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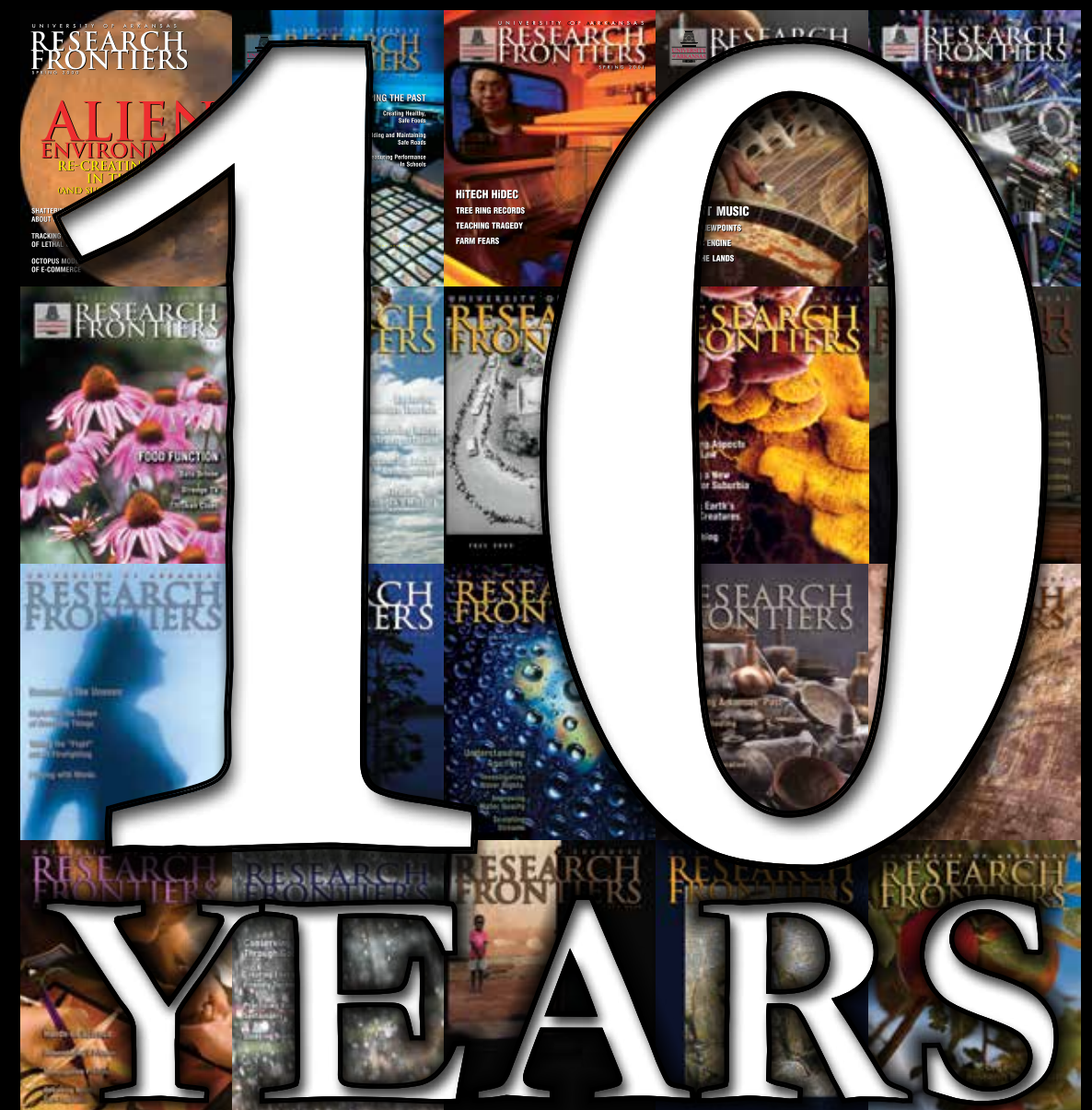
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UNIVERSITY OF ARKANSAS RESEARCH FRONTIERS

SPRING 2010



A Decade of Difference

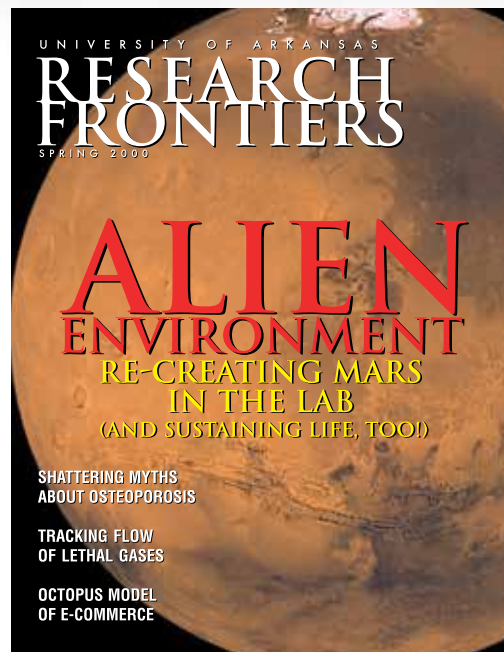
Ten years ago this spring, the University of Arkansas published the first issue of *Research Frontiers* magazine. The four main features showcased cutting-edge research in business, chemical engineering, osteoporosis and space and planetary science.

The cover story on space science featured the work of two university researchers, one in biological sciences, one in chemistry and biochemistry. One, Timothy Kral, examined methanogens, ancient life forms that survive under harsh conditions, and showed that they might survive under some of the conditions found on Mars. The other, Derek Sears, studied meteorites and their origins and looked for possible answers to the puzzle of the existence of water on Mars.

In the spring of 2000, Sears had adopted a planetary environmental chamber that had been decommissioned from a mission at the Jet Propulsion Laboratories in Pasadena, Calif. As *Research Frontiers* went to press, the chamber had yet to be used.

Flash forward a decade, and the University of Arkansas has the Arkansas Center for Space and Planetary Sciences, a multi-disciplinary, multi-department and multi-college center with 19 faculty members, a thriving graduate program and several functioning planetary environmental chambers. Scientists within the center study planetary geology, planetary atmospheres, astronomical processes, astrobiology and mission design and engineering.

This issue of *Research Frontiers* features four of the newest members of the Space Center faculty and their cutting-edge contributions to the field of



space and planetary sciences. Some of them have been published in *Science* and *Nature*. All have substantial funding from NASA or NSF. All of them are pushing forward the boundaries of their fields.

Recent graduates of the program work for NASA at the NASA Ames Research Center in Moffet Field, Calif., the Jet Propulsion Laboratory in Pasadena, Calif., the Johnson Space Center in Houston and the Glenn Research Center in Cleveland, Ohio.

The Space Center demonstrates how research can grow and thrive in an atmosphere like the one found at the University of Arkansas. The center's birth is but one of hundreds of such stories on our campus. We invite you to read these stories within our pages over the next decade.

Melissa Lutz Blouin
Editor, Research Frontiers

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Think Agile Think Melodic Think Tuba

By Barbara Jaquish

When most people think of tubas, do they think 'agile' or 'melodic'? Benjamin Pierce does. And in his hands, the tuba and its lighter, higher cousin the euphonium are full-throated, nimble and versatile.

"The tuba is capable of producing beautiful sound," the University of Arkansas music professor says. "It has a gorgeous, singing quality, particularly in the upper register."

Invented in 1835, tubas are relatively recent additions to the orchestra. Thus, not much music has been written for the tuba, other than modern works. Pierce expands the repertoire by adapting baroque and classical pieces, particularly those written for violin or cello. He likes to think that if the original composers could hear one of his three CDs, they would approve.

"If they'd had the tuba, some of those composers would have written for us," Pierce says. "Baroque instruments were so poor by modern standards, and the music sounds so good on the tuba. I think they'd be delighted to hear their music played by us."

Many modern instruments, such as piano, flute and horn, were not available to baroque musicians.

"I've heard Bach played quite effectively on marimba, even on banjo by Bela Fleck," Pierce says. "The music itself is timeless, and I'm a big believer in the *music*."

In fact, he says, "I'm really not a huge proponent of the tuba as a fantastic instrument. It may be, but really it's just the instrument I happen to play."

On his CDs, Pierce offers a range of music. The pieces on *Pierce Plays Bach* were mostly adapted from keyboard. Bach's "Fugue in D Minor" for organ – played memorably by Bela Lugosi's Dracula – was overdubbed with 12 tubas, all played by Pierce.

On *Wheels of Life*, Pierce plays several contemporary pieces written for tuba. "Wheels of Life: In Reminiscence" was composed for Pierce by Wendy Wan-Ki Lee, with Jun Okada playing the piano.

Its three movements express Buddhist philosophy in Western music.

For the Hungarian Dance No. 5 on the CD *Cheers*, Pierce played 16 tubas and euphoniums. Acknowledging the outsized showiness of the piece, Pierce writes in the liner notes, "Low brass players learn to laugh at themselves."

Typically, musicians play either euphonium or tuba. Pierce plays both and has won more than a dozen major international competitions – most, if not all, of such competitions in the world. By preparing for international competitions, he has learned a tremendous repertoire. He recommends competition to his graduate students "mainly because it will make them play better. Plus, I have some students who I think can win."

An advocate of liberal arts education for musicians, Pierce is enthusiastic about teaching tuba and euphonium to graduate students, who are preparing to become concert musicians or college professors, and to undergraduate music education majors, who are training to become band directors.

"It is great to get to work with future band directors who will go out and teach my children and other children."

On the Web, *Research Frontiers* offers a video of Pierce playing with the University of Arkansas Tuba Quartet and clips of the music mentioned in this article. In a separate video, physicist William Harter explains how a human breath can enter a tuba's mouthpiece, travel the 12 to 18 feet of the instrument's tubing and come out the bell so deep, rich and LOUD. <http://researchfrontiers.uark.edu/> ■

Photo by Russell Cothren

U N I V E R S I T Y O F A R K A N S A S

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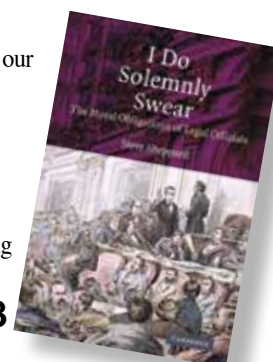
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▼ Tuba Physics

Why do tubas make such a big sound when you blow into them? Physicist Bill Harter explains.



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Experience the tuba in concert and hear Ben Pierce, professor of music talk about the instrument and the many pleasures of performing with this brassy behemoth.

► What is low impact development? Why is it important what water has been found on the moon? What are stem cells?

Find the answers to these and other questions in the UA Q&A feature on the Research Frontiers Web site: researchfrontiers.uark.edu.



Image by: NASA

Enterprise Center Means Room for New Businesses to Grow

The Enterprise Center will allow for growth at the Arkansas Research and Technology Park, which in recent years has seen a boom of companies created from University of Arkansas research. The park currently houses 25 companies at various stages of development.

"We're happy that we've been running at 100 percent capacity, but at the same time, you must maintain an inventory of available space in order to grow," said Casey Mileham, administrative assistant for the Arkansas Research and Technology Development Foundation. The building is part of the foundation's master plan, which includes almost 1 million square feet of office and laboratory space, and follows five years after construction of



the Innovation Center, a 35,000-square-foot building that now houses self-sustaining companies.

"The Enterprise Center is a testament to the growth of cutting-edge basic research taking place on our campus," said Chancellor G. David Gearhart. "We look forward to seeing that growth continue as the Arkansas Research and Technology Park expands."

The Enterprise Center will be a LEED-certified building and will be laboratory ready,

meeting power and air-handling requirements and vibration controls needed to build wet labs or clean rooms.

"We have been meeting with several potential tenants in order to identify their specific needs," Mileham said. ■

Photo by Eric Pipkin

New Logistics Model Improves Forecast Accuracy of Orders

Whether it's dog food or iPods, tires or televisions, most consumers have endured a frustrating out-of-stock experience. Retailers hate it as much as customers – perhaps more, because they lose money and credibility. Examining this problem at a specific link in the retail and consumer-packaged goods supply chain, a logistics researcher and his colleague discovered that application of a common error-correction model improves the accuracy of forecasting orders.

"The statistical model we used provides a better understanding of orders in a supply chain and can improve short-term forecasting," said Matt Waller, professor of marketing and logistics. "It has been used heavily in macroeconomics but not in logistics. Our theoretical analysis suggested such a method should improve short-term order forecasts, so we used it to forecast distribution-center orders and found that it reduced error relative to baseline methods used by the consumer-packaged goods industry."

Within the retail and consumer-packaged goods industry – which affects American consumers daily – the inability to accurately forecast supply orders is perhaps the greatest obstacle to establishing and maintaining an appropriate amount of goods on retail shelves. Suppliers annually devote millions of dollars toward human and technological resources, including sophisticated and expensive software packages, to address the problem and still struggle to find the right balance.

Supplied with 104 weeks of data from a global consumer packaged-goods company, Waller and Brent Williams, assistant professor at Auburn University, tested the performance of the error-correction model in the ready-to-eat cereal, canned soup and yogurt categories and found significant improvements in order-forecasting accuracy. Their findings will improve important supply-chain measurement standards, such as inventory turnover, gross margin return on inventory investment and in-stock levels. Improvements in these areas will lead to greater service and convenience for consumers and increased profits for retailers.

Waller holds the Garrison Endowed Chair in Supply Chain. ■

Designing the Neonatal Intensive-Care Unit of the Future

Architecture students had an unusual audience for their work last summer – nurses and hospital staff from the neonatal intensive care unit at Phoebe Putney Memorial Hospital of Albany, Ga.

Four student design teams spent the summer designing a neonatal intensive-care unit. The professor, Tahar Messadi, asked them to concentrate on designs that would promote family-centered care, while also considering circulation patterns, natural light, acoustical conditions and efficient use of space.

He also asked the teams to document the research that supported their designs, both from an extensive literature survey and from field interviews. There is increasing evidence that the physical design of health care environments affects health-related outcomes such as patient stress, sleep and even the transmission of infections.

The students’ research included a trip to visit Putney’s current neonatal intensive-care unit, which reinforced what they had learned.

“Before the studio class, most of the students had not heard of a ‘NICU’,” said Sheila Bosch, director of research for Gresham, Smith and Partners, a national architecture, engineering and interior design firm working with the hospital. “Upon seeing the faces of fragile infants, some of whom were fighting for their very lives, I believe it really hit



Photo by Russell Cothren

home with the students that their work as designers is more than form and function – it can significantly alter the experience of those for whom they design.”

Each design team approached aspects of the neonatal intensive-care unit differently: the first team provided a separation of public traffic from the nursing and custodial traffic; the second team used a traditional layout of rooms but gained efficiency in use of space; the third team created open-air gardens to allow parents or siblings a space to step away from the stress; and the fourth team created a design that allowed open-bay rooms to be turned into private rooms.

“I was incredibly impressed at the level of sophistication of the presentations,” said John Fischer, vice president of Phoebe Putney Memorial Hospital, sponsor of this project. “Every group has come up with creative solutions. Nothing is perfect at this stage, but they’ve all found practical solutions.” ■

Researchers Examine Ways to Combat Flu Virus



Photo by Russell Cothren

Tthanks to a grant from the National Institutes for Health, four researchers are studying novel ways to prevent and treat the influenza virus, which kills about 36,000 people each year and sends another 200,000 to the hospital.

Viral mutations keep people flocking to the doctor’s office for annual flu shots. Proteins on the outside of the virus shell – the “H” or hemagglutinin and “N” or neuraminidase proteins – change shape rapidly and render vaccines ineffective. These protein mutations allow the virus to slip by a previously infected immune system and subject the victim to fever, chills and aches.

“The virus is ‘smart’ in that it modifies proteins on the outside so that the hosts’ body cannot recognize it,” said Suresh Kumar, assistant professor of chemistry and biochemistry. “We need to be one step smarter than the virus and attack something it is not anticipating.”

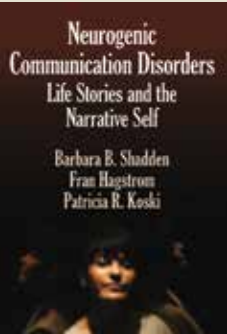
Kumar and his colleagues Yu-Chun Du, Robyn Goforth and Ralph Henry in biological sciences will study a different viral protein called NS1.

“NS1 facilitates the virus to hijack the host cell machinery to make its own proteins,” Kumar said. It also blocks the cells’ natural defenses – a group of proteins called interferons.

Because NS1 interacts with host cells, it changes little over time, making it a target for researchers who hope to shut down the flu. However, to create a novel vaccine or treatment based on this protein, scientists must understand how it works.

“The aim of this grant is to identify novel host proteins that interact with NS1,” Kumar said. ■

Rebuilding Identity When Communication Is Impaired



What happens to a person’s identity when stroke or disease profoundly impairs the ability to communicate? In *Neurogenic Communication Disorders: Life Stories and the Narrative Self*, researchers explore “the messy but powerful relationships between communication impairment and maintenance of a viable sense of self.”

Speech-language professors Barbara B. Shadden and Fran Hagstrom and sociologist Patricia R. Koski brought diverse perspectives to bear on questions of the construction of a sense of self and approaches to treating individuals with communication disorders.

“At the heart of our work is the premise that everyday communicative acts and interactions are powerfully linked to who we are, as we see ourselves and as others see us,” the researchers wrote. “If we accept this premise, it alters our perception of what is ‘broken’ and what needs to be ‘fixed’ for those living with acquired communication disorders.”

The researchers looked at people affected by communica-

tion disorders associated with stroke, amyotrophic lateral sclerosis, Parkinson’s disease, Alzheimer’s disease and other dementias.

To maintain the narrative self, an individual must first recognize the disruption the disorder creates in the life story. Then, the person can create a new narrative that includes the illness and bridges past self to present self.

“The way you create yourself is that you tell a story,” Koski said. “Think of how you present yourself to other people. You tell a story. It’s not just a presentation of self – it’s a creation of self.”

“But if something happens to that communication tool that lets you tell that story,” Shadden asked, “then how do you do it? How do you create yourself? What do you do if your tool has failed you and others don’t know who you are?”

Such tools include, among other things, beliefs, assumptions, values, posture, gestures, facial expressions and assistive devices. For people who cannot use language, assistive devices may involve computer programs or other people.

“In my discipline people think if you get the right computerized device into someone’s hands that will solve the problem. That’s the easy part,” Shadden said. “What matters about a tool is what you do with it.”

The researchers offer a new perspective to clinicians, emphasizing living with the communication disorder “rather than curing the communication impairment.” ■

Researchers Skeptical of Claims by Online Dating Sites

With an estimated 40 percent of the 100 million U.S. singles trying online dating, researchers caution users that some Web sites’ claims of scientific justification may be “junk science.”

Psychology professor Jeffrey Lohr and two psychology graduates, Aimee King and Deena Austin-Oden, analyzed several leading dating Web sites and found that promotional claims were more self-serving opinion than legitimate psychological science. They published their results in Volume 15 of *Skeptic Magazine*.

Many matchmaking sites use traditional tactics such as anecdotes and personal testimonies in hopes that consumers will accept the endorsement as fact. Consumers must be cautious of customer satisfaction testimonies because the matchmaking sites pre-select satisfied customers, rather than a representative sample, the team said.

Even when dating services cite scientific evidence, consumers don’t always get all the facts. In an eHarmony

comparison, the researchers found that the site neglected to reveal that they compared their couples, married only an average of six months (the “honeymoon period”), to couples in the control group who were married an average of two years. Opinions expressed during the honeymoon period should not be compared to the opinions of couples after the honeymoon is over, said the researchers.

eHarmony asserts that its matchmaking model is based upon measurement and compatibility. eHarmony has a patent on its compatibility tests, and does not reveal to users the characteristics of their key attributes or how those attributes are used to pair them with others. PerfectMatch.com uses a compatibility system based on “over 35 years of research” developed by “a chief relationship expert,” while Match.com claims its method works by the volume of success stories.

Many Web sites make claims that they cannot substantiate. For instance, Match.com claims that they are responsible for “twice as many marriages as any other site in the world.” The site measures success according to the number of marriages. However, Match.com does not use divorce to measure failure and thus cannot offer scientific research to support the usefulness of their claim. ■

THE ARMANA BONES



By Lana Hazel

Anthropology major Amy Chancellor spent her summer working with the dead.

As a freshman, Chancellor was the youngest team member on the university's summer research trip to Tel el-Armana, Egypt, where they spent five weeks digging up and studying 3,500-year-old skeletons.

"The study is very important bioarchaeologically speaking because we can see exactly how they lived and died," she said.

The Armana Project is a University of Arkansas faculty-led study abroad trip that was started in 2007 by professor Jerome Rose, who has been working on excavations and analysis in Egypt since the 1980s. Chancellor was one of 14 students – eight were from the University of Arkansas – to accompany Dr. Rose to Tel el-Armana last summer.

Amarna was the capital of Egypt in the 1350s BCE under Akhenaten, but, after he died, the city was burned to the ground and everyone moved away.

Most cemeteries are used for hundreds of years and any analysis provides generalized information about health and diet. The Armana cemetery is special because its only being used for 15

years allows researchers to learn specific details about those who worked there during Akhenaten's rule.

The team has found over 100 individual skeletons in the part of the cemetery that has been excavated so far and often unearths bones that can be matched to others.

Chancellor described the process of digging up skeletons and analyzing the bones as being able to construct a snapshot of that community that lived 3,500 years ago.

"It's a very intimate science because we are actually working with people," she said. "All the research just creates such a connection to people from a different time."

In addition to working with the team to take X-rays and photographs, Chancellor's individual research project involved osteometrics. While others examined bones to determine age, disease and cause of death, she calculated the heights of the skeletons. From their measurements, she could tell things about what they ate and their general conditions of life.

She determined the average height for males was 5'4" to 5'6" and females stood between 5'1" and 5'5".

"The people were four inches shorter than basically everybody else, ever," she said. "We called the 5'8" male 'the Giant.'"

Chancellor said she had taken an osteology class the semester before and it made sense for her to use those skills in the lab.

She said the bones tell the story of the forced laborers who had to work intensely to build the capital city of Armana. The underdevelopment of the males reveals that they experienced poor nutrition and high stress.

"We learned that their diet lacked meat and we can see a lack of vitamins in the bones," she said. "We know they ate grains a lot."

Males suffered more from the lack of growth than females did, which lessened the structural differences between males and females. The project Chancellor designed was a process of analyzing the skeletons for their sexes based on those small differences.

"Amy was able to develop a series of measurements for determining if it is a male or female that we will be able to use at a later time," Rose said. "Sometimes we only find partial skeletons and it is difficult to tell their sexes without the pelvis or skull, but Amy's measurement criteria lets us determine that anyway."

The lab where Amy worked on her project was cramped but sufficient. Without air conditioning, the rooms were uncomfortably hot in the daily 120-degree temperatures.

"If it had been as humid as Arkansas heat we would have all died for sure," Chancellor said. She said they were thankful the refrigerator was able to keep their bottled water – which they referred to as "life" – at a typical room temperature.

The students stayed in individual stucco bedrooms at the field school, with mosquito nets over their beds. Egypt is a primarily Islamic country, and Chancellor said it was normal for the team to wake up around the 4:30 a.m. prayer time.

"One morning we heard jingling in the courtyard at 4:40 a.m., and we found a goat from a neighboring farm running from the kitchen to the dining area to the garden," Chancellor said. "It had to have been a sight to see a bunch of foreigners chasing a goat in their pajamas." ■





Homelessness

More than Just Numbers

by Barbara Jaquish

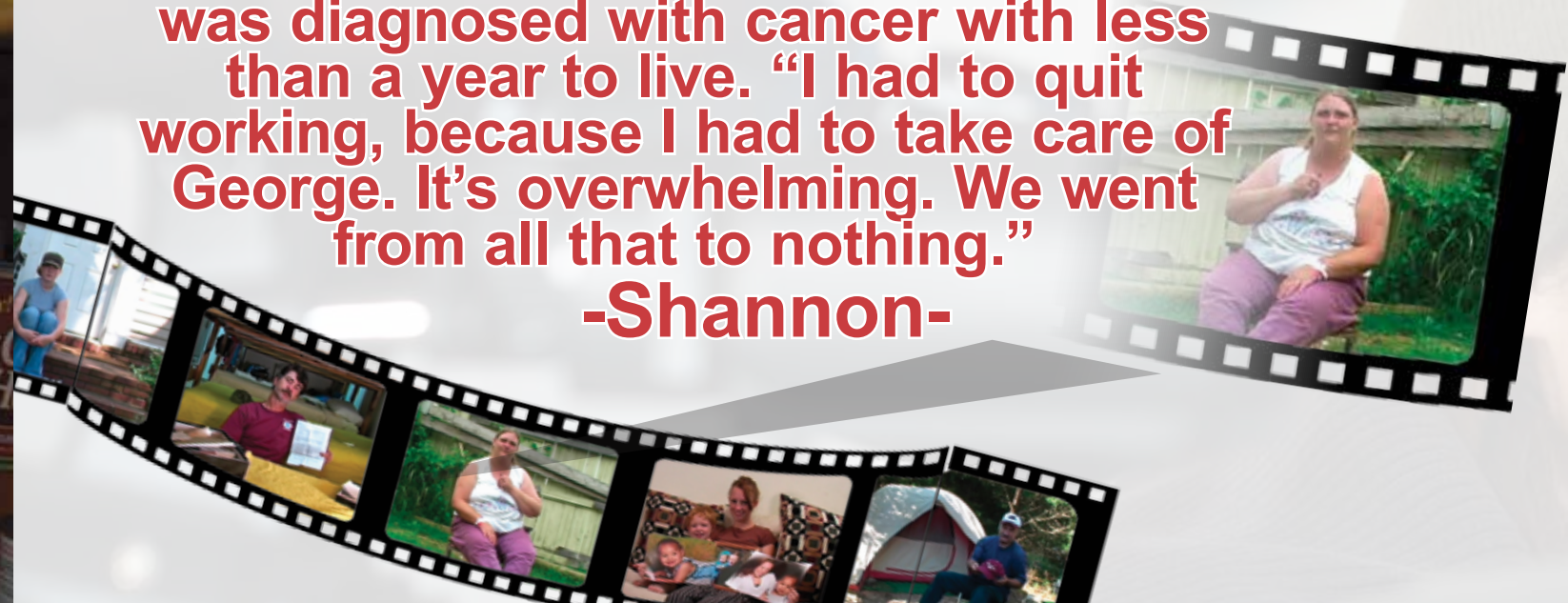
Sociologist Kevin Fitzpatrick and artist Bethany Springer, pictured above, are changing the way we think about homelessness. One uses data and the other a video camera to reveal the complexity of the lives behind the statistics.



Sociology professor Kevin Fitzpatrick holds the Bernice Jones Chair in Community.

New Ways of Thinking about Homelessness

“It was great. George was working and we had a nice house, a three-bedroom house.” Then her husband was diagnosed with cancer with less than a year to live. “I had to quit working, because I had to take care of George. It’s overwhelming. We went from all that to nothing.”
-Shannon-



The faces and stories that illustrate this article are pulled from The Homeless Project. A sample of the individual videos are available at researchfrontiers.uark.edu.

On a February day in 2009, a troop of trained volunteers surveyed homeless people in two counties of Northwest Arkansas. They stopped people at soup kitchens, homeless shelters and day programs. They walked into wooded camps and searched abandoned buildings. They collected data from school systems about students who had no stable home.

Although Washington and Benton Counties were doing better than much of the country during the economic downturn, when the numbers were tallied for the Northwest Arkansas Point-in-Time Homeless Census, sociologist Kevin Fitzpatrick reported that approximately 1,287 adults and youth in the region were homeless, an increase of 10 percent from the census of 2007.

The very nature of homelessness makes it difficult to arrive at an accurate count. People move in and out of homelessness as the economy and personal circumstances change. Homeless people may be visible and accessible at shelters or soup kitchens, or less easy to identify when they live on the street or bunk with family or friends.

The Northwest Arkansas census counted homeless people at one point in time in just two counties. Nationally, an estimated 1 million people are without a home on any given night, and about 2.5 million people are homeless at some time during each year. The recession could mean an additional 1.5 million individuals will experience homelessness at some time during 2009 and 2010.

In addition to providing an estimated number of homeless

people at one point in time, Fitzpatrick and colleagues interviewed 269 adults to give service providers the information they need about the characteristics, living circumstances, service use and needs, and chronic conditions of homeless people in Northwest Arkansas.

From Anecdote to Data

Fitzpatrick brings the perspective of nearly two decades of studying homelessness and related problems of mental health and substance abuse. He first began studying homelessness at the University of Alabama-Birmingham at a time when it was commonly believed that homeless people were just isolated individuals. In the early 1990s, his publications on friendship networks and social ties were among the first to examine the isolation explanation for homelessness.

“What we found on the initial assessment in Birmingham totally surprised us,” he says. “These people were as connected as the general population, when we looked at the average number of friends and social ties and where they were getting their support and how they were getting it.”

Ten years later, Fitzpatrick was in Arkansas, the language had changed and the assumption was that homeless people had no social capital.

“We learned through engaging in this community and looking more carefully that they do, in fact, have social capital. It’s called

bonding capital, the kind of social capital that oftentimes low-income, disadvantaged people have. You’re bonded to people who are like you, and you help each other,” Fitzpatrick explains.

Oftentimes low-income people may not have much bridging capital, the kind of social ties or network that can get you a new job. The challenge for service providers, Fitzpatrick says, is to help homeless people build these connections to develop job, educational and housing opportunities.

In the early 1990s, little research had been done to understand who homeless people were. Governments and agencies were operating on assumptions and anecdotes. Fitzpatrick’s local county in Alabama – like most counties at that time – didn’t even know how many people lived under its bridges or in its shelters.

After conducting a census of homeless people, he and his colleagues in Birmingham – Mark LaGory and Ferris Ritchey – developed a comprehensive needs assessment. Between the unique value of the data – it was “a gold mine” that no one else had tapped – and the compelling needs of the population, Fitzpatrick’s academic career path was launched.

“While we were busy writing up our results for the academic world, we also fielded questions from service providers. We found we had to learn how to translate it into language that was not only accessible to the community but useful,” Fitzpatrick said. “For me that changed my whole perspective on the problem and I soon

became as much an advocate as I did a researcher.”

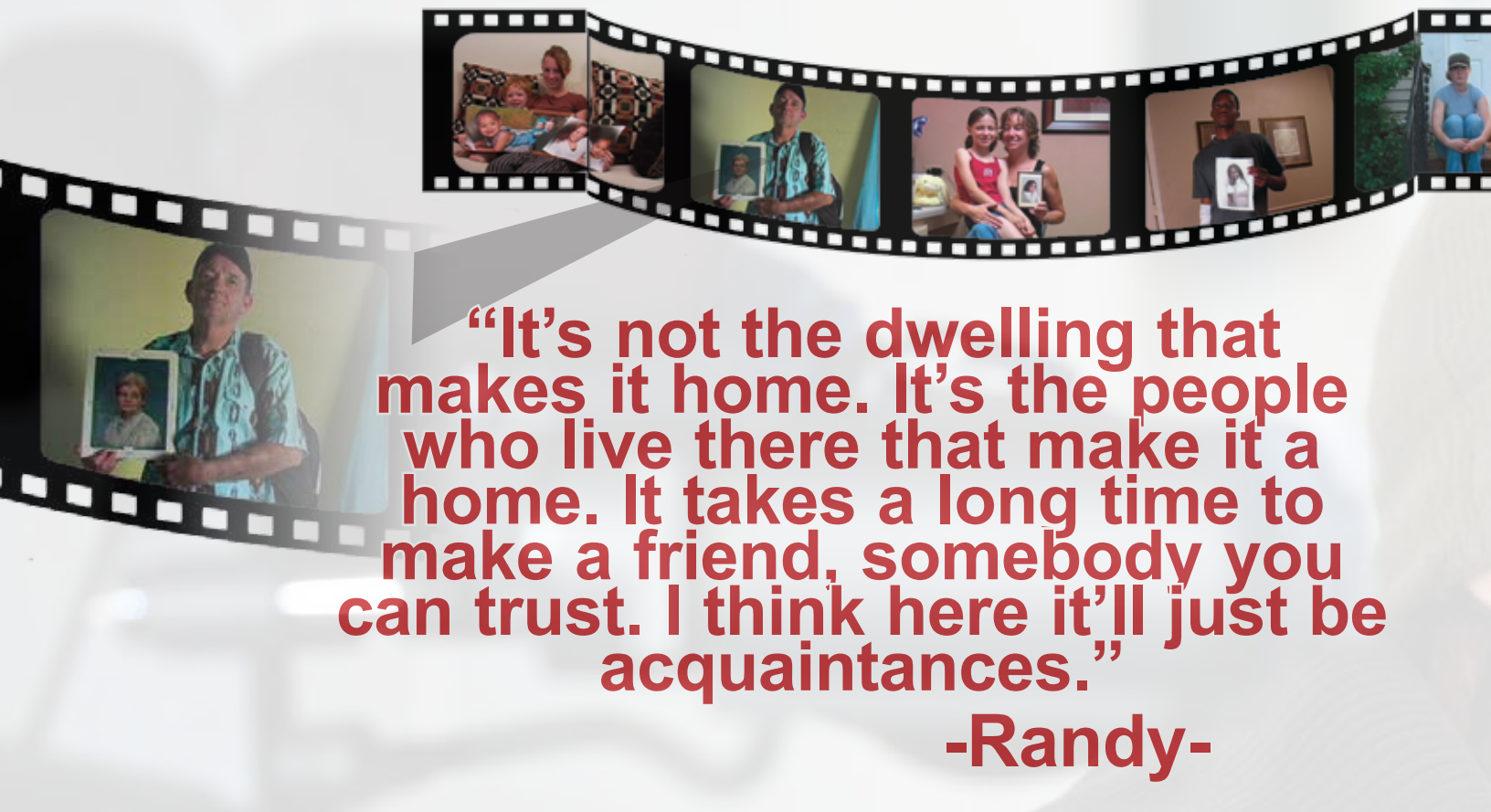
Originally, Fitzpatrick and his colleagues in Birmingham were simply trying to understand who the homeless people were. Later, they examined causes, because people wanted to know what they could do in response to the problem. Then they looked at consequences, particularly the mental health and physical health consequences, “and for ten years that’s all we wrote about.”

Partnerships and Policy

Since arriving at the University of Arkansas in 2005 to fill the Bernice Jones Chair in Community, Fitzpatrick has reached out and developed partnerships with service providers. He directs the Community and Family Institute, which coordinates projects with foundations and service providers.

“It’s really rewarding for me. I see this as a charge of my endowed chair to act as a resource,” Fitzpatrick said. “I’ll never stop writing – that’s always going to be a part of how I am wired. But I’m wanting to constantly do more than just grinding out products for the academy.”

Today he hears from service providers who want different information. They seek new ways to think about the problems and new strategies. This new generation, he says, “is asking bigger questions about policy and what can be done in the immediate period.”



“It’s not the dwelling that makes it home. It’s the people who live there that make it a home. It takes a long time to make a friend, somebody you can trust. I think here it’ll just be acquaintances.”

-Randy-

Precipitating Events

Fitzpatrick has a particular interest in how mental health problems and substance abuse can destabilize lives and trap people in homelessness. Decades of research show that depression is one of the most debilitating mental health problems.

“Regardless of prior history, being on the street is a particularly depressing circumstance,” Fitzpatrick said. “In the Birmingham study, the homeless people we interviewed were showing symptoms of depression at three to five times the rate found in the general population.”

Because depression is often seen as “an under-the-radar kind of illness,” Fitzpatrick suggests that service providers, nurses and physicians, and people who see homeless people need to be more sensitive to signs of depression as they “unravel the service dilemma” for the people they serve.

Fitzpatrick notes being surprised – and shaken – by the people he has met whom he wouldn’t have expected to be on the street – college graduates, lawyers, nurses.

“You know I could fill a book with people I’ve met along the way who aren’t who we think they are,” Fitzpatrick said. “Oftentimes, it’s a precipitating event – a fight, an illness, a loss of job, a debt that can’t be paid – that one event that pushes people out of a secure environment into the insecurity of homelessness.”

The tight economy and loss of jobs have swamped many lives. The effect, Fitzpatrick believes, “will be off the charts.”

“I think that you’re going to see a dramatic uptick in demand for services, because there were a lot of near-homeless people before this precipitating event. This economic downturn was all that they needed to go under.”

Demand for services is up all around the country. In Fitzpatrick’s corner of Arkansas, community meal programs are swamped. Affordable, accessible health care continues to be a big issue – more than 90,000 people have no health insurance in Northwest Arkansas. Seven Hills, a homeless program in Northwest Arkansas, is seeing hundreds of visitors each month, dramatically up from the 70 to 80 individuals they saw in 2008.

Filling Gaps

The people Fitzpatrick meets on both sides of the front desk at the local shelter have moved him to investigate ways to mitigate health care gaps. One approach that has been successful in other parts of the country is mobile health care clinics.

“Are we going to solve homelessness in the next five years or ten years? Probably not,” Fitzpatrick said. “I think that homelessness is complicated, and trying to find one cause or focus on only one consequence has been futile.”

At the same time, until the country creates more affordable housing and social support for those pushed over the edge by a series of precipitating events, Fitzpatrick sees value in plugging gaps and changing minds.

“You know, I think that if you want to serve a meal or if you want to put quarters in a cup, you are filling a gap. Those are simple acts, they’re short term solutions, but still they fill a gap. Addressing social problems is about plugging the hole. And about trying to find ways to change peoples’ current way of thinking.” ■

Making the Invisible Visible

When Bethany Springer moved to downtown Fayetteville, Ark., in 2006 to teach sculpture at the university, she spent some time absorbing her new surroundings.

“Because my research focuses on the idea of place and displacement, I usually approach a new ‘home’ with the question: What is seen and what is not seen? Usually communities exhibit both prosperity and need, but Fayetteville was different,” she says.

Soon it struck her that she didn’t see any homeless people openly dwelling in downtown areas in Northwest Arkansas, and that was a point of departure for *The Homeless Project*. With help from sociologist Kevin Fitzpatrick, Springer interviewed 27 people living in local shelters, makeshift campsites and transitional housing. Each interview has been edited into a three-minute video portrait with accompanying audio testimony.

As a touring public art project, the testimonies and videos are designed to be exhibited in storefront windows. Passersby in two Northwest Arkansas downtowns saw the videos on 40-inch flat-panel television screens set up in storefront windows and heard the testimonies through speakers mounted outside.

As an artist, Springer feels like she is orchestrating the voices of the homeless people she interviewed: “They need to be heard, and so I am trying to help by respectfully presenting their private experiences in public space.”

The Homeless Project is, in a sense, a collaboration between the artist and those interviewed.

“When experiencing art, many viewers seek meaning that is often consciously intended by the artist. Yes, I am editing footage and arranging sound and video clips to create a certain atmosphere, but the meaning and power of *The Homeless Project* lies in the testimonies themselves. So, the participants created the meaning. If people see this and are moved by it or begin thinking about our community differently, then it’s because of the weight of what the interviewees have told me.

“As the landscape of Northwest Arkansas continues to develop, it is important to address the needs of all community members, especially those whose presence is less visible. I believe that these conversations, presented in public space, will encourage open dialogues to address the necessity for stable and affordable housing amid extensive growth in Northwest Arkansas.” ■

“My private space is when I have a book in my hand, and I’m reading it. That’s me. That’s where my home is because it keeps me from reality.”

-Tammy-



healthy STANDARDS

Logistics researchers examine the problem
of data in health care management

BY MATT MCGOWAN

PHOTOS BY RUSSELL COTHREN

WelchAllyn

SureTemp

Heather Nachtmann points to the salmonella/peanut butter outbreak of early 2009 as the perfect example of why hospitals – all of them! – need to use only one number to identify identical parts used in hip-replacement surgeries and angioplasties. Seems prudent, but what does contaminated peanut butter have to do with identifying orthopedic implants or small balloons inserted into obstructed blood vessels? Not much, she says, other than an important lesson that could save human lives.

“When that happened and word spread up and down the retail grocery supply chain, jars of peanut butter vanished from grocery shelves,” said Nachtmann, an associate professor of industrial engineering. “I’m sure there were exceptions due perhaps to personnel constraints in some stores, but in general,

once that recall was announced, any peanut butter that could have been contaminated was gone. It all happened very quickly.

“Unfortunately, if this scenario were to occur today with an implant or a pacemaker or any other device inserted into a patient, the health care supply chain could not respond as quickly. So our peanut butter can be recalled instantly, but things that touch our body, things that keep us alive, take hours to pull out of use.”

The problem, Nachtmann says, has to do with information: access to it and the quality of it. The retail and grocery industries use numbers – Universal Product Codes, which can be found next to every bar code – that consistently and reliably identify unique products throughout the supply chain. This simply means that an individual product – Ben and Jerry’s Chocolate Fudge Brownie for



instance – tied to a specific number can be identified, regardless of its location, which may be the manufacturer, a distribution center or a specific grocery store.

Although there is a movement in this direction, the health care supply chain does not have Universal Product Codes. It has numbers – just not the same numbers for identical products, and this lack of consistency pervades not only the entire health care supply chain but, in some cases, hospital systems themselves.

Nachtmann and Edward Pohl, also an associate professor of industrial engineering, discuss this and other findings in “The State of Healthcare Logistics – Cost and Quality Improvement Opportunities,” their report on the U.S. health care supply chain, a complex and expensive system that industry analysts and economists have labeled as inefficient and a significant source of rising health care costs. The researchers surveyed 1,381 professionals from all major sectors – providers, manufacturers, distributors and group-purchasing organizations – of the health care supply chain. They found that in addition to being an extremely expensive undertaking – the average health care provider spends more than \$72 million a year on supply-chain functions – the U.S. health care supply chain is immature and starved for accurate and accessible information.

A Universal Language

The health care supply chain is a network of information and logistics within the broad spectrum of U.S. health care. In addition to direct health care providers such as acute-care hospitals and long-term facilities, surgical and diagnostic centers, physicians’ clinics, pharmacies and other facilities, the network includes laboratories, equipment manufacturers, suppliers and distributors. Group-purchasing organizations – businesses established to increase purchasing or bargaining power for bulk supplies – also play an integral role in the health care supply chain.

To some degree – whether it’s a small manufacturer that produces custom implants or a huge hospital system that serves thousands of patients – every entity within the categories above contributes to and benefits from the health care supply chain, especially if it runs smoothly. But most players, Nachtmann and Pohl discovered, are only poorly prepared to participate in it. Many survey respondents indicated that their organization’s supply chain operated merely as an ad hoc, unstructured system in which management practices and processes were loosely defined but not implemented.

A major obstacle to implementation – indeed, the major barrier to an integrated and mature supply chain, respondents said – is a lack of data standardization. Specifically, nearly three out of four survey participants, most of whom worked for a health care provider, indicated that lack of data standards was a significant barrier to their organization reaching an acceptable level of collaboration among all health care supply-chain members.

Data standardization? It’s the same thing as good, accurate and consistent information about each and every product. Nachtmann alluded to a definition above, but in industry-speak, data standards refer to universally agreed-upon and accepted representations, formats and definitions for common data ascribed to equipment, supplies and records. In other words, one standard data system to document and track every object that goes in and out of every health care supply-chain entity.

“What we’re talking about is language,” Nachtmann says, “one language to identify syringes, staples, surgical scissors and knives, heart monitors, latex gloves, hoses, stethoscopes, cafeteria trays... you name it. Everything. One language used by every player.”

Money To Be Saved

The benefits of such a language transcend the pre-eminent goal of patient safety. Each year health care supply-chain organizations devote billions of dollars to health care delivery, the business of procuring and distributing materials, equipment and information to help professionals do their jobs. The average provider in Nachtmann and Pohl’s study spends more than \$70 million a year, nearly one-third of its annual operating budget, on supply-chain functions. Traditionally, Nachtmann says, hospitals and other health care providers have focused so intensely on quality patient care that health care delivery has suffered.

“Health care providers are worried about saving lives, not operating efficiency,” she says. “But now they realize that a lot of money can be saved.”

Supply chain inefficiency is not a new problem. For many years, at least since the early 1990s, industry analysts and supply chain professionals have targeted health care supply chain and logistics as an area in which inefficient practices can be eliminated or at least reduced enough to facilitate health care delivery at a reasonable cost. Down in the trenches, health care supply-chain professionals know that incorrect or inconsistent product data causes pricing errors, wasted time and labor redundancy by personnel trying to resolve rebate, return and credit issues with suppliers.

But how do these inefficiencies play out? Consider the recall scenario above. A manufacturer discovers a flaw on a specific implant used in hip-replacement surgeries and immediately issues a recall to all clients. As this information travels throughout the supply chain, workers at distribution centers and provider facilities try to identify the correct part. This process is often tedious and time-consuming – not to mention subject to human error – because the manufacturer’s number associated with that part differs from the distribution center’s number for the same part, which in turn is different from the provider’s number. Three numbers or codes for the same, identical object. The whole process of identifying and pulling the right part requires a great deal of record reconciliation and human labor. Moreover, this proprietary state exists horizontally as providers themselves – or suppliers – do not share the same number for an identical part.

“Compounding this problem,” Pohl says, “is the fact that product identification codes may not be consistent between branch hospitals in the same network or even between floors of the same hospital.”

Experienced industry professionals know that data standards increase compatibility, reduce redundancy and improve collaborative exchange. Their ideas and efforts have only intensified as health care costs have risen at an unsustainable rate. The problem has spawned national associations, organizations and even research centers – including the University of Arkansas’ Center for Innovation in Healthcare Logistics.



What we’re talking about is language, one language to identify syringes, staples, surgical scissors and knives, heart monitors, latex gloves, hoses, stethoscopes, cafeteria trays... you name it. Everything. One language used by every player.



Movement Afoot

With group-purchasing organizations leading the way, the health care supply chain crawls toward much-needed change. Thirty-five percent of the survey respondents stated that their organization was moving toward the adoption of a data standards system. More than 65 percent of group-purchasing organizations had done so. A significant number, more than 50 percent, of manufacturers had committed to a data standards system. At 38 percent and 31 percent, respectively, distributors and providers were slower to convert. On the negative side, most participants stated that their organization had not adopted a data standards system or did not know if one had been adopted. For health care providers alone, this percentage – “no” or “don’t know” – was about 70.

The researchers asked participants about their organization’s readiness level for the adoption of a data-standards system. One out of three participants who worked for an organization that planned to adopt such a system believed their organization was either “ready” or “very ready” to do so. Forty-three percent of the respondents indicated that their organizations were only “marginally ready” or “not ready at all” to adopt standards. A small percentage (10 percent) had already adopted a location-identification standard, and even fewer had adopted



a product-identification standard, but, encouragingly, a majority (about 60 percent on each) of respondents thought their organization would adopt both within three years.

All of this, however, may mean nothing if the various systems differ, which could create more roadblocks to communication. Importantly, an overwhelming majority – 88 percent – of those organizations moving toward the adoption of data standards will use the same systems: Global Trade Item Numbers, or GTINs, and Global Location Numbers, or GLNs. Developed by the health care function of GS1, a global organization that designs and implements global product standards to improve efficiency of the supply chain, GTINs and GLNs are the formal, proper names for product-identification and location-identification standards, respectively. Together, they function as the universal language that Nachtmann mentioned: One language to identify and locate objects. The latter function is critical, Nachtmann says, because some systems are so large and complex that they often have multiple billing entities – one number for the main hospital and a different number for the children’s hospital, for example. In the most extreme cases, she and Pohl found systems that had billing-location numbers broken down by floor or offices within the same building. Inconsistent naming schemes led to confusing and chaotic situations in which there were multiple codes for the same provider. For example, delivery and billing problems abound in a situation such as this:

- SAINT JOHN’S QUEENS HOSPITAL 1100004570208
- ST JOHN’S QUEENS HOSPITAL 100084547
- SAINT JOHNS QUEENS HOSPITAL JAOE
- SAINT JOHN’S QUEEN HOSPITAL 50003000431
- SAINT JOHN’S QUEEN’S HOSPITAL CA2053
- ST. JOHN’S QUEENS HOSPITAL OM 12345

Establishing Global Location Numbers does not mean that providers must limit the number of unique billing entities, Nachtmann says. Hospitals and health care systems could set up as many numbers or codes deemed necessary to implement their billing, supply-chain and logistics operations. But, to avoid confusion generated by the above example, providers must use only one number for each unique location.

“There is a strong movement across the health care supply

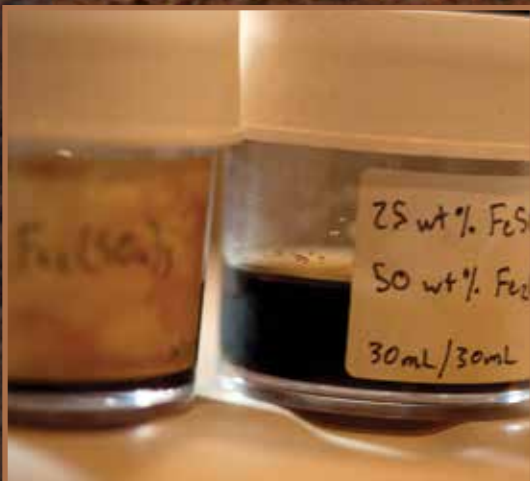
chain to implement location and product identification standards,” Pohl says. “But the implementation of these standards by individual organizations will do little good if the supply chain partners of those organizations choose not to implement the same standards. Most organizations formally encourage adherence, we found. I think there will be more compliance and cooperation over the next three years, and I think we’ll see significant progress toward universal standards for data. The research was sponsored by the Center for Innovation in Healthcare Logistics and the Association for Healthcare Resource and Materials Management, a national association for health care supply chain and materials-management professionals. The Center for Innovation in Healthcare Logistics is an industry-university partnership that leads a nationwide effort to identify and foster systemwide adoption of health care supply chain and logistic innovations. The center facilitates collaboration among researchers at the University of Arkansas, health care provider organizations and industrial sponsors, including Wal-mart Stores, regional Blue Cross Blue Shield companies, VHA Inc., the Association for Healthcare Resource & Materials Management, Procter and Gamble and IBM. The center began operations in May 2007 and has sustaining funding of more than \$3 million for five years. ■

Experienced industry professionals know that data standards increase compatibility, reduce redundancy and improve collaborative exchange. Their ideas and efforts have only intensified as health care costs have risen at an unsustainable rate.

Bringing Space Science Down to Earth

By Melissa Lutz Blouin

Four young astronomers and planetary scientists are investigating everything from the weight of dark matter – think several billion times the mass of the sun – to differences at the neutron level, all to tell us more about the universe we live in.



Top left: Chevrier and graduate students in the Arkansas Center for Space and Planetary Sciences study the flow of liquids in soils to better understand the gullies found on the surface of Mars.

Middle and bottom left: Chevrier uses different chemical compounds known to be found on Mars to study the interactions of these compounds under the temperatures and pressures found at the surface. By doing so, they have made a comprehensive model of how brines, which are combinations of salts and water, behave on the planet's surface.

Photo courtesy of NASA

SIFTING THROUGH DIRT FOR CLUES TO PLANETARY ORIGINS

Vincent Chevrier did not set out to study dirt. But as a geochemist at the Arkansas Center for Space and Planetary sciences, his research into the soil composition and chemistry of Mars has provided a fascinating challenge that made up for moving from rocks to mere bits of dust.

In fact, soil on Mars has become the focal point for much scrutiny, as it may contain clues as to the history of and current presence of water – and possibly life – on the planet.

“We know from our experience on Earth that life can evolve almost anywhere,” said Chevrier. Microbes have been found in most of Earth’s extreme environments – in radioactive sites, at freezing and boiling temperatures, in strong acids. “There are only two things you need. First, you need liquid water. Then, you need an energy source.”

How do scientists study the environment and possible inhabitants of a planet that lies between 36 million and 250 million miles away from Earth, depending upon the two planet’s orbits? At the University of Arkansas, scientists use the Andromeda Chamber, a planetary environmental chamber that can be set to the atmospheric conditions found on different planets throughout the solar system.

Studying the geological and chemical processes under Martian conditions in the environmental chamber helps researchers form ideas of the history of Mars, which is relevant to the search for current life there.

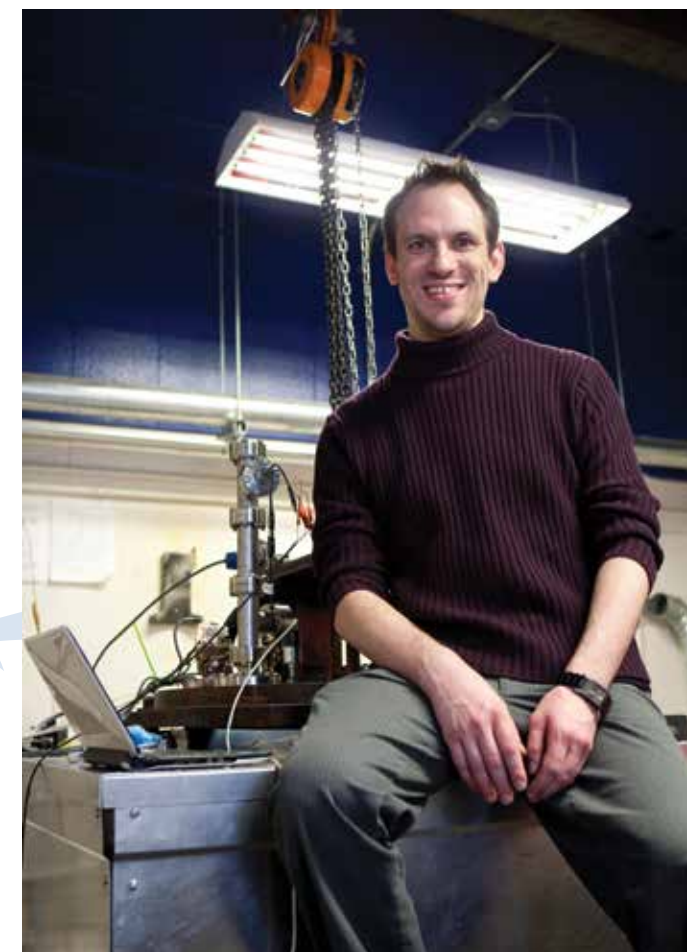
“We’re pretty sure there was a lot of water on Mars about four million years ago,” Chevrier said. “The question is: Where did the water go? We don’t know the answer yet.”

Scientists do know that huge ice deposits exist on the planet. They also have detected salts of various kinds, including the most recent discovery of perchlorates by the Phoenix Lander. Much as salt is used to lower the freezing point of water on icy roads, scientists suspect that salts on Mars may create brines, salty mixtures that could contain liquid water.

Chevrier and his team have designed experiments to understand the behavior of brines under Martian conditions. They have used different types of salts found on the planet and looked at what happens when they freeze and evaporate.

“From those experiments we’ve developed a comprehensive theory of brine behavior,” Chevrier said. This theory describes what happens when you have an exchange between the surface and the atmosphere.

The techniques and equations that Chevrier and his graduate students have developed for Mars have resulted



Photos by Russell Cothren

Research professor Vincent Chevrier uses a planetary environmental chamber, pictured behind him, to study the chemical processes that take place on the surface of planets such as Mars.

in a \$790,000 grant from NASA and the university to study Titan, the largest moon of Saturn.

Titan is the only satellite in the solar system that has a substantial atmosphere. The atmosphere is about 95 percent nitrogen, with small amounts of methane, hydrogen and hydrocarbons. The temperature of Titan’s surface is –290 degrees F, so no liquid water exists on the moon’s surface. However, the space mission Cassini Huygens showed that liquid methane lakes, clouds and snow-topped mountains suggest a complex “hydrologic” cycle on Titan that involves organic molecules. Chevrier’s research will help determine the short and long term stability of light organic volatile compounds such as methane and ethane on the surface and subsurface of Titan. Knowing this could also help explain how the planet evolved and provide insights into the origins of the solar system.

SOLVING PLANETARY PUZZLES ONE NEUTRON AT A TIME

Other scientists take a different approach to studying the solar system: They look at the little picture.

For instance, to get at the origins of the planet Earth, geochemist Fangzhen Teng studies the humble neutron.

Neutrons don't get much respect in the atomic world; they don't see much action, unlike protons and electrons. Chemically speaking, they don't add or detract anything from the atoms they reside in.

Yet some elements contain slightly different numbers of neutrons. Called isotopes, these related but distinctly different entities originate in different ways from different sources, and studying them can lead scientists to new insights about the world we live in.

In elementary school, students learn that the planet we live on has a core, mantle and crust. But although scientists have a general idea of how the Earth formed, they know little about its evolution.

"There are three layers of the Earth, like an egg," Teng said. He uses isotopes to study how the Earth's crust has evolved over time, and how the crust and the mantle interact with one another.

"Isotopes are very sensitive to sources," Teng said. "We can use isotopes as a tool to attack these problems."

Teng uses the isotopes of three different elements to address different questions: magnesium, iron and lithium. Magnesium and iron isotopes behave in similar ways, but iron can separate into two oxidation states, which makes it useful in determining how planets formed.

In a paper published in *Science*, Teng and his colleagues reported that they found iron isotope fractionation, or separation, in basalt samples from the Kilauea Iki lava lake on the main island of Hawaii.

Teng likens the change in iron isotopic composition in basalts to the baking of a cake: With a cake, you start out with certain ingredients, but the baking process changes the ingredients and their proportions within the cake. In the same way, the process that makes basalt magma through partial melting of the mantle peridotites, or rocks, changes the iron isotope compositions.

If basalts from the moon or Mars have similar iron isotope separation, it suggests that they formed through heat processes similar to those on Earth. However, if rocks from these planetary bodies do not have iron isotope separation, it suggests that they were formed in a different way.

More recently, Teng has examined magnesium isotopes in the Earth's mantle and compared them to the isotopes



Photos by Russell Cothren

Fangzhen Teng, assistant professor of geosciences, prepares samples for study in the lab. Teng studies isotopes, elements with different numbers of neutrons, which can tell scientists important information about how planets formed.

from meteoritic material. Magnesium makes a particularly good marker for planetary origins because, first, isotopes of magnesium can be separated during evaporation and condensation in the solar system and, second and more uniquely, one isotope of magnesium, Mg26, is a decay product of Al26, which existed in the early solar system for less than 5 million years. Thus, materials with different origins and ages contain different amounts of Al26, which results in different amounts of magnesium isotope.

Teng's group analyzed different types of rocks from different depths of the Earth's mantle from a site in North China and compared the results to those of samples from chondritic meteorites. They looked at magnesium isotopes in samples from the whole rock, but they also separated out minerals from the rocks and examined the magnesium isotope composition of these minerals as well.

"The samples from Earth were slightly different from one another," Teng said. Their compositions also matched closely with those of the meteorites, suggesting that Earth formed at the same time as much of the meteoritic material in the solar system.



left: A sample from the moon.

Center: Teng and his colleagues must work in a clean room because the chemicals used to examine the isotope compositions react easily with salts from human skin.

Right: Chemicals used as standards for comparison with the geological samples. Big picture: Isotopes found in olivine crystals, such as the ones shown here in this rock, contain clues to the evolution of Earth and of the solar system.

BLACK HOLES, QUASARS, SPIRAL ARMS AND DARK MATTER

While Chevrier and Teng concern themselves with planetary origins and evolution, astronomers Daniel and Julia Kennefick have more distant concerns – the closest being about 1,174,917,830,400,000 miles away. The Kenneficks study the origins and evolution of galaxies.

“We’re looking at how galaxies form, work and evolve,” Julia Kennefick said.

Together with astronomy professor Claud Lacy and astronomer Marc Seigar from the University of Arkansas, Little Rock, they are part of a research group known as AGES, the Arkansas Galaxy Evolution Survey. They are surveying galaxies with active, growing supermassive black holes, using techniques to “weigh” the black holes in their centers.

In 2008, researchers in the AGES group showed that a relationship exists between the mass of the black hole at the center of a galaxy and the angle of the spiral arms that spin out from the galaxy’s center. The smaller the pitch angle of the spiral, the larger the black hole mass at the galaxy’s core. The larger the pitch angle of the spiral, the smaller the black hole in the middle. The researchers will use this relationship to estimate the masses of galaxies from extensive archives of images provided by large telescopes, such as NASA’s Hubble Space Telescope. In addition to surveying galaxies and estimating the masses of black holes, the Kenneficks are trying to explain how the relationship between the spiral arm pitch and the black hole mass works.

“Now we’re really at the ‘why’ stage: How does a galaxy work, and why are these two things related?” Julia Kennefick said. “We’re trying to find a link between the two things.”

The AGES project will allow the researchers to study hundreds to thousands of galaxies and the black holes at their centers so they can begin to see patterns.

They also are trying to solve a mystery: The Case of the Missing Black Holes.

Looking back in time, scientists can detect massive black holes in distant quasars, which look like they weigh up to 18 billion solar masses. But younger galaxies appear to have smaller black holes, leading Julia Kennefick and others to ask: Where are all the large black holes now?

“They shouldn’t have disappeared. They should still be there,” she said. “They are there – we just can’t detect them anymore. They are quiescent.” But if the spiral structure of a galaxy gives scientists a way to estimate the size of the

quiescent black hole hidden at the center, perhaps the largest black holes can be found after all.

The black holes may provide a way to trace the evolution of galaxies, but the black holes themselves remain a puzzle.

“We really don’t know how they work because we can’t see them directly,” Julia Kennefick said.

The mystery may be a matter – of dark matter, that is. “Dark matter” refers to the unseen, undetected material that seems to exert influence on the universe and cannot be explained by conventional matter as it is understood today.

“Dark matter doesn’t react to light or other electromagnetic radiation,” said Daniel Kennefick, “But it does have gravity.” A recent paper suggests that the density of dark matter controls how well a black hole can grow.

Dark matter also might help explain certain characteristics of galaxies that are poorly understood. For instance, researchers expect galaxies to behave as if their masses reside towards their centers, where most of the starlight comes from, but this turns out not to be the case. Also, the laws of gravity suggest that if two galaxies meet, they should pass through one another. Instead they form a deep “hole” from which they can’t escape.

“The dark matter may explain why galaxies merge and why you get clusters of galaxies,” Daniel Kennefick said. It also may explain why the spiral structure of the galaxy should be related to the size of its black hole. Astronomy professor Claud Lacy is studying binary black holes of merged galaxies to determine the characteristics of such combinations, again allowing researchers to better understand how dark matter, black holes and galaxy shapes interact with one another. ■



Daniel and Julia Kennefick study the evolution of galaxies.

Photo by Russell Cothren

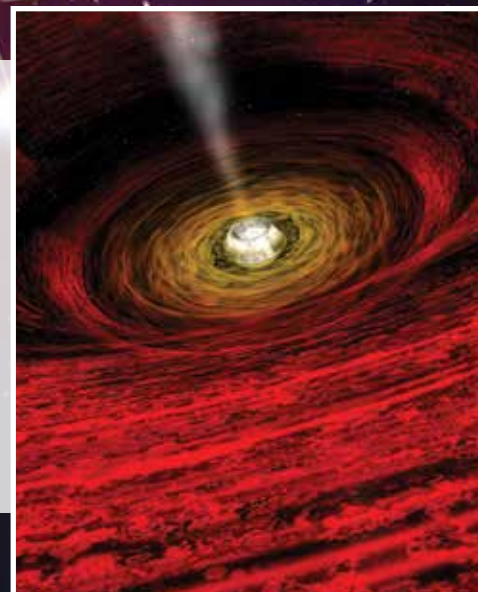
Large picture: The matter in galaxy cluster 1E 0657-56, also known as the “bullet cluster”, is shown in this composite image. At 3.4 billion light-years away, the bullet cluster’s individual galaxies are seen in the optical image data, but their total mass adds up to far less than the mass of the cluster’s two clouds of hot X-ray emitting gas shown in red. Representing even more mass than the optical galaxies and X-ray gas combined, the blue hues show the distribution of dark matter in the cluster.

Right: In the center of a swirling whirlpool of hot gas is likely a beast that has never been seen directly: a black hole. Studies of the bright light emitted by the swirling gas frequently indicate not only that a black hole is present, but also likely attributes.

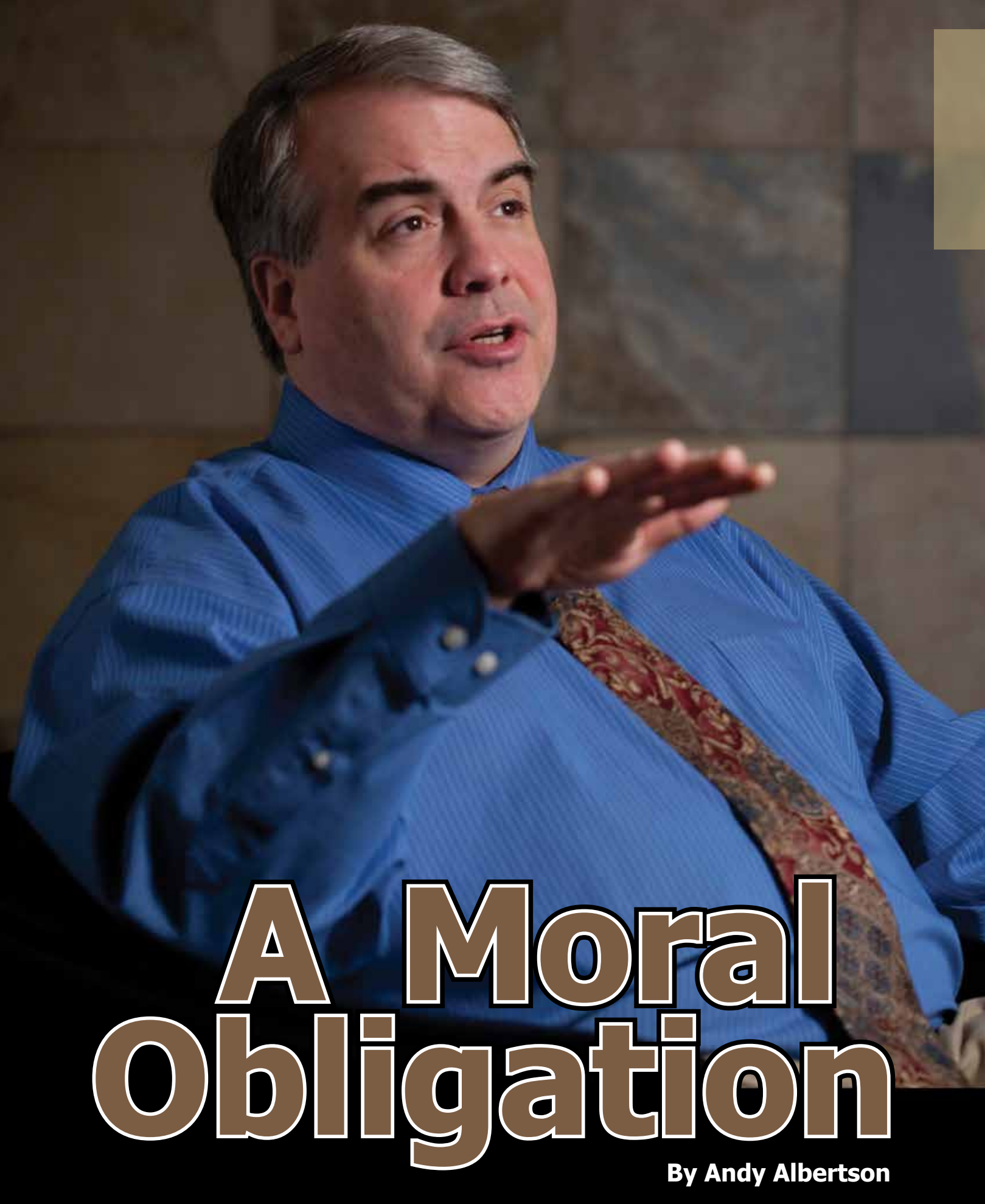
Left: The two bright sources at the center of this composite X-ray (blue)/ radio (pink) image are co-orbiting supermassive black holes powering the giant radio source 3C 75. Surrounded by multimillion degree X-ray emitting gas, and blasting out jets of relativistic particles, the supermassive black holes are separated by 25,000 light-years.



NASA / CXO / D.Hudson, T.Reppich et al. (ATFA)



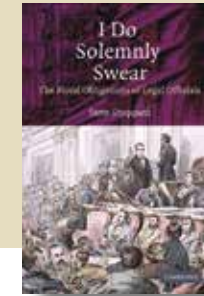
X-ray: NASA/CXC/GA/ M.Martini et al.
April Hobart, CXO



Question and Answer with Steve Sheppard

William H. Enfield Professor of Law

Sheppard is the author of *I Do Solemnly Swear: The Moral Obligations of Legal Officials*, published in 2009 by Cambridge University Press.



Q Why did you decide to write *I Do Solemnly Swear*?

Sheppard: I get mad at newspapers and the television when I see presidents, governors, senators, and others say they have no choice but to do something stupid, and they blame the law. It is not the law's fault. The law is not that stupid, and it deserves better. This book explains why – and how the law should be served by these people.

How long did it take you to write the book?

Sheppard: Not long – about ten years. But I had the advantage of having written several articles and a master's thesis on little bits of the problem in advance.

Did you experience any significant challenges while writing the book?

Sheppard: Lots. It is a big question – why the law deserves better and how it should be served – and it is a question for which people think they know the answer. It really took a lot of work not only to read the arguments people have made for the past 2,500 years but also to figure out what makes sense in our time and what makes sense for American law, and maybe for law everywhere and all the time.

Did you know the answer before you started?

Sheppard: I thought I knew the answer before I started, but I was wrong. I was lucky to have some really good teachers – people like H.L.A. Hart, Ronald Dworkin, and John Finnis – and I thought I could answer the question using their books. I did use some of their arguments, but to make them effective so a lawyer or a judge could use them I needed two old lawyers – Cicero and a German judge named Leibniz. These are thoughtful people who had the benefit of doing the law, and the practicality of their arguments made my teachers' more abstract arguments come together.

Do you use examples in your book?

Sheppard: Yes. I think it is hard to understand the law in the abstract and much easier to understand in cases. I used law in the American colonies to illustrate my points. Maybe I should say I studied them to figure out my points.

One of the biggest disasters in American law was the colonial trial of the people accused of witchcraft in Salem. Success or failure there depended on how the judges did their job. Those who studied and were thorough and used the law had few problems.

Those who played politics or did what others wanted or listened to arguments based on fear, or religion, and not on evidence – those folks killed a lot of innocent people. Salem is a story you can learn things from. But I use a lot of other stories. I looked to people like Pontius Pilot and to stories like Herman Melville's. And I looked at some famous cases, like Bill Clinton's and Tom DeLay's. I tried to learn something that we all can use to make the system better.

So, how does the legal system work?

Sheppard: The legal system depends upon officials doing their jobs as human beings. The legal system is not a machine with cogs. In order for the system to succeed, officials must write laws that are fair and effective and provide the people bound to those laws with the security, economy, and hope that they and the community need. But laws well written are not enough. Other officials must act toward every person with equal care and must pursue the truth in every question – even if it takes time and money. They may not allow the system itself to become oppressive or captive to those with influence. Every official must have enough discretion to see that laws pursue truth and justice in a meaningful sense for every individual.

It is terribly dangerous to think of justice as anything but for the individual. The theories of justice now popular in universities are too grand. They ignore the law, which must always be about justice for the individual: it is the personal responsibility of every official to ensure that justice for each person within their power.

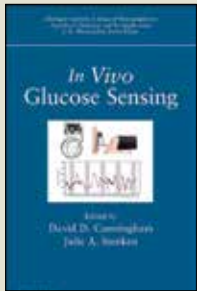
In the book, I call this a retail model of justice, but most theories of justice today are wholesale. These theories tend to ignore the requirements of office that make retail justice more likely: hard work, investigation, skepticism, but above all the ability to listen to the people one is about to deprive of some opportunity by law to ensure that nothing is overlooked.

This might seem pretty obvious, but it isn't how people talk about justice very often today. In fact some think officials aren't supposed to do this work but just be mindless tools to implement rules written on pieces of paper. The law requires much more than this.

Who do you hope reads *I Do Solemnly Swear*?

Sheppard: I suppose there is something in the book for everybody. I would like officials to read it to understand better what most people with such jobs already understand – their jobs are hard, maybe impossible. But the book also will give them tools to do them better. In a democracy, though, all of us are officials. All of us are accountable. It is, after all, all our fault. ■

Photo by Russell Cothren



In Vivo Glucose Sensing

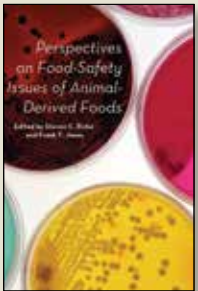
Edited by Julie Stenzen
and David D. Cunningham
John Wiley & Sons.

Scientists hope to provide people who have diabetes with a glucose monitoring system that doesn't require needle sticks and lasts for six months or more, but they are still a long way from this goal. A new book edited by Julie Stenzen, Twenty-First Century Chair in Proteomics, and David D. Cunningham of Abbott Laboratories brings together current research and outlines the challenges that remain on the path to creating a better glucose monitor.

The book provides state-of-the-art information on glucose monitoring to clinicians and medical educators. Scientists striving to make sensors that monitor glucose in real time struggle with two major challenges: First, researchers must address the foreign body reaction, where a person's body tries to wall off the implanted material from healthy tissue.

This problem plagues current implanted sensors, since they require frequent finger-sticks to recalibrate due to the walling off process. And after seven days, these sensors cannot be used for making clinical decisions and must be replaced.

Second, researchers working on pain-free optical-based measurements struggle with the variability of blood chemistry and tissue differences from person to person. This causes challenges for sensor calibration. ■

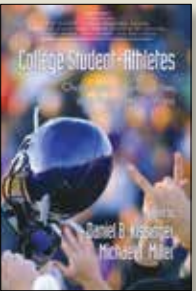


Perspectives on Food-Safety Issues of Animal-Derived Foods

Edited by Steven C. Ricke
and Frank T. Jones
University of Arkansas Press

As recent stories in the news have shown, maintaining the integrity of the food supply is of critical importance to the consumer. Thousands of Americans die each year from food-borne illnesses, and millions more get sick. Strides have been made to reduce the incidence of food-borne diseases originating from animal-derived foods, but food safety and food-borne pathogens remain problematic. Food-safety scientists conduct research to understand causative factors in food-borne pathogen prevalence and to develop novel ways to limit contamination.

The 24 essays in this book highlight research from the Food Safety Consortium, established in 1988 by Congress as a research alliance of food-safety scientists at the University of Arkansas, Iowa State University, and Kansas State University. Scientists review findings in five areas: pre-harvest food-borne pathogen ecology and intervention strategies, post-harvest food-borne pathogen ecology, rapid methods and detection strategies for food-borne pathogens, antibiotics and antimicrobials in food safety, and emerging issues in food safety. ■



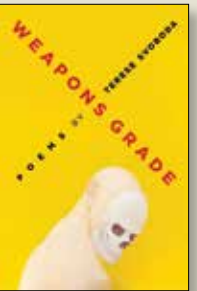
College Student-Athletes: Challenges, Opportunities, and Policy Implications

Daniel B. Kissinger and Michael T. Miller
Information Age Publishing

College Student-Athletes examines a little-studied subpopulation of college students, student-athletes. Education professors Kissinger and Miller have assembled an eclectic group of scholars to explore the personal, academic and policy issues facing student-athletes. The volume aims to start a discussion about student-athletes "from the perspective of students first, athletes second" as well as to "introduce significant points to the conversation about the physical, mental and academic welfare of athletes."

The editors note that, outside the athletic realm, there is limited awareness of the resiliency required of student-athletes to navigate all the normal developmental events that all students face in college as well as "the unique challenges inherent in the student-athlete experience." Student-athletes balance competing responsibilities, among them athletic and academic obligations.

The range of essays reflects the array of challenges facing student-athletes. The volume concludes with a discussion of policy implications for college athletic enterprises. ■



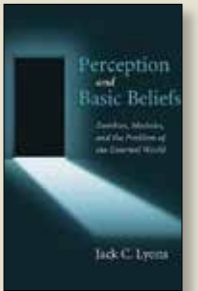
Weapons Grade: Poems

Terese Svoboda
University of Arkansas Press

In her poetry Terese Svoboda walks out to the edge where language is made and destroyed. Her subject is human suffering. Her work is often the surreal poetry of a nightmare yet is written with such wit, verve, and passion that she can address the direst subjects.

Weapons Grade is a collection of poems about the power of occupation – political and personal. They often play with sestina, sonnet, and couplets, as if only form can contain the fury between the occupier and the occupied. There's a pervading sense of dread, of expiation, of portents – even in potato salad. There's also elegy and lullaby and seduction but, in the words of the sixties tune "Wooly Bully," the reader must "Watch it now, watch it." The poems veer from the political to the personal, then finish on the elegiac, releasing complex and unexpected meaning with emotional precision. Looking directly into the contemporary apocalyptic, *Weapons Grade*, Svoboda's fifth collection of poetry, draws readers back to the radiant present.

Svoboda is the author of ten books of prose and poetry, most recently *Black Glasses Like Clark Kent* that won the Graywolf Nonfiction Prize. ■



Perception and Basic Beliefs: Zombies, Modules and the Problem of the External World

Jack C. Lyons
Oxford University Press

Perception and Basic Beliefs: Zombies, Modules and the Problem of the External World, by Jack C. Lyons, associate professor of philosophy, has been published by Oxford University Press. In it Lyons offers solutions to two closely related problems in epistemology. One problem involves the difference between seeing that something is the case and believing it on the basis of what we do see. The second problem is that of specifying which beliefs are epistemologically basic; that is, which beliefs are directly or non-inferentially justified and which are not. Lyons offers an externalist theory, arguing that what makes a belief a basic belief or a perceptual belief is determined by the nature of the cognitive system, or module, that produced the beliefs. He develops a general theory of basic beliefs and argues that perceptual beliefs are a species of basic beliefs. *Perception and Basic Beliefs* provides a positive solution to the traditional problem of the external world. ■



Interpreting a Continent: Voices from Colonial America

Kathleen DuVal and John DuVal, editors
Rowman & Littlefield

A new anthology considers colonial history from multiple perspectives. In addition to English-speaking explorers, settlers, revolutionaries and lawmakers, editors Kathleen DuVal and John DuVal give voice to those who spoke and wrote in French, Spanish, Dutch, German, Russian and Icelandic.

The editors supplemented documents with maps and photos of pottery and leather art, as well as accounts collected and translated by Europeans at the time.

Reports were written sometimes literally under the gun, such as Gov. Antonio de Otermín's account of the Pueblo Revolt of 1680:

"Feeling some respite thanks to this miraculous success, even though I had lost much blood having survived two arrows in my face and, miraculously, a harquebus ball in my chest the day before, I set about getting the cattle to drink, and the horses, and the people."

Kathleen DuVal is a history professor at the University of North Carolina, Chapel Hill. English professor John DuVal is former director of the program in literary translation at the University of Arkansas. ■

What makes hair go gray?

Bill Buron, assistant professor of nursing in the College of Education and Health Professions, replies:

Understanding the process of going gray begins with a brief review of basic physiology. Melanocytes surrounding each hair follicle inject a special blend of dark (eumelanin) and light (pheomelanin) pigment, or melanin, into each hair strand during normal hair growth. A progressive decrease in melanin with aging will eventually lead to gray, and then white hair. While it remains unknown what causes a reduction in melanin, some theories exist. For example, some researchers suggest that melanin production is regulated by a “melanogenesis clock” that slows over time. Others suggest that melanocyte stem cell failure, resulting in a reduction of melanocytes over time, causes graying of hair. More recently, a research group found that physiologic stress in the form of ionizing radiation caused irreparable damage to DNA and the renewal of melanocyte stem cells in mice. Finally, another group of scientists suggest that a natural process of bleaching by hydrogen peroxide causes gray hair. The investigators found low levels of catalase, an enzyme known to break down hydrogen peroxide, and high levels of hydrogen peroxide in gray hair shafts. In addition, they found low levels of tyrosinase, an enzyme important to melanogenesis in hair follicles.

While it is becoming more evident that gray hair may be caused by a number of factors, perhaps the best indicator is genetically linked, and expressed at similar ages within families. This ongoing research may be especially exciting for those who seek the fountain of youth through gray hair prevention and reversal; or indifferent for those who embrace the dignity associated with going gray. ■

Photo by Russell Cothran



What is a Ponzi scheme?

Tim Yeager, professor of finance in the Sam M. Walton College of Business, replies:

A Ponzi scheme is an investment pyramid that pays returns to investors from money obtained from subsequent investors, rather than from the cash flows earned from the investment. A Ponzi scheme attracts new investors by offering short-term returns that are abnormally high because the new investments are used to reward existing investors—those higher up in the pyramid. To sustain itself, the system requires an ever-increasing flow of money from new investors.

The scheme is destined to collapse under its own weight because eventually the flow of new investments will be less than the required payments to existing investors. The recent collapse of the Bernie Madoff investment fund was

triggered by the recent financial turmoil, which led to an inability of Madoff to attract sufficient new investors combined with an unusually large demand for withdrawals from existing investors.

The scheme is named after Charles Ponzi, who emigrated from Italy to the United States in 1903. He set up an investment fund allegedly based on trading in international postage stamps. Ponzi was not the first to run such a pyramid scheme, but he was so successful at defrauding investors that his soon became a household name. Madoff's scheme is alleged to be the largest financial fraud committed by a single individual. Perhaps one day we may come to refer to such pyramids as Madoff schemes. ■