanics were satisfied with their accessibility to specialty physicians and a lower percentage of Hispanics had visited a doctor within the last six months.

Despite their potential inadequate access to health services, more in-depth analyses led by Borders revealed that Hispanic elders in West Texas tend to have better physical health status than their non-Hispanic white counterparts. Hispanic elders were found to be less likely to have most chronic diseases, with the exception of diabetes and they reported having better physical health-related quality of life. Few differences were found between elders residing in metropolitan versus rural areas.

Rohrer said the study revealed many interesting facts, but that this survey should not be considered the last word on the health care needs of the rural elderly.

"There will be more rounds of surveys and more results compiled," he said. In fact, a second round of questions which further expands on pharmacy needs, transportation and other barriers already has been administered, and the results are being analyzed, he said. Plans are under way for another possible round of questions that will further inquire into the respondents' health status.

Studies such as these will become even more important as the United States population continues to age and as age demographics shift throughout rural and urban areas, said Joel Kupersmith, M.D., dean of the School of Medicine and the Graduate School of Biomedical Sciences.

"Many young people are leaving rural areas, so examining the rural elderly is key," Kupersmith said. "Rural health care presents different needs for us to address. This gives us our first good look at this group and tells us a lot about their access to health care and what we can do to meet their needs." ←

# THE WALL STREET WOMEN





# business

management styles differ noticeably between genders, but one Texas Tech University researcher believes that the mass media perpetuates equivocal images of women executives, and often makes being a woman executive an issue in the workplace at all.

"The issue is awareness of how women are portrayed, and how that impacts what we expect to see of women," said Linda Krefting, Ph.D., associate professor of management in Texas Tech's College of Business Administration. "What press coverage does is contribute to what people think they know, and that, over time, colors what people perceive and how they react to what they read and experience."

According to Krefting, the images of women presented in a highly respected business publication with global distribution are often ambiguous. Krefting has done an extensive study of the coverage of women in the *Wall Street Journal*.

"There is ambivalence in perceptions about women executives," said Krefting. "One study I've read states it this way: 'Women experience a double-bind on perceived competence; either it is questioned, or it is acknowledged, but at the cost of losing likeability and influence.' That perception creates problems. While we have documented perceptions, and we continue to document concerns about women and executive work, we haven't really asked the questions 'where do these perceptions come from? how do they arrive? how do they get reproduced?' These are unusual questions to ask in management."

Krefting points to two types of evidence that ambivalent perceptions exist: the persistence of the glass ceiling for women executives and the stagnant enrollment of women in elite Master of Business Administration (MBA) programs.

"Over the last decade, enrollment of women in law schools and medical schools, even in the elite programs, has increased more than 40 percent, and it has been stuck at 30 percent for MBA programs. So part of the argument about the glass ceiling is that there is an inadequate pipeline, if you have stagnant enrollment in the best programs."

Krefting says a whole set of issues that gets raised about both of those problems are the perceptions of women executives, and that those perceptions play a role in limiting their advancement to the top and limiting the willingness of women to enroll in MBA programs.

From a study published in 1998, Krefting offered the following results of a survey of college students who were asked to choose descriptors of successful middle managers in general, successful

female middle managers and successful male middle managers.

"There was reasonably consistent agreement describing successful middle managers and male middle managers, but when it came to describing successful female middle managers, there was a real split between how female students described them, and how male students described them. Not only that but they were nearly all polar, positive versus negative descriptions."

Some of the descriptors chosen by male college students included: bitter, dawdle and procrastinate, deceitful, frivolous, hasty, nervous, passive, quarrelsome, reserved, uncertain and vulgar.

Descriptors chosen by female students to describe female middle managers included: ambitious, assertive, competent, creative, direct, emotionally stable, firm, helpful, objective, prompt, sophisticated and tactful.

Krefting regards this study as evidence of multiple perceptions, both positive and negative, of women executives, and indicates the distinction between male and female observers is not always found.

"I've been interested in figuring out where these perceptions come from, because if these perceptions are those of current college students, it's not because they have extensive experience with middle managers, male or female. The perceptions have to be coming from somewhere. Media is at least one of the possibilities."

Several sections of the *Wall Street Journal* fell under Krefting's scrutiny. She looked at the coverage of the deaths of Princess Diana and of Mother Teresa, the *WSJ* op-ed pages from July to December 1997, the *WSJ* front pages from July 1999 to July 2000 and the *WSJ* cartoon portfolios featuring panels from the 1950s through the 1990s. Much of her study surveyed articles for representations of women executives in the year following the appointment of Carly Fiorina as the head of Hewlett-Packard. In the year following Fiorina's appointment, the *WSJ* ran no less than 40 stories on various women executives.

"The *Wall Street Journal* actually may have more to do with what's framing the real issues out there than any other publication because of its circulation," Krefting said. From her research Krefting concluded that media, the *Wall Street Journal* in particular, sends a strong message. "We often tell women that they should value their differences, but then when it comes down to holding them accountable, those differences are looked at negatively," Krefting said. ←

WIRED

		Veneration	Firmness	
	Benevolence	Spirituality	Hope	Conscientiousness
	Tolerance			Approbation
Ideality		Sublimity		Caution

## gray

matter has long been a gray area for researchers. But new, high-tech brain-mapping equipment at Texas Tech University Health Sciences Center is helping School of Allied Health researchers unravel some of the mysteries about how the brain works.

The school's Center for Functional Brain Mapping and Cortical Studies in the Department of Communication Disorders recently began using electronic brain mapping equipment, which offers a look at the responses of the brain stem to different sounds.

"Basically, what we're doing is watching the brain think," said Dwayne Paschall, Ph.D., assistant professor in the Department of Communication Disorders. "The way that the brain works is to send small electrical signals from one location to the next. And by putting electrodes on the outside of the head, we can watch it send that electrical signal from location to location. Then we can draw this information onto a visual image of the patient's brain and see which parts are working.

"This allows us to create a map to watch how the brain is sending signals all over the head," he said.

Paschall said brain mapping is useful in a variety of situations – hearing loss, brain damage and any kind of speech problem. It is especially effective in assessing those who have difficulty communicating verbally. For example, a young child who has difficulty hearing can be tested while asleep. "We can give them different sounds to listen to and see how the brain is functioning to process those sounds," he said.

"In an older patient who may have had an accident or a stroke, we can measure how the brain is recovering after that particular incident, and monitor the change in language. And sometimes in coma patients, we can measure brain changes and determine with some success when that patient is likely to recover."

The brain-mapping unit also can be used in the operating room to monitor the patient's nerves or neural function during surgery.

"We monitor several different modalities during an operating room session," Paschall said. "We have electrodes in different parts of the body, which is especially useful if the surgeon is working around nerves."

A number of different brain-mapping techniques are currently being used, Paschall said. Functional MRI, which is more commonly known, monitors changes in the brain that happen over a second or two. And Positron Emission Topography (PET) measures changes in certain electro-chemical properties of the brain.

"What we're measuring with our brain mapping equipment is actual electrical signals in the brain," Paschall said. "We can take them and superimpose or lay them on top of an MRI picture of the brain. This way we can see exactly which bumps and ripples in the brain are producing the activity, which parts are actually working. And we can measure that as it changes very quickly over time."

Paschall said a difference between this technique and MRI or PET methods is it allows measurement of activity over the entire surface of the brain, rather than just one nerve or one neuron, and on a very fast time scale.

"We know that the brain has a lot of different parts, and we know different parts are involved with doing a single activity," Paschall said. "So something as simple as writing or listening in a noisy environment involves multiple areas of the brain, and if we're just looking at one part, we're missing how the brain functions as a whole.

"This equipment is what allows us to do that, to look at the whole brain and see how all the different parts come together to solve one particular problem." ←

BRAIN IMAGE COPYRIGHT 2001 RESEARCH IMAGING CENTER - UTHSCSA



AMANDA ABBOTT (CENTER) WITH HER SIBLINGS (FROM LEFT TO RIGHT) ROBERT, NILES, JOHN AND KAREN.

# First Generation

# today

college students have endless opportunities, but many of today's students are first-generation college students who do not have the guidance needed to take advantage of the opportunity to attend graduate school after earning their bachelor's degree. Texas Tech alumna Amanda Abbott, is the second of six children and the first in her family to attend and graduate from college. But Abbott had a slight advantage over other first-generation college students — the Ronald E. McNair Post-Baccalaureate Scholars Program.

The McNair Scholars Program provides first-generation college students from low-income families the support and opportunity to make their dreams of graduate education come true.

Texas Tech University is one of the 156 universities nationwide to have a McNair Scholars Program. According to Kelly Powell-Sharp, assistant director of the Texas Tech McNair Scholars Program, each academic year, 20 junior or senior students take part in the program. The goal of the program is to help prepare these students for graduate school.

"Many of the students in the program haven't had anyone to show them the way," she said. "Being in college is like being in a blind, dark tunnel at night for many of them. We've had students in the program whose parents never graduated from high school. They need someone to fill in the gaps and that is the purpose of the McNair Scholars Program."

The program, according to Abbott, provides guidance and assistance that first-generation college students do not get anywhere else. Participants of the program are offered several types of support, which include: graduate student mentors, faculty mentors, in-depth workshops, academic assessment, financial assistance and individual academic strategy.

Texas Tech alumnus Thomas Haupt, a former McNair participant, said that for first-generation college students just pursuing an undergraduate degree is a big deal.

"Sometimes you have a tendency to feel like a higher degree is out of reach," Haupt said. "Often students do not have the right references or resources. That is why having a mentor is so important."

Faculty mentors help the students with their research as well as sharing experiences and teaching. Graduate student mentors allow students the chance to learn more about their respective

fields and it encourages a peer relationship between the mentor and student.

Elizabeth Teagan, Ed.D., director of the McNair Scholars Program, said an important component is that students have an ongoing dialogue with their mentors. She said the interaction McNair scholars have with their faculty mentors is crucial.

"First-generation low-income students may not feel as if they belong," she said. "They benefit from a professional and personal relationship to help guide them."

Abbott said the program not only is a benefit to her, but to her siblings.

"My 20-year-old brother has asked me about attending college, and I eagerly tell him all I can," she said. "Being the second oldest and going to college, I feel like or hope that I'm setting an example for my younger siblings. Having mentors (as a part of the McNair program) helped me the most. I would have to say that they've helped me the most in putting my research project together and guiding me in my future plans. Giving me advice about working, interviews and making career choices are just a few other things that they've helped me with."

Abbott was accepted in the program as a senior. She said after gaining experience as a teacher she will return to school to obtain her master's degree. Like all program participants, Haupt and Abbott are heavily involved in their research. Participants are involved with research projects that correlate with their majors.

"Our program has students from all disciplines and each one's research is different," Powell-Sharp said. "While in graduate school, students will have to do research and this program is a wonderful way for students to gain the hands-on research experience."

The McNair Scholars Program is funded by the Department of Education under Title IV of the Higher Education Act of 1965. Texas Tech received funding for the program in 1995 and accepted its first students in 1996. The McNair Scholars Program is named for Ronald E. McNair, Ph.D., a first-generation college student that received his doctorate in physics from Massachusetts Institute of Technology. He was one of 10,000 applicants to be selected as one of 35 astronauts accepted into the NASA space program. In 1986, McNair was one of the victims of the tragic Challenger accident. Now every student accepted into the program will continue McNair's legacy. ←





**B O D Y A R T**

*STORY BY MARY HUDSPETH, PHOTOS BY ARTIE LIMMER AND JOEY HERNANDEZ*

**A**lthough it may seem like a good idea at the time, individuals who are seeking to assert their independence or promote their individuality by getting a tattoo or having any number of body parts pierced may be paying a higher price in the long run if the piercing happens to get infected or if they wish to remove the tattoo.

What was once considered a practice of bikers, sailors and rebellious teenagers has now entered into general society, according to Myrna Armstrong, Ed.D., R.N., a nursing professor at the Texas Tech University Health Sciences Center. Individuals of all ages, races and genders now are participating in the practice of body art. With body art growing in popularity, the health risks associated with the practice are now growing as well. Armstrong's research has ranged from studying the increase of tattoos among women to the health risks of tattooing and body piercing to tattoo removal.

Armstrong says the major reason for college students to seek one or more of the different types of body art is self-identity. Among younger college students—freshmen and sophomores—their reasoning is more about impulsiveness, something that sounded like a good idea at the time or because they are away from their parents for the first time. Among older college students—juniors and seniors—the decision is more about emulating older adults and definite decision-making. Armstrong said the older students usually take more time to research their decision, whereas the younger ones don't care as much.

"Both types of body art—piercings and tattoos—provide an internal meaning to those who choose to get them. Piercings are less permanent, so if individuals change their mind, they may remove the jewelry and leave only some scar tissue behind. There are no accurate figures on how often this occurs," Armstrong said.

One major problem, according to Armstrong, is that medical practitioners are not educated about how to treat the infections and other health problems associated with body piercings in particular. Armstrong says health care providers are important resources for information for those individuals who choose to have body art. "Often health care providers do not agree with what their patients are doing so as far as body art goes, they close their eyes to it. But with more people taking part in the practice, health care providers should become more involved and informed about it so they may be as knowledgeable as possible," she said.

Armstrong discusses a study that was conducted in England of emergency room doctors that found that only four out of 30 doctors knew how to remove the jewelry from a body piercing. "In an emergency situation, if the jewelry is cut, which often happens, then the tissue may be torn," she said.

Also, if a patient presents with an infection around a pierced area, often the doctor's immediate response is to take the jewelry out. "If the jewelry is taken out, the reason for the piercing hasn't been removed, and the individual will pierce again," Armstrong said. "The person needs to be informed about proper cleansing in order to avoid an infection if they pierce again."

Armstrong said of the commonly pierced body parts, navel piercings get infected most often at a 45 percent infection rate.

The reason for this, Armstrong said, is the location of the piercing. "The navel area is moist and warm and can be easily irritated by things rubbing against it, like a belt," she said.

Several problems are associated with tongue piercings. Among these are chipped or cracked teeth, nerve damage and aspiration, or withdrawal of the jewelry by fluids or gases from the body. Something known as 'wrecking ball syndrome' also may occur which refers to the constant motion of the ball on the tongue hitting against the teeth. In the case of tongue piercings, Armstrong said dentists should be informed about proper care and treatment of tongue and mouth piercings.

Body piercings can develop systemic infections requiring hospitalization. For example, infections from nose piercings can get into the sinus tracts and then the blood stream. This has caused at least one heart infection.

Armstrong said problems are associated with each type of piercing, so the individual needs to be informed about the risks and learn how to take care of health issues.

Many risks also are associated with the establishments where body piercings and tattoos are administered. According to Armstrong, consumers should consider four factors when searching for a tattoo parlor. The first thing the individual should check out is the artist who will be administering the tattoo or body piercing.

"Because the artist does not have to be certified and there are no educational regulations, the individual consumer should at least make sure the artist is reputable," Armstrong said.

Another consideration that should be investigated is the equipment that will be used to administer the tattoo or piercing. Armstrong says consumers should make sure the equipment is sterilized before each use.

The environment of the tattoo parlor also should be observed carefully. "The tattooing or body piercing procedure is invasive where open wounds are created so the consumer should be certain there are not dogs, fish, kids, beer, etc., in the same environment in which a tattoo or piercing is being administered," Armstrong said.

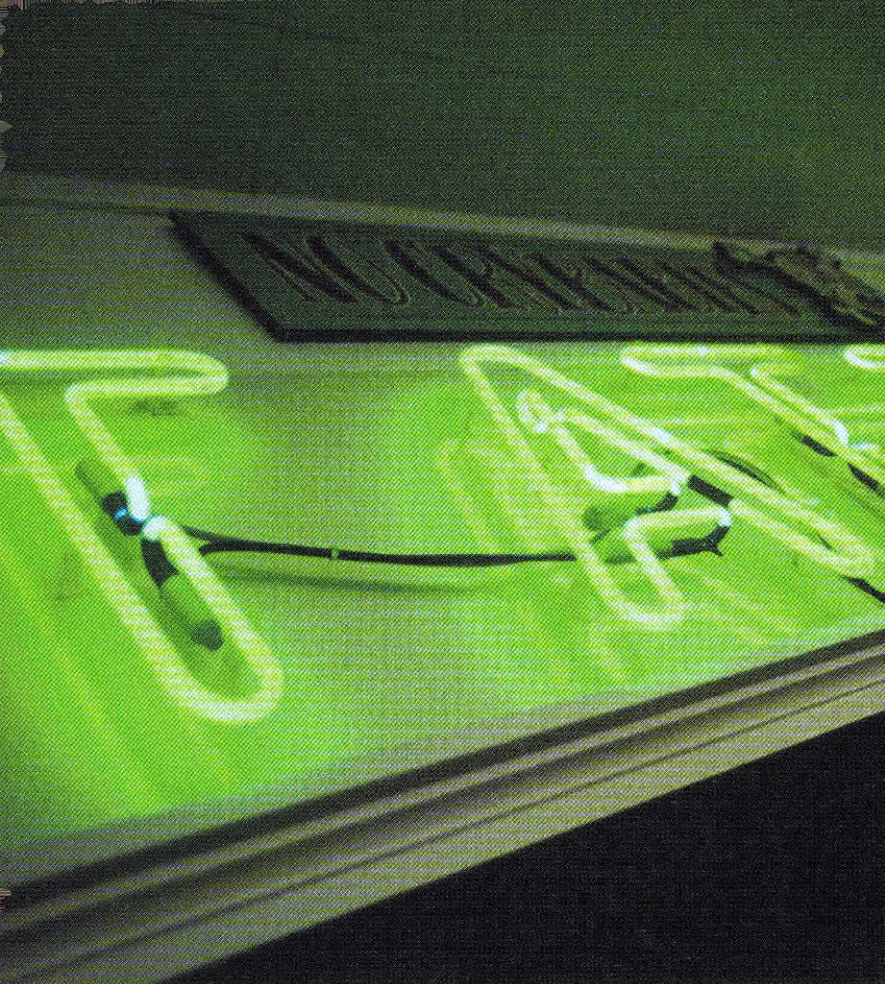
Finally, the individual consumer should observe whether the tattoo parlor has a regulatory atmosphere. The overall environment should appear clean and sterile. The person administering the tattoo or piercing should be clean as well. Armstrong says individuals should watch the artist when he or she administers the piercing or tattoo on someone else and watch the technique with which it is carried out.

Armstrong said the artist also should be wearing gloves. "The artist should be wearing sterile gloves for clinical purposes. Watch them and make sure they don't wear them and scratch their head or answer the telephone with them on. They should wear a fresh pair for every client they see," she said.

Armstrong also encourages adolescents to take their parents with them when observing a tattoo parlor. She said if the parents are not involved in the decision, the adolescent will find a way to carry out their wishes or they will do it themselves. Armstrong has heard of people getting tattoos and piercings at such places as in mobile vans, in cars and at sorority or fraternity parties.

Among possible diseases that may be contracted from either





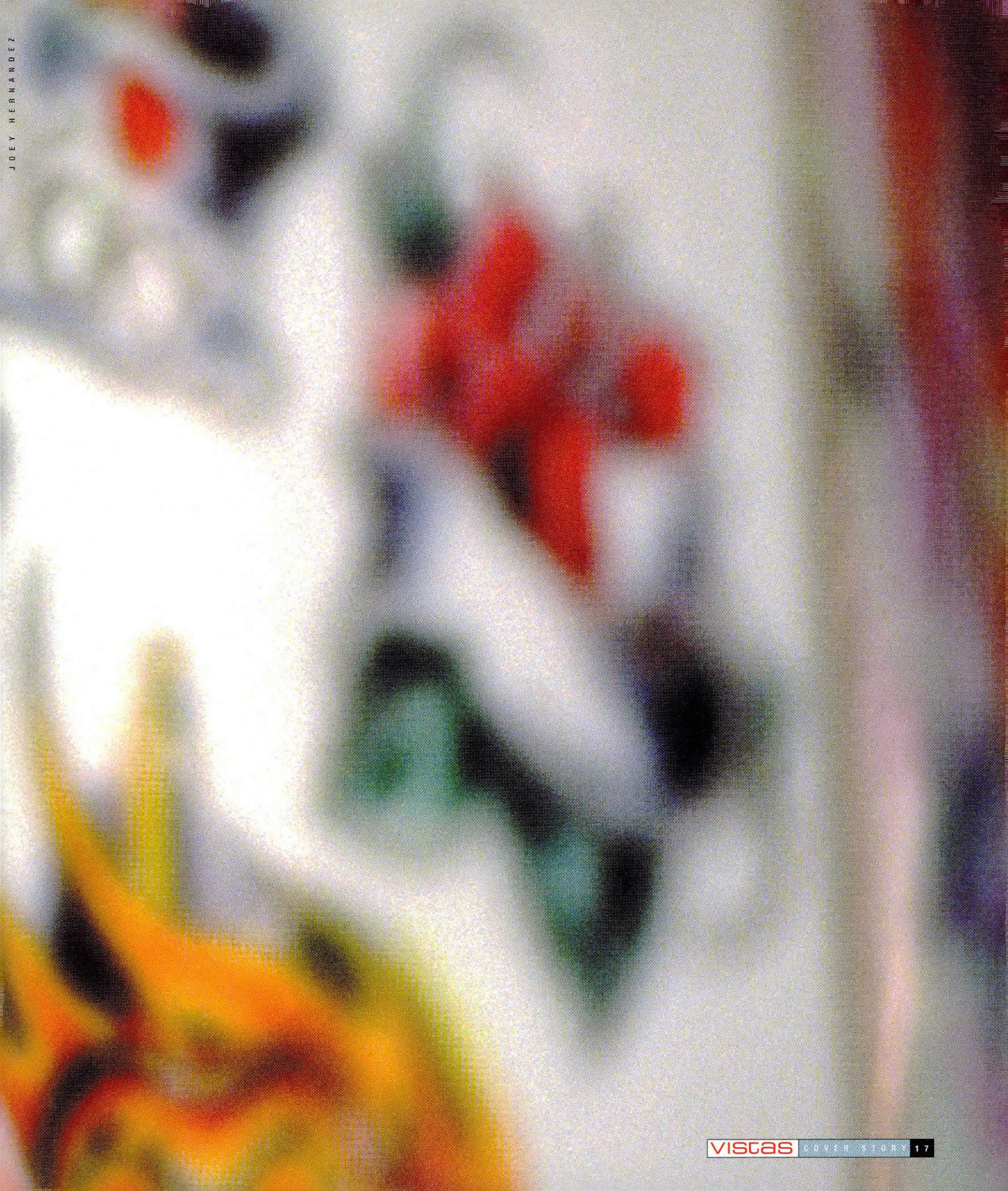
WHAT WAS ONCE CONSIDERED A PRACTICE OF BIKERS, SAILORS AND REBELLIOUS TEENAGERS HAS NOW ENTERED INTO GENERAL SOCIETY.



ARMSTRONG ADVISES THAT INDIVIDUALS SHOULD WATCH THE TATTOO OR PIERCING ARTIST BEFORE MAKING A DECISION ABOUT ONE'S OWN BODY ART. THESE ONLOOKERS WATCH WHILE A FRIEND HAS HER NAVEL PIERCED AT INFLUENCE IN LUBBOCK.

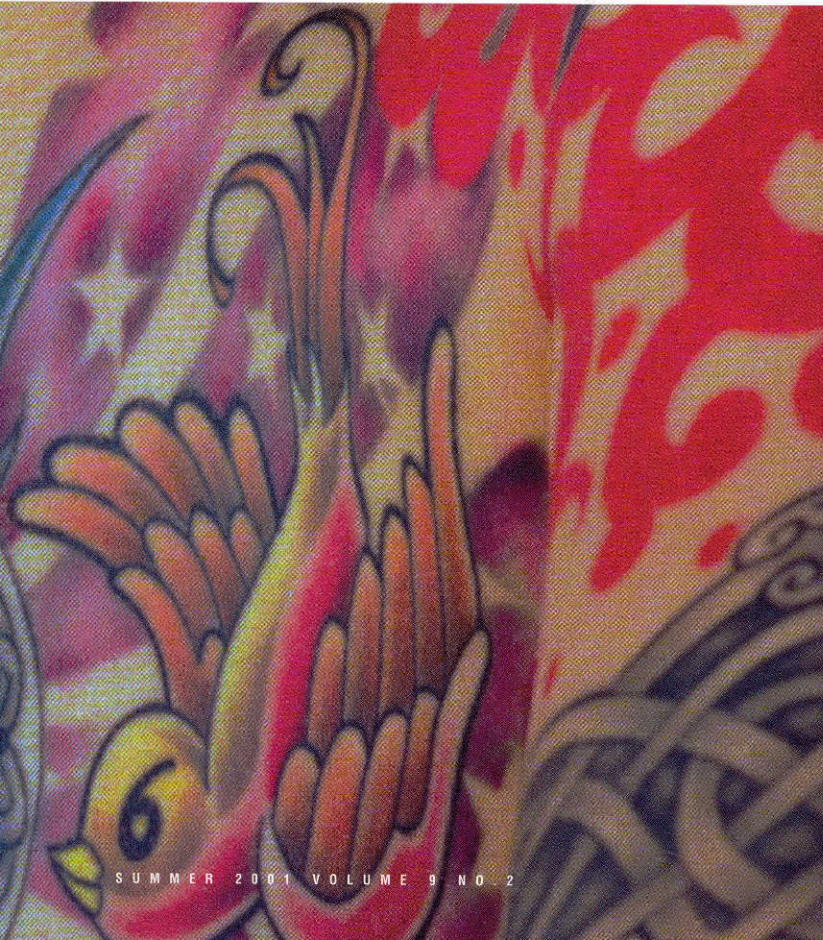








“BOTH TYPES OF BODY ART—PIERCINGS AND TATTOOS—PROVIDE AN INTERNAL MEANING TO THOSE WHO CHOOSE TO GET THEM.”



the tattoo artist or the equipment, Hepatitis B is the biggest immunized against the disease, and a large segment of the population doesn't have the immunization either," she said.

"Hepatitis B is a threat because there only needs to be a minute amount of infected blood and the virus can live outside the body for two to three months. If infected blood happens to get on a counter or telephone, then the risk is there," she said.

The disease takes two to three months to surface after a person is infected. Hepatitis B is more diagnosable than Hepatitis C and is a chronic condition that in some cases can cause cancer of the liver.

Although many may worry about the chances of contracting HIV from tattoo parlors, Armstrong says that overall, the risk is pretty questionable because the HIV organism cannot live outside the body for any length of time.

Besides tattoo parlors, many people seek body piercings from kiosks and businesses at shopping malls. Armstrong said generally the piercers in these establishments are unqualified to be doing piercings. "They often do not properly inform their clients about proper care of the piercing, and then infections can develop, some of which can lead to disfigurement, the earring becoming embedded.

"In this case, the individual should shop around and observe the procedure on others and see how it is carried out. At tattoo studios, the employees are more likely to know what they are doing, but it is still important to use a reputable artist," she said.

What may have seemed like a good idea at the time for some people, many live to regret having their body permanently tattooed and then may seek out ways to have their tattoo removed. One problem with tattoo removal is the cost. "The tattoo may have originally cost \$35 to \$50, but it costs at least \$1,000 to have it removed, and it is not covered by insurance," Armstrong said.

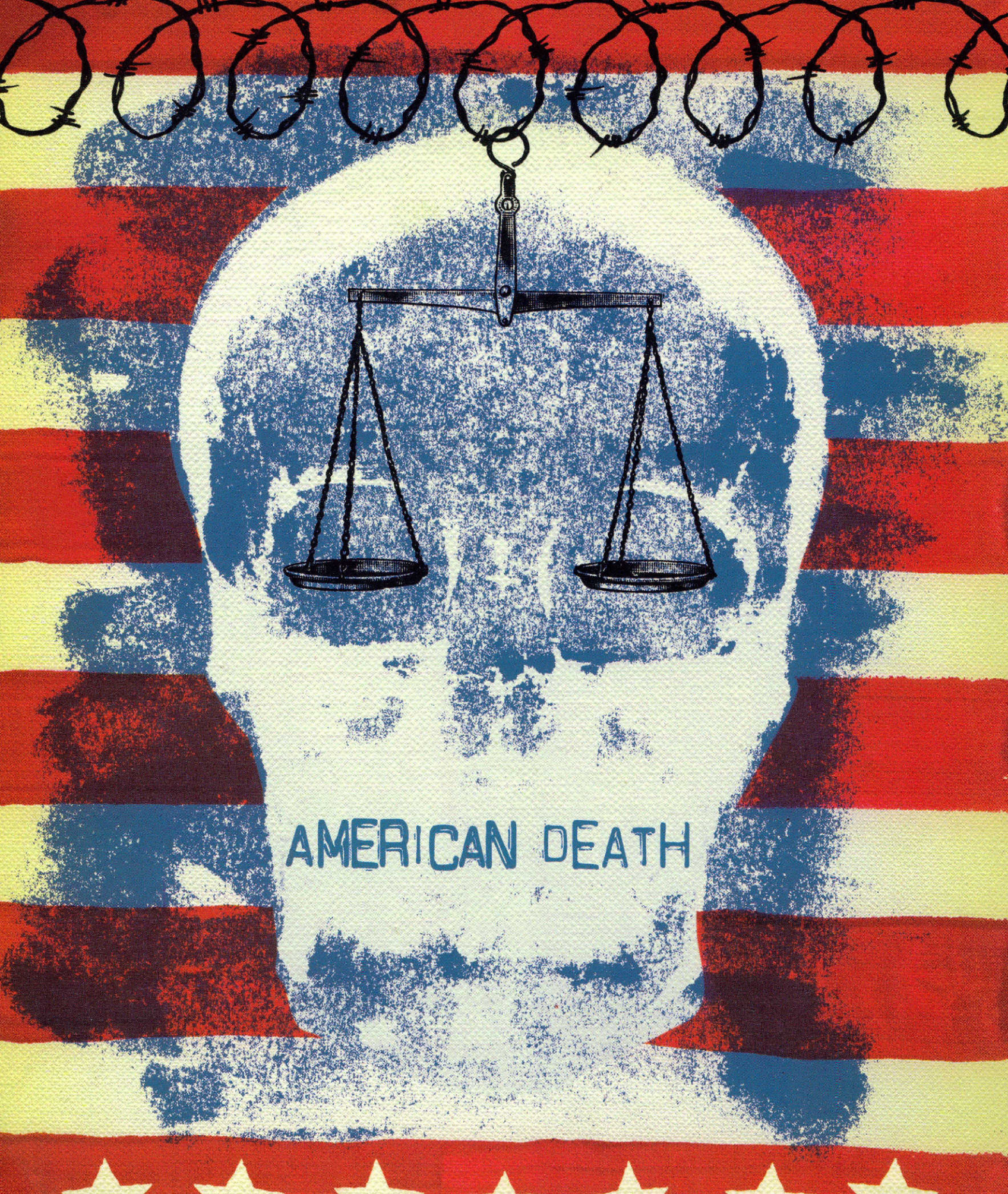
Besides the expense, the procedure, done by laser, is also painful and is not guaranteed to remove the tattoo entirely.

"The only color that can be 100 percent removed is black ink. If a physician guarantees the successful removal of a tattoo, then be careful," she said. Having a tattoo removed takes between five and 10 months, and often people get discouraged, and the process is painful. "The laser feels like a rubber band snapping against your skin repeatedly. The older the tattoo, the easier the mark can be removed. The newer the tattoo is, the harder it is to break up the pigment," Armstrong said.

Incorporated into advertising, television and seen on everyone, including women and those in the corporate workforce, body art has become part of American culture.

"Body art is not just for the 13- to 25-year-old set anymore. It's everywhere. And as body piercing becomes more traditional, it becomes more creative. And tattooing is here to stay," Armstrong said. "Consumers need to be informed before they take the plunge into body art. They must be aware of the health risks, and know the ways to avoid them." ←

EDITOR'S NOTE: VISTAS WISHES TO THANK THE STAFF AT INFLUENCE IN LUBBOCK FOR THEIR COOPERATION IN PHOTOGRAPHING TATTOOS, PIERCINGS AND BODY ART AND PROVIDING MODELS AND VISUALS FOR THIS ARTICLE.



AMERICAN DEATH

## TIMOTHY J. FLOYD J.D. - ILLUSTRATION BY DIRK FOWLER

The death penalty is an increasingly significant issue in American public life. The year 2000 saw the state of Texas set a record for executions by one state in a year. The federal government is now sentencing people to death and is set to resume executions for the first time in nearly 40 years. There are more people on death row nationally than in any time in our history.

Yet, at the same time, an increasing number of voices have expressed reservations about the death penalty. Gov. George Ryan of Illinois has declared a moratorium on executions in his state, citing concerns about the number of innocent persons who had been wrongfully sentenced to death. Conservative commentators such as George Will and Pat Robertson have expressed doubts about the death penalty in this country.

In such a climate, all citizens have an obligation to think through their position on the death penalty. But if we are going to deliberate moral justifications for the death penalty, we mustn't stop with determining whether capital punishment is morally justifiable in the abstract, or whether the death penalty can ever be justified. If we wish to think seriously about the death penalty in America at the turn of the millennium, we must analyze the death penalty as it actually exists and is carried out today.

Although many express support for the death penalty on the grounds of deterrence, there is no reliable evidence that the death penalty prevents murder. In

fact, the states without the death penalty have markedly lower murder rates than do states with the death penalty. Instead, the death penalty today is more often justified upon retribution grounds: that some persons commit such heinous acts that the only just response is to take their life. The modern American death penalty is designed to select the worst of the worst—the most depraved murderers who commit the most heinous crimes—for society's ultimate punishment.

How well are we doing in this task? Unfortunately, the death penalty in America today is not necessarily imposed upon those who commit the worst crimes.

Lawyers who lack the skills, resources and commitment to handle such serious matters often defend poor people accused of capital crimes. There are numerous cases in which the poor were defended by lawyers who lacked even the most rudimentary knowledge, resources and capabilities needed for the defense of a capital case. Death sentences have been imposed in cases in which defense lawyers had not even read the state's death penalty statute, referred to their clients by a racial slur, were intoxicated during trial, or slept through part of the trial. Since 1973, in large part because of inadequate representation at trial, 93 people have been freed from death row after proof surfaced that the defendant was actually innocent of the crime.

But there is another disturbing failure in our death penalty system. Studies reveal an overwhelming body of evidence that

race plays a decisive role in the question of who lives and dies by execution in this country. Race influences which cases are chosen for capital prosecution and which prosecutors are allowed to make those decisions. Likewise, race affects the makeup of the juries that determine the sentence. Racial effects have been shown not just in isolated instances, but in virtually every state and over an extensive period of time.

The federal government will soon resume executions after a 40-year hiatus in federal executions. A study conducted by the U.S. Department of Justice at the request of President Clinton was released on Sept. 12, 2000. The report revealed that 80 percent of the cases submitted by federal prosecutors for death penalty review in the past five years have involved racial minorities as defendants. In more than half of those cases, the defendant was African-American. Of the 24 people on the new federal death row, only three are white. Yet racial minorities commit fewer than half of the homicides in this country.

We may never agree as to whether the death penalty is justifiable in the abstract or as a matter of principle. But surely we can agree that a death penalty system in which persons are chosen for execution based upon the quality of their lawyers or upon the color of skin falls far short of our ideal of "Equal Justice Under Law." ←

TIMOTHY J. FLOYD IS THE J. HADLEY EDGAR PROFESSOR OF LAW AT TEXAS TECH UNIVERSITY'S SCHOOL OF LAW AND SERVED AS DEFENSE COUNSEL IN THE FIRST CASE IN THE NATION UNDER THE FEDERAL DEATH PENALTY ACT OF 1994. THE CASE WAS ARGUED BEFORE THE UNITED STATES SUPREME COURT IN FEBRUARY 1999.







# From wasteland to promisedland

There is a saying that *what is one person's trash is another person's treasure*. That's the premise of researchers from Texas Tech University and the Texas Cooperative Fish and Wildlife Research Unit who are developing a system that would turn the wasteland of cattle feedlots and power plant residue into a promised land of economic development. These scientists have developed a system that integrates these much-maligned modern necessities into basic components of profit centers and energy savers.

BY LESLIE WOODARD | PHOTOS BY JOEY HERNANDEZ



ick Parker, Ph.D., director of the Texas Cooperative Fish and Wildlife Research Unit,

and an adjunct professor of biology and of range, wildlife and fisheries management at Texas Tech, and Clifford Fedler, Ph.D., a professor of civil engineering, have been building and studying an aquaculture system since 1989. Parker and Fedler have developed a non-mechanical, gravity-flowing purification system for livestock waste. A series of recycling ponds takes in livestock waste, separates liquids and solids and filters wastewater before it flows to an area playa lake that feeds the Ogallala Aquifer, a natural underground water source for much of the Great Plains.

Groundwater below some feedlots contains high nitrogen levels, according to High Plains Underground Water Conservation District tests. As cattle manure lies on the ground, the waste naturally separates into liquid and solid components, and the liquid can infiltrate into the underground water supply.

"The nitrites and nitrates found in contaminated water are a human health risk because they combine with hemoglobin and prevent the carrying of oxygen. If nitrogen from the waste water filtrates into the groundwater, then we could have a public health risk," Parker said, explaining the need for such a purification system.

In the natural process of water purification, microorganisms as well as plant and animal life remove nitrogen and other unwanted nutrients. In fact, the various life forms in each recycling pond of the Fedler and Parker system, further purify the wastewater,

making it suitable for the life forms in the next pond. The wastewater, now with nutrient levels safe for human consumption, returns to playa lakes and ultimately seeps into the Ogallala Aquifer.

Parker says their recent tests have included monitoring a number of fish species in the ponds to see if the fish would live in certain water conditions. They measure the growth rate of the fish; water quality including amount of ammonia, nitrites and nitrates present and other water quality concerns.

In the first pond, algae is grown and harvested to remove some of the nitrogen from the water. "In addition to reducing nitrogen levels, algae also are used as the basis for some pharmaceutical products. Suddenly the nitrogen liability has become an algae asset," Parker said.

As the waste products are "digested" in the first pond, energy is released in the first pond in the form of biogas, which is methane with about 40 percent carbon dioxide. Parker and Fedler designed a greenhouse-type bubble to capture the biogas. By capturing the carbon dioxide from the initial stages of digestion that normally would be going into the atmosphere, a livestock producer can use the carbon dioxide to enhance the growth of economically valuable plants.

In addition to algae, other plants that thrive from water treated in the first pond are duckweed and water lilies. Duckweed

is the world's smallest flowering plant and floats on the surface of the water. It would be found in open playa lakes except the region's wind blows it to the edge of the pond. It is found in playas where plants such as cattails protect it from the wind. With a pond protected by a greenhouse-type cover, a producer simply skims the duckweed off the surface of the water.

Some of the most recent research by the Fedler and Parker team has studied the inclusion of duckweed into the diets of cattle, swine and sheep, in place of soy meal. Duckweed is about 40 percent protein and mixes well into the feed. The studies show the animals whose diets included the duckweed perform better than the group of animals who only had the soy meal as an additive. "Soy is a processed grain, whereas duckweed is a whole and complete plant material containing natural nutrient elements and vitamins," Parker said.

From the wastewater treatment system demonstration unit in place at the Texas Tech farm in New Deal, Fedler calculated that the amount of duckweed they are producing from that feedlot and treatment system can supply 11 percent of the protein needed by the cattle housed there. "Even in the cases of the swine and sheep, which we haven't finished the numbers on, the diet with the duckweed proved to be as good or better than the normal diet," Fedler said. "So if we can achieve the same quality of feed, by producing less expensive feed, recycling the wastewater and producing aquatic plants, this additive would be much more cost effective and take care of the waste problem at the same time."

Translated into human terms, Parker says you can find items in health food stores, such as algae, which are in capsule form or powder, that people are adding to their diets for better performance. Duckweed is just one example of a product that can be grown in this system that has high value. There are similar possibilities with other aquatic plants.

"A four-inch pot of some ornamental water lilies might sell for as much as \$70. We have producers in Texas that export water lilies around the world," Parker said. "Why couldn't West Texas producers do the same? These are the kinds of value-added products a cattle producer might create from this wastewater system," Parker said.

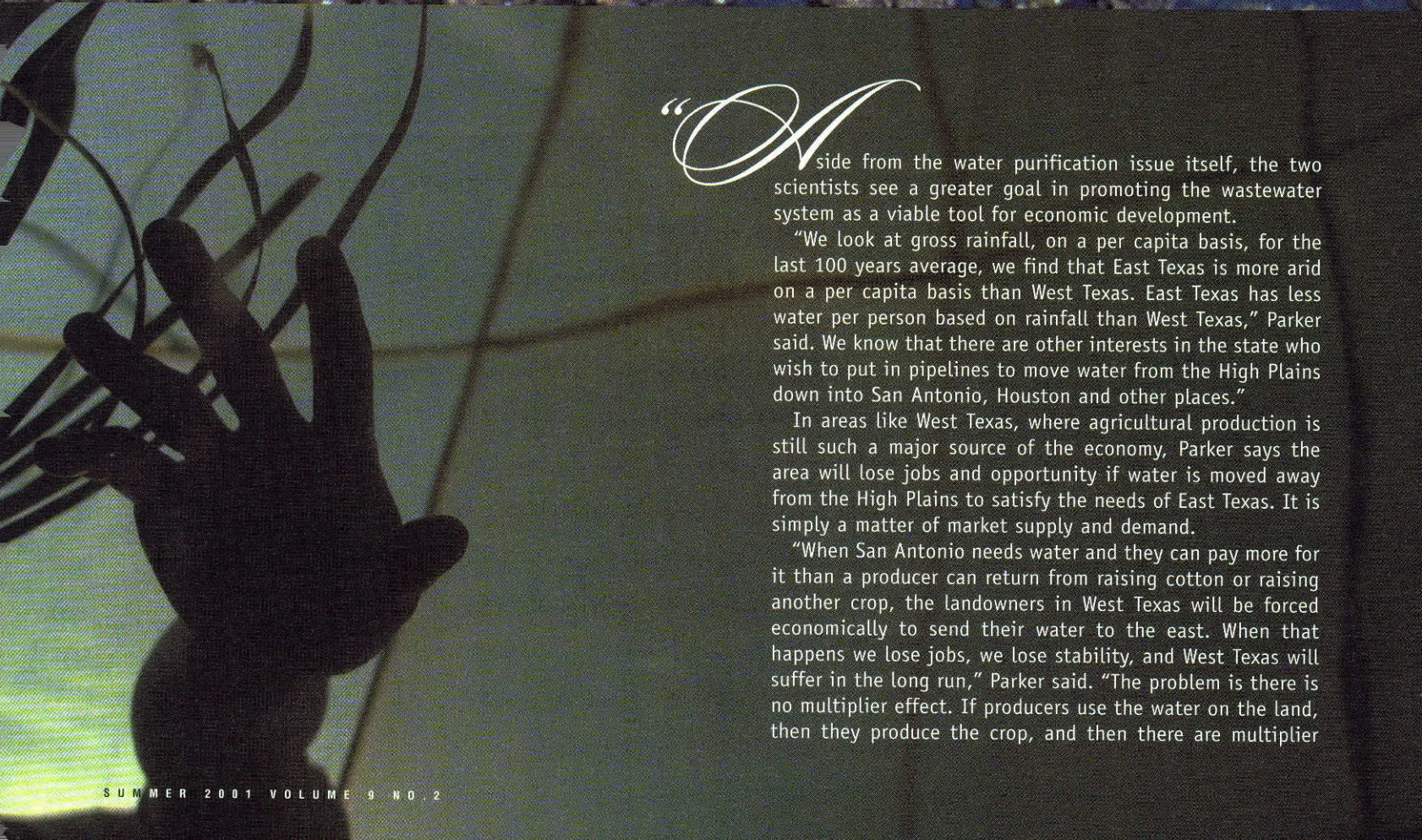
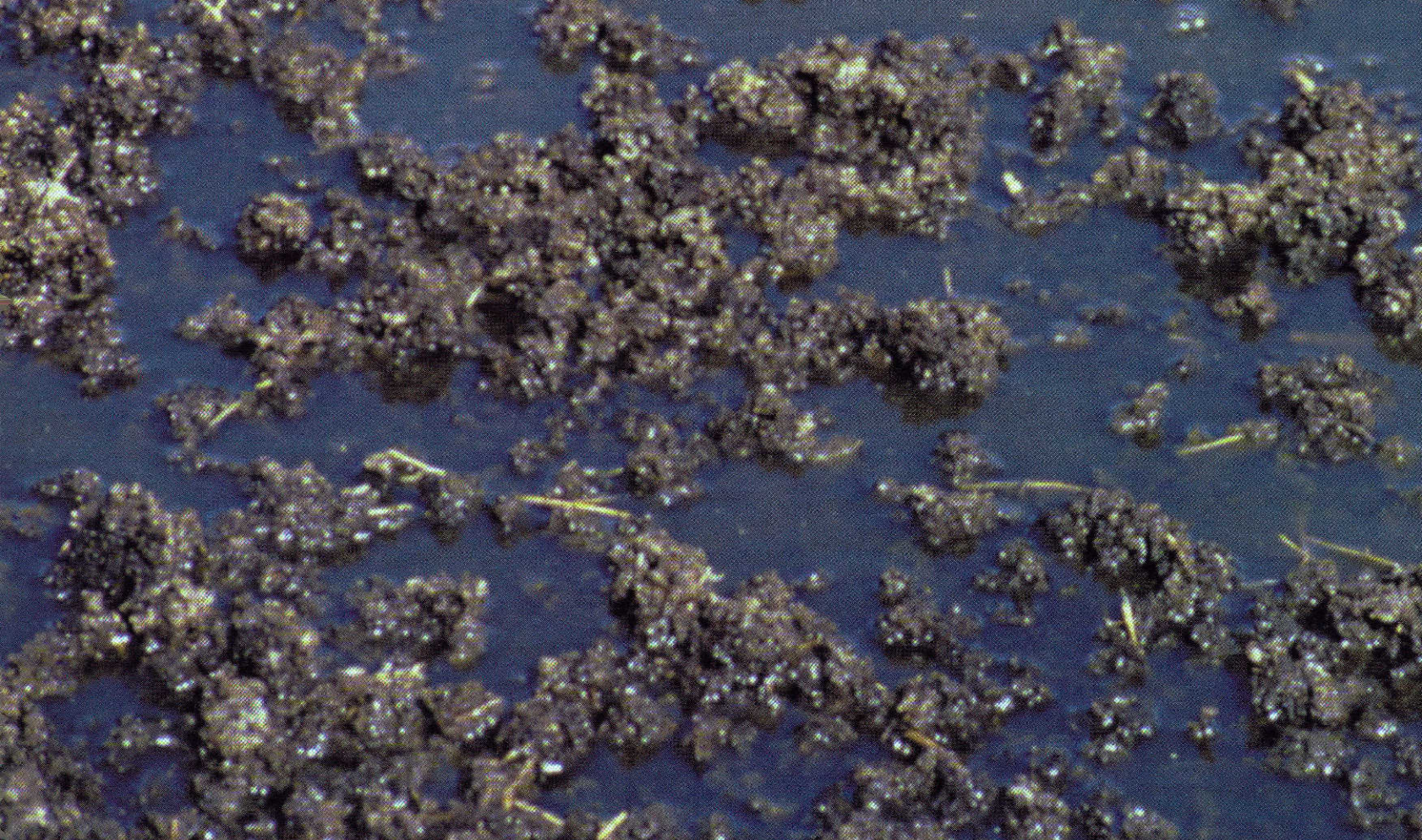
The economic benefit of combining aquaculture and agriculture is one issue that convinced the Environmental Protection Agency to fund Fedler and Parker's initial research. Since the original project began, Texas Tech's Integrated Wastewater Treatment and Aquaculture Production venture has received funding from national, state, local and industry sources.

Fedler's and Parker's research team has spent the last several years refining the operation of the system itself, but also finding viable ways to make the system work to producers' economic advantage.

"The most significant thing we've learned in the past few years is that it is economically feasible to recycle water and produce products of high value, while being environmentally and ecologically sound, rather than polluting surface water or the aquifer," Parker said.

*"It is economically feasible to recycle water and produce products of high value."*





“Aside from the water purification issue itself, the two scientists see a greater goal in promoting the wastewater system as a viable tool for economic development.

“We look at gross rainfall, on a per capita basis, for the last 100 years average, we find that East Texas is more arid on a per capita basis than West Texas. East Texas has less water per person based on rainfall than West Texas,” Parker said. We know that there are other interests in the state who wish to put in pipelines to move water from the High Plains down into San Antonio, Houston and other places.”

In areas like West Texas, where agricultural production is still such a major source of the economy, Parker says the area will lose jobs and opportunity if water is moved away from the High Plains to satisfy the needs of East Texas. It is simply a matter of market supply and demand.

“When San Antonio needs water and they can pay more for it than a producer can return from raising cotton or raising another crop, the landowners in West Texas will be forced economically to send their water to the east. When that happens we lose jobs, we lose stability, and West Texas will suffer in the long run,” Parker said. “The problem is there is no multiplier effect. If producers use the water on the land, then they produce the crop, and then there are multiplier

effects with related business, like tractor sales and fertilizer and processing and all these other things.

"It is not enough to use water, but we have to reuse water. Every time you reuse it, you create another set of opportunities and more economic return, so you need to be able to link those into every gallon of water that is pumped and used for something."

Parker uses greenhouses as an example. With the recent change in the price of natural gas, Parker said, it seems unlikely that greenhouses using natural gas as a heat source are going to remain very competitive in northern parts of the state, compared to those that might be placed further south, where they would have to have fewer days of electricity.

"That opens up an opportunity, that we could use that biogas, which would be generated from the manure from the feed lots, and also use the heat generated by compost piles," Parker said. "Compost piles operate at about 160 degrees, so you simply capture that heat and put it back into greenhouses."

Parker reiterated the idea that there are a number of products being produced in greenhouses that have high value; so rather than raising crops in these greenhouses, which sell for pennies a pound, one might produce crops that sell for dollars per ounce. He said there are people who are producing chives in greenhouses, and shipping them all over the United States. Many people and companies are producing other high-value vegetable products as well as ornamental products.

"I've visited some sites in Israel where they're extracting the red color pigment from peppers, which is then sent to the United States. That extract becomes a very high-value product to use as a natural food-coloring agent. So they're growing peppers, but they're not selling peppers themselves. They're selling something derived from peppers," Parker said.

So, Parker says, if high-value products can be produced, which they have proven, then a chain of jobs is created, not only by producing, but extracting, packaging and taking a product to market.

"What we're proposing is recycling some of our water, some of our organic waste, and putting it back into greenhouses and providing the heat, the water and the nutrients. Today greenhouses are sitting out there, independent, and they pay for heat, they buy fertilizer and they're sitting alone," Parker said. "But if we move those greenhouses in with other components, which could be feedlots in the example that Dr. Fedler and I are using, or it could be municipal waste from municipal waste treatment plants, in a case of a municipality that has sludge to handle and waste to treat, then they have a nutrient-rich effluent. So those could be built back into reuse systems to produce high-value products.

"We think that in West Texas we must aggressively pursue this type of development if we're going to be sustainable and have a sustainable future up here, rather than piping all of our water to East Texas, and the jobs going with it," he said.

Now Parker and Fedler are working to market their wastewater purification process as an economic development and energy-saving tool for businesses, which are willing to take a chance on something new. They are receiving help with strategy from Texas Tech's Small Business Development Center. "What we hope to do

is present this to some of the communities around us that have the economic development tax, who are trying to find a way to improve jobs in their region," Parker said. "They're all under the gun by regulators, the EPA being one, to meet certain environmental quality standards for their effluents. So if we can find a way to take this waste, meet those environmental standards while producing something that has value, then we meet their needs in more than one way."

Parker used the example of Pinetop, Ariz., to illustrate his point. Pinetop has a ski resort area. The city was taking the sludge from its municipal wastewater treatment plant and putting it in landfills. When the Environmental Protection Agency strengthened the regulations regarding landfills, the price of landfills went up and the use of landfills became much more restricted. Putting things in landfills that didn't have to go there was economically unsound. Pinetop started combining the sludge from its wastewater municipal treatment plant with its solid waste from garbage trucks, and mixing those things together. When they were finished, they could sell everything that they produced, as a compost to go back into gardens. They could use it within the city and they also would sell it to nurseries and to others.

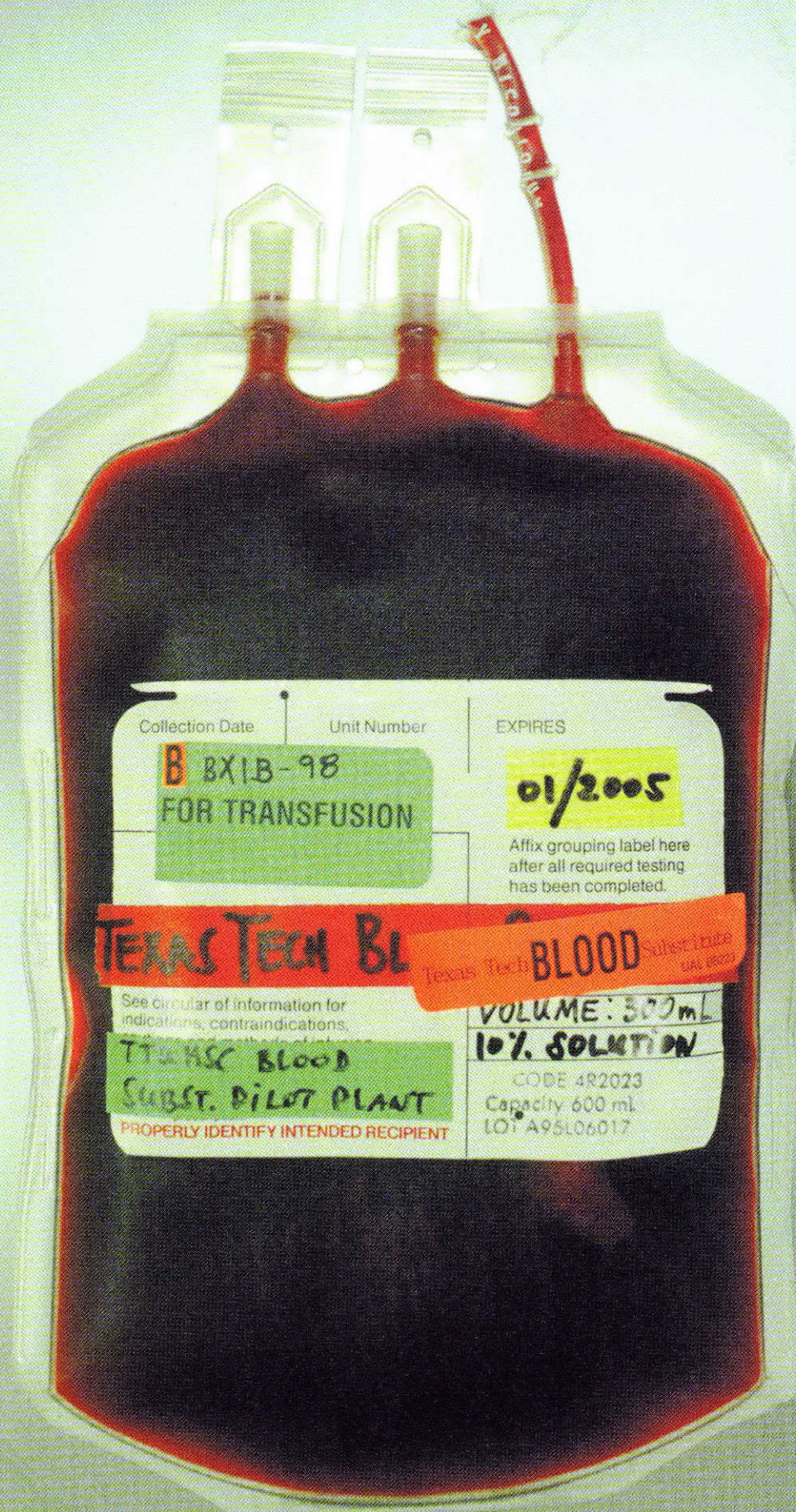
"So now they sell all the stuff – their garbage, along with their sludge," Parker said. "First they were putting it all in landfills, now they're selling it all. They also take the heat from the compost piles and heat their greenhouses. So here's an example of a little city that has done what we're talking about doing. If someone wanted to go there and visit, they could see the system working. Ideally, we need some city to step forward to try our system."

Another answer, said Parker, would be that within this "test" city, if there is an existing cattle feed lot, and it is creating a problem because of environment, or ground water infiltration or nutrient enrichment, something could be done around that site, to use this source and treat it. If such a facility existed and there was land adjacent to it that could be used to locate this system in, that could be accomplished in fairly short order.

"But this would be an add-on system. That is, you're taking an existing facility and adding something to it," Parker explained. "You would not have the highest level of efficiency built into it because you would not have it designed for the flow for it to be as efficient as it could be."

"On the other hand, if you're starting from scratch and a town wants to build something like this to create new jobs, the town might find a site, put in a feedlot, put in all of these components downstream into this agricultural development/research type park, and put them in sequence so that the water flow, the nutrient flow, was all laid out in an efficient manner, rather than having to traffic pipes and wind things around with an add-on system."

The wastewater treatment system developed by Fedler and Parker has been proven effective through their years of research. By convincing cattle producers or municipalities to implement the system, it just might be the answer to taking away wastewater, while keeping the ground water in West Texas. From the wasteland of feedlots, compost piles and power plant effluents, also could come new jobs, new sources of income and a new economic boost. ←



Collection Date

Unit Number

EXPIRES

**B** BX1B-98  
FOR TRANSFUSION

**01/2005**

Affix grouping label here  
after all required testing  
has been completed.

**TEXAS TECH BL**

**TEXAS TECH BLOOD** Substrate  
GAL 48223


See circular of information for  
indications, contraindications,  
and other information.

**TTXSC BLOOD**  
**SUBST. PILOT PLANT**

**VOLUME: 300 mL**  
**10% SOLUTION**

CODE 4R2023  
Capacity 600 ml  
LOT A95L06017

**PROPERLY IDENTIFY INTENDED RECIPIENT**



# SEARCHING FOR {THE SUB}STITUTE

STORY BY MICHAEL SOMMERMEYER AND JULIE TOLAND PHOTOS BY ARTIE LIMMER

CREATING A SUBSTITUTE FOR HUMAN BLOOD HAS BEEN AN ELUSIVE DREAM FOR MANY YEARS. BUT RESEARCHERS AT TEXAS TECH UNIVERSITY HEALTH SCIENCES CENTER HAVE BEEN ABLE TO DO WHAT OTHERS HAVE NOT.



## THE WORLD

HEALTH ORGANIZATION REPORTS THAT 100 MILLION UNITS OF BLOOD PER YEAR ARE NEEDED AROUND THE WORLD. BUT CURRENTLY ONLY 75 MILLION UNITS ARE AVAILABLE. THE UNITED STATES ALONE ANNUALLY USES ABOUT 11 MILLION UNITS AND A SHORTAGE OF 4 MILLION UNITS PER YEAR IS PROJECTED BY THE YEAR 2030. COUPLED WITH THE SHORT SUPPLY IS THE FACT THAT BLOOD CAN ONLY BE STORED FOR 42 DAYS.

The problem only grows more urgent as nations attempt to cope with the high costs of collecting and testing blood for disease. The World Health Organization reports that of the 75 million units of blood collected around the world, only 20 percent are tested for HIV, hepatitis and a host of other diseases. Most testing occurs in the United States, where the implementation of sensitive screening has reduced the risk of infectious disease transmission to 1 in 60,000 blood transfusions for hepatitis B and 1 in 500,000 for HIV, with intermediate transmission rates for hepatitis C and the human T-cell leukemia virus.

The lack of testing occurs mostly in developing and undeveloped nations. For instance, it is reported that India fails to screen 50 percent of its donated blood for disease, and roughly 10 percent of the country's paid donors test HIV-positive. Only 16 of the 35 member states of the Pan American Health Organization screen their blood supplies for hepatitis and the AIDS virus. And the World Health Organization is worried about other emerging risks of blood transfusions: retroviruses, prions of human and animal origin, new viruses such as hepatitis G, tick-borne illnesses and a variety of parasites and bacteria.

In a novel research project that has been under way at Texas Tech Health Sciences Center since 1982, scientists hope to replace blood with an effective, safe and inexpensive fluid that has all the essential properties of red blood cells, but without the diseases and short shelf life. Doctors Mario Feola, M.D., professor of surgery; Jan S. Simoni, DVM, Ph.D., research assistant professor of surgery; and the late Peter C. Canizaro, M.D., former professor and chairman of surgery (1982-1990), have numerous patents for their process which allows for the manufacture of a red cell substitute. Scientists at the Eighth International Symposium on Blood Substitutes in November 2000 recognized the process as one of the best likely solutions to the increasing blood shortage problem.

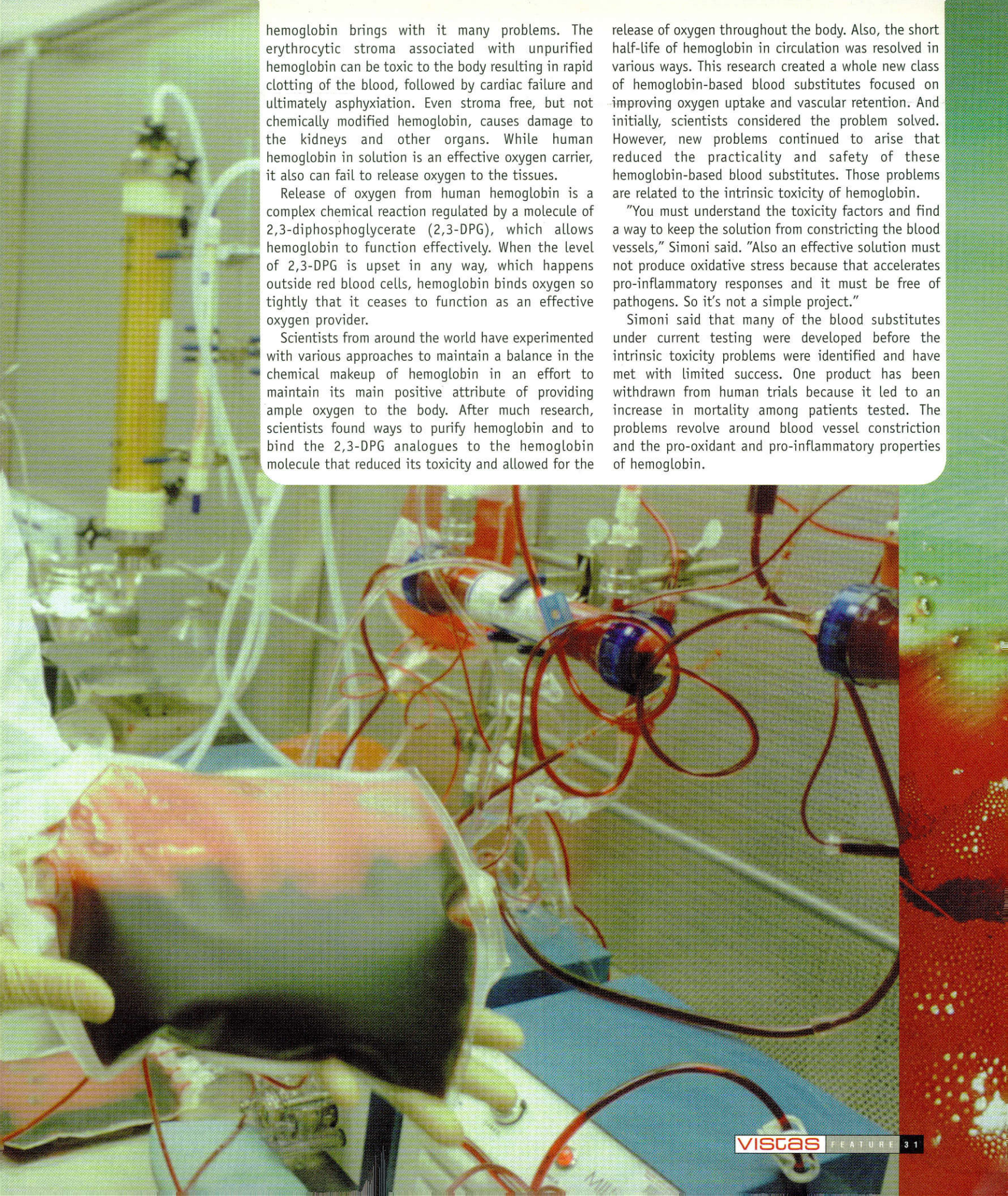
The challenge to create a non-toxic, safe and economical blood substitute has become biotechnology's "holy grail," noted Simoni, a research assistant professor in the Department of Surgery at the health sciences center. He said a universal blood substitute could open significant global markets to a blood substitute that would be pathogen-free and universally compatible with all blood types. Such a product could alter emergency treatment procedures for patients in hemorrhagic shock, prolong the survival time of organs donated for transplantation, improve blood's oxygen carrying capacity to treat life-threatening illnesses such as heart infarcts and strokes, be used in tumor radio sensitization and be used in the treatment of sickle cell anemia and other hematological disorders.

"There is a \$15 billion potential market for the company or research group that develops an oxygen-carrying solution that performs like red blood cells," Simoni said.

The U.S. Army recognized the need for a blood substitute following World War II. The loss of blood among soldiers in combat, coupled with the inability to store blood for long periods of time, convinced the military that a solution needed to be found. Traditionally blood has been used when a patient needs an immediate transfusion. However, such transfusions require cross matching of blood types to ensure that a patient does not suffer a severe hemolytic reaction. This step is very impractical on the battlefield. However, oxygen-carrying properties of hemoglobin in solution make it very attractive as the basis for a blood substitute. For many decades, the U.S. Army was the leading force in searching for an effective substitute for blood. Doctors always saw it as a potential lifesaver for anyone needing an immediate transfusion when there is no time to identify blood type.

Since the 1930s, hemoglobin has been experimentally used as a way to increase blood volume and to transport oxygen throughout the body. While it seems like a simple solution,





hemoglobin brings with it many problems. The erythrocytic stroma associated with unpurified hemoglobin can be toxic to the body resulting in rapid clotting of the blood, followed by cardiac failure and ultimately asphyxiation. Even stroma free, but not chemically modified hemoglobin, causes damage to the kidneys and other organs. While human hemoglobin in solution is an effective oxygen carrier, it also can fail to release oxygen to the tissues.

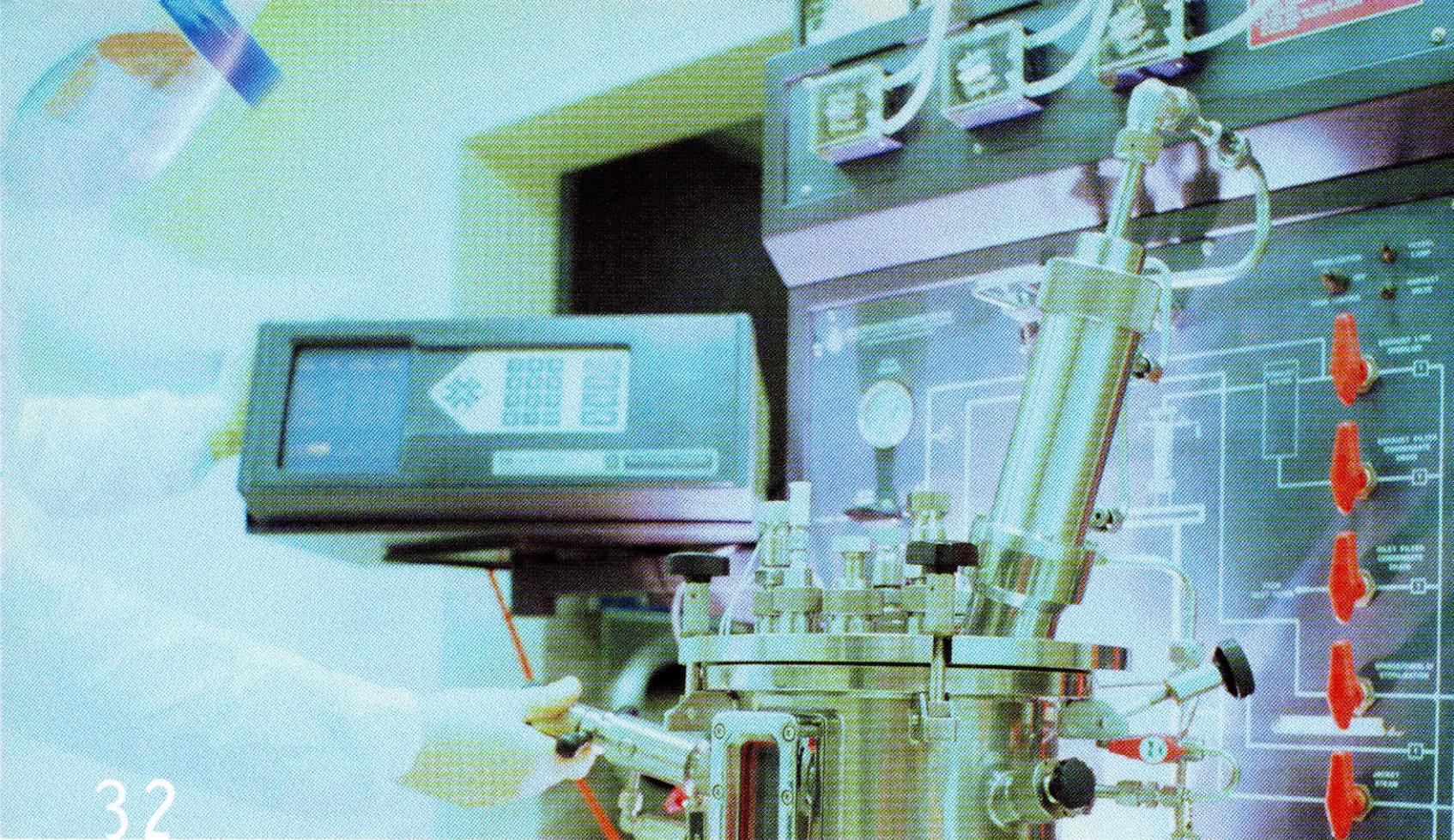
Release of oxygen from human hemoglobin is a complex chemical reaction regulated by a molecule of 2,3-diphosphoglycerate (2,3-DPG), which allows hemoglobin to function effectively. When the level of 2,3-DPG is upset in any way, which happens outside red blood cells, hemoglobin binds oxygen so tightly that it ceases to function as an effective oxygen provider.

Scientists from around the world have experimented with various approaches to maintain a balance in the chemical makeup of hemoglobin in an effort to maintain its main positive attribute of providing ample oxygen to the body. After much research, scientists found ways to purify hemoglobin and to bind the 2,3-DPG analogues to the hemoglobin molecule that reduced its toxicity and allowed for the

release of oxygen throughout the body. Also, the short half-life of hemoglobin in circulation was resolved in various ways. This research created a whole new class of hemoglobin-based blood substitutes focused on improving oxygen uptake and vascular retention. And initially, scientists considered the problem solved. However, new problems continued to arise that reduced the practicality and safety of these hemoglobin-based blood substitutes. Those problems are related to the intrinsic toxicity of hemoglobin.

"You must understand the toxicity factors and find a way to keep the solution from constricting the blood vessels," Simoni said. "Also an effective solution must not produce oxidative stress because that accelerates pro-inflammatory responses and it must be free of pathogens. So it's not a simple project."

Simoni said that many of the blood substitutes under current testing were developed before the intrinsic toxicity problems were identified and have met with limited success. One product has been withdrawn from human trials because it led to an increase in mortality among patients tested. The problems revolve around blood vessel constriction and the pro-oxidant and pro-inflammatory properties of hemoglobin.



**"WE WILL MAKE A DIFFERENCE VERY SOON. BLOOD SUBSTITUTES ARE NO LONGER SCIENCE FICTION. THEY ARE A REALITY AND A NECESSITY."**

The currently tested hemoglobin-based blood substitutes tend to shut down the blood flow in capillaries. While this property helps slow blood loss during a severe cut or hemorrhage, it also prevents blood flow through all tissues in the body when such a blood substitute is used. Another reported disadvantage of solutions under current testing has been the aggravation of oxidative stress and amplification of systemic inflammatory reactions.

"Understanding the limitations of the first generation blood substitutes, some developers have found alternative applications for their existing products, such as treatment of hypotension associated with septic shock, treatment of anemia or a temporary treatment until safe blood could be found. It is clear that such products cannot be used for the treatment of hemorrhagic shock, which is the most important segment of the blood banking industry," Simoni said.

After years of searching, Feola, Simoni and Canizaro have developed a process that makes it possible to create a non-toxic and effective blood substitute product that can be used for the treatment of hemorrhagic shock. The U.S. and international patents awarded to Texas Tech cover the process developed by these university scientists to eliminate hemoglobin toxicity and improve its function as a universal blood substitute. Texas Tech researchers identified the factors that led to toxicity and then developed a purification method that ensures the absolute purity of hemoglobin solutions and a chemical modification method that ensures the lack of toxicity. In addition, the research has led to the development of a blood substitute that has, besides physiological properties of hemoglobin, additional pharmacological activities that effectively

eliminate blood vessel constriction, improve the release of oxygen into the body and produce anti-oxidant and anti-inflammatory effects. The solution is also free of bacterial and viral contaminants. Simoni said that the theoretical basis for their development was in contradiction to the popular theory about blood substitutes, which led others to design an ineffective, even toxic product. "What we have learned is that free hemoglobin-based blood substitutes can no longer be considered inert 'vehicles' for transporting oxygen and carbon dioxide, but they should possess pharmacological properties which can diminish intrinsic toxic effects of hemoglobin and will help eliminate the pathological reactions associated with hemorrhagic shock. Our developed cross-linking agents used in the hemoglobin chemical modification procedure possess these pharmacological properties," he said.

"We have shown that this blood substitute is safe and effective when tested in both animals and humans," Simoni continued. "The effect of the Texas Tech blood substitute was investigated 'in house' in a collaboration with many Texas Tech University Health Sciences Center faculty members. Now, research on its therapeutic effect at the molecular level is studied together with Feola, John Griswold, M.D., chairperson of the Department of Surgery, and Donald Wesson, M.D., chairperson of the Department of Internal Medicine. This product also was tested by independent laboratories in the United States, Europe and Africa and did very well," Simoni said.

The Texas Tech blood substitute is a complex fluid composed of purified bovine hemoglobin, cross-linked intramolecularly with o-adenosine triphosphate (o-ATP) and intermolecularly with o-

adenosine and combined with reduced glutathione (GSH). The patented hemoglobin solution contains physiological properties of hemoglobin and pharmacological properties of ATP, adenosine and GSH that improve blood volume and tissue oxygenation, produce vasodilatory effects and reduce the vasoconstriction that follows hemorrhage, and stimulate the bone marrow to rapidly reproduce natural blood elements. In addition, the blood substitute has anti-oxidant and anti-inflammatory properties and doesn't result in any toxic reactions. All of these elements work together to create a blood substitute that is possibly the perfect resuscitative fluid for the treatment of acute blood loss, Simoni said.

The scientists chose bovine hemoglobin because it is similar in its molecular structure to human hemoglobin and is a better oxygen carrier than human hemoglobin. The bovine hemoglobin affinity for oxygen is regulated by chlorides rather than 2,3-DPG, as in human hemoglobin. It does not have to be chemically modified with 2,3-DPG analogues in order to unload oxygen. "This initially controversial idea, proposed in the early '80s by Dr. Feola, now has wide acceptance in the blood substitute industry," Simoni said.

The substitute also is not susceptible to certain diseases, such as AIDS or hepatitis, which can be transported by human blood, and there is a large-scale availability of bovine erythrocytes. While the recent question of whether human blood can transmit Creutzfeldt's-Jacob's disease or its bovine variant is still under study, Simoni said the use of bovine hemoglobin provides a dramatic improvement in blood safety.

"Blood-borne diseases could be avoided by collecting red blood cells from selected healthy cattle. There are plenty of methods to screen bovine blood for prion proteins, which are known to cause mad cow disease (Bovine Spongiform Encephalopathy, BSE). Besides, the developed process might remove the prion proteins from the hemoglobin solution. Texas Tech's hemoglobin chemical modification procedure also can be applied to different types of hemoglobin, such as human, pig or recombinant.

Located in a clean room in the Department of Surgery at the health sciences center is the Blood Substitute Pilot Plant, a working laboratory where the techniques and processes to develop the blood substitute were invented. A blood centrifuge, separation machines, filtration and chromatographic equipment, sanitary pumps, stainless steel sterile vessels and a bioreactor allow the scientists to create small batches of the blood substitute. The facility can produce pure, unmodified and chemically modified hemoglobin solutions in batches of 20 units each, a small amount when compared with the worldwide need of 100 million units. To address this volume, Simoni said that researchers are in the process of finding a way to upscale their blood substitute production. Texas Tech's blood substitute must still be approved for human trials in the United States, and from there, development of the process into a commercial product will require the construction of a facility capable of producing hundreds or thousands of units of the

blood substitute. This next step will require additional funding and support.

"I'm excited about it," said H. Walter Haeussler, Texas Tech's director of technology transfer and intellectual property. "It's significant research and an important contribution to the pharmaceutical industry. However, it's also living proof that if you build a better mousetrap, folks will not beat down a path to your door to embrace it."

Haeussler said that unfortunately only a handful of pharmaceutical companies are considering blood substitute research, and each has its own project under way. This makes it difficult to bring the Texas Tech product to market without a sizable investment from an interested company. He anticipates that it would take upwards of \$500 million and as long as 10 years to develop the blood substitute and take it through the human trials required for approval by the Food and Drug Administration.

Haeussler, who over his career has helped bring hundreds of university-developed products to the marketplace through start-up companies, said it is a multi-stage process and he is actively working to help fund the first stage.

"It's important to have all the right elements in place, and then we can move forward to begin funding human trials and producing this blood substitute in larger quantities," Haeussler said.

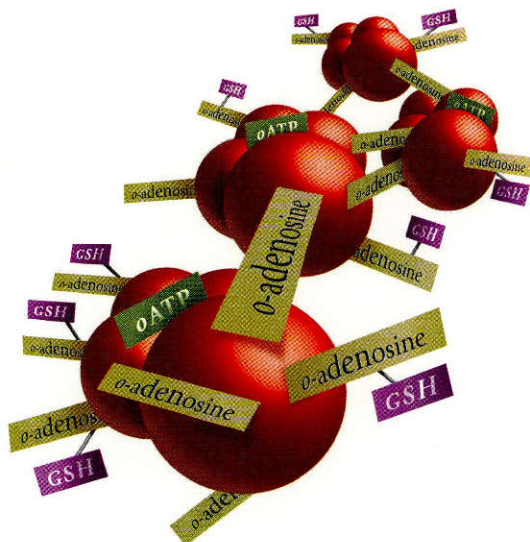
A small company, intent on producing small amounts of the blood substitute and conducting human trials, would cost around \$15 million to start, according to Haeussler. This would initiate the project and allow the university to begin the process of proving the effectiveness and safety of the product. Haeussler said eventually

a larger pharmaceutical company might invest in the project, especially if Texas Tech can prove it has a commercially and medically acceptable product.

"Once trials begin, it is easier to show a track record of success, which then makes it hard for an established company to ignore," Haeussler said. From there, a larger company might invest in the Texas Tech firm or agree to purchase it and develop the product.

In the meantime, Simoni continues to present papers and showcase the success Texas Tech has had in developing its blood substitute. He says eventually the years of research, testing and refining will provide the world with a safe blood substitute.

"It will be rewarding when we can eliminate the shortages of blood in the world by providing an effective and inexpensive blood substitute that could save millions of people every year. I'm very proud that Texas Tech and Lubbock will have made such a great contribution to this important medical field," Simoni said. "I'm very hopeful that we will make a difference very soon. Blood substitutes are no longer science fiction, they are a reality and a necessity." ←





S P A C E  
age  
T E R R A F I R M A

STORY josh murray PHOTOS artie limmer and melissa goodlett



## CAN YOU IMAGINE

the life of an astronaut in space? Now imagine living without fresh vegetables for many months at a time. Can you imagine living in the balmy region of South Texas? Now imagine living in one of the colonias near the United States and Mexico border, where people live without basic water and sewer systems, paved roads or safe housing. These two lifestyles, a NASA astronaut and a colonias resident, could not be more opposite, and yet they share a common need for two of the human body's necessities—fresh water and fresh vegetables. Texas Tech researchers with the Center for Space Sciences are helping NASA astronauts—who at one end of the spectrum have tremendous technology—and the

colonias residents—who have very little comforts of the modern technological world.

For years now, NASA astronauts have pushed the limits of space exploration. They have gone faster and further into space, and in the future astronauts will be looking at extended-stay planetary missions. Surrounded by tremendous amounts of technology that provide for almost their every need, the astronauts still long for fresh vegetables during those extended missions. And along the Texas and Mexico border, more than 340,000 Texas residents live unsafely in colonias, the Spanish word for neighborhood or community.

The technology for delivering both fresh vegetables and clean water is available, and both institutions, Texas Tech and NASA, plan to deliver fresh onions to astronauts and clean water to the South Texans. However complex it may seem, all of the researchers conclude that this project is about delivering optimum conditions for a healthy life.

The Texas Tech Center for Space Sciences headed by James L. Smith, Ph.D., senior associate dean in the College of Engineering, said this joint effort with NASA's Johnson Space Center in Houston will enter into the second year of study in the fall of 2001.

"NASA came to Texas Tech because they wanted a presence in West Texas and they wanted to utilize the strengths of the university, especially in engineering, agriculture and science," Smith said. Ellen Peffley, Ph.D., associate professor of plant and soil science, is directing the growth of an onion crop in the engineering development unit, a closed growth chamber similar to one that will accompany the astronauts on long-term planetary missions. Working with Peffley are Cary Green, Ph.D., assistant professor of plant and soil science; Paul Pare, Ph.D., assistant



(LEFT TO RIGHT)  
ANDREW JACKSON, PH.D., ASSISTANT PROFESSOR OF CIVIL  
ENGINEERING, ELLEN PEFFLEY, PH.D., ASSOCIATE PROFESSOR OF  
PLANT AND SOIL SCIENCE, KEN RAINWATER, PH.D., P.E., ASSOCIATE  
PROFESSOR OF CIVIL ENGINEERING.

professor of chemistry and biochemistry; Leslie Thompson, Ph.D., associate professor of food technology; and David Tissue, Ph.D., assistant professor of biological sciences.

The onion was chosen for its high level of phytochemicals, a compound in the onion that delivers health benefits. Together, the researchers are growing onions in a hydroponic, or soil-less system. The question these researchers must address is this: what happens when the onions are grown under elevated levels of carbon dioxide and salinity with increased light?

Today, Peffley and her team do not have all of the answers, but each day they are closer to finding a solution for this long-term project.

"I'm having such fun. Every time we get one piece of information, the five of us sit down and use that information in five different ways," Peffley said. "And that's exactly what should happen in science."

The science, so far, has grown onions much faster. In fact, with the increased amount of carbon dioxide and increased light, the onions are growing in about half the time it takes on Earth, and surprisingly, the onion's root system shows tremendous growth. Peffley said maximizing the use of the entire plant, roots and all, is part of the challenge.

"NASA has grown tomatoes and lettuce successfully, but they haven't grown bulb crops," Peffley said. "We've discovered that it's not so easy."

Peffley said the engineering development unit is very clever. The researchers set the electrical conductivity, the pH level, and add the basic nutrient solution, but when one of those elements fall below the set standard, the unit restores optimum conditions.

While it may not be easy, the group of researchers has had success with the onion crop. One of the phytochemicals the researchers are examining is quercetin, an antioxidant. Grown under high concentrations of carbon dioxide and light, Peffley expects the onions to contain high amounts of the compound.

"These onions should be a better food," Peffley said. "They will be functional foods with antioxidants that transcend nutrition."

Peffley said on long-term missions, astronauts suffer from depressed immune systems and their bodies do not function as well as on Earth.

"We would like to provide the astronauts with something that has twice the benefit," she said.

School-aged children also will benefit from this research. Peffley said the researchers have spoken to about 350 students about their work so far.

"It's important for students to know that science is fun. NASA is very keen in educating K-12 students," Peffley said.









## AS FOR THE WATER

issue, Texas Tech engineers are conducting research in five areas including the role of pharmaceuticals in wastewater recycling systems; the use of alternative soaps and detergents used during space missions; the potential for integrated water recovery processes; the need for culturally appropriate water recovery systems in the colonias of South Texas; and an appropriate water recovery system designed for use in Alaska.

Lloyd Urban, Ph.D., P.E., professor of civil engineering; Andrew Jackson, Ph.D., assistant professor of civil engineering; Heyward Ramsey, Ph.D., P.E., associate professor of civil engineering; and Ken Rainwater, Ph.D., P.E., associate professor of civil engineering, are working to develop a water-recovery system to be used in the colonias. Also working with them is Dean Muirhead, Ph.D., a post-doctoral research associate in The Department of Civil Engineering. He said the role of engineers is important to the success of the project in South Texas.

"We are attempting to solve very practical problems. As environmental engineers we have a long history of treating

water and wastewater," Muirhead said. "A good engineer will solve the problem at the least cost possible, and this is especially important for low-income communities."

Transferring the technology used at NASA to the colonias appears to be the most urgent.

"The unique thing about this project so far is that we are studying the social and environmental problems within the colonias first," Muirhead said. "Then the technology is born out of those problems." Muirhead said that most houses in the colonias direct toilet water to cess pools and the gray water from sinks, and showers drip outside through pipes. With a rock reed filter system, technology NASA developed more than 30 years ago, a solution may be apparent for the colonias. The system allows water to flow over a bed of gravel and through plants to absorb waste.

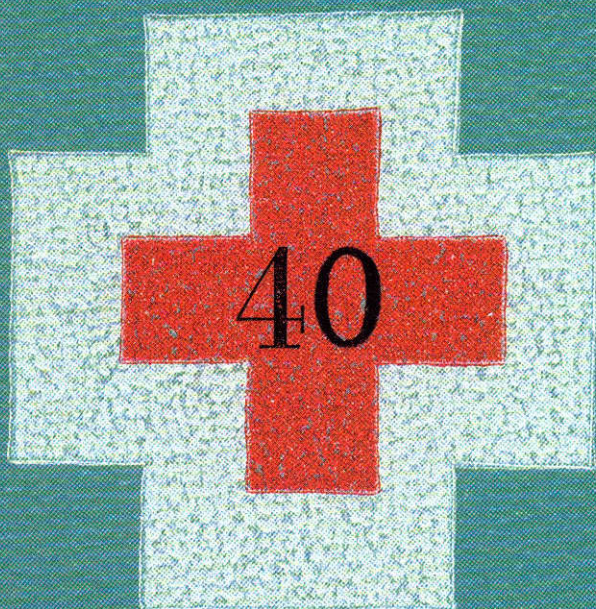
Texas Tech researchers know that they must allow the people of the colonias to maintain their independence for the appropriate water filtration system to ever be successful. Muirhead said that most of the adults in colonias are migrant workers and are gone most of the year to look for work, leaving the older children to care for younger brothers and sisters. "We want to include the people of Cameron, Hidalgo and Starr counties in developing this technology," Muirhead said. "We're impressed with the energy and talents of the people working in the colonias. They are totally committed to improving the living conditions."

Initially, analysis of the water samples will be conducted at the Johnson Space Center, and later, those samples will be sent to Texas Tech for a more detailed observation.

The Texas Tech engineers' work does not end in the colonias. Muirhead said the engineers will be looking at an alternative to soaps and detergents used during space missions. "Currently the astronauts use a coconut-based soap that dries the skin," he said. "We are going to be looking at some alternative soaps, and how they will affect the waste water treatment process."

And like the scientists studying the plants, the engineers know that collaborating with the science teachers and involving the children of the colonias will be important to application of any type of water recovery system. Muirhead said next summer, plans are underway to bring children to the Johnson Space Center to teach them about the technology.

In the future, it will not be hard to imagine astronauts eating fresh vegetables during a planetary mission, and in the future it will not be hard to imagine everyone in Texas having a fresh water supply because it will be a reality. And it will be a reality because of Texas Tech researchers working side-by-side with NASA to answer challenging scientific questions. ←



# NURSING

not required. For

*US into the future*



BY ALEXIA GREEN RN, PH.D

The nursing profession has a long history of cyclic shortages, which have been documented since World War II. The acute shortage impacting the nation during the late 1990s and the early 2000s is a direct result of the struggle to implement managed care as a means of controlling the escalating cost of health care. As we move further into the 21st century, the profession faces another shortage, one that promises to be more complex, long lasting, and will dwarf all shortages to date.

While the U.S. nursing population is aging and more nurses are moving into primary care settings, a multitude of aging baby boomers is resulting in an increasing demand for quality health care. As a result, there is a need for more nurses, especially those who deliver specialized care. Professional nursing is the largest U.S. health care occupation and according to the Bureau of Labor Statistics, employment opportunities for professional nurses will grow more rapidly than all other U.S. occupations through 2008. Planning for an adequate work force will be one of the most critical challenges of the new century. A closer look at several variables provides insight into the complexity of the shortage and the need for an array of actions.

One factor in the aging of the nursing work force is that younger birth cohorts, those born after 1955, are smaller in population size as well as significantly less likely to choose nursing as a career. According to the American Association of Colleges of Nursing, national nursing school enrollments have dropped by 20.9 percent over the past five years. One explanation for this trend is that students have other options as many are seeking opportunities in technology or management, leaving traditional service-based jobs like teaching and nursing unfilled.

Texas is unique in that it has not seen the significant decline in applicants as other states have. In fact, Texas schools of nursing turned away 3,000 qualified applicants in 2000, primarily related to a lack of funded faculty positions and a shortage of faculty.

One of the most critical problems facing nursing and nursing work force planning is the aging of nursing faculty. In 1999, the median age of nursing faculty in Texas was 51, while only 7.3 percent of nursing faculty were younger than 40. Almost 57 percent of the Texas nurse faculty work force will retire in the next 15 years. Both the aging of nursing faculty and overall flat enrollment in doctoral programs that produce nurse educators has

impacted the capacity of nursing schools to educate sufficient numbers of registered nurses to meet the future demand.

The nation, and Texas in particular, has a long history of insufficient numbers of registered nurses to work in the long-term care setting. According to a recent report by the Institute of Medicine, a serious shortage exists in the long-term care work force. The aging of the U.S. population and the projected growth of the oldest age bracket (85 years and older) will have a major effect on the demand for and supply of long-term care nursing services. The Institute of Medicine further reports that the population aged 85 years and older is the fastest growing group among the elderly population (65 years and older). Most of the increase in demand for long-term care services is expected to occur when the baby boom generation enters the elderly ages. The first of this generation will reach age 65 in 2011 and the last will do so around 2030. Unfortunately, only 10 percent of the nursing work force is younger than 30, while more than 60 percent of current nurses are older than 40 and will retire and become elderly themselves over this same time frame.

The evolving nursing shortage has significant implications for all of us—nurses, patients, health care providers, educators and the public. The Texas Tech School of Nursing has put into place several strategic initiatives to begin addressing this critical need. The school is actively recruiting qualified faculty, while creating innovative development activities for current faculty in an attempt to expand the expertise in teaching and research related to the aging. And the undergraduate and graduate curriculums have been redesigned to address the needs of graduates in a rapidly changing health care environment. The School of Nursing is working with community leaders to identify specific strategies to address the shortage in West Texas. Efforts are under way to identify additional resources to increase student scholarships and to support recruitment and retention of nursing faculty.

When it comes to recruiting and encouraging young people into nursing as an attractive profession, support from policy makers, the public and the health care community is critical. We need to increase the number of faculty and students in nursing, but more importantly, we need to prepare a nursing workforce with the right educational mix to be prepared for a health care environment that has grown increasingly complex. ←

ALEXIA GREEN, PH.D., IS DEAN OF THE TEXAS TECH SCHOOL OF NURSING AND PRESIDENT OF THE TEXAS NURSES ASSOCIATION.

# TEXAS TECH™

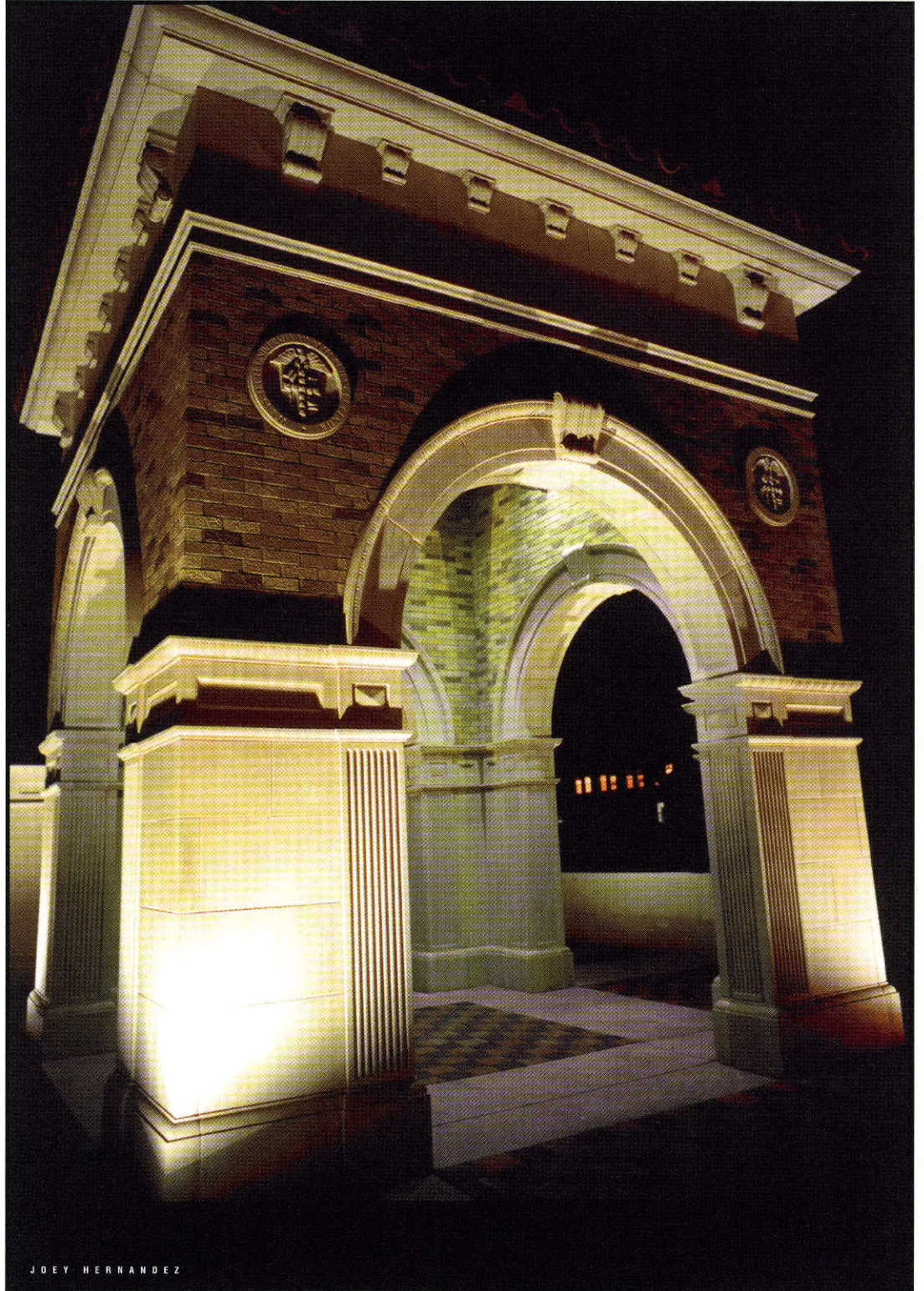
NEWS & PUBLICATIONS  
BOX 42022  
LUBBOCK, TEXAS 79409-2022

NON-PROFIT ORG.  
U.S. POSTAGE  
PAID  
LUBBOCK, TEXAS  
PERMIT NO. 719

CHANGE SERVICE REQUESTED

## VISTAS CAMPUS SCENES

The Broadway Entrance to the Texas Tech University campus has been enhanced with new gate houses, built in the traditional Spanish Renaissance architecture of the institution. The gate houses were a gift in honor of William Burton "Dub" Rushing and Mozelle E. Partain Rushing, given by Don and Ted Rushing. They dedicated the gate houses to their parents for their lifelong loyalty to Texas Tech.



JOEY HERNANDEZ