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UNIVERSITY OF ARKANSAS

RESEARCH FRONTIERS

SPRING 2002

SCIENCE OF THE SMALL

SOUND METHODS

YOU ARE WHAT YOU BUY

A SENSE OF PLACE

Internet: www.uark.edu



John A. White
Chancellor

Message from the Chancellor:

The American Association for the Advancement of Science cited the smallest science for the biggest technological breakthrough of the year 2001. Scientists have succeeded in making electrical circuits at the molecular scale. These circuits can perform basic functions, including amplifying signals, inverting currents and performing simple computations. This marks a revolution in the field of nanoscience, one that absorbs the time of University of Arkansas researchers in physics, chemistry and engineering.

To make molecular circuits efficient and easy to use, researchers must first understand the science that governs them. Our researchers are studying the fundamental properties of “atomic sandwiches,” using a Molecular Beam Epitaxy (MBE) machine to create surfaces, quantum dots and wires one atom at a time and a Scanning Tunneling Microscope (STM) to observe these structures.

Few institutions in the country have access to both types of equipment simultaneously, but thanks to the foresight of the Arkansas State Legislature, the National Science Foundation and our researchers, we now have one of the top facilities in the country for such work. Results coming out of University of Arkansas laboratories last year included a paper in *Science* on spintronics, the use of an electron’s spin to generate power, and a paper in *Nature* on fundamental properties of ferroelectric materials used in medical ultrasound and naval sonar.

Nanoscience research on campus is further supported by a multi-year NSF grant for a Materials Research in Science and Education Center (MRSEC), which helped create the Arkansas-Oklahoma Center for Science in Physics and Nanostructures (CSPIN), a joint effort of the University of Arkansas and the University of Oklahoma. The other institutions that received MRSEC awards the same year include the California Institute of Technology, Pennsylvania State University and the University of Virginia.

Our researchers work at the forefront of a potential revolution in science. The National Nanotechnology Initiative, an interagency government group that works to support the future of this promising technology, cites creating novel materials, building designer drugs, saving billions in energy costs and reducing pollution as a few of the advances this technology could bring to the world.

You will learn more about this exciting research in the pages that follow.

Happy reading,

John A. White
Chancellor, University of Arkansas

WHY DO HUMANS HAVE A SENSE OF SMELL? AND WHY ARE SOME THINGS (LIKE SKUNK SPRAY) SMELLY, WHILE OTHER THINGS (LIKE ALUMINUM CANS) ARE NOT?

William Etges, associate professor of biological sciences, replies:

A scent or odor is a chemical or mixture of chemicals that can be detected by smell or physical contact. We are 10,000 times more sensitive to smells than taste. Humans can detect thousands of different odors because they possess about 10 million receptors for these chemicals in the olfactory lining of the nose. Dogs have 200 million! Everything from the thousands of varieties of perfumes and the smell of fresh mown grass to road kill on a hot summer’s day and a skunk’s spray can be detected by these olfactory receptors. Organisms produce these chemicals for a wide variety of reasons—some are known as pheromones like musk to attract members of the opposite sex for mating. Migrating salmon can “smell” the stream they hatched in from the ocean. Plants produce compounds to attract insect pollinators. Not all are perceived by humans as “pleasant”—the world’s largest flower (2 meters wide) produced by the tropical *Titan arum* plant smells like decaying flesh to attract pollinating flesh flies. Predators will remember to avoid skunks on their menu once they have been sprayed. Why these smells are

generally perceived as “bad” and others are pleasant is probably the way this information is perceived by the brain. It is not well understood but varies among organisms. The smell of rotting meat or vegetables has probably been associated with the health risks of eating them since man’s early history. ■



Russell Colgren

WHY DOES YOUR VOICE BECOME SQUEAKY WHEN YOU INHALE HELIUM?

John Ewbank, professor of chemistry and biochemistry, replies:

Many of us have experienced the effects of helium on our speech. Our voices are sometimes said to “squeak” or to sound like Donald Duck. The basis of this effect is very simple, but the details are quite complicated.

The main effect of a gas on sound is to control its speed. In air, which is mostly nitrogen, sound travels at about 350 meters per second. This is why a clap of thunder follows the lightning flash by about 5 seconds for each mile of distance. However, in a “lighter” – or lower density – gas like helium, the speed is nearly three times faster; likewise, a heavier gas slows the sound.

During speech, the vocal chords generate a fundamental frequency that is accompanied by a set of harmonics – higher frequency multiples of the fundamental. The spacing of these harmonics is determined by the shape and size of the vocal tract, which constantly changes during the formation of words. At any given time, some of these harmonics will match the vocal tract configuration and be reinforced, or resonate, while others will be dampened.

When helium is present, the speed of sound increases, shifting the resonance to higher frequencies for a given arrangement of the vocal tract. Thus, the so-called “timbre” of the voice is now dominated by sounds that occur at higher frequencies, leading to the squeakiness or the “Donald Duck” effect.

For a detailed explanation see the University of South Wales Web site: www.phys.unsw.edu.au/PHYSICS_1/SPEECH_HELIUM/speech.html. ■

Got a question? Send it to UA Q & A, 800 Hotz Hall, Fayetteville, AR 72701, or send questions by e-mail to <blouin@uark.edu>.

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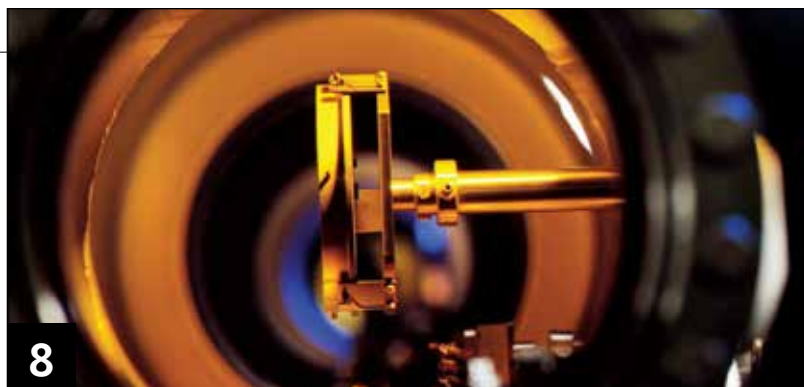


RESEARCH
FRONTIERS

OUR Job # 01-192, Research Magazine Spring 2002

SMALLSCIENCE

Researchers in physics, engineering and chemistry push the limits of size to understand basic questions at the nano-scale level. By doing so, they must learn the laws and principles of a new kind of physics that doesn't follow established scientific "rules."



Cover Photo By Russell Cothren

SOUNDMETHODS

Employers often balk at the challenge of integrating people with hearing loss into the workplace. Researchers at the University of Arkansas show them how to do so with ease and help deaf and hard of hearing individuals thrive in the workplace.



BUY/PASS

Marketing research at the University of Arkansas shows why people buy and don't buy certain items. Their work shows that such decisions can't always be predicted by traditional surveys.



STAGESCENE

An architecture historian examines the sense of place and myth that developed in New Orleans over 100 years. She traces the city's history from the French Quarter to replicas at Disney World.



2 Research Briefs

Vintage violin; job stress; mothballed submarines; disappearing Petra; hate sites/fan sites; communication disorders and caregivers; edible proteins; political activism in the disabled community.

6 Field Notes

Business and law take two researchers on separate journeys to Harvard and Japan.

30 In Review

Books by faculty from sociology, history, anthropology, business, English and the University of Arkansas Press.

33 UA Q&A

Why do some things have a scent, while others don't? Why does your voice turn squeaky if you inhale helium?

Cover: Physicists, chemists and engineers use a Molecular Beam Epitaxy machine to create devices one atom at a time. They study quantum dots, semiconducting surfaces and the optical properties of their creations to determine the underlying rules of nanoscience.

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UREL JOB # 01-192, Research Frontiers Magazine, Spring 2002

Photos By Russell Colthren



From left, research specialist Earsie deFeliz, food scientist Navam Hettiarachchy and master's degree candidate Chun Kai Yang work with a machine that produces an edible protein film. Hettiarachchy's research has shown that soy protein films can be impregnated with an antimicrobial agent to provide an effective barrier against *Listeria monocytogenes*, a pathogen that can cause food-borne illness. The tomatoes on the left are wrapped in soy protein. The ones to the right are not.

PROTEIN FILM PROTECTS AGAINST FOOD PATHOGENS

An edible protein film made from soybeans can help protect refrigerated and pre-cooked, ready-to-eat food from dangerous bacteria.

Food scientist Navam Hettiarachchy has produced edible films from soybean proteins that can be coated right on food products or used in place of plastic wrap for prepackaged foods. These films can be impregnated with antimicrobial agents that inhibit growth of bacteria such as *Listeria monocytogenes*.

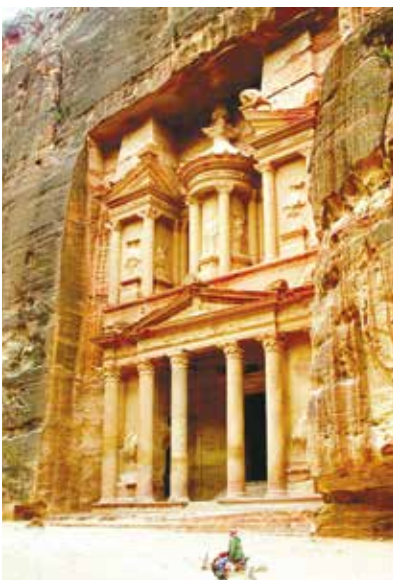
"Soy protein films have the potential to meet a demand for biodegradable packing material, and these films can function as carriers of antimicrobials that help protect against food-borne illnesses," Hettiarachchy said. "We're trying to learn the properties of protein films that will work best as carriers for release of antimicrobials."

Two of the most important of these characteristics, she said, are their ability to either dissolve or resist dissolving when in contact with water.

The films are applied to foods by wrapping them in a dry film or by spraying them with a liquid that dries into a protective coating. Because they are edible and have no effect on flavor, they can be prepared and eaten with the food, leaving nothing to remove and throw away.

"Our tests have shown that these edible films can act as suitable carriers for delivering effective antimicrobials to the surfaces of food products," Hettiarachchy said. "They have promising applications for pharmaceuticals, fruits, vegetables and meat products." ■

Photo Submitted



PETRA DISAPPEARING UNDER TOURISTS' FEET

The colorful sandstone walls of an ancient city may disappear under the weight of tourists who wish to see it, according to a geosciences professor.

Petra, a World Heritage Site two hours from Amman, Jordan, attracts international tourists, whose numbers have increased nearly tenfold in the past decade. These crowds may be crumbling the site as they breathe, says geosciences professor Tom Paradise.

Paradise works with the Petra National Trust – a Jordanian non-governmental organization. He studies the deterioration of the sandstone at Petra, seeking to determine the effects of sandstone composition, climate, sunlight and tourism on the disintegration of the structures.

He and graduate student Mick Frus measured the interior humidity of Al-Khazneh – popularized by the movie "Indiana Jones and the Last Crusade." They found that when 35 or more people occupied the interior for more than five minutes, the humidity levels rose from 40 to 60 percent – enough to cause severe deterioration of the tombs' internal structure. During the peak tourism season, 35 or more people occupy Al-Khazneh almost all day, Paradise said.

"Certain things in Petra have deteriorated more in the past 10 years than in the past two thousand," Paradise said.

Paradise reported his findings to the UNESCO World Congress in Venice, Italy, last year.

Based on these concerns, the Ministry of Antiquities in Jordan closed the interior of Al-Khazneh to tourists in the summer of 2001. ■

RINGS TELL TALE OF STRINGED HISTORIC INSTRUMENT'S ORIGIN

Malcolm Cleaveland, professor of geosciences, and his colleagues used tree ring records to accurately date the wood used in a famous violin purported to be made by Stradivarius and showed that the wood was hewn during the violin maker's lifetime.

The violin bears the name Messiah and is believed to be one of the instruments made by the famous violin maker Antonio Stradivarius. After a colorful past, the instrument landed in the Ashmolean Museum at Oxford, England.

Four years ago an expert declared the Messiah a fake. The controversy escalated as a British investigator dated the instrument to the 1680s, while a German tree ring expert put the date in the late 1730s – too late to be an authentic Stradivarius. The British investigator measured the violin itself, while the German researcher measured the rings using photographs.

A panel of American dendrochronologists measured the tree rings in the Messiah. The researchers brought specialized equipment to the Ashmolean, where they measured the tree rings lying beneath a coat of varnish on the front piece of the violin.

The researchers compared the rings to tree ring chronologies for Norway spruce found at high altitudes in the Alps of Austria, Italy, Germany and France. They also compared the Messiah tree rings to those of another famous instrument, the Archinto, which they

measured at the Royal Academy of Music in London. The Archinto, a confirmed Stradavarius dat-



Geoscientist Malcolm Cleaveland examines the Messiah, an instrument purportedly made by Stradivarius. Cleaveland and his colleagues dated the wood to the violin maker's lifetime.

Photos Submitted

ing back to 1696, had more rings for comparison – 159 versus 109 in the Messiah.

They were able to determine, by comparing the Messiah to the Arhcinto and the Archinto to the tree ring chronologies, that the wood in the Messiah dates back to 1686 – during the lifetime of Stradivarius.

"We can't confirm that this is a Stradivarius, but we can say that it's in the right time frame," Cleaveland said. ■

COMMUNICATION REHABILITATION SHOULD INCLUDE CAREGIVERS

Health care professionals should look at the whole family and use an individualized treatment plan for stroke victims with diminished communication abilities, says Barbara Shadden, professor of communication disorders.

"What's missing in treatment is taking the temperature of the family system on a regular basis," said Shadden.

Shadden studies aphasia, a brain-generated defect in understanding and using language that often occurs in stroke victims. She runs the university's program in communication disorders and has led a support group for stroke victims for the past 20 years.

She has noted that the sociological and psychological challenges for aphasic people and their families often take a back seat to other considerations.

"If you have a stroke, the doctor's trying to help you

live. The therapist is trying to help you to walk, to speak," Shadden said. "No one is saying, 'Where's the spouse, where are the kids?'"

Traditionally, speech and language therapists treat the brain-damaged language behavior, but that doesn't always help aphasic patients learn to re-adjust to life after a stroke or cope with their illness.

"Ideally, for intervention in cases like these, you would like to have a team," Shadden said.

Unfortunately, health care is headed in the opposite direction – emphasizing efficiency, economy and functionality. That may result in visits that treat patients generically instead of individually.

"The bottom line is that our models of aphasia must be as comprehensive as possible, even if the complexity of the model is uncomfortable," Shadden concludes. "We must consider all players affected by aphasia, standing back from our mission as patient advocate long enough to recognize that more than one set of needs must be addressed." ■

MOTHBALLED NUCLEAR SUBS CREATE ENVIRONMENTAL DISASTER

Russia's attempt to raise the sunken nuclear submarine Kursk from the bottom of the Barents Sea generated concern worldwide about radiation leaks and environmental con-tami-nation.

University of Arkansas chemical hazards expert Jerry Havens has found that concern about the Barents Sea and nearby Kola Peninsula are very real, if late in coming.

"What has already happened there is an

environmental disaster," said Havens, Distinguished Professor of chemical engineering and director of the Chemical Hazards Research Center (CHRC). "Even though it is in the Arctic, which is a particularly fragile

environment, it is a disaster that will affect the rest of the world."

Havens studied the situation recently when he served as a technical reviewer for the Technical Guidance Group of the Arctic Military Environmental Cooperation (AMEC) program, a trilateral NATO initiative comprising the United States, Russia and Norway.

Russia began decommissioning half of its nuclear-powered ballistic missile submarine (SSBN) fleet about the same time its economy collapsed. Faced with more than 100 SSBNs and no money, the Russian Defense Ministry brought the submarines to port at their nuclear naval bases on the Kola Peninsula, near the Kamchatka Peninsula, and parked them.

"Many of these seriously deteriorating submarines are over 30 years old and some are in danger of sinking at the dock," Havens explained. "These nuclear submarines pose a trans-national-boundary environmental threat primarily because of the highly radioactive spent fuel that remains in their nuclear reactors."

"It is critical that the United States participate in the efforts to prevent further damage to the environment," said Havens. "It's not just Norway's problem or Russia's problem. We are all in the same world, and if we don't work together to solve these truly international problems, eventually the pollutants released into the Barents Sea will wash up onto our own shores." ■

losing its best customers."

Many companies, uncertain of the best approach to take amid rapidly changing technologies, have relied on legal responses. The standard "cease-and-desist" approach can actually damage the company trademark and image, according to Kopp, who has identified several more effective strategies.

This is particularly true when applied to the more than 4,400 fan sites, which are developed by people who are enthusiastic about a particular product or company. Their opposite—hate sites—may be even more numerous. Almost every company and product has a detractor on the Internet. "There are hate sites for the Walt Disney Company, Barney the purple dinosaur, Macintosh computers, Chase Manhattan Bank, alternative rock music, ex-wives, ferrets, zucchini and the New York Yankees," said Kopp.

While hate sites pose obvious problems, they can also provide opportunities. Many companies monitor their hate sites because they provide feedback about products that they may not find elsewhere. ■

INCREASED EMPLOYEE CONTROL REDUCES HEALTH CARE COSTS

Increased employee control over workplace policies or procedures is the only stress-related factor that has a measurable impact on health care costs, according to University of Arkansas researcher Dan Ganster. Ganster is professor of management and chair of the management department in the Walton College of Business.

"Health care costs are the single largest, uncontrolled expense for most companies," explained Ganster. "We wanted to determine which of the many factors that have been associated with workplace stress actually contributed to health care costs."

Stress has been shown to be an important factor in employee health care costs, contributing to both mental and physical problems. Many studies have pointed to job-related stress as a factor in major health problems like heart disease. This is the first study to look at the long-term impact on health care costs of a wide range of health-related conditions affected by stress.

Ganster's study showed that individuals who felt high

demand and low control had significantly higher health care costs at the end of five years. These employees also had higher residual cortisol levels, a physiological indicator of stress. Increased cortisol levels persisted several hours after they left the job, which, according to Ganster, indicated an inability to unwind.

"It was the after-work cortisol elevations that predicted health care costs," Ganster added. "This may mean that the short-term effects that researchers usually study, such as job attitudes, headaches or interrupted sleep, don't really have much impact on overall health." ■

POLITICAL ACTIVISM GROWING AMONG DISABLED

Despite political involvement suffering a decades-long decline, researchers at the University of Arkansas and Rutgers University identified one social group in which activism has been growing. A nationwide telephone survey conducted by the two universities revealed that disabled Americans under the age of 55 have become increasingly active in political matters.

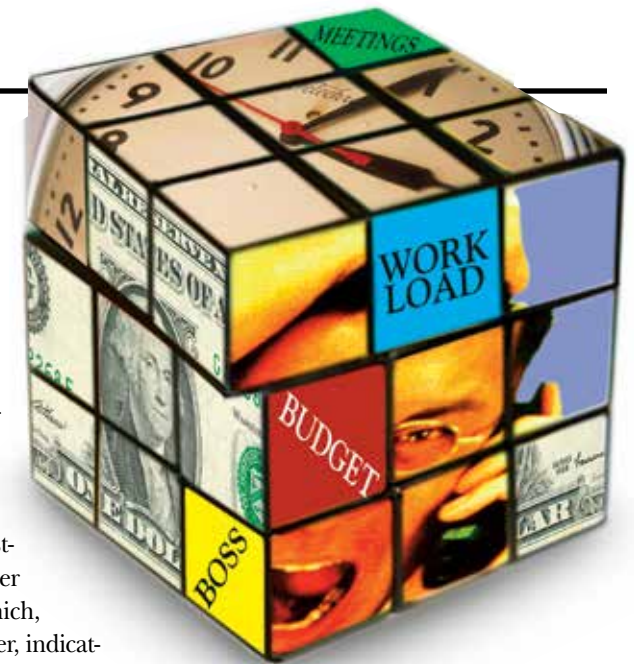
Selecting random households throughout the United States, the researchers polled 1,132 citizens with disabilities and 1,112 citizens without disabilities. Participants answered questions about their voting habits, political involvement, employment, religion, the nature of their disability, if any, and general demographics. The survey also documented group activities, civic skills, access to transportation and overall life satisfaction.

In addition to showing increased political activism among young disabled Americans, the survey allowed researchers to draw correlations between specific social activities and political involvement. Reviewing the data, UA political scientists Todd Shields and Kay Schriner found that greater levels of social integration and participation led to increased political awareness and activism among disabled individuals.

However, only one type of activity was linked to activ-

ism on behalf of disability issues. Membership and attendance at disability support groups proved to be the only predictor of disability activism – even when those groups were not politically focused. The finding indicates that the disabled community should not depend on politicians or partisan groups to raise awareness. Rather, they should use the organizations and associations already in place to rouse political consciousness within their own community.

"This study shows that the disabled community not only has a responsibility to create a more politically active and aware group of people, but it has the perfect opportunity," Schriner said. From transportation issues to educational policy and even scientific frontiers such as stem cell research – disabled people have vested interests in the outcome of those debates, she said. "Now is the perfect time for them to get involved – influencing the issues that will most impact their quality of life." ■



STRUGGLE TO PREVENT MEDICAL ERROR TAKES LAW PROFESSOR TO JAPAN

By Melissa Blouin

To err is human, but when hospital personnel err, someone's life, or health, can become endangered. Robert B. Leflar, the Arkansas Bar Foundation Professor of Law, studies how hospitals handle such errors both in the United States and Japan. He seeks to understand the effectiveness of both health care systems in preventing medical errors and in learning from previous mistakes.



Above right, Robert Leflar spent seven months on Tokyo University of Law faculty. Above, Ozone shopping street in Tokyo.

He received an Abe Fellowship that allowed him to spend a semester at the Harvard School of Public Health and seven months at the University of Tokyo.

The problem of medical error looms large on both sides of the Pacific. The Institute of Medicine estimates that medical mismanagement accounts for between 44,000 and 98,000 deaths each year in the United States. A hospital patient has a one in 25 chance of suffering from a significant preventable injury during his or her stay.

"It's a huge social problem," Leflar said. Medical errors can range from obvious mistakes such as mis-prescribed medications due to a doctor's sloppy handwriting or surgery performed at the wrong site or even on the wrong person, to subtle misjudgments about a patient's diagnosis or proper treatment course.

Leflar has pored over the legal and medical literature at Harvard and in Tokyo. He has interviewed physicians,

lawyers, health care activists, health care economists and patients. He has visited Japanese hospitals, health care companies and health care programs.

Governments in the United States and Japan have begun to take steps to prevent medical error. By examining the way these two different cultures handle a similar problem, Leflar hopes to call attention to what is working for each society.

Hospitals can learn from their mistakes, but also may face lawsuits if patients find out.

"There's a tension between creating a culture of safety in hospitals and maintaining public accountability," he said.

To develop the culture of safety, hospitals must analyze injuries and near misses to determine what went wrong and how to prevent repetition in the future.

"The problem is, it's hard to get hospital personnel to do [analyses] if they might be accessed by plaintiffs' attorneys," Leflar said.

The Joint Commission for Accreditation of Healthcare Organizations (JCAHO) now requires hospitals to perform root cause analyses of all injuries and deaths to receive accreditation. This requirement went into effect last July, and over the next three years all U.S. hospitals will be scrutinized for such reports. If hospitals do not comply, they could lose federal funding.

"It puts pressure on hospitals to look at what they're doing wrong," Leflar said. "But since they know their analyses might become lawsuit fodder, some may not do a proper job."

The Japanese Ministry of Health has taken a different approach to reporting medical error. Japanese hospitals are not required to meet accreditation standards. The health ministry is seeking analyses only on "near misses," hoping that medical personnel will see this as less threatening.

"You can tell what was about to go wrong from that information," Leflar said. Although Japanese hospital regulation skirts the issue of accountability, both doctors and hospitals can face criminal penalties for abnormal deaths due to medical error.

Leflar's previous comparative studies on Japanese health law have attracted international attention, with publications in Japanese, Italian, and Spanish as well as various English-language journals. Leflar will return to Tokyo this summer for follow-up research. ■



Images Submitted

JAPAN'S FINANCIAL CRISIS LIKELY TO CONTINUE FOR YEARS

By Carolyn García

After being a visiting professor in Japan, Raja Kali is less than optimistic about the Japanese economy and its impact on the global economy.

"Because of the hierarchical and custom-bound nature of Japanese society, the economy is inertial and not well adapted to change. Consequently the 'creative destruction' that we associate with recessions in the United States that enables the economy to emerge after a recession with renewed vigor seems unlikely in Japan," said Kali. "The Japanese economy does not display signs of turning the corner any time soon. This could prove to be a serious drag on a global recovery."

Kali, assistant professor of economics in the Sam M. Walton College of Business, received a grant from the Japanese government to collaborate on research with Yupana Wiwattanakantang of the Institute for Economic Research at Hitotsubashi University in Tokyo.

During his time in Japan, Kali and Wiwattanakantang completed a research project on corporate debt maturity in Thailand and presented their results at the Asia Pacific Finance Conference on Rebuilding Our Financial Architecture.

"Thailand provides an excellent 'natural laboratory' for testing the effects of cronyism after the crisis," said Kali. "However, we are inclined to believe that similar results might be found in many other emerging economies."

Thailand was the first domino to fall in the 1994 collapse of Asian financial markets. It was followed by South Korea, Malaysia, Indonesia, the Philippines and, finally, Japan. Kali points to crony capital lending as a contributing factor. He conducted the first empirical study to show it was an important cause of the Asian economic crisis, which continues to have a profound effect on world markets.

"Firms with crony ties to banks and politicians had far greater access to long-term debt," explained Kali. "Most firm characteristics identified as important in the corporate finance literature played almost no role in explaining the allocation of long-term bank credit. Cronyism

appeared to be by far the main driver of pre-crisis lending patterns."

Cronyism occurs when bankers give credit to friends and relatives rather than using "hard" market criteria to evaluate creditworthiness. Based on implicit guarantees to banks by the government, this



Above right, researcher Raja Kali at the Asakusa in Tokyo, Japan. Above left, Kali at the Institute of Economic Research, where he examined the role of cronyism in the downturn in Asian economies. Above, the library at the University of Hitotsubashi, Tokyo.

credit often goes to projects of dubious quality promoted by friends or relatives, according to Kali.

"Banks [or bankers] obtain private benefits from such projects if they succeed and do not lose if the projects fail, since they expect to be bailed out by the government," Kali explained. "This implicit guarantee by the government weakens bank incentives to monitor and liquidate poor-quality projects."

These expectations filter down to the company, which has little incentive to ensure project success, since it expects to be refinanced by the bank because of its close ties regardless of its losses. In emerging economies it may be difficult for the government to monitor firms and prevent long-term refinancing of bad projects. ■



Images Submitted



science of the small

by Melissa Blouin

You cannot see it with your eyes or touch it with your fingers. You may not even be able to conceive of nanotechnology—a novel science that seeks to create devices and machines out of molecules. But physicists and engineers believe this fledgling field will revolutionize computer technology, transform industry and change the way doctors practice medicine.

Quantum dots of Indium Arsenide form atomic islands on a gallium arsenide surface. Physicists grow three-dimensional atomic islands using Molecular Beam Epitaxy and study the properties of these miniscule compounds.



Microelectronics-photonics graduate student Hong Wen transfers a sample from the Molecular Beam Epitaxy (MBE) machine to the Scanning Tunneling Microscope (STM). The researchers can grow devices one atom at a time using the MBE, then examine their handiwork using the STM.

Before the promise of nanotechnology can be fulfilled, some basic scientific principles of the nanoscale must be uncovered and better understood. Properties that work well at the macroscopic level often fall apart when taken to 10,000 times smaller than the diameter of a hair.

“Technology has given us tools to see what is happening at the nanoscale level,” says Greg Salamo, University Professor of physics. “And now we can look at a new science—one that is likely to have material that behaves differently than material we have now.”

Salamo uses the analogy of water running through a hose to explain the challenge of nanoscale science to the uninitiated. When you turn on a faucet, water pours out the end of the attached hose. If you cut the diameter of the hose in half, water still emerges when you turn on the faucet. However, if you shrink the hose diameter to the nanoscale, you can’t get any water through.

“The science has changed,” Salamo said. In a nanoscale system, the chemical and optical behavior of molecules changes, and the mechanics function differently.

To understand the science, researchers experiment with many different atomic structures and surfaces, but they must be selective when choosing structures to pursue. Using a molecular beam epitaxy machine (MBE), a device that can deposit one layer of atoms on a surface, University of Arkansas researchers have the potential to make billions of different materials. Salamo holds up a small textbook to make his point.

“This book has billions of atoms in its layers of pages,” he said. “You could spend a lifetime, and a lot of money, making novel materials—without finding the ones of import to medicine, technology and the environment. You have to figure out the underlying science so that you can make good predictions of what materials have potential.”

To create the devices that researchers want to make—smaller, faster, more reliable computers, communications devices, medical instruments and novel materials—scientists must first determine some of the different properties that govern the atomic world. On a small scale, surface interactions become important, chemical behavior changes and optical properties respond differently.

“The smaller something is, the more surface it has in proportion to its size,” said physics professor Min Xiao. “These nanoscale surfaces interact with the environment in ways we don’t yet understand.”

A group of researchers at the University of Arkansas works to lift the curtain of darkness that currently surrounds nanoscale proper-

ties. The researchers’ investigations into the properties of quantum dots, optical wires, spintronics, ferroelectric materials, nanowires, nanocrystals and nanomachines have pushed forward the frontiers of this fledgling science.

Atom by atom

Today’s manipulation and exploration of the atomic world originated through high-resolution instruments that allow researchers not only to detect atoms, but also to deposit them in layers atop surfaces. This atomic layering, or building of “atomic sandwiches,” allows researchers to study the properties of atomic interactions. They can watch how atoms form surfaces and manipulate the physical properties of a system to get surface formations that provide the underpinnings for new devices.

Salamo studies the properties of nanostructures called quantum

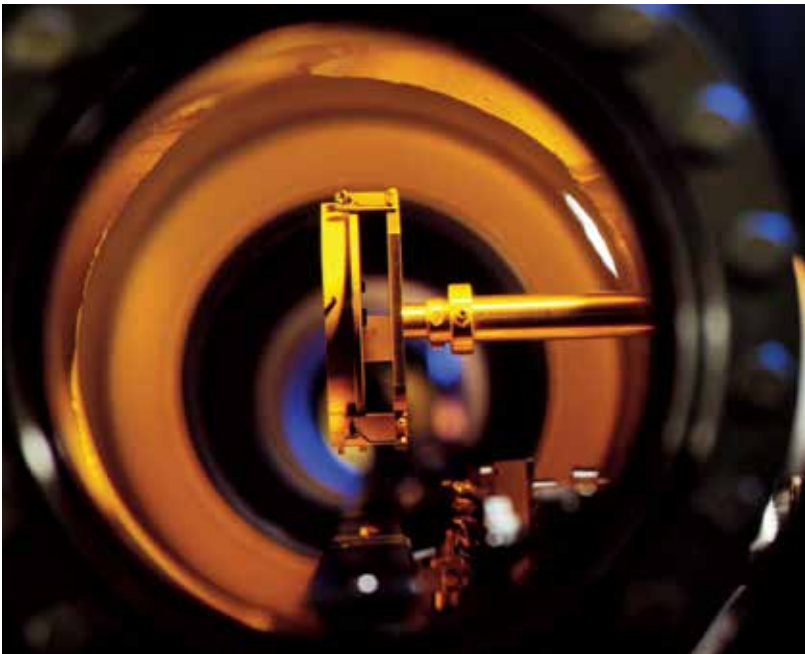
dots, islands of atoms deposited on a surface. In a surface system, these dots get around: Small atomic islands get swallowed by larger ones. This tendency of nanostructures to enlarge themselves through this process is called ripening. The size and density of these dots vary depending upon the growth temperature, the gas used on the surface, the atomic order and the nature of the material.

When an atom rests atop another atom, differences in size and charge can cause surface strain. This can confound scientists trying to manipulate quantum dots—or it can be used to effect desirable structural and optical changes.

Salamo and other scientists want to control the size of these quantum dots because size determines color in optics. In addition to creating better lasers and detectors, ordered arrays of quantum dots could replace high-resistance electrical wires, leading to lightning-fast technologies.

Light, color, size and shape

Physics professor Min Xiao studies how nanostructures respond to light. At the nanoscale level, atomic size controls the amount of light absorbed and emitted, and thus controls subsequent optical behavior. By controlling this behavior, scientists could produce optical paths, or “wires,” that would replace high-resistance electrical wires and operate at lower energies and higher efficiency than current technologies.



Researchers use a transfer arm to slide a sample into the MBE chamber to the left. The work takes place in a complete vacuum, so researchers must manipulate the samples using such arms from the beginning to the end of the procedure.

Photos By Russell Collier

Xiao's background in atomic physics has provided him with the tools to study the optical properties of quantum dots. He focuses on dots formed from cadmium selenide (CdSe) and treats the dots as "artificial atoms."

"With a few hundred atoms in each CdSe dot, the system behaves in ways similar to atoms," Xiao said.

These dots span about 4 nanometers and assume rod-like shapes. He examines how the optical environment affects the properties of small particles. This could be useful in medicine, for biological molecules are sensitive to polarization by light, and this property may be helpful in developing nanoscale biosensors for disease detection or monitoring, Xiao said.

Xiao studies the different energy levels in these dots and how these levels change with the adsorption and dispersion of light. His studies will also shed more light on atomic physics.

"Atoms are hard to 'hold' in one place," he said. "Quantum dots behave like atoms, but you can 'hold' them."

Xiao has created a microscopy instrument that uses nitrogen and a powerful camera to detect the weak light from a single quantum dot. He and his team of researchers were the first scientists to look at the CdSe rod shapes using this technique.

The Other Side of the Spectrum

Physics professor Yujie Ding is working to design a device that emits coherent light in the far infrared part of the spectrum. Light from the far infrared could prove a powerful detection device—more penetrating than X-rays, but not as harmful to the body. Also, many toxic gases emit light in the far infrared, so a detection device at these wavelengths could be used to detect pollutants at the parts-per-million level.

However, creating coherent light—light that focuses to a small beam—in the far infrared has proved an elusive task due to the light's long wavelength. The electrons in atoms can be in one of two energy levels, and at long wavelengths, these levels become indistinguishable from one another. This makes it difficult for researchers to detect a "jump" from one state to the other, which is how lasers can be used for detection.

Ding is trying to use quantum mechanical knowledge to build a "nano-barrier" that would isolate the electrons in the different levels. Ideally, this would force electrons to be kicked from one level to

another when a photon is emitted, allowing a detector to track the change.

Ding describes the nano-barrier as a kind of a high-energy wall with two low-energy wells on either side. The idea is to get the electrons to jump from one well to another in the presence of a photon.

"If you can get all the electrons to jump to one level and send a photon in, then they will all jump down," Ding said. This could create coherent light.

Ding makes these devices using the MBE. He experiments with different materials for the barriers and wells—using gallium arsenide, indium arsenide and indium phosphate. He built a spectrometer to examine emission lines to determine the thickness of his devices. Then he pumps photons across the surface to see if coherent light waves emerge.

In this way, nanoscience will open up the far infrared spectrum, allowing scientists to build safe methods of examining the human body and better ways to detect pollutants.

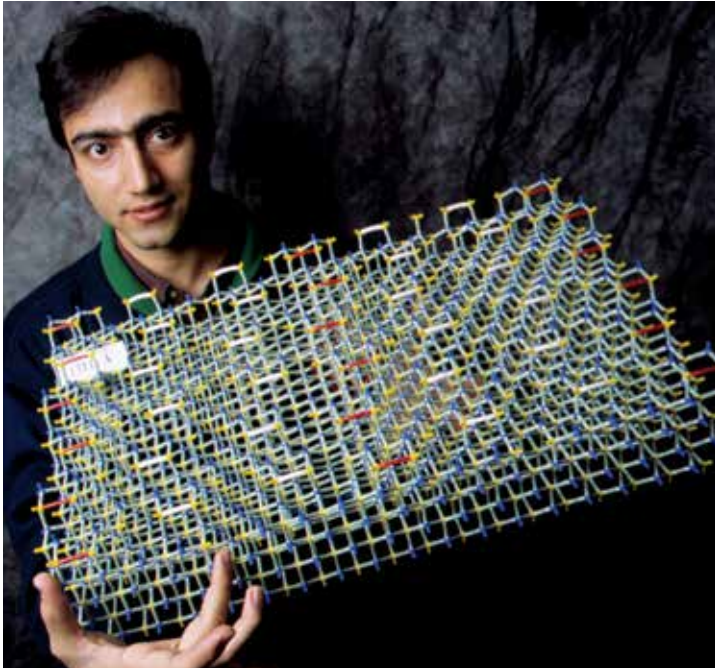
The Spin on Surface Science

A group of university physicists has achieved the highest efficiency ever in transferring polarized electrons into a semiconductor surface, which could lead to the creation of small but powerful computational devices that may revolutionize the electronics industry. In doing so, they also discovered some of the underlying mechanisms that prevent researchers from successfully injecting spin-polarized electrons into a semiconducting surface.

Vincent LaBella, D.W. Bullock, Z. Ding, C. Emery, A. Venkatesan, William F. "Lin" Oliver, Greg Salamo and Paul Thibado of the University of Arkansas and M. Mortazavi of the University of Arkansas, Pine Bluff, reported their findings in *Science* in 2001.

Physicists hope to harness the power of an electron's spin—an inherent quality all electrons exhibit just as all electrons have a charge—to make multifunctional computational devices, in which a single multifunctional device would replace hundreds of conventional devices, leading to fast, small electronics that consume less power.

Currently, electronic devices use an electron's mass and charge to do the necessary work, but these devices have limitations in their size and power—researchers estimate that in about 10 years the prevalent technologies used today to make small, powerful devices will reach that limit.



Vahid R. Yazdanpanah, a graduate student in the microelectronics-photonics program, holds a model of a gallium arsenide crystal. Models like this one help physicists predict the properties of semiconducting crystals that are important in the electronic devices of today and the nano-scale devices of the future.

Photo By Russell Cothren

For the past decade, researchers have explored the idea of exploiting an electron's spin to enhance the performance of devices. Spins can rotate in a coherent manner and thus alter the resistance of a device in a controlled way. These properties may enable greater storage capacity and information processing from spintronic devices than they do today.

Until now, however, injecting spin-polarized electrons into a semiconductor surface has been difficult—a high percentage of the electrons change their spin orientation during the injection process. The highest spin efficiency recorded was 40 percent at 10 degrees Kelvin, a temperature too low for effective use in electronic devices.

LaBella and his colleagues achieved injection efficiency of 92 percent into a gallium arsenide GaAs (110) surface at a temperature of 100 K, which is the temperature of liquid nitrogen, a substance often used in the semiconductor industry.

The researchers incorporated a magnetic nickel Scanning Tunneling Microscope (STM) tip to inject electrons that are 100 percent oriented in one direction. They used a technique they call "spin-polarized tunneling induced luminescence microscopy" (SP-TILM) to determine whether or not the electrons retained their spin. The STM also enabled them to correlate surface features in the topography of the semiconductor with the degree of spin disruption.

The researchers found that areas with an atomic "step," a spot where the atoms do not form an even surface, cause spin disruption. The particular form of GaAs they used, GaAs (110), has few steps in it, accounting for the high degree of success in injecting spin-polarized electrons. The places where these steps occurred caused the spins to flip.

"Until now, no one has pinned down the fact that steps scatter spins," LaBella said.

It takes a free electron to scatter another electron's spin, and usually within a crystal all electrons are paired up, unless there is a broken bond. In the case of GaAs (110), all the electrons are in filled orbitals, so the spins are stable. There are plenty of surfaces where the electronic configuration is not as smooth, implying that they would be less efficient surfaces for use in spintronics, LaBella said.

The researchers plan to study other industrially important surfaces using the same techniques.

"We can use this as a tool to study the effects of defects on the spin injection process," he said.

Spins, Magnets and Powerful Computations

Mark Filipkowski, associate professor of physics, seeks to understand spintronics from a different angle by examining the electrons inside a device.

This image shows the spatially resolved spin injection probability for a gallium arsenide crystal known in scientific circles by its structure number 110. The blue region is the flat terrace and indicates a high spin injection efficiency—about 92 percent. The red region is about 10 nanometers wide and corresponds to a 5 nanometer-high step on the surface where the spin injection efficiency drops to 16 percent.

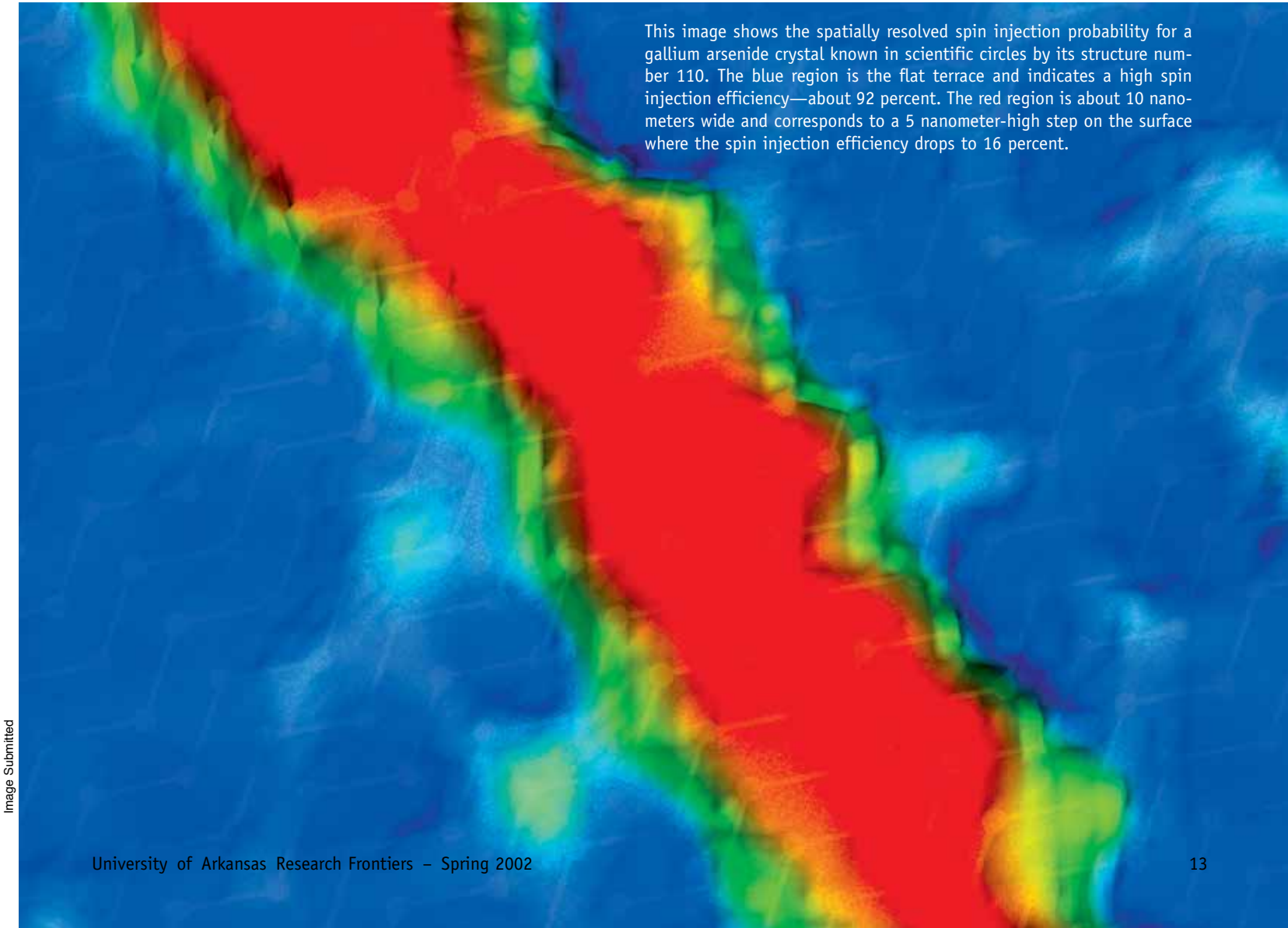


Image Submitted

The semiconductor crystals of cadmium selenide (CdSe) emit different colors of light depending upon their size. Researchers hope to use this property and others to create biosensors, medical diagnostic tools and vehicles for drug delivery.

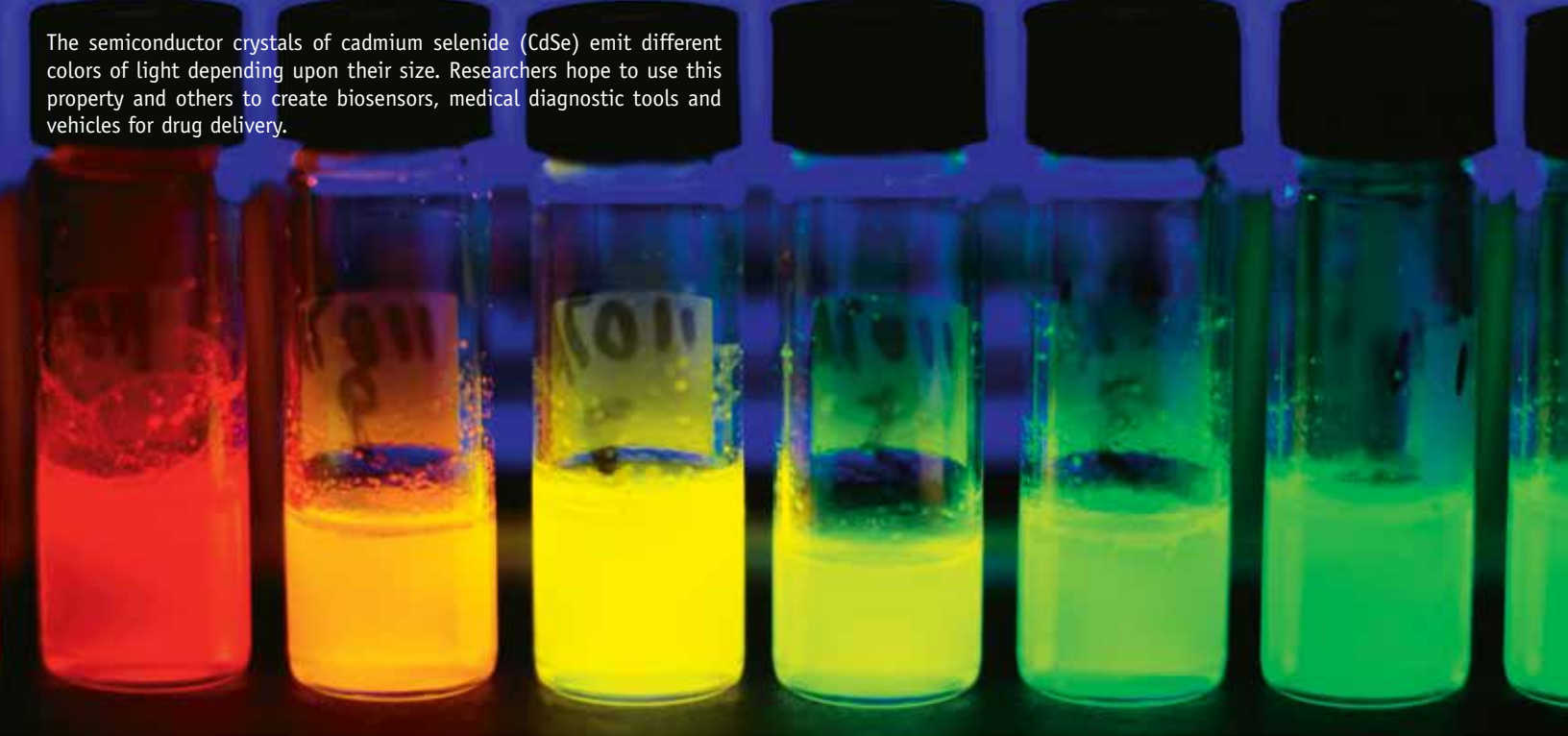


Photo By Russell Cothren

“My approach is to look at the inside of that material,” he said. “If one were to make a device to inject spin, nuclear magnetic resonance (NMR) can look inside the material” to determine what happens to the electron spins.

Spintronics is based on the idea that electrons have spin, and NMR is based on the concept that nuclei have spin. So if spin injection succeeds, then nuclear magnetic moments would become more organized. Thus, NMR serves as a way of detecting the achievement of spin injection.

The ultimate goal of Filipkowski’s research would be the use of spin field effect transition (spin FET) in computers, where a “gate,” which is used in conventional field effect transistors to turn current on and off, also could rotate the electrons’ spin within the device.

Applying these concepts could lead to the use of multi-level logic. Current computer systems use binary logic—based on either a “0” or a “1” (“on” or “off”). Multi-level logic states would increase computing power a hundred fold or more and use less energy.

Also, by using magnetic materials that stay magnetized, computers would retain more information in their memories, allowing for greater storage capacity, Filipkowski said.

“If you ponder the possibilities, they’re quite dramatic,” he said.

Optimal Energy States

More detail in medical ultrasound reports and better sonar detection for the navy may be possible soon because of a discovery about the material that makes these technologies possible.

Graduate student Aaron George, assistant professor of physics Laurent Bellaiche and visiting professor Jorge Iniguez of Rutgers University have found that when these materials pass through a certain state, their energy becomes optimized, creating an effect 10 times that currently commercially available. This could make the piezoelectric compounds used in medical ultrasound and naval sonar more powerful and efficient.

“This finding means we can drastically improve the response of devices,” which will help advance sonar and ultrasound used in both the military and medical fields, Bellaiche said.

Piezoelectric compounds are crystals that change shape when encountering an electric field or create an electric field when they change shape. Bellaiche and his colleagues used computer models to study the properties of these compounds. They reported their findings in *Nature* in fall 2001.

Some piezoelectric systems form crystals with two different types of atoms distributed throughout. Bellaiche and his colleagues sought to find out if they could guide the atomic arrangement of such crystals by placing the two different atoms in layers rather than randomly. They wanted to see what the piezoelectric effects and other responses of such crystals might be.

They selected Scandium and Niobium (Sc and Nb), using the arrangement of the atoms inside each layer as the variables, and created a model that could calculate the amounts of the two atoms, which have different atomic numbers and therefore different charges.

By changing the ratio of the atoms inside each layer, the researchers generated strong internal electric fields in different directions, causing the crystal to change structural phases.

Some ratios became polarized in one direction, creating a rhombohedral phase, while others switched the direction of polarization and created another phase, called an orthorhombic phase, an effect not seen before. Furthermore, in between the two polarized phases, the researchers discovered a piezoelectric response that is 10 times larger than responses currently used commercially.

“It’s a new fundamental structural property,” Bellaiche said.

The large piezoelectric response represents the process of changing shape, and it is at this point that a small electrical pulse can produce the largest change.

The researchers performed most of their computations at a temperature of 20 K, but the same result can be found at any temperature.

“At any range you can have a structure that will give you a huge response,” Bellaiche said. Changing the temperature means the large effect will take place with a different ratio of the two atoms.

A fluid approach: Nanocrystals in solution

While physicists strive to create tiny structures on semiconducting surfaces, chemistry professor Xiaogang Peng studies the formation of nanocrystals in solutions. This technology could be used in biosensors, medical diagnostics and even drug delivery. It also may be used in information technology, because the nanocrystals can be put into polymers or on substrates and demonstrate potential as light-emitting diodes, solar cells and lasers.

First, however, scientists face the challenge of controlling the size, shape and numbers of nanocrystals in solution. Semiconducting nanocrystals emit different colors of light depending upon their size. But many factors, including expensive and dangerous synthesis methods, have continued to stymie scientists attempting to control crystal growth.

Previous synthesis techniques for creating nanocrystals of cadmium selenide (CdSe) required using dimethyl cadmium as a precursor—a toxic, expensive, unstable material that explodes with little provocation. Because of the danger and expense involved in using this precursor, very few people worked with CdSe nanocrystals.

Peng and his colleagues discovered a cheap, safe and efficient method of creating and controlling certain types of nanocrystals through synthesis experiments in their laboratory. They devised a method that allows researchers to use different combinations of precursors for both cadmium and selenium. With the various precursors Peng’s group made the rods, rice, dots and branched shapes in their nanocrystals.

“These findings changed the field,” he said. “Availability of high-quality nanocrystals should not be a problem in a few years.”

Peng’s group focuses on the underlying mechanisms needed to create and control nanocrystals. They manipulate the size and shape of these crystals through changes in temperature, reaction time and the type and amount of reactants. They examine the results using optical spectrometers to determine the type and amount of nanocrystals in solution.

Using these techniques, the researchers have created a range of uniform crystals in solution, including dots, rods, rice and hyper-branched shapes. They have “pictures” of the nanocrystals taken with a transmission electron microscope (TEM)—and amplified 50,000-100,000 times.

Many physicists, engineers and biochemists have an interest in

applying nanocrystal technology to their fields, but Peng emphasizes that the fledgling field requires answers to some fundamental questions before people can make progress.

“If you want to go further, if you want to go faster, you need to understand the underlying science,” he said.

Nano-machines

Mechanical engineer Ajay Malshe has visions of developing composite materials and nanomanufacturing processes; combining nanotechnology and biology for advanced coatings and devices; and solving some age-old issues at the DNA and cellular level. He and his team use modeling and experimental techniques to try to create machines at the nano-scale level.

Malshe’s team is crating the blueprint for a nanofabrication laboratory on a chip. The work combines a microelectronic mechanical system (MEMS) platform with a focused ion beam of charged particles to fabricate and run it. The nano-fab-lab-on-a-chip would have a 350 nanometer drill, an indenter coated with metal, a nano-shaped nozzle to deposit interconnects and an array of DNA molecules.

Malshe also has another biological machine on the planning table. Working with his colleague Steve Tung and Micahel Manson of Texas A&M University, he is also working on a “nano-pump” that would use living cell “biomotors” as the pumping method to move fluid through tiny channels. In the future, nano-sized flagella as

small as 30 nanometers across may be used for advanced drug delivery, genomic and proteomic applications.

“Flagella are the world’s smallest motors, made by nature,” said Malshe.

Malshe also has several other projects in the works. He and his colleagues William Brown and Deepak Bhat are developing a nano particle composite hard coating. He is also investigating the effects of surface engineering on nano-mechanical properties of three-dimensional nano-structures. And he studies

ultra fast lasers for writing nano-scale periodic structures, which may be used for creating nano patterns in design applications.

Malshe sees nanoscience leading to advanced engineering that drives both living organisms and machines.

“Chameleons and spider webs are well-engineered systems,” he said. “We cannot even make a single simple cell today, but nanoscience may lead us to that one day.”

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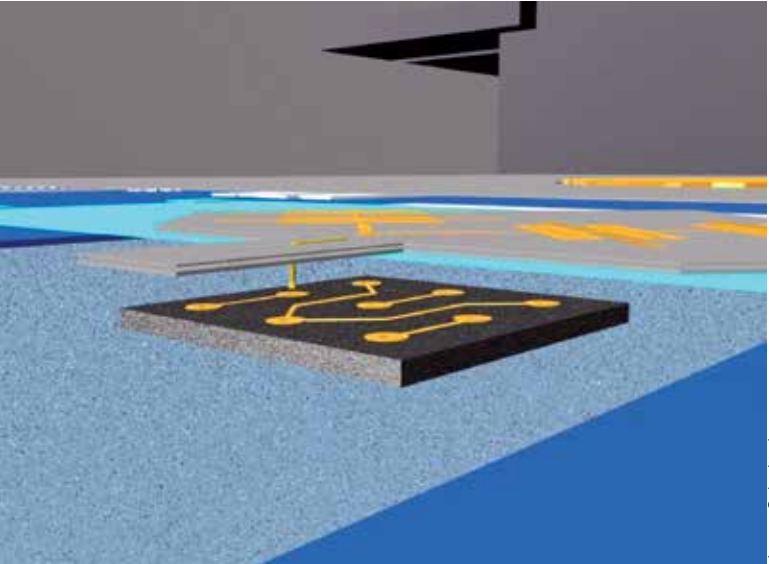


Image Submitted

Model of the future: Mechanical Engineering professor Ajay Malshe seeks to create microscopic-sized machines to build nano-scale devices.

Sound Methods

Two decades of research at the University of Arkansas have helped millions of deaf and hard of hearing Americans gain lasting employment and independent lives.



By Allison Hogge
Photos by Russell Cothren

Just off Markham Street in Little Rock, situated between War Memorial Stadium and the University of Arkansas Medical School, stands a one-story brick building on a long stretch of lawn. Inside are a few classrooms, a computer lab, some faculty offices and a modest sign that reads RT-31. You may not have heard of RT-31, but odds are the research that goes on in this nondescript building has impacted the life of a person you work with, live near or love. And odds are, that research may one day help you.

The sign stands for Research and Training Center, number 31—more formally known as the University of Arkansas Research and Training Center for Persons Who are Deaf or Hard of Hearing. For two decades, this center and the researchers who run it have led the nation in the study of rehabilitation services for people with every level of hearing loss, from the moderately hard of hearing to the profoundly deaf. It is one of only two R&T centers in the nation to focus on the needs of this dis-

ability group and the only one to address the full gamut of the deaf and hard of hearing population.

Founded in 1981, RT-31 represents a collaboration between the University of Arkansas and Arkansas Rehabilitation Services. The center operates on funding from the National Institute on Disability and Rehabilitation Research, part of the U.S. Department of Education, which recently awarded the center its fifth-consecutive \$3 million grant to conduct a new five-year program of research.

Over the past 20 years, that research has examined nearly every aspect of the employment and career advancement of deaf and hard of hearing individuals. They have disseminated the findings of more than 38 comprehensive national research projects to schools, post-secondary programs, vocational rehabilitation agencies, employers and many other constituencies nationwide—informing these groups how best to guide deaf and hard of hearing workers into gainful, lasting employment and more fulfilling, independent lives.

Yet even as the researchers at RT-31 make progress, their work becomes more critical and more challenging. As a group, the deaf and hard of hearing are becoming part of the mainstream—not only because they increasingly join the larger society in workplaces, classrooms and social settings, but also because each year, more of the mainstream society joins them.

More than 27 million Americans live with some degree of hearing loss, nearly one out of every 10 people. Of those individuals, 14.3 million fall between the ages of 18-64, the prime years of employment. That means that without appropriate training and accommodation, the nation loses a significant portion of its capable, willing workforce. Furthermore, as the Baby Boomer generation ages, the hard of hearing community grows. Experts estimate that within 20 years, hearing loss may affect one in seven Americans, as opposed to one in ten.



Doug Watson

That represents a substantial and growing constituency, but the research at RT-31 touches an even larger population, according to Doug Watson, director of the center.

“Multiply 27 million by the average American family. That’s more than 100 million people interacting with deaf and hard of hearing individuals every day, and that doesn’t even account for co-workers, acquaintances, neighbors,” Watson said. “By improving the opportunities for these people, you improve the quality of life for their families and communities. It bolsters the workforce. It educates other people.”

Deaf & Hard-of-Hearing Facts

- 27,326,000 Americans are deaf or hard of hearing.
- Deaf and Hard of Hearing individuals represent the largest disability group in the nation, comprising 40 percent of all disabled Americans.
- Approximately 70 percent of deaf and hard of hearing Americans work, compared to an employment rate of 20-50 percent in other disability groups.
- 258,000 deaf and hard of hearing students attend U.S. colleges, universities and technical institutes, according to the U.S. Department of Education.
- Within 20 years, hearing loss will jump from affecting one in ten Americans to affecting one in seven.

In other words, improving employment opportunities for workers with hearing loss is as good for society as it is for the individuals. The researchers at RT-31 don’t just advocate those benefits; they stand as living proof. Of the four faculty who have been with the center more than 15 years, three—Doug Watson, Glenn Anderson and John Schroedel—are themselves deaf or hard of hearing. In fact, RT-31 was the first research and training center in the nation to employ disabled individuals in key leadership positions.

Growing up in the 1950s and ‘60s, attending schools with hearing children, trying to read the chalkboard because they couldn’t hear the lecture, not knowing which colleges or careers would be open to them—these researchers learned first-hand the obstacles deaf and hard of hearing people face. Now, they’re using their personal and professional expertise to help tear those obstacles down.

“The average deaf person doesn’t have the advantage of scientific training,” Watson said. “Just because they have a disability doesn’t mean they’re an expert in it. That’s what makes our work important. Our goal for the past 20 years has been to help others become more empowered.”

SILENT PROGRESS

The deaf and hard of hearing population represents the largest chronic disability group in the nation. Prior studies have estimated that it accounts for more than 40 percent of the entire U.S. disability population. But it also represents one of the most employable disability groups. An estimated 70 percent of deaf and hard of hearing individuals work, whereas employment rates for people with other disabilities often hover between 20-50 percent.

Over the past four years, surveys conducted by the National Organization on Disability have indicated that, not only are disabled adults less likely to find employment, they're also more likely to end up in less challenging or engaging jobs and to receive lower wages than their non-disabled colleagues.

Although vocational rehabilitation programs nationwide have had great success in training and placing individuals who are deaf or hard of hearing, they've done little to track the progress or satisfaction of their clients within these jobs. As a result, questions lingered about the long-term employment experiences among this disability group, including their prospects for attaining higher wages, promotions and accommodations, their social integration in the workplace and their overall career satisfaction.

In 1983, researchers at RT-31 undertook a program to answer those questions. Traveling across the nation, John Schroedel and his colleagues visited 47 top post-secondary colleges and technical institutes with special support services to interview their deaf and hard of hearing graduates in the classes of 1983, '84 and '85. They interviewed 740 students who agreed to participate in a series of follow-up surveys to be conducted at five-year intervals.



John Schroedel

The result was a first-of-its-kind longitudinal study of the career progress and socioeconomic accomplishments among deaf and hard of hearing individuals in the United States. The study spans 15 years, with its most recent survey and analysis completed in 1999.

Those 15 years represented a critical timespan, according to Schroedel. In their educational programs, these students had benefited from the Vocational Rehabilitation Act of 1973, which required institutions that received federal funding to make their programs accessible to the disabled. And in their careers, these same individuals had witnessed the passing of the Americans with Disabilities Act in 1990—legislation that opened new opportunities and empowered the disability community with fundamental civil rights.

Tracking the progress of these students would indicate not only how successful they had been as individuals but also how successful our nation had been in supporting and accommodating their needs. The course of the study produced some surprisingly optimistic results and some significant disappointments.

Among the positive findings was that by 1999, 85 percent of survey respondents were in the workforce—a close comparison to the 90 percent of college graduates without disabilities who were employed or looking for jobs at that time. Further, the respondents showed greater career diversity than the researchers expected. Their occupations covered 70 different fields, from computer programming to social work, teachers to engineers—indicating that college or subsequent training had presented this population with a variety of career options.

Many respondents continued to improve their career opportunities over the course of the study by attaining higher degrees of education. The initial survey found only 5 percent of respondents holding masters or doctoral degrees. By 1999, the number who had completed graduate school jumped to 16 percent.

The 1999 study also found that the majority of respondents had achieved financial independence, with 81 percent reporting that their own earnings sufficed as their primary source of income. More than 80 percent received benefits from their employers, including vacation time, sick leave and health insurance. When the survey asked if individuals had been promoted during the last four years, 45 percent responded “yes.”

But that result indicated that most of these workers had not experienced advancement for several years, if ever. When asked to speculate why, most respondents

cited “lack of opportunity.” In further analysis of the data, Schroedel identified factors that seemed to enhance a deaf or hard of hearing person's prospects for promotion. Those factors included working for the same employer over a long period of time, acquiring a mentor in the office and requesting workplace accommodations to facilitate job performance.

Unfortunately, other negative findings proved difficult to explain or solve. Unemployment among the college-educated deaf and hard of hearing population equaled twice the unemployment rate of mainstream, educated society—5 percent compared to the 2.5 percent among people without disabilities. Further, deaf and hard of hearing respondents earned \$10,000 to \$20,000 less than hearing Americans with similar educational backgrounds.

Within the deaf and hard of hearing community, the study also found a persistent wage disparity between men and women. Previous research conducted by Schroedel and Watson had shown that deaf men earned on average 30 percent more each year than deaf women and that this gender gap extended back at least into the 1960s. But by tracking incomes over a 15-year period, the researchers made a counterintuitive discovery.

“That gap is actually widening, and it's widening in spite of the fact that women respondents as a group are better educated than the men,” Schroedel said. One explanation may be that women chose to pursue fields such as social work or teaching, which grant greater personal satisfaction but lower pay, Schroedel suggested. “But even in the scientific and technical fields, women earn less than men,” he said.

Over more than 15 years, the duration of this project has offered researchers a snapshot of the deaf and hard of hearing population, and a moving picture of its progress and trends. From those insights, Schroedel and his colleagues have drafted recommendations that may ensure future generations of deaf and hard of hearing graduates attain higher career aspirations and greater social success.

Many of these recommendations target high schools and post-secondary education programs in hopes of setting students on the right path before they enter the workforce.

“One of the things this study illustrated is the importance of obtaining the highest possible degree before beginning a career. Also relevant is the importance of persisting through college,” Schroedel said. “Three out of every four deaf students drops out before attaining a degree, so much more attention needs to be paid to retaining those students and offering them appropriate support services both in academic and social settings.”

BRIDGING COMMUNICATION BARRIERS

Imagine a staff meeting, 20 people gathered around a conference table. Lively discussion leaps from person to person. Brainstorming and problem solving proceed at rapid pace. It's the business ideal of a productive and stimulating exchange. But for a deaf or hard of hearing employee, such random group interchange can be disorienting. Now imagine one-on-one performance evaluation between a supervisor and a hard of hearing worker. The chaos and confusion disappear, but a new set of challenges arises.

For persons with hearing loss, one of the greatest obstacles to workplace integration is finding convenient and accurate methods of communication for a variety of work-related settings. Communication difficulties overshadow many aspects of employment for these individuals, including whether they find employment in the first place. Because most human resource managers have little or no experience with this disability group, concerns about communication frequently prevent applicants with hearing loss from being hired.

“This whole situation is compounded by the fact that deaf and hard of hearing people, themselves, often don't know what accommodations they need, where to acquire those accommodations or how much they'll cost,” said Steve Boone, director of research at RT-31.

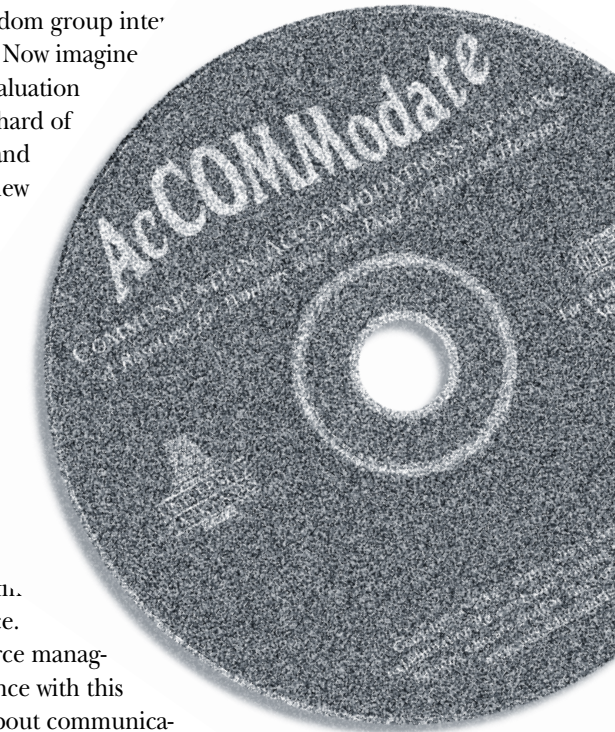


Steve Boone

In 1991, Boone and his colleagues at the UA Research and Training center initiated a program of study to assess the knowledge and needs of deaf and hard of hearing employees. They collected surveys from 582 people associated with national consumer organizations such as Self-Help for the Hard of Hearing and the Association of

Late-Deafened Adults.

The researchers also identified 52 businesses with deaf and hard of hearing employees to participate in a second survey for employers. Results from these two groups showed substantial confusion about workplace accommodations. Nearly 70 percent of employers admitted they didn't understand the nature of workplace accommoda-



Persons with Hearing Loss in Arkansas

Based on year 2000 statistics

- State Population: 2,578,000
- Hard-of-hearing persons: 169,500
- Persons who became deaf at or after age 19: 44,800
- Persons who became deaf before age 19: 7,700
- Total number of persons with hearing loss: 220,000



A TDD machine enables deaf individuals to communicate over the telephone by providing them with a written transcript of the call.

tion. And a significant number of deaf and hard of hearing respondents said they didn't know how to request accommodations from their employers or which accommodations to ask for.

These issues led Boone and his colleagues to produce a curriculum on workplace accommodations, suitable both for employers and their deaf and hard of hearing workers. In 1996, with technical assistance from the University of Arkansas for Medical Sciences, RT-31 converted the curriculum into a CD-ROM program. This software provides explanations about a variety of accommodations—their purpose, cost and design—as well as suggestions on how to request such accommodations. The program also includes a checklist by which employees can assess their need for particular support services.

According to Boone, employers often assume that all deaf and hard of hearing people are alike and therefore require the same accommodations. In fact, there's an entire spectrum of communication abilities and preferences within this population, from the signing deaf to lip readers and hearing aid users. As a result, accommodation needs must be judged individually.

And there's an equally wide array of accommodations that employers and their workers can choose from. Results from both surveys indicated that devices comprised the most common category of accommodations in present-day workplaces and that the most popular of these devices was an amplified telephone. More than half of the deaf and hard of hearing respondents reported using such equip-

Computers and Web cameras link deaf individuals to sign language interpreters stationed at distant sites.



ment on the job.

However, a significantly lower number of workers—between 25 and 38 percent—indicated that other accommodation services were provided, even when those accommodations presented low-cost or cost-free solutions to communication problems. Accommodating a disabled employee can be as simple as assigning an office mentor, Boone said—someone who ensures the hard of hearing worker keeps informed about office happenings and who alerts the worker in case of emergencies or a sudden turn of events.

With a little forethought, employers may be able to avoid communication difficulties altogether by restructuring job responsibilities within the office. For example, a deaf or hard of hearing worker may exchange the telephone duties usually associated with his position for the mail-opening duties of another employee. The RT-31 survey showed that such creative solutions are rarely considered or used.

Not all accommodations are quite so cost-effective. TDD machines—which enable deaf individuals to communicate over the telephone by providing them with a digital readout or printed transcript of the call—can cost as much as \$600. And meetings for which sign language interpreters, note-takers or captioning transcribers must be present can quickly escalate into the hundreds of dollars.

Some employers may consider these costs worthwhile because the accommodations often benefit the office as a whole, hearing and disabled employees alike. But many businesses still hope for less expensive, more convenient options. In this regard, new technologies show remarkable promise, according to Boone.

E-mail and Internet communication have already become a staple of the business world as well as a lifeline for deaf and hard of hearing individuals. Pagers and instant messaging have enabled people with hearing loss

to exchange information and to interact more quickly and conveniently than ever before. But other technologies, not yet widely available, may provide the greatest progress to date, by making real-time interpretation available without bringing the interpreter and client face-to-face.

A handful of states, including South Carolina and Minnesota, have begun to explore remote access technologies such as video relay services, which use computers and web cameras to link deaf individuals to sign language interpreters stationed at distant sites. Similar technology can connect individuals who prefer written transcripts to CART writers (Computer Assisted Real-time Translation).

Instant access to translation and interpretation from any location could grant deaf and hard of hearing individuals greater freedom, particularly in scheduling out-of-town job interviews or other important meetings for which they'd normally have to pay interpreters to travel and provide translation in person. Over the next five years, Boone and his colleagues at RT-31 will undertake a new research project to assess the convenience and accuracy of these innovative technologies.

Meanwhile, individuals and employers rely on more conventional accommodations. Although interpreters and devices are sometimes costly, they're almost always worthwhile, explained Schroedel. "A business may spend \$100 on accommodations for a single meeting. But the benefits of allowing that deaf or hard of hearing employee to participate, to understand what's going on and how he or she can contribute to goals, may more than make up for the money spent.

"And that doesn't even account for the psychological and social benefits," Schroedel added. "Workers who feel that the boss respects and accommodates them will be more motivated, more invested and more productive."

LOOKING AHEAD

Of all federally funded programs, vocational rehabilitation services may give the most back to individuals, society and the nation as a whole.

"Rehabilitation is the most successful federal-state human service program in this country, and it has been for more than 70 years," Watson said. "It's the only program in America that gives back 10 to 15 times more in tax dollars than it uses."

For more than 20 years, the UA Research and Training Center for Persons Who are Deaf or Hard of Hearing has contributed to that success. Researchers in the center have given nearly 600 presentations at national and international conferences. They've published 104 books, 246 articles and chapters and 61 research reports. They've produced 24 training packages and numerous videos, CDs and web publications. And they've staged 270 train-

ing workshops, reaching more than 14,500 people in 45 states.

The research they've conducted and the insights they've gained in that process directly feed into their new round of projects—an ambitious agenda that includes the collection of the first-ever nationally representative household sampling of hard of hearing Americans. Researcher Glenn Anderson will examine how national legislation and state workforce development initiatives have impacted vocational rehabilitation services for individuals who are deaf and hard of hearing. In addition, RT-31 will expand its research to address the needs of



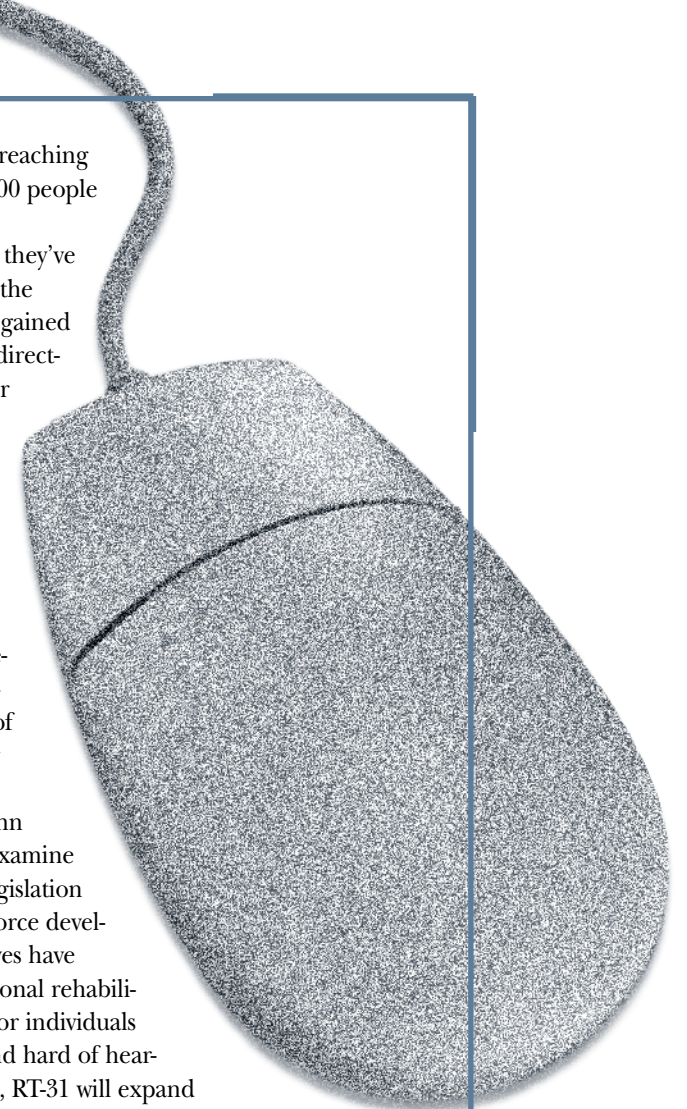
Glenn Anderson

families with deaf infants.

But the most significant accomplishment at RT-31 may be the fact that they've trained over 150 rehabilitation counselors for productive careers in providing vocational rehabilitation and independent living services for individuals who are deaf and hard of hearing.

Looking back at what the center has accomplished over the past two decades, Doug Watson acknowledges that future progress will fall largely into the hands of others. "We've come a long way, but the pioneers who built this field are retiring," he said. "Now it's a matter of convincing the next generation that they can accomplish even more—with the proper training and commitment—to build from the foundation now in place in our nation." ■

To read more about the researchers and current research projects at RT-31, visit the Research Frontiers web site at http://pigtrail.uark.edu/pubs/Research_Frontiers/default.html.



You are what you eat. Most of us have heard this truism for most of our lives. Everyone from our mother to the exercise guru on TV tells us that. But as it turns out, that is only partially true. In reality, whether you eat it, wear it, or drive it ...

You Are What You Buy

By Carolyné García

So what does that make you? According to Jeff Murray, professor of marketing in the Sam M. Walton College of Business, it makes you what you are today, and what you will be tomorrow. According to Murray, an interpretive consumer researcher, people buy, or refuse to buy, products as a way to create their personal identity.

“We used to call that self concept or self image,” Murray explained. “Many researchers in cultural studies now refer to the same thing as identity. It is an ongoing process of making unplanned choices that come together to create our own personal style.”

As applied to consumer behavior, interpretive research is a relatively new approach to market research. The research process differs in many ways from more traditional approaches. And, unlike traditional approaches, interpretive researchers work from the premise that all consumption falls into the category of lifestyle choices and identity formation. Since it allows companies and researchers to understand consumer behavior in greater depth, it is growing in popularity and respect as a source of quality information.

Meaty Beaty Big and Bouncy: What’s New in the Marketplace?

Companies are constantly searching for new ways to reach the consumer, and they rely heavily on market research to tell them what consumers want and need. Confronted with a seemingly endless barrage of new products, consumers are becoming more sophisticated and more selective. The “gee whiz” novelty of a product quickly becomes “ho hum” if consumers are unable or unwilling to incorporate it into their lifestyle.

It is almost impossible to estimate how many new products are introduced to the U.S. marketplace each year. Industry experts estimate more than 25,000 grocery items alone were introduced in 2001. Add to that consumer electronics, software and games, drugs, household goods, tools, automobiles, paper products, entertainment products, and the estimate easily reaches 100,000 new consumer products each year.

The cost to bring a new product to consumers varies widely. It might cost several million dollars to bring a new drug from inception to market and more than \$1 million to introduce a new car model, but only a few thousand to create a new flavor of toothpaste or add antibacterial agents to an existing product. Taken together, however, the annual cost of bringing new products to market surpasses several billion dollars.

Given the enormous costs and competition, most companies try to ensure their new product will survive. In fact, the cost of bringing a new product to market



Although they don’t typically don lab coats and grab video cameras, marketing professor Jeff Murray, left, and graduate student Scott Smith, right, do conduct detailed, in-depth interviews to determine the preferences of individual consumers like University of Arkansas alumnus and past ASG president Eddie Armstrong, center. They have examined music preferences, vegetarianism and even voluntary simplicity in an effort to discover why people buy—and don’t buy—specific items.

Photos by Russell Colthren



includes research to determine consumer response to the new item. Methods vary from employing professional taste testers to conducting after-purchase surveys of buyers, organizing focus groups to setting up a consumer research office in a mall, mailing out surveys to collecting data from cookies set up on a Web site. However, the methods are all designed to help the manufacturer gauge market acceptance of the product.

In spite of all this investment and research, many new products introduced this year with great fanfare and advertising will disappear without notice in two or three years. Because of the substantial costs of product failure to manufacturers, who may not even recover their initial investment, market researchers look for new ways to assess consumer preferences.

By the Numbers: A Brief History of Consumer Research

Most of us have had some experience with market research. A researcher approaches in a store or mall, offering money or coupons if we will sample their product and fill out a questionnaire. A survey arrives in the mail with a promise of coupons or samples if we will reveal them our preferences on a variety of consumer goods. A Web site asks that we answer questions before we can use the site. Sometimes we respond, but often we are too busy. We brush off the researcher or toss the survey or fake the Web survey. So how do companies discover what we want?

Consumer research began in 1928, when William Benton, a strong proponent of radio and creator of the Voice of America, conducted the first survey to measure consumer preference for radio as an advertising medium. Many researchers conducted market

research projects through the 1950s, but their methods were not uniform, and the results were largely anecdotal.

In the late 1950s, a comprehensive study of American business schools recommended that market researchers apply the same methods as researchers in natural sciences. Researchers responded with enthusiasm, and marketing research became quantitative, relying on statistical analysis to highlight market trends and consumer preferences.

While this remains a staple of consumer research, by the 1980s researchers began to realize that something was missing. As more people with backgrounds in psychology and sociology entered marketing, the interpretive approach to consumer behavior emerged as an important adjunct to traditional quantitative research.

Interpretive Research: What's Next?

A traditional market research project may include input from hundreds of people. But, because they want responses, researchers cannot seem too intrusive, so the questions tend to capture broad surface patterns. They also are limited by questionnaire space and the imagination of the researcher. The choices presented to the respondents may not reflect their actual feelings, so they choose something as close as possible. Or perhaps they choose something completely outrageous—the researcher has no way of knowing for sure. Then all of these responses are averaged together to produce a sketch of consumer behavior that may be useful in some circumstances, but leaves out important information.

By contrast, an interpretive researcher may only interview a dozen or so people about a specific consumer behavior, but the extensive interviews require several hours. The transcribed interviews are then examined in detail to find common threads that indicate why these consumers chose a particular product or behavior. Like traditional researchers, interpretive researchers begin with a specific question. For example, a researcher may look at the proliferation of tattoo parlors and wonder if and why more individuals are choosing to get a tattoo.

“Traditional research provides a very shallow look across a broad population. It is a mile wide, but an inch deep,” explained interpretive researcher Deborah Evers, who studies vegetarianism. “Interpretive research provides a very deep look at a narrow topic; it is a mile deep and an inch wide.”

Interpretive research can examine to any aspect of consumer behavior, but it is particularly suited for understanding niche markets. Murray’s group includes researchers who explore consumption choices like music, fanaticism and tattoos, as well as lifestyle choices like vegetarianism and voluntary simplicity.

“It can be argued that all markets are becoming more and more niche markets because of the explosion of information that consumers are exposed to,” said Evers.

Identity Formation: Who Are You?

According to Murray, identity formation involves both distinction and social integration. We make choices because we want to distinguish ourselves, to stand apart. But we also want to be a part of a group or subculture. One of the best examples of this is clothing choices among teenagers. While their clothing choices often reflect a desire to distance themselves from their parents, they show a desire to align themselves with their peer group.

“Identity includes both the discursive and the non-discursive,” Murray said. “The discursive part is the way we talk about ourselves, which influences who we become, while non-discursive is the way we feel. Interviews themselves only tap the discursive part, but we can look for the non-discursive through observation and analysis across cases.”

The natural extensions of distinction and social integration are inclusion (I belong to, I am a member of...) and exclusion (I disassociate from ...). Evers found this to be particularly true in her study of vegetarians.

“I found distinct stages of identity formation for vegetarians,” she explained. “It begins with exposure, when the informants realize that they know practicing vegetarians, and proceeds to experimentation. This involves trying out some things and observing the reaction of others.”

The next stage, social recognition, occurs when the informants begin to consistently identify themselves as vegetarians. A final stage, expansion, involves exploration of other meanings of vegetarianism. Murray describes this process of identity formation as “customization” or personalization of cultural meaning.

“People can now create a ‘pastiche’ identity,” said Evers. “An identity that in the past would have seemed

incongruous is now just custom-built to a variety of interests. For example, you can find a vegetarian beef rancher; a pollo vegetarian, who eats chicken; a pescos vegetarian, who eats fish; and meat eaters that distinguish pasture-raised from factory-raised meat.”

Consumption Patterns: Talkin’ About My Generation

As consumers become more selective, they form distinctive subcultures of consumption patterns. While these subcultures are virtually impossible to understand by using a traditional statistical approach, interpretive consumer research can provide companies with valuable information about the cultural practices of these markets. And companies are catching on: In markets as diverse as cleaning products and leisure, companies like Proctor and Gamble and Best Western hotels are turning to interpretive research for insight into consumer behavior.

“One of the ways that companies have tried to address these niche markets is by fragmenting their product lines,” explained Murray. “They make changes, introduce new products in an attempt to reach these consumers. But the key to product adoption is context—is the product appropriate to the subculture?”

A key element of this is authenticity. Consumers who identify with a particular subculture, whether it is skateboarding or opera, are seeking authentic products. Knowing what is authentic is one way to identify as part of the subculture. Companies, on the other hand, need to commercialize their products if they are going to be profitable.

“It is a fine line that companies walk,” Murray noted. “If they become too commercial, they lose their ‘authentic’ status and, therefore, their consumer base.”

Dan Fisher, a graduate student in Murray’s research group, is examining how authenticity and commercialization interplay in popular music. He sees music as “a commodity system that cuts across consumer contexts. People use music for their own purposes—to get a sense of self, to find out who they are, to escape from or add meaning to their lives. But it is also a \$12 billion per year industry. And that is just in album sales in the United States.”

As such, music demonstrates the tension between social integration and distinction. By adopting a par-



ticular music group or style, a consumer can simultaneously identify with a subculture and distinguish himself from the larger society. And by finding a musician or group that appeals to a subculture, companies can develop or extend their market.

"This is a particular problem for marketers, who must figure out how to grow their market share without overexposing their product," Fisher said. "The field is littered with the bodies of music groups that became too commercial too fast and lost their core audience."

Fisher can cite many examples of music groups and individuals—from Green Day to Luciano Pavarotti—that have become too commercial and lost their aura of authenticity.

"In the past, models emphasized the production side. They assumed that the industry controls the market and consumers don't really make many decisions," he explained.

That may have been true in the days when consumers could only receive one radio station or buy vinyl records, but technology has made those models obsolete. Today, music groups can release their own recordings on CD at minimal cost, or they can broadcast on the Internet. Fans make their own CDs and share them with friends and build Internet sites devoted to the musicians. The music industry has become consumer driven.

Direct Hits: Taking it to Xtremes

Scott Smith, a graduate student using interpretive techniques to study fanaticism, points to Xtreme sports as an example of successful subculture marketing. "Mountain Dew didn't create Xtreme sports, but its marketing strategy brought it to a wider audience without destroying its authenticity."



Mountain Dew marketers did not risk damaging their market. The athleticism and risk-taking behavior required to participate in Xtreme sports made it unlikely that the activity would become mainstream.

However, by using Xtreme sports in their advertising, the company cultivated both the subculture following and the "armchair athletes," whose participation might be limited to watching television while drinking Mountain Dew.

"They reached their target population and, at the same time, exposed the mainstream consumer to a subculture they may not have known existed," Smith explained.

The hardest part about studying fanaticism, whether it is in sports or religion, television or music, food or work, is how to define it. While an outside observer might label someone a fanatic, often that individual does not identify himself as such. And some people identify themselves as fanatics who seem to have very little involvement with the product.

"Fanaticism may be in the eye of the beholder," Smith explained. "While you or I might label someone at a Star Trek convention dressed up as a Klingon a fanatic, that person doesn't necessarily agree. That may just be one of many life activities, and they see themselves as being much like everyone else."

The same may be true of collectors or hobbyists, according to Smith.

"It is a fine distinction between a fanatic and a collector. We might label someone a fanatic for having 1,000 Pez dispensers or candlesnuffers or walking sticks. But if their stuff is valued highly on Antiques Roadshow, they instantly become an astute collector." Smith's study of fanaticism made him conclude that mass culture peer pressure no longer has as much influence on purchasing decisions as it once did.

Sometimes participants in a subculture actively try to overcome mass culture pressure, such as the cultural stigma associated with tattoos. In her study of tattooing, researcher Anne Velliquette found that tattoo artists actively engaged in impression management with their clients, stressing that the shop is a studio and the work is art. Not only does this legitimize the work as art, but it serves to decrease the stigma for the consumer.

Currently an assistant professor of marketing at the University of Utah, Velliquette studied consumer behavior as a graduate student at the University of Arkansas. She found that tattoos represent many different things to their owners, including group commitment, personal identity, resistance or identity change.

"We discovered that the use of tattoos to express one's inner self was probably the most commonly stated motivation for acquiring a tattoo," said Velliquette. "The tattoo becomes an extension of the person, symbolizing the person's narrative story."

Who Sells Out: Choosing Not to Consume

Not all consumption involves a decision to buy. Researcher Helene Cherrier has identified a subculture she terms voluntary simplifiers, who make the choice to lower their consumption. These people do

not identify with an environmental movement, she explains, and because they are not associated with a social movement, they have gone largely unnoticed by marketers.

"It is important for marketers to realize that voluntary simplifiers are still consumers," Cherrier said. "But they are more thoughtful about their purchases. They focus on what is important to them and they resist traditional forms of salesmanship."

As a movement, voluntary simplicity has been around since the time of Plato. In the United States, it has emerged as a major trend several times. Religion was a key element during the early years of the nation, when groups like the Quakers opposed excessive consumption. During the Civil War, it emerged as a political issue and was promoted by Roosevelt as a public virtue before and during World War II.

Ironically, the trend toward voluntary simplicity has expanded through the Internet. Online communities and support groups spread the trend among diverse people and cultures. Voluntary simplifiers range from senior citizens who sell their large family home and move into a smaller home in a retirement community to young, mobile professionals who don't want to be "tied down" to their possessions.

"The trend toward voluntary simplicity has been expanding for more than a decade," explained Cherrier. "In 1988 voluntary simplifiers were the fastest growing market segment. In addition, recent world



events have forced consumers to re-think their buying habits."

Who's Last ?

You may be what you buy, but the reality is that you buy what you are—whether you realize it or not. When consumers choose any products—a Mercedes rather than a Volkswagen beetle, an "original" Volkswagen beetle rather than the "new, improved" design, designer jeans instead of khakis—they are basing their choice on what the product means to them, how it makes them feel, what kind of image it projects to others.

"Although we have become accustomed to trivializing it, all consumption is about identity construction," Murray said. "If you chop this part off in the study of consumer behavior, you may lose the most important part." ■

COOL HUNTING: Who's First

Interpretive research can take many forms. In addition to the standard interviews, some companies pay families to allow a researcher to come into their home and follow them around, recording their actions and selections in addition to interviewing them. Best Western hotels paid vacationing couples to videotape themselves in the car and hotel room to better understand how people choose a hotel and what they want from the experience.

One of the most interesting approaches involves "cool hunters." Cool hunters, who work for market research consulting companies, travel around, talk to people and look for the interesting things that may be the amenable to commercialization.

For more information on cool hunters, check out these Web sites:

BBC Feature on Cool Hunters

www.bbc.co.uk/whatson/features/archive/coolhunters.shtml

PBS Frontline feature on cool hunters

www.pbs.org/wgbh/pages/frontline/shows/cool/etc/hunting.html

A Sense of Place

By Melissa Blouin

Architecture historian Ethel Goodstein looks at the history of buildings not brick by brick, but as a backdrop to cultural change. She examines the structures' images in literature, in movies and in art as well as the buildings themselves.

"Architectural history provides a way of thinking about the world," Goodstein says. "People should think about how they respond to the barrage of images of the built environment that are so visible these days."

Goodstein recently completed a manuscript based on 10 years of research that chronicles a century in the life of New Orleans, a city that struggles to reconcile its mythical past with the reality of its present. She focused on the 100 years between 1884 and 1984, years bracketed by large expositions, the New Orleans World's Industrial and Cotton Centennial in 1884 and the Louisiana World's Exposition in 1984.

Goodstein's work reaches beyond the French Quarter and the Garden District. She chronicles the advent of skyscrapers, the transformation of a red-light district into a federal housing project, and the way Americans distill and sanitize New Orleans through popular cultural icons like Disneyland and Las Vegas casinos.

Goodstein started out looking at post-modern culture in the South. She asked the question: How has Southern architecture evolved in between the plantation and the post-modern era?

"There is very little distinctly Southern architecture since the plantation," she said.

Using New Orleans as a case study, she examined the goals and realities of the people who lived there – the urban boosters who promoted city growth, the marginal ethnic communities, including African-Americans, Italian immigrants and other minority groups, and the prostitutes who worked in Storyville. She looked at these cultures through the buildings that provided the background for their stories.

"Architecture is always the story of something else," she said.

"Architecture is always there. It's the perpetual stage set."

In the late 19th century, New Orleans' urban boosters encouraged growth, and many high-rise buildings were built then, including the Maison Blanche store building in 1910. The boosters traded on the French Quarter's appeal, with its narrow streets, wrought-iron balconies and European flavor, to attract people, goods and growth to the city.

"Today, New Orleans continues to replicate its own mythology in the design of its Riverwalk Mall and the gaming halls of its controversial new casino," she said.

New Orleans images also permeate literature and cinema – depicting the city as historic, European and decadent. Portrayals of Creole culture appear in advertising images from the 1880s-1950s. The author William Faulkner described the French Quarter as "...a courtesan whose hold is strong upon the mature, to whose charm the young must respond" ... a romanticized allusion that has roots in the city's history.

Goodstein examined the evolution of Storyville, an enclave of legalized prostitution that occupied 20 city blocks off Basin Street in the early 20th century. The district was promoted through a book called the Blue Guide, which extolled the voluptuousness of the houses along with the women. The book described oriental rugs, crystal chandeliers and lavish trappings. The advertisements showed the buildings' interiors and exteriors.

The city shut down Storyville in 1917, and eventually declared the area "blighted," making way for the 1939 construction of the Iberville Houses, one of the South's first federal housing projects. The human costs were high, Goodstein notes, for innumerable residents were left homeless as the exclusively white projects neared completion.



A neighborhood like Storyville offers a look at changing perceptions of place in a city, and depicts changing images of poverty, deterioration and "otherness."

The architectural evolution also continued elsewhere in the city. A prominent local firm, Curtis and Davis, designed the award-winning New Orleans Public Library (1959) and many public school buildings that integrated modern design features with traditional Southern building conventions.

Although New Orleans includes these broad architectural subtexts, few tourists ever experience the different lives of the city. Instead, most follow the narrow path of Bourbon Street—a kind of decadent Disneyland. But these aspects of the city—the French Quarter, the Riverwalk Mall and the casinos—are essential at this time to the city's economic survival and development.

Disneyland itself replicated the French Quarter, opening New Orleans Square in 1965. Goodstein argues that while such places try to represent a mythic past, they suppress difference while attempting to portray difference, leaving visitors with a sanitized, diminished version of reality to be consumed and not experienced.

Thus, she questions what role history and built form serve in contemporary American society.

"How do we talk about history in a society that borrows from the past?" she asks. "How do you build for a culture that sees in the visual equivalent of sound bytes?"



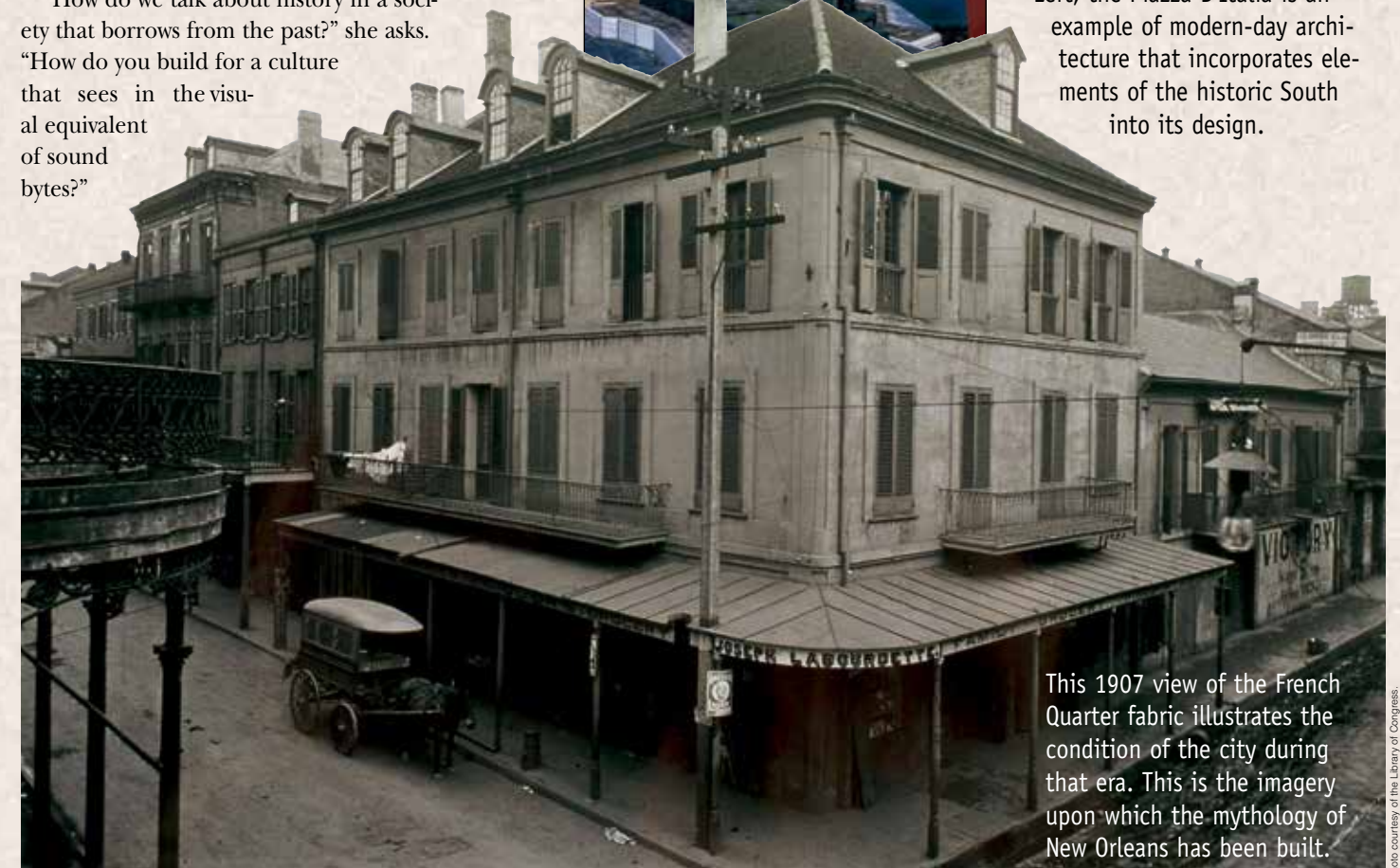
Photo courtesy of the Library of Congress



Ethel Goodstein, photo

Above, the houses in Storyville, a notorious red-light district in New Orleans during the early 1900s, were later demolished and replaced with federal housing projects.

Left, the Piazza D'Italia is an example of modern-day architecture that incorporates elements of the historic South into its design.



This 1907 view of the French Quarter fabric illustrates the condition of the city during that era. This is the imagery upon which the mythology of New Orleans has been built.

Photo courtesy of the Library of Congress



Arkansas, Arkansas: Writers and Writings from the Delta to the Ozarks

John Caldwell Guilds, editor

University of Arkansas Press

From the flatlands of the delta and the Arkansas River Valley to the Ouachita Mountains and the Ozark plateau, Arkansas is filled with geographic variation and inspirational vistas. A new collection edited by English professor John Caldwell Guilds proves that Arkansas' literary landscape is equally varied and just as inspiring.

The two-volume anthology *Arkansas, Arkansas* encompasses the whole of Arkansas literary history, from the expeditionary journals of Hernando de Soto to the poetry of Maya Angelou. It includes more than 1,000 pages of selections, some penned by writers living in the state, others written about it. Entries range from biographies to poems, histories, journals, travel writings and fictional stories.

Guilds arranged the anthology in chronological order, with the first volume representing the exploration of Arkansas and its progression to territory and statehood. Authors include Henry Dumas and John Gould Fletcher.

The second volume contains poetry and prose from the past 25 years, illustrating the proliferation of talent that has made Arkansas a player on the literary stage. Authors such as Bill Harrison, Leon Stokesbury, Barry Hannah, J. William Fulbright and Ellen Gilchrist ensure that the state's literary heritage is as indelible and rich as the land itself. ■



British Quakerism: 1860-1920

Thomas Kennedy

Oxford University Press

Quakerism is a religious sect renowned for its commitment to nonviolence. But in a new book, history professor Thomas Kennedy indicates that the commitment was not always as strong as it is today. In fact, it would take a handful of young men and a world war to make pacifism a central tenet of the religion.

The 19th century represented an era of relative peace in Britain. Amidst this tranquility, the Quakers underwent a transformation of values that diminished their commitment to pacifism.

To increase its dwindling membership, 19th century Quakers strove to converge with mainstream Protestantism. From a faith that emphasized personal introspection, the Quakers evolved into an evangelical religion.

Many young Quakers, disillusioned by the Society's new outlook, began agitating for a return to traditional Quaker values, including a commitment to pacifism. The reformers numbered only 150 out of 20,000 Quakers, but their arguments soon acquired weight with the outbreak of the first World War.

Despite persecution, many young Quakers refused to support or participate in the war. They opposed exemption based on their religion in the belief that all men should have the option not to fight. The war's brutality and the convictions of these young men persuaded British Quakerism to commit its followers to pacifism. ■



In the Shadows of State and Capital: The United Fruit Company, Popular Struggle, & Agrarian Restructuring in Ecuador, 1900-1995

Steve Striffler

Duke University Press

It's a David and Goliath story: how Ecuadorian peasants—some of the poorest, most powerless people in the world—took on a multinational corporate giant. In the process, they changed the nature of agrarian economics throughout Latin America—first by gaining control of production and industry, then gradually by losing it.

Anthropologist Steve Striffler recounts the arrival of the United Fruit Company (Chiquita) in Ecuador in the 1930s, which brought to the region both a plantation-style production system and a highly stratified class society. But with the creation of class hierarchy came conflict. In the 1960s, worker insurrections besieged United Fruit, forcing the company to retreat from its banana fields and withdraw from the country.

For a few utopian years, peasant cooperatives controlled agricultural production. But capitalist ventures soon crept back—this time in the form of contract farming.

Blending the techniques of history and anthropology, Striffler examines state and popular archives as well as United Fruit documents. He records the oral testimony of workers, peasants, plantation owners, political activists and United Fruit administrators. The resulting book illustrates the role of class conflict in shaping economic reform, in Ecuador and beyond. ■



First Encounters: Native Americans and Europeans in the Mississippi Valley

George Sabo III, Luis Restrepo, Linda Jones

Arkansas Archeological Survey

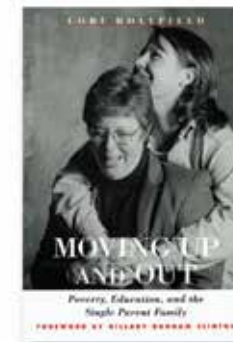
The first contact between Native Americans and Europeans amounted to far more than a date in a history book or a dotted line across a map. It was a collision of cultures unlike any the world has witnessed since.

Now, students can explore the complexity of these events through a multi-media CD-ROM developed by anthropologists and linguists at the University. "First Encounters" presents an interactive curriculum that guides students through the historical, cultural, geographic and artistic implications of first contact.

Lesson modules provide information on various topics, presenting material both from the Native American and European perspectives. Students can undertake lessons at different levels, making the software suitable for use in classrooms from junior high into college.

The program provides text passages enhanced by pictures and music and engages students with interactive tutorials, quizzes and exercise assignments. An extra language feature allows students to explore the material in Spanish or French.

"First Encounters" represents one of 12 projects funded in the first year of the National Endowment for the Humanities Teaching with Technology initiative. Visit <http://www.uark.edu/depts/contact/> for more information. ■



Moving Up and Out: Poverty, Education and the Single Parent Family

Lori Holyfield

Temple University Press

A new book from sociologist Lori Holyfield makes the point that "in American culture it is not so important that we all be equal so much as it is that we all have equal opportunities."

Addressing the issues of poverty and family, Holyfield's book encompasses both the scholarly and the personal. As a researcher, she weighs the impact of education on generating self-reliance and upward mobility among poor women, particularly single mothers.

As a sociologist, Holyfield documents the history and success of one grass-roots program—the Arkansas Single Parent Scholarship Fund—which set out to make education accessible to such women. Her investigation gives voice to single parents throughout the state, relating the barriers and struggles that hinder so many from attaining post-secondary education.

Holyfield describes in detail how Arkansas founded its Single Parent Scholarship Fund program and how it has successfully pursued its purpose for more than 15 years.

Finally, as a recipient of a single parent scholarship and as a single mother herself, Holyfield embodies the triumph and the hope that such programs can provide. As Hillary Rodham Clinton writes in her foreword to the book, "There is no reason that this wonderful idea can't work in places beyond Arkansas." ■



Monsters, Mushroom Clouds, and the Cold War

M. Keith Booker

Greenwood Press

Since its heyday in the 1950s, science fiction has captured the American imagination by transporting readers to distant galaxies and far-flung futures. But a University of Arkansas researcher claims the themes of sci-fi books and movies are far from otherworldly. In fact, they offer profound commentary on the political, social and economic climate of this country.

Focusing on what he terms "the long 1950s"—from 1946 to 1964—Keith Booker, professor of English, finds political and post-holocaust themes embedded in much of science fiction. In many books and films, extraterrestrial beings or futuristic utopian societies represent more than flights of fancy. Rather, they reveal the author's misgivings about the increasing alienation and routinization of American society at the time. Further, Booker draws ties between alien invasion plots and monster movies and the growing xenophobia that gripped Americans during the Cold War era.

By luring readers into fantastical landscapes and plot lines, writers of science fiction essentially assumed control of reality, at which point they could pursue political, social and economic policies to their most radical end. The result is a form of social criticism, safe because it's couched as fiction, popular because it entertains. ■



Human Behavior and the Social Environment, Third Edition

Joe M. Schriver

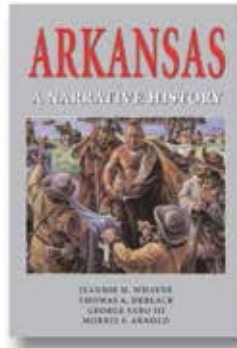
Allyn & Bacon

How do the communities, families and cultures that people grow up in determine their actions and values? How do ethnic and economic classes affect their interactions with society at large? The field of social work endeavors to promote human well-being through the alleviation of poverty and oppression. But to effectively serve people, social workers must first understand the interconnections between people's behaviors and the social context in which they live.

Human Behavior and the Social Environment explores how biology, sociology, psychology and culture influence people's actions and interactions. Author Joe Schriver, professor of sociology, has created a framework that examines social development on every level, from individuals to families, groups, organizations and communities.

His text outlines traditional theories of human behavior while introducing alternative perspectives, including feminism, multiculturalism and gay-lesbian/bisexual viewpoints. It also modernizes the study of HBSE by considering the impact of globalization on poverty and the effects of technological advances on the lives of individuals and on the field of social work itself.

Now in its third edition, Schriver's book has been adopted by 40 states for use in more than 100 schools, including Harvard, Vassar, Rutgers and Tulane. ■



Arkansas: A Narrative History

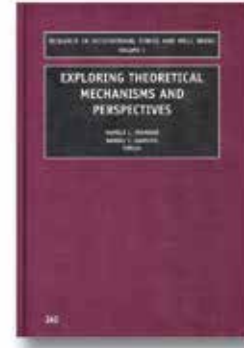
Jeannie M. Whayne, Thomas A. DeBlack,
George Sabo III, Morris S. Arnold

University of Arkansas Press

Four scholars track the tensions, negotiations and interactions among the different groups of people who have called Arkansas home. Anthropology professor George Sabo III discusses Native American pre-history and the shocks of climate change and European arrival. Morris S. Arnold, United States Circuit Judge for the Eighth Circuit, examines the accommodations worked out between French and Spanish colonists and native communities and the roles of minority groups and women in developing law, government and religion; producing goods; and market economies.

Jeannie Whayne, chair of the history department, shows how these relationships unfolded during American settlement. She discusses how mutuality ended when white settlers transplanted plantation agriculture and slavery to formerly native lands. Arkansas State University history professor Thomas DeBlack shows how plantation society, though prosperous, brought the state into the Civil War.

Whayne then discusses different groups' access to the political process; postwar economic issues; and the interrelated problems of industrialization, education and race relations. The authors then examine how the Civil Rights Acts of the 1960s transformed political and social landscapes, but left behind vestiges of old attitudes and prejudices. ■



Exploring Theoretical Mechanisms and Perspectives: Research in Occupational Stress and Well Being

Daniel C. Ganster and
Pamela L. Perrewe, editors

JAI

Stress in the workplace is a major source of cost for employers and employees alike, resulting in missed work, reduced productivity and increased medical costs, as well as decreased well being for employees. University of Arkansas management professor Dan Ganster and co-editor Pamela Perrewe of Florida State University invited seven of the top researchers in the field to each write a chapter reviewing current research in a specific area of occupational stress and well being.

Work stress spans many disciplines and it is increasingly difficult to track and integrate the work from these disciplines. *Exploring Theoretical Mechanisms and Perspectives* allows influential stress writers to critically examine cutting edge research from their respective disciplines. Topics range from a cultural perspective of social support to the role of emotions in occupational stress and include discussions of psychosocial factors and physiological disorders, as well as factors that mediate and moderate stress.

This is the first volume in a series. The second volume, which is due out next December, will focus on health outcomes and physiological aspects of workplace stress, and the third volume will focus on European research. ■