Fall 2004

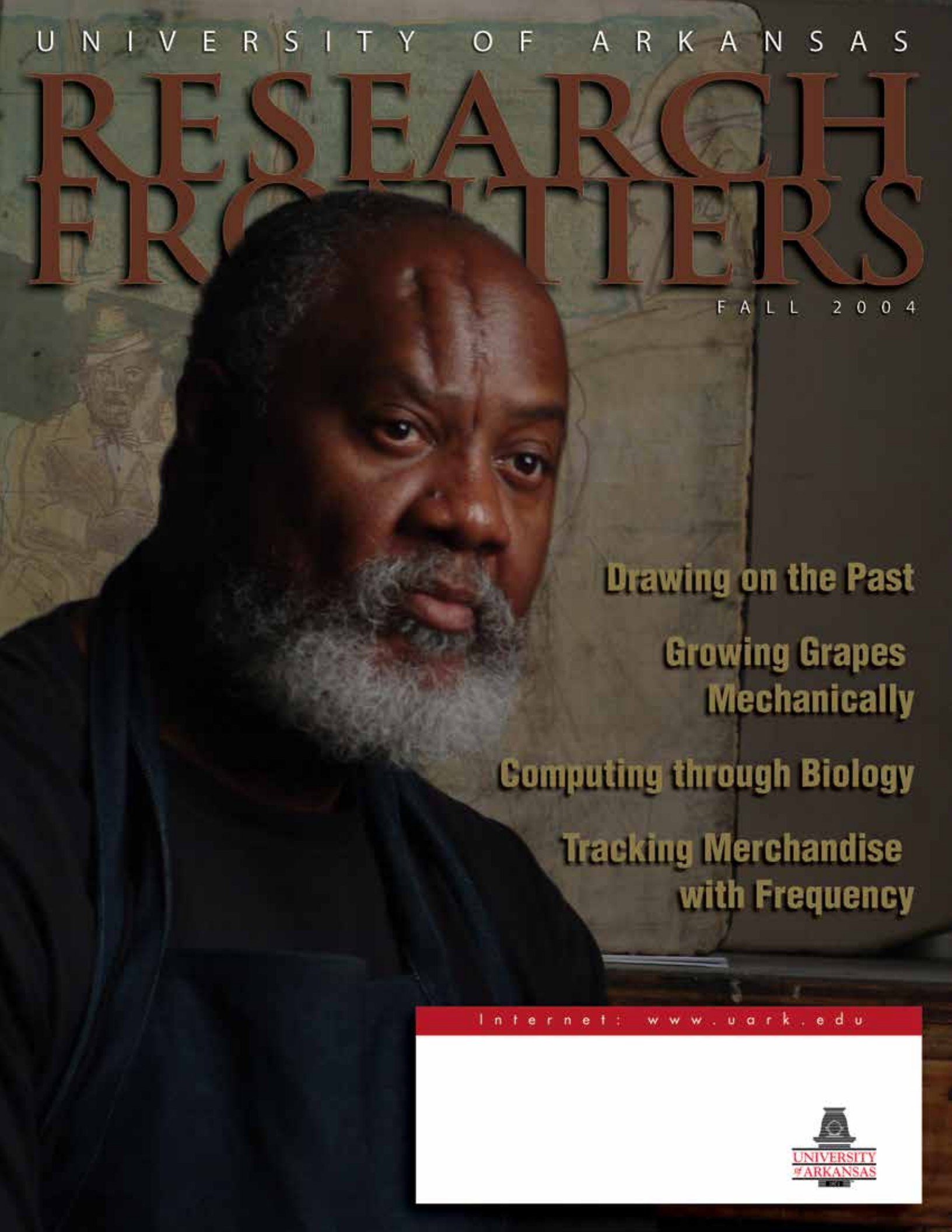
Research Frontiers, Fall 2004

University of Arkansas Fayetteville. Office of University Relations

UNIVERSITY OF ARKANSAS

RESEARCH FRONTIERS

FALL 2004



Drawing on the Past

Growing Grapes Mechanically

Computing through Biology

Tracking Merchandise with Frequency

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UNIVERSITY of ARKANSAS

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Chancellor

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Message from the Chancellor:

With fall semester already in full swing, we look forward to another banner year for the University of Arkansas and UA research. It's been almost impossible to keep up with all the praise UA research has received nationally and internationally in the past several months.

Expect even more positive recognition in the days ahead.

I'm pleased to report that the Council for the Advancement of Science Writing (CASW) is holding its 42nd annual New Horizons Briefing at the University of Arkansas Nov. 7-10. The University joins some very distinguished company – other universities that have hosted the briefing include Harvard, Stanford, Duke, Cornell and Penn State. Future hosts include Carnegie Mellon and Johns Hopkins.

The CASW briefing will bring more than 100 of the best science writers from the national news media, scientific agencies and organizations and research universities to our campus. Attendees will include reporters from newspapers, magazines, radio and television. While here, they'll meet with University of Arkansas researchers, tour cutting-edge UA research facilities and become acquainted with Arkansas' unique scientific and cultural offerings.

In a letter accepting the University's bid to host the conference, CASW executive director Ben Patrusky wrote: "There is little doubt that the University of Arkansas is bursting with terrific scientific/technological talent and first-rate stories, thus making your institution a choice venue for the briefing…let me assure you, based on my long years of organizing these briefings, that there is probably no more effective means of alerting the national and world press – and through them the public – of Arkansas' scientific prowess."

Word of the University of Arkansas' research is spreading, and the CASW briefing will further that recognition exponentially. The effects of the CASW conference will last for years, advancing the academic reputation of the University on a national and international level.

The conference will also bring researchers from across the country to Arkansas. We look forward to showing off our state and region.

Sponsorship of the briefing is part of the continuing effort to support the emergence of the University of Arkansas as a nationally competitive, student-centered research university serving Arkansas and the world. The stories in this issue illustrate why it is possible to attract such attention, to the good of our University and our state.

Happy reading,

John A. White
Chancellor, University of Arkansas

Water Tank Cosmogony

The leaves that sank to its bottom
were not magnified by the trembling
of the liquid, nor its stillness, nor
its bevel at the corrugated rim.
A season decanted where a bullfrog
drummed his throat to the black gnats
strafing the watery lens – but how,
across that long drought summer
when we sold the herd, through fields
of parched, uneaten pasture, did he hear
its oval note of rain and aluminum?
I would have turned the valve that night
and let the water flow, a rippling plane,
into the grass, but I just stood there,
frozen like the frog in the beam
of my flashlight, while the deep grass
roar of summer pulsed around us,
and a meteor swam, I swear,
like a tadpole though the glistening dark.

Fishing at Night

As if what waited
in the dark
were different
than what travelled
through it: a chalk
moon rose and filled
the fossil beds
with light. Print
of a crinoid,
print of a shell.
Here at the slate bar's
end, where water
swirls and eddies,
I worked the bait
into the dark, bent
my concentration
to its snags and cur-
rent, the line
going taut then
slack. It wasn't
so much the river
as it clucked
and settled over eggs
of chert, but how
it hatched itself
years deeper
in its groove,
how it whispered
obsolescence
with each cleaned hook,
my own veins
pressed like fish scales
in a sunless,
uncracked rock
or book.

Assistant professor of creative writing Davis McCombs was a Wallace Stegner fellow at Stanford University from 1996 to 1998. His poem "The River and Under the River" was featured in "Best American Poetry 1996." His book "Ultima Thule" was the 1999 winner of the Yale Younger Poets competition.

Photo By Eric Pipkin


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INTERNMENTART

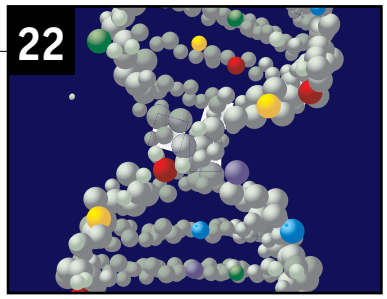
Art professor John Newman explores the landscape, history and culture of a World War II Japanese internment camp in Arkansas and how its inhabitants related to the mostly African-American community that surrounded it.

GRAPEGROWING

Almost every aspect of grape growing requires intensive hand labor. Researchers at the Institute of Food Science and Engineering have created a total vineyard mechanization system that will change the way farmers grow grapes.

DNADATABASE

Imagine that all of the information on the Internet could be stored in a drop of liquid. UA researchers are helping to make this idea become a reality using DNA. They are peering into the blueprints of life to see how the complex molecules might be used for computing.



HIGH-TECHTRACKING

How do retail outlets track a four-pack of toilet paper from the time it leaves a warehouse until a consumer buys it? Researchers at the Information Technology Research Center are using new technology to help businesses keep track of the millions of items they store, move and sell every day.

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Cover: More than 120,000 Japanese-Americans were sent to internment camps during World War II. Art professor John Newman examines the cultural landscape surrounding one of those camps, located in Rohwer, a small farming community in southeastern Arkansas.

"Doping" Helps Control Size Changes in Nanoscale Materials

Researchers want to build nanoscale materials because they promise to be five to 10 times stronger than conventional materials, which could lead to longer-lasting computers and other electronic devices. But these materials lose their attractive properties at high temperatures. To make nanoscale materials retain their size and shape at high temperatures, a little "doping" helps.

When building material atom by atom, temperature increases change the size, shape and properties of the material – an undesirable result for a stable component in a device. Panneer Selvam, professor of civil engineering, graduate students Paul Millett and Shubhra Bansal and Ashok Saxena, dean of the College of Engineering, created a computer model using copper atoms, a material often used to create connections between devices. The researchers introduced an antimony atom to see how it would affect the properties of the material.

The introduction of a different type of atom, called "doping," prevents the material from changing shape and size and helps it retain its properties. Unlike an alloy, where researchers might use mixtures of different metal atoms to create more desirable properties, a "dopant" atom remains separate from the other atoms in the metal, migrating to its surfaces or edges.

In the simulation, the antimony atom moved through the material to settle at the grain boundary, the place where one layer of copper atoms ends and another layer begins. Having an atom of a different size from the main material changes the distance between the atoms, which appears to allow the material to retain its shape and size when the temperature changes. The researchers ran the simulation with one antimony atom and 1,800 copper atoms, then ran it again with one antimony atom and 10,000 copper atoms.

"We can design new materials using processes like these," Selvam said. "This study tells manufacturers that they can make these particular types of materials." ■

Photo Submitted

An integrated stair, elevator and signage in the Statens Museum for Kunst, Copenhagen exemplifies Universal Design principles.

Architecture Professor to Develop Affordable, Accessible Housing for Arkansas

UA architecture professor Korydon Smith wants to open the door to independent living to everyone. The key to accomplishing this task lies in a new program led by Smith, the University of Arkansas Universal Design Project. Initiated by the Governor's Task Force on Supported Housing and funded by Arkansas Rehabilitative Services and other agencies, the program is a pioneering attempt to develop accessible housing standards, design prototypes and enact policy changes at the state level.

"Arkansas is the first state to take this proactive approach, and we're hoping it can become a national model," Smith said. "Our state leads the nation with the highest poverty rate and third highest disability rate, so it's essential that we provide affordable, inclusive housing for everyone," he added.

Smith began last summer with demographic and economic research coupled with travel across Europe, where the most innovative responses to accessibility and affordability are taking place. This extensive research laid the groundwork for the heart of the project, the development of inclusive design standards for the state of Arkansas. Smith plans to collaborate with a host of professionals, including architects, engineers and developers, as well as representatives from groups such as Habitat for Humanity and People with Disabilities. Once the standards are drafted, Smith will work with state officials to develop policies and tax incentives that support the construction of affordable, fully accessible housing. Eventually, working with the state of Arkansas, he plans to design prototypes for single- and multi-family residences.

Smith hopes to craft innovative solutions that will place Arkansas in the vanguard of the inclusive design movement.

"My long-term hope for the prototypes is that they're transformative – something that's adaptable to changing site conditions, urban or rural contexts, diverse users and social contexts, and local materials," he said.

Other goals for the project include the publication of a state resource manual, development of training workshops and presentations, and the establishment of a center for inclusive design at the University of Arkansas. ■

Two Surveys Examine Accountability and the No Child Left Behind Act

While schools throughout the United States grapple with mandates of the No Child Left Behind Act of 2001, a UA study released by the Research and Advocacy Network notes "flaws that make implementation nearly impossible" and suggests direction for improvement.

Entitled "Accountability and No Child Left Behind," the study affirms support for accountability and universal proficiency but notes that "what has been missing is … the technical expertise and the resources necessary to provide for education reform and the teaching of all children."

The study was commissioned by the Network, a consortium of superintendents of 37 Arkansas school districts representing more than 50 percent of the state's students and coordinated by Leslie V. Carnine, executive in residence of the College of Education and Health Professions. In addition to Carnine, authors of the study are Carleton R. Holt, assistant professor of educational administration, and Marsha Jones, assistant superintendent of curriculum for Springdale Public Schools.

The study presents the results of two recent surveys, one of superintendents from throughout Arkansas and the other a poll of public attitudes and opinion, conducted by the UA Survey Research Center, that reached 600 Arkansans statewide. Carnine noted that both surveys revealed the need for further research. From the responses of superintendents, it was clear there is a need for strategies to bring research-based methods to all school systems. Results of both surveys suggested that the use of negative sanctions must be examined to determine their impact on the ability of institutions to work effectively. ■

Researcher Studies How Dispersed Sierra Leoneans Maintain Sense of Community

When civil war broke out in the West African country of Sierra Leone in 1991, it sent thousands of Sierra Leoneans fleeing to peace and asylum abroad. Meanwhile, thousands more who had come to the United States in previous years found themselves unable to return to their families and culture in Sierra Leone.

A book by anthropologist JoAnn D'Alisera explores how the displaced people found their identity and a sense of community in the United States. "An Imagined Geography," published in March by the University of Pennsylvania Press, challenges the long-held anthropological paradigm that communities are bound and defined by geography.

D'Alisera studied Sierra Leonean Muslims who had come to the United States in three separate waves of immigration. The first wave was after 1965, when immigration law changed. In the 1970s came economic refugees. The 1990s brought the civil war and a new wave of civil war refugees fleeing for their safety. As the civil war escalated, travel between Sierra Leone and the United States became more difficult and was impossible at the height of the war in the mid-1990s. Many of the Sierra Leoneans who had entered the United States in the first two waves found themselves stuck there.

D'Alisera's book shows how the immigrants maintained an intense sense of community through weddings, rituals and travel, even while they were spread throughout the United States and the world and could not return to their homeland. ■

Photo Submitted

Researchers Study Arbitration Outcomes

The average cost of litigating a dispute between an employer and employee can range from tens of thousands to hundreds of thousands of dollars. When faced with such soaring expenses, more and more businesses are opting for alternative ways of resolving disputes that will allow them to avoid the courtroom. One of the most popular of these is arbitration. In arbitration, a neutral third party hears testimony and evidence from the parties involved and then renders a legally binding decision.

Two economics researchers at the Sam M. Walton College of Business, assistant professor Cary Deck and professor Amy Farmer, have received a grant from the National Science Foundation for the purpose of studying this growing field.

Deck and Farmer have planned a one-year study that will examine how the amount of information each party, including the arbitrator, has going into the process affects the final settlement.

"We also want to see how the method of arbitration affects the outcome," Farmer says.

"This has important ramifications for the employer-employee relationship. How do these different forms of arbitration affect strategies…and does one form favor either employers or employees?"

The two most common forms are conventional arbitration and final offer arbitration. In conventional arbitration, the parties present their cases, and the arbiter issues a judgment as he or she deems fair. In final offer arbitration, after presenting their cases, both parties present the arbitrator with a specific settlement amount, and he or she must choose between them.

"This should be very interesting research," notes Deck. "Take major league baseball, for example. Final offer arbitration has received a lot of attention in the popular press because it's the method used for settling salary disputes in baseball. However, our preliminary findings have shown that final offer arbitration actually favors team owners rather than players." ■

Photo By Russell Cothren

From left, professors Myria Allen, communications, Cynthia Riemenschneider, information systems, and Margaret Reid, political science, share a laugh. The researchers found that women in information technology positions laugh to build solidarity with one another and diffuse the intensity of discussing taboo subjects, such as discrimination and promotion obstacles.

Workplace Barriers Give Women Something to Laugh About

When it comes to workplace hardships, women manage to find lots to laugh about, according to three UA researchers.

Professors Myria Allen, Margaret Reid and Cynthia Riemenschneider published the results of their study, "The Role of Laughter When Discussing Workplace Barriers: Women in Information Technology Jobs," in "Sex Roles: A Journal of Research."

The team gathered 39 women in information technology positions at a large company and put them into six focus groups. The groups discussed their professional experiences, barriers they faced and reasons women leave their IT jobs. Their discussions included discrimination, promotion obstacles, being overlooked by clients and problems juggling career and family.

The researchers noticed a pattern in group laughter amongst the women. They wondered what triggered the laughter: Why do women laugh at certain things? What function does laughter serve for women when they get together and talk about problems they face in the workplace?

The researchers found that women laugh for a variety of reasons when it comes to discussing their careers. They laugh to build a sense of solidarity amongst other women in their group, to minimize the force of discussing taboo subjects and to deal with incongruity between what is logical and expected and what the women experience. ■

UA Law School Launches Journal of Food Law and Policy

Photo By Russell Cothren

While the U.S. food system is generally considered one of the safest and most efficient in the world, there are unique legal concerns arising in modern food production that the government, food companies and consumers share alike. Recent lawsuits against fast-food companies, claiming their "super-sized" portions contributed to obesity are one example. And the discovery of a B.S.E-infected cow on a Washington State dairy farm last year may raise legal questions as it forces the United States to rethink the regulation of the cattle industry.

With increasing questions about the nation's food supply and its regulation on the forefront of American minds, the School of Law has created a cutting-edge academic journal, the Journal of Food Law and Policy, to address legal issues in the rapidly evolving food industry. It is the first of its kind in a U.S. law school and a suitable fit for the University, which is home to the National Agricultural Law Center, the leading national resource and provider of objective, scholarly and authoritative agricultural and food law research and information.

"Food law and policy is an emerging area of law that continues to grow in significance," said Michael T. Roberts, research associate professor of law and director of the center. "As the marketplace for food products becomes increasingly globalized, it is more important than ever for a law journal to be created to help develop a basic understanding and analysis of the complex array of laws and regulations that govern the manufacture and marketing of food.

Food law has grown in significance as industries that process, distribute and market food and fiber have rapidly evolved. Practitioners who specialize in administrative law, international law, products liability, intellectual property, environmental law, business law and many other sectors are frequently faced with cases and questions that require a knowledge of food law.

The articles published in the journal will address cutting-edge legal and policy issues and may include such topics as food safety, biotechnology, obesity litigation, international trade and standards, security and terrorism, food and dietary supplements, labeling and food products liability litigation. ■

Blending Plastics, Semiconductors to Form Flexible Chips

Disposable cell phones, flexible computer screens and wristwatch computers could be within technology's grasp if organic plastics and electronic materials are combined to share some traits. Cheap, flexible plastics conduct electricity slowly; while fast, "smart" electronic semiconductors are heavy, brittle and expensive. So physics professor Huaxiang Fu examined the theoretical properties of an organic and inorganic semiconductor hybrid. He and Jing Li of Rutgers University found that the hybrid retains the electronic properties of semiconductors and the flexibility of organic material – and has some advantages over pure semiconductor material.

Researchers have synthesized organic-semiconductor hybrids, but their properties are not understood. Fu and Li's calculations provide an overview of the knowledge needed to foster widespread use of hybrid composites. They examined the properties of a single atomic layer of semiconductor material sandwiched between two atomic layers of organic polymers.

Knowing the probable properties of such materials allows researchers to make decisions about which materials to pursue for development into devices.

"This is a powerful example of what theory can do," Fu said.

Researchers thought that atomic bonding in the organic material would affect the semiconductor's properties, and it does but only slightly.

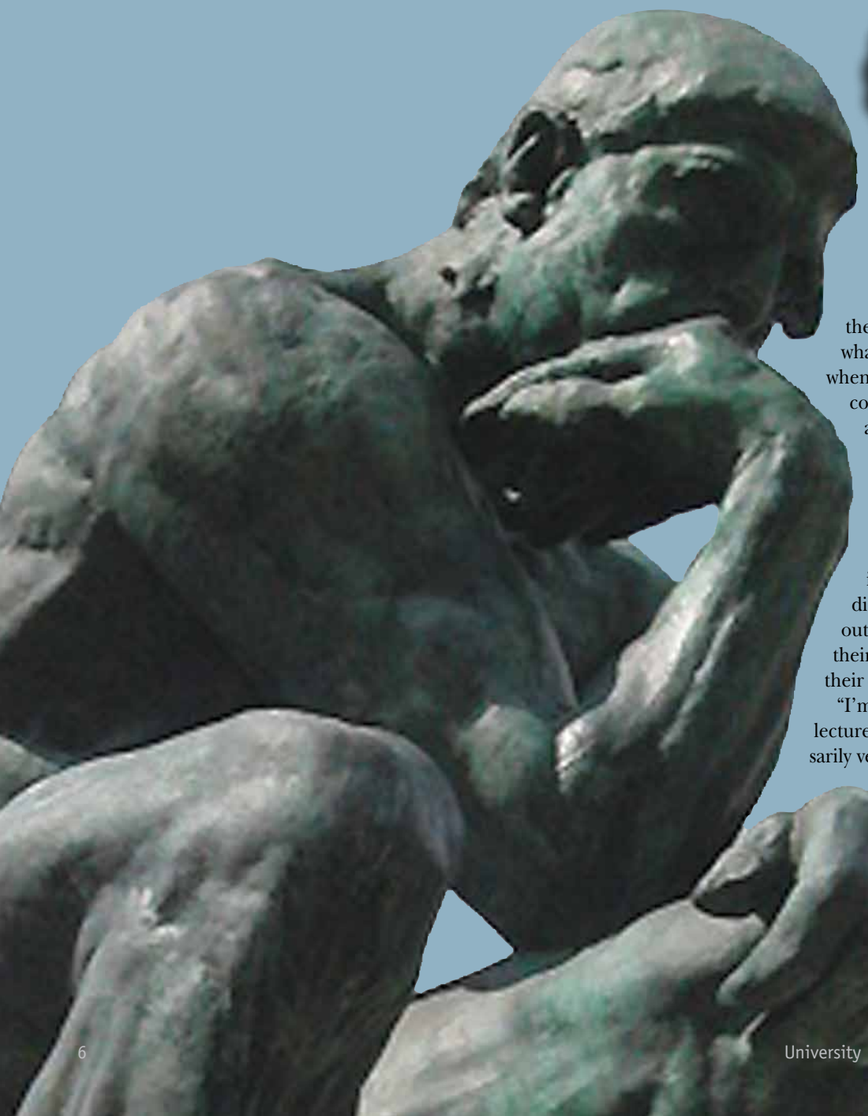
Fu and Li found that the hybrid material conducted electricity nearly as well as pure semiconductor material. Further, they discovered that the hybrid material has a large energy absorption window, which means it uses energy more efficiently than pure semiconductor material.

With a hybrid, researchers and manufacturers could use less of the expensive semiconductor material and still get the same or better electronic performance from a device. Further, the material will be flexible.

"This will make devices much less expensive and easier to process," Fu said. "The market for these materials could be potentially huge." ■

Thinking about Thinking

By P.J. Hirschey



Descartes said, "I think, therefore I am." A more updated version of this quote might be something like, "I think about thinking; therefore I think better." That is precisely what UA student Michael Pate discovered when he began conducting research into cognitive function and problem solving last autumn.

Pate became interested in various techniques of learning and problem-solving during a course that he took under agriculture professor George Wardlow on methods in agricultural education. In it, Wardlow discussed alternatives to traditional teaching approaches and pointed out ways in which teachers could encourage their students to take greater control over their own thinking and learning processes.

"I'm one of those instructors who thinks that lecture is very time efficient, but it's not necessarily very learning efficient for the students," Wardlow explains. "In most of the classes that I teach, we try to incorporate a lot of 'hands on' work, as well. I do that to model for our students that want to be teachers or industry instructors alternatives to lecture that can improve learning efficiency."

Intrigued by the ideas the class raised, Pate applied for and received a research grant from the Bumpers College to study the issue with Wardlow.

He then set out to put these ideas to the test. His research focused specifically on a technique known as Thinking Aloud Pair Problem Solving (TAPPS). TAPPS is a technique designed to encourage metacognitive thinking (see side bar) by ensuring that students verbalize their thoughts while working through a task.

Pate tested students in a mechanics class as they worked to troubleshoot and repair lawnmower engines. He divided the class into two groups. All of the students were then given engines with the same problem and asked to diagnose and repair them. Students in the control group worked alone, while students in the second group worked in pairs. In each pair, one student was assigned the job of problem-solver, and the other was assigned to be the listener. The sole responsibility of the listeners was to encourage their partners to fully verbalize their thought processes while troubleshooting and making repairs. They were told to meet even the shortest silences with questions and prompts to keep their partners talking. Listening partners were not allowed to offer suggestions or instructions but were simply there as a 'sounding board' for the problem solvers.

Pate discovered that students who used the TAPPS technique showed more than double the success rates in repairing their equipment than did students in the control group, and finished their repairs an average of six minutes faster. The reason for this success, he found, lay in having the students constantly verbalize their thoughts. By doing this, the students were forced to become aware of their own thought processes, which encouraged them to check themselves and correct faulty steps in logic, thereby making the process more efficient.

"I think it shows us another way to get our students to think in steps, to think more clearly and to be more aware of what they are doing," explains professor Don Johnson, one of Pate's advisers in the project. "Our goal now is to move students from needing the listening partner, especially since he or she isn't actually doing anything to help solve the problem. We found that even though the control group was encouraged to think aloud, none did. They don't use this process unless someone is there to prompt them."

Pate and Johnson point out that the next step is to develop successful techniques to train students in metacognitive thought without needing to be prompted. This would produce students with more efficient problem-solving skills, Johnson notes.

For Pate, who plans to teach agriculture at the high school and later college levels, the possibilities for classroom application are intriguing.

"This represents a new way of teaching students how to think," he said. "They are going to face all kinds of problems on a daily basis both in school and outside of school, and this technique is effective on far more than just lawnmower engines." ■

Metacognition: The Road Map to Understanding

Have you ever taken a long road trip? You know where you're beginning. You know where you want to go, but what is the best way to get there? There are many different routes you could take. All lead to the same destination, but some are faster and more efficient than others.

Learning and problem solving work in much the same way. When presented with a problem, you know the starting point; you know your destination–the solution. But how do you know the best, most efficient mental route to take?

That is where metacognition comes in. Metacognition is a buzz word heard often in educational circles today. The term was coined by John Flavell of Stanford University in 1976, but the concept it describes has been around for more than 100 years. However, providing a precise definition for this concept has proven tricky, even for experts in educational psychology.

"Metacognition is about being aware of and taking control of your cognitive processes," explains George Wardlow, a professor of agricultural and extension education. "Then, you can purposefully channel your cognitive resources to solve problems. You could say metacognition is, at its most basic, thinking about thinking."

Being aware of one's own thoughts sounds simple, but, surprisingly, for most people it isn't as easy as it seems, because people act intuitively, without really being aware of why they are doing what they're doing. This type of "auto-pilot" thinking works well for handling many situations, but when faced with complex problems, students who have not developed metacognitive skills have difficulty solving them and often give up in frustration.

Many educational psychologists now stress an instructional approach known as Cognitive Strategy Instruction (CSI) as a way to develop these metacognitive skills. By using an approach known as 'scaffolding,' teachers support, rather than explicitly direct students as they learn, by providing learning prompts and checklists, demonstrating proper procedure, and encouraging thinking aloud (see Pate article). This technique encourages students to understand how they arrive at a solution, rather than just "knowing" the "right" answer. Once these thinking skills become familiar to students, they begin to exercise them unconsciously, which leads to greater efficiency in both learning and problem solving. ■

ROHWER

Art professor seeks to reveal community surrounding internment camp

On Dec. 7, 1941, Japan attacked the United States naval base at Pearl Harbor. Within hours of the bombing, FBI agents, most without evidence or warrants, rounded up over 1,000 Japanese in the U.S. mainland and Hawaiian islands. Though there was no proof that Japanese-Americans were spying for Japan, the federal government decided nobody of Japanese ancestry could live on the West coast.

On Feb. 19, 1942, President Franklin D. Roosevelt issued Executive Order 9066, which forced more than 120,000 Japanese-American people to leave their homes in California, Washington, Oregon and Arizona, with few belongings. They were taken to 10 internment camps, where many lived behind barbed wire fences with armed guards for the next three years.

Arkansas was chosen as a home for two internment camps, probably because it was landlocked and far from the cities of the Pacific and Atlantic coasts. One of the internment camps was located in Rohwer, a small farming community in southeastern Arkansas. The other was several miles away, in Jerome.

By Erin Kromm Cain

Gift of the Walter Muramoto Family, Japanese American National Museum (97.292.13B)

John Newman

When University of Arkansas art professor John Newman was in college at the University of Kansas, he got a peek into what life was like in the Japanese internment camps of the 1940s. He didn't realize at the time just how close to home that part of history was.

Newman's advisor, University of Kansas professor Roger Shimomura, had firsthand experience with internment camp living. Shimomura, his parents and his grandparents had been moved to Camp Minidoka in Idaho from Washington when he was two years old.

Years later, Shimomura inherited his grandmother's diary, where she had recorded holidays and other events that took place while his family was at the camp. Shimomura translated these memories into a series of comic book-like prints incorporating people in traditional Japanese dress with familiar Western images.

"He used images of the geisha, or a Japanese samurai, and he'd make a linear drawing, then fill it in with flat color," Newman said. "Then he'd intertwine these cultural images with everyday people in the camp."

Shimomura also inserted figures from Western pop culture into his prints – Superman, Mickey Mouse and other recognizable characters.

The pictures were memorable for Newman, who described one depicting an internment camp birthday celebration.

"There was a birthday cake, and a little boy sitting on a chair looking at it, and it's like you're looking at it through barbed wire," Newman said, sketching out a rough representation of the image on a scrap of paper. "In the window behind the little boy, you could see the silhouette of a guard."

In another of Shimomura's pieces, a woman in traditional Japanese dress faces a boy wearing the typical casual clothing of contemporary Western children.

The prints elicited in Newman a feeling of pity for the Japanese families uprooted and moved to this prison-like camp in rural Idaho. He and Shimomura discussed what it had been like there, but for the most part it was a distant fact that didn't really affect Newman personally.

What really interested Newman, as an artist, was the type of work Shimomura was doing – the compositions' linear qualities and Japanese styles. He was excited about it and told his mother about Shimomura's prints. Her reaction surprised him.

"She said we had an internment camp in Rohwer, where I'd lived as a very young child," Newman said.

He was now faced with a somewhat difficult situation – he felt the need to deal artistically with this unexpected connection to the past, but at the same time he didn't want to take away from Shimomura's project.

"That was his thing, but then it became my thing too," Newman said.

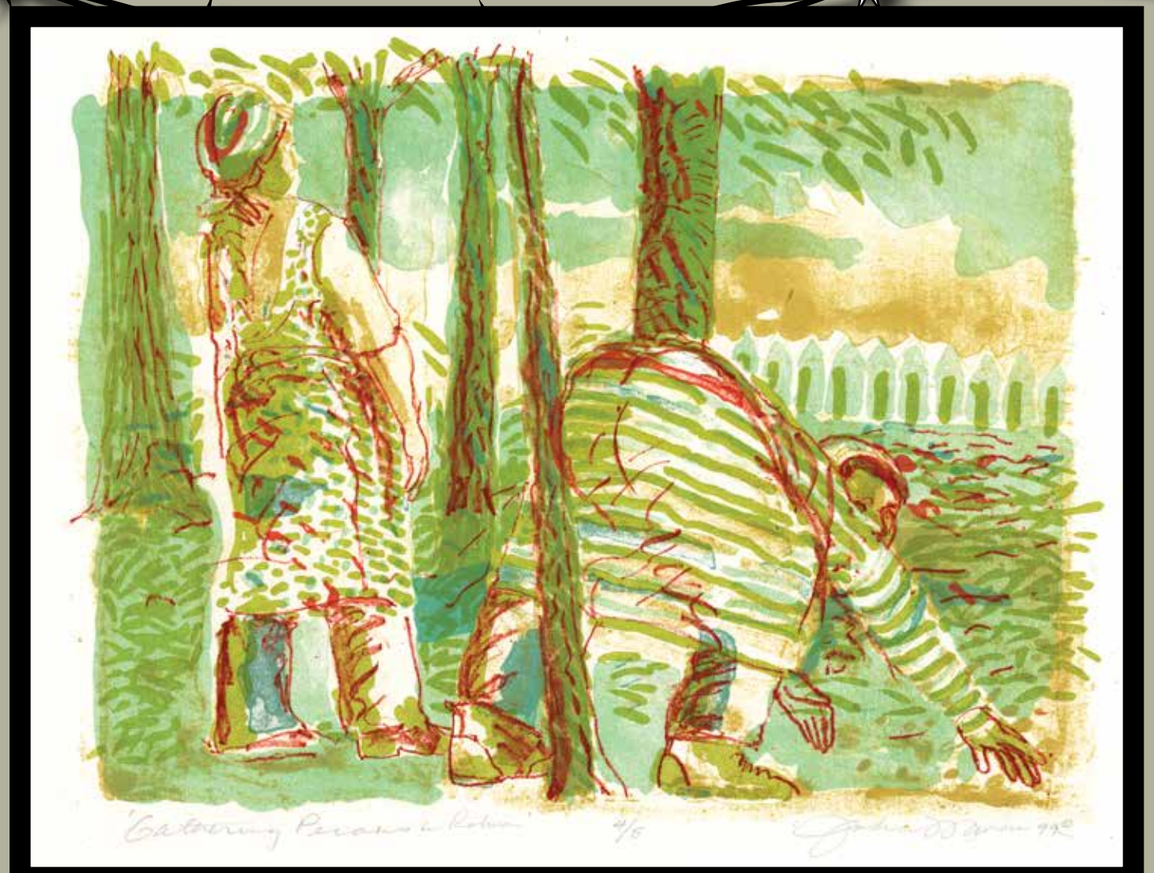
For years, the desire to put that past on paper tugged at Newman. He had always been interested in the Delta area of Arkansas and its unique blues music. He'd eavesdrop on his mother and grandmother when they sat on the front porch and talked about growing up in the Delta.

Shimomura had created prints based on the life of Japanese internees at the camp. Newman said he couldn't speak to that situation, because he wasn't Japanese and hadn't been an internee. But what about the people like him, who had lived in Rohwer when the Japanese were sent there? How were Rohwer and its inhabitants changed by the influx of internees?

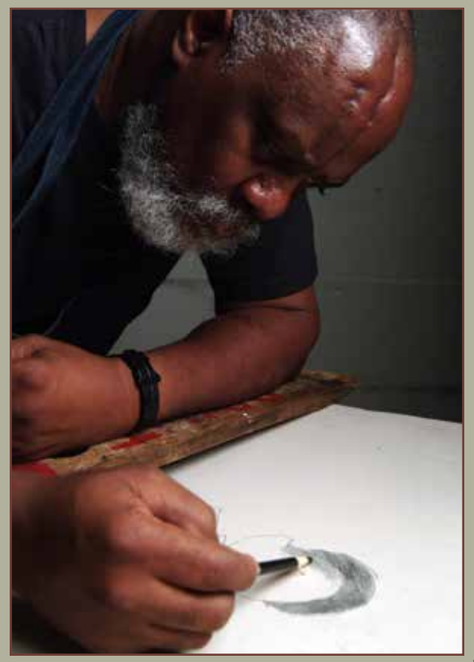
"I want to deal with that time, when blacks were in the area with the Japanese," Newman said.

About five years ago, he started his research into the Rohwer internment camp. He took a sabbatical and visited Rohwer about once a week in the fall of 2002, shooting videos and taking photos of people to whom he talked. He interviewed Rosalie Santine Gould, who was mayor of the nearby town of McGehee from 1983 to 1995 and who has been collecting artifacts from the camp since the 1950s. Newman also talked to a former internment camp schoolteacher and other people from the Rohwer area.

Newman hopes to create artwork that reflects the lifestyle in Rohwer during that time period – how people lived, how they entertained themselves, what kind of music they listened to, and what their day-to-day life was like. He plans to include photos and artifacts in his exhibit, and set the scene by playing the music that was popular in the Delta at the time.



My mom's family used to gather pecans. One day she and my grandmother went up this hill, looking for the pecans, and when they came over the top of the hill, they saw the cabins where the Japanese lived. They had no idea it was there before that.



Newman's task has been challenging. Much of the published information about Rohwer deals with the internment camp, not the community itself. Newman located about 200 photos of the camp and couldn't find one black person in any of the pictures. He is now searching through old area newspaper collections to find media photographs from the time.

"I'm shooting for photographs from black newspapers, from 1942 to 1945, to see the way people dressed and what they were doing then," Newman said.

Many people have moved away from the Rohwer area since the internment camp closed. Newman relies on writings, newspapers, interviews and stories he's heard from family members for much of his information.

Former McGehee mayor Gould has been a wealth of information to Newman. She moved to the Rohwer area from Tiller, about seven miles north of McGehee, in 1949. She has dedicated much of her time to collecting artifacts from the time of the internment camp and has been instrumental in helping it earn historical status.

"I was at the University of Arkansas when the Japanese-Americans came to Rohwer," she said. "I didn't know anything about them; nobody did. People didn't know why they were there – if they were prisoners of war or what."

Gould describes the Rohwer of the time as simply a widespread community of farmers and sharecroppers, most of whom survived on their own crops, hogs or cattle on 40 to 60 acre tracts. Some made money selling cotton or soybeans.

The people of Rohwer worked hard from dawn to dusk, with no time for recreation or diversion, according to Gould. They didn't have electricity, running water, telephones or a sewer system. They had to ration their resources, including gas, so they couldn't drive to McGehee for recreation even if they'd had the time.

In contrast, the federal government hurried to provide the incoming internees with telephone service, running water, sewers and even fresh fruits and vegetables from other cities such as Little Rock.

Despite these incongruities, the internees had a good relationship with the Rohwer community.

"The Japanese-Americans were given quite a bit of land on which to raise vegetables," she said. "They used them in the camp and also provided Camp Robinson and the Veteran's Hospital in Little Rock with vegetables they raised."

The internees also taught the Rohwer farmers to irrigate and introduced them to different vegetables they'd never seen before, such as eggplant.

The Japanese-Americans were allowed out any time they wanted, according to Gould, while white people actually had to have passes to get into the camp. It operated just like a city, complete with hospitals, churches, nurses, doctors and a school.

"The young people would go out and camp on the Arkansas Rivers with the Boy Scouts," Gould said. "They played football and basketball with the Caucasian children and would go swimming."

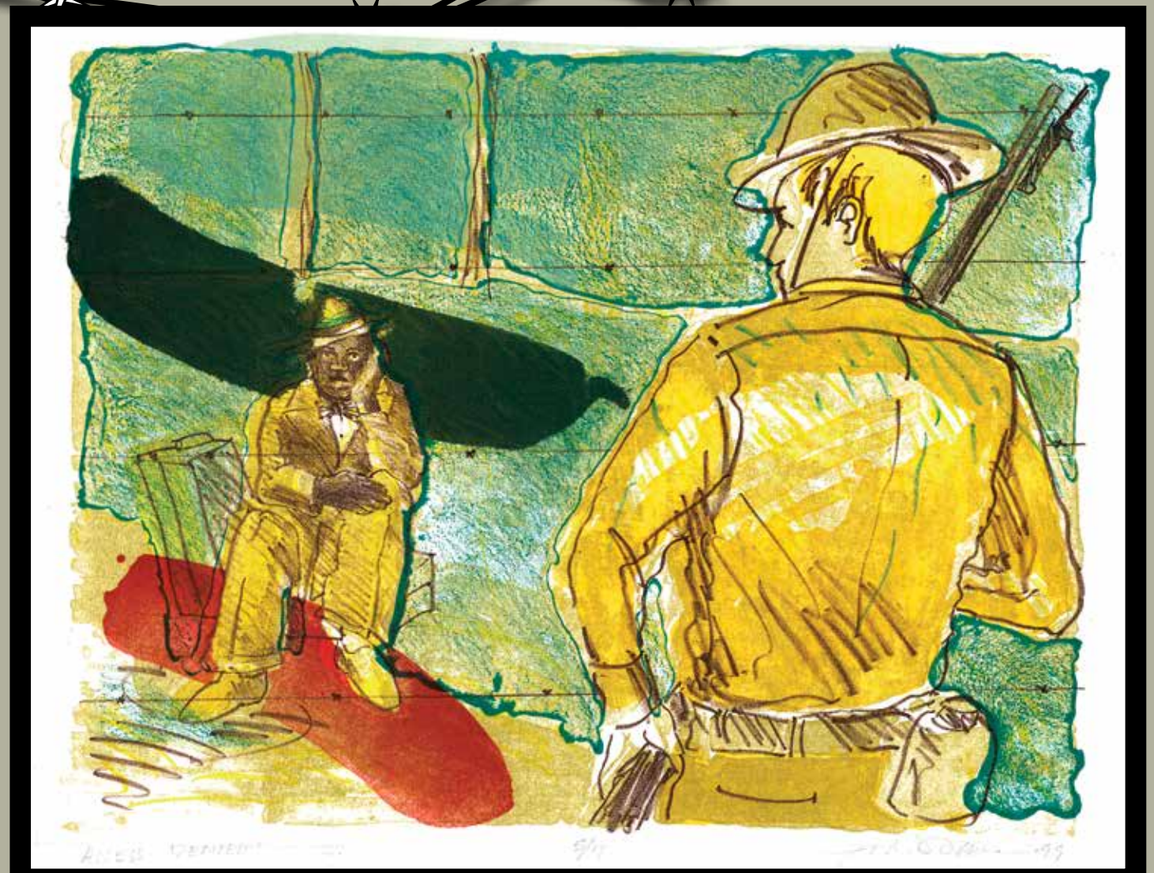
The children in the camp's school put on plays and excelled at art. They carved and painted little birds and other animals that they would use to decorate their clothes. Gould has collected about 30 of the pieces, as well as nearly 200 paintings done by high school students at the camp.

"I also have over 100 autobiographies written by the eleventh and twelfth graders," she said. "They're fascinating to read."

Since Gould started collecting artifacts from the internment camp, her home has become a sort of museum to the former internees. They arrive by the busload, two or three families at a time, to look into their pasts. Most of them were children when they were put in the internment camp.

"Those kids didn't really seem to have worried about it too much at the time – they adapted to where they were going," Gould said. "As long as they could play, they were content."

She has two or three guestbooks full of the names of former internees who have visited her.



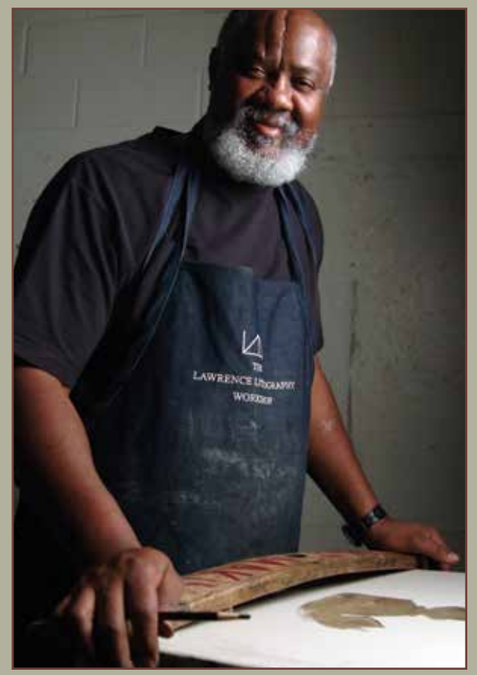
My uncle told me of a black man who married a Japanese woman before the war. When she was put into the Rohwer internment camp, her husband traveled to Arkansas to see his wife. He was forced to sit outside the fence surrounding the camp until the guards would allow him to see her.

"They are the most gracious people in the world, so thankful that they are remembered," Gould said. "It kind of breaks your heart, because they're trying to say thank you, and I want to say, 'Shoot, I'm the one who's reaping all the benefit, making such good friends with these people.'"

In contrast to the people of Rohwer, the Japanese internees came from urban areas of California or Washington and were better off financially than most of the black sharecroppers. Their arrival was a boon to the nearby town of McGehee, with a population of about 4,000. They helped boost McGehee's economy by spending their money at its shops and businesses.

"The Japanese people looked pretty sharp for those days," Newman said. "You could tell they had more money, because when the little store would open, we had to hurry there before the Japanese could come buy all the candy."

Financial status didn't mean much in the internment camp, however. The internees lived in desperate conditions on about 600 acres in a wooded, swampy area of Desha County in southeastern Arkansas. The camp consisted of 51 blocks with about 300 people per block. Each block contained 14 residential barracks, a mess hall, recreational building, laundry and bathroom building. The barracks measured 120 feet long and about 20 feet wide. The recreational buildings were used for judo, boxing, weaving and other activities.



The Japanese had the opportunity to find work outside the camp picking peaches or doing other labor. Many of the adults were in their early 20s and welcomed the chance to leave the camp, even if it meant sweating out the day toiling in the Delta. Cars came to transport those who wanted to work.

Newman compares the lack of freedom of the internment camp experience to being in the military.

"When I was in the military, you could walk around on the base and go out on Fridays, but you were still tied to the base," he said. "That's how the Japanese were – they were never really free to do what they wanted."

His uncle told Newman the story of a black man who married a Japanese woman before the war. When she was put into the Rohwer internment camp, her husband traveled to Arkansas to see his wife. He was forced to sit outside the fence surrounding the camp until the guards would allow him to see her.

Segregation took a unique turn with the arrival of the Japanese. The whites and blacks already attended their own separate schools, and now a new school was built just for the internees. The school was so well built that the white students moved into it after the Japanese left in 1945.

Most of the Japanese internees returned to their previous homes in larger cities or on the coast when the internment camp closed.

Nearly 50 years later, many former internees return to Rohwer to remember those who died and were buried in the community while they were at the camp. Several monuments have been erected to remind residents and visitors of the camp's historical significance.

All that marks the spot now is 24 graves in a cemetery at the south end and an abandoned smoke stack on the north end, where the hospital once stood. Four monuments remind visitors who once lived there. The homes built for the Japanese were sold and hauled off to provide housing for others in the region after the camp was closed.

Newman's trips to Rohwer and the Delta region have been meaningful to him in more than just a historical way. He has driven over the levy where his mother stood and looked down at the very land where his family members used to live.

"I saw where my cousins lived and my grandma's house, just on the other side of the levy," Newman said. "It was one of the few times I'd been there since I left as a child."

Rohwer Japanese-American Internment Camp opened on September 18, 1942 and housed internees until the last ones left on November 13, 1945. At its peak, the camp held 8,475 Japanese-Americans. One of the monuments recognizes 31 men from the Rohwer Camp who were killed fighting for America in World War II in the 442 Regiment, while their families waited behind in the camp. The camp also has been designated a National Landmark, thanks to hard work by Gould. Only one other former internment camp – Manzanar Camp in California – has been designated a National Landmark.

The University of Arkansas at Little Rock is working in conjunction with the Japanese-American National Museum in Los Angeles to raise awareness of the two internment camps in Arkansas. They have helped put together a textbook to be used in the curriculum at every Arkansas school this year.

The Rohwer Japanese-American Internment Camp also was home to some familiar names, including George Takei, an original member of the Star Trek series. Takei, who was three when his family was taken to Rohwer, wrote about the experience in his autobiography.

Professional ice-skater Kristi Yamaguchi's grandparents were held at the Rohwer camp as well. Two famous artists, Ruth Asawa and Henry Sumimoto, also spent time at the Rohwer camp.

While Newman has learned a lot about the Japanese-American internees, he still has much information to gather about the people who lived in Rohwer during that time. His work was featured in an exhibit in the Ann Kitrell Art Gallery on September 18, around the same time his former advisor, Shimomura, will exhibit his art. ■

At its peak, the camp held 8,475 Japanese-Americans.

Gift of the Walter Muramoto Family, Japanese American National Museum (97.292.15E)

Southeast Arkansas

RESOURCES

Life Interrupted - http://www.lifeinterrupted.org/

A More Perfect Union - http://americanhistory.si.edu/perfectunion/experience/index.html

Japanese-American National Museum - http://www.janm.org/

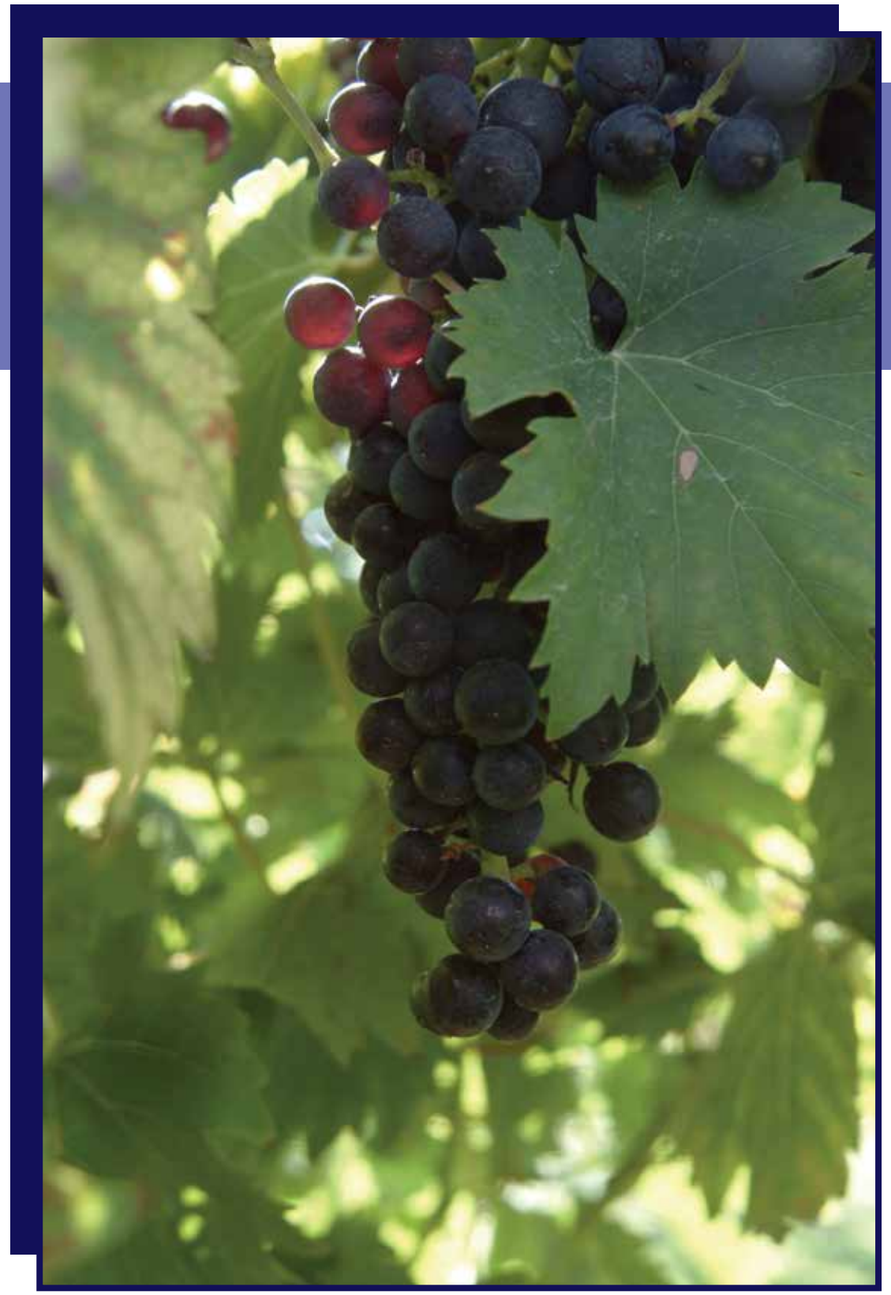
Japanese-American Internment Camps During WWII - University of Utah Library - http://www.lib.utah.edu/spc/photo/9066/9066.htm

The National Archives - http://www.archives.gov/research_room/alic/reference_desk/military_resources/japanese_internment

The Truman Presidential Museum and Library - http://www.trumanlibrary.org/whistlestop/study_collections/japanese_internment/background.htm

Virtual Museum of the City of San Francisco - http://www.sfmuseum.org/war/evactxt.html

The United States Army - The Decision to Evacuate the Japanese from the Pacific Coast- http://www.army.mil/CMH-PG/BOOKS/70-7_05.htm



Fruit of the Vine

By Melissa Lutz Blouin

The University of Arkansas has a way to make grape harvesting efficient. California wineries are looking to UA researchers to help mechanize vineyard production.

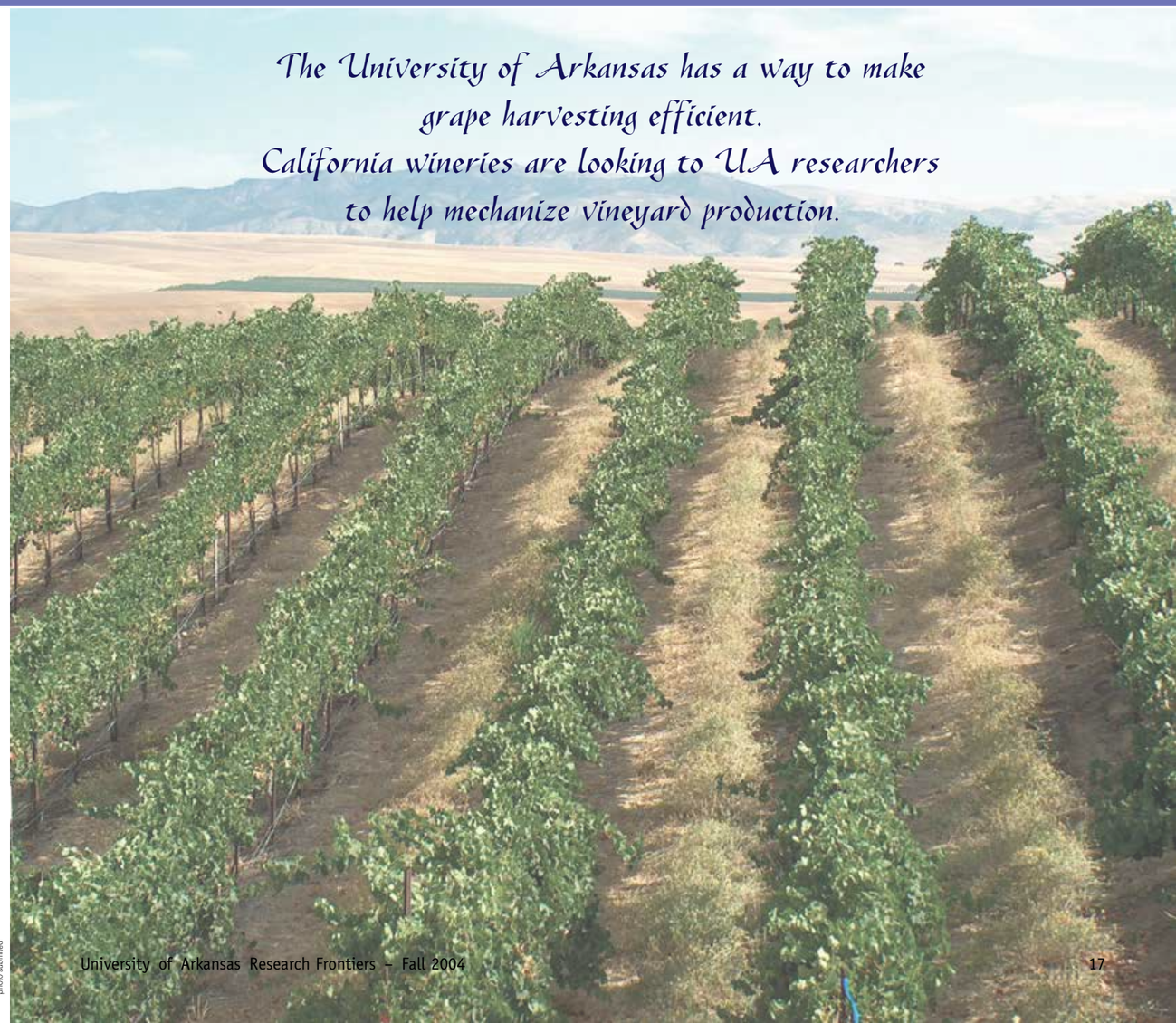


photo submitted

The next time you sip some wine

or gulp grape juice reflect a moment on the long, winding, torturous route the wine or juice took to end up on your table. First, the vines the grapes grow on must be carefully pruned and trimmed for maximum fruit yield. Then, the fruit must be thinned to ensure the grapes reach their maximum flavor and sweetness. After that, someone has to pick the grapes.

To make wine, all that must happen before the crushing, fermenting and other processes that finally bring the drink to your dining room table.

Wine cultivation is a process with roots that began growing almost 8,000 years ago. Archeologists have found ancient clay vessels containing wine residues at a site in Hajji Firuz Tepe, Iran, that date back to 5400 B.C. Some of the techniques used 1,000 years ago still are used today. But modern-day wine growers have new concerns in today's global market, and University of Arkansas researchers have created a system that may revolutionize the labor practices used in the production of grapes.

Justin Morris

Justin Morris, Distinguished Professor of food science and director of the Institute of Food Science and Engineering, grew up on a fruit farm. So it seemed natural for his career path to lead to research on making fruit production less labor-intensive. Although mechanical harvesting of grapes has existed for years, Morris envisioned a system that would allow mechanization of almost all of the hand-labor operations in a vineyard.

People might imagine that the harvest draws the most workers to the field to pluck the juicy orbs from the vine, but it turns out that the grape picking proves to be the last in a long line of tasks required to grow and maintain a successful vineyard. The neat, even-looking rows of vines are sculpted and maintained several times a year by workers, who might hand-prune the vines, trim back shoots and thin fruit, depending upon the season. The workers painstakingly perform all of these operations to achieve one goal: to maximize fruit quality and production.

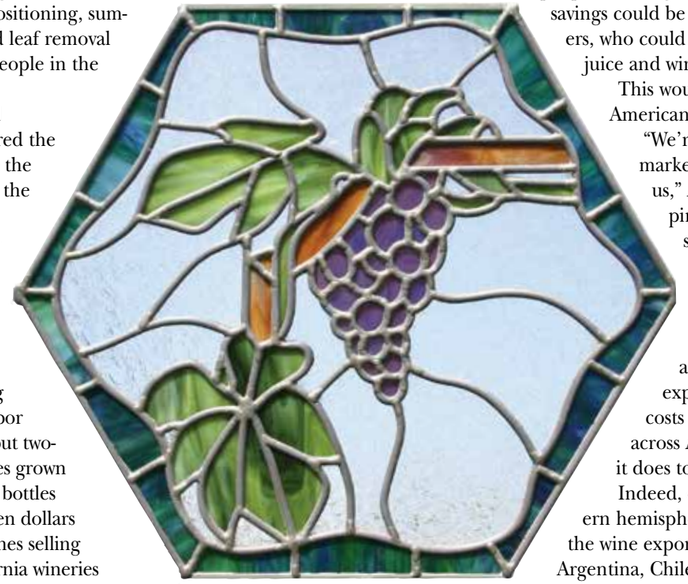
About 35 years ago, Morris teamed up with a local grape grower and inventor, Tom Oldridge, and began to experiment with machines that might help reduce the labor-intensive nature of growing and harvesting wine and juice grapes. They assembled different types of equipment from old parts on Oldridge's farm outside of Lowell in hopes of developing a machine or machines useful throughout the whole process of growing and harvesting grapes.

"We both had been working with grapes all of our lives," Morris said. "Pretty soon you start thinking like a grape."

Through the years, they tried different types of machines and attachments and various techniques, evaluating the results by the quantity of harvest in the field and the quality of the product through sensory evaluations at the University of Arkansas.

"If we decreased the quality, we would take another approach," Morris said.

After more than 35 years of research, the University obtained a patent in 2002 for the Morris-Oldridge System, a vineyard mechanization system that uses more than 40 different machines and attachments that allow for the total mechanization of operations for the major trellising systems used throughout the world. The patent contains 98 pages of detailed illustrations and explanations of the equipment and its uses. The equipment has made it possible to do dormant pruning, canopy management, shoot and fruit thinning, shoot positioning, summer shoot pruning and leaf removal faster and with fewer people in the field than before.



OXBO International Corporation has acquired the license to manufacture the patented system under the name vMech®.

"Looking at the vineyard industry, there's a real need to begin supplying a complete mechanized system," said Andy Talbott, vice president for marketing and sales at OXBO. Labor costs continue to rise, but two-thirds of the wine grapes grown in California end up in bottles of wine that sell for seven dollars or less. With foreign wines selling at similar prices, California wineries can't afford to increase the price. They also can't afford to employ large numbers of laborers as costs continue to rise.

In 2002 and 2003, Morris worked with OXBO and French Camp Vineyards in Paso Robles, Calif., to conduct research comparing hand-farmed and machine-farmed grapes at the vineyard. French Camp Vineyards has 1,725 acres of grapes on the central coast of California. The mechanized system was used on 475 acres in 2003 and, this year, they have about 905 acres of grapes being raised using the vineyard mechanization system.

The researchers compared yields, grape weight and the quality parameters – flavor and color – for these two methods using six heavy-hitter varieties in the grape industry: Chardonnay, Sauvignon Blanc, Merlot, Sangiovese, Syrah and Zinfandel. They found that in most cases, the two methods proved comparable in yields and quality. With Merlot, the machine-farmed grapes yielded a better-tasting wine than the hand-farmed grapes.

In 2004, the vineyard will produce about 7,000 tons of grapes using the mechanized system and sell them to 10 or so wineries.

"The idea is to produce grapes of just as high quality as hand-farmed using the mechanized system," said Hank Ashby of French Camp Vineyards.

The difference should show up in the cost of doing business. Ashby estimates that the mechanized method could save the vineyard about 50-70 percent per acre in labor costs. This could translate into a savings of as much as $1,500 per acre.

A mechanized system would require skilled employees who can operate the machinery and could reduce the number of people laboring in the fields. These cost savings could be passed on to consumers, who could see less expensive grape juice and wine as a result.

This would be welcome news to American wine producers.

"We're in a challenging grape market. Imports are killing us," Ashby said. Low shipping costs allow countries such as Australia and Chile to export their wines to the United States, yet keep costs low. He recently heard an Australian wine exporter comment that it costs more to move grapes across Australia in a truck than it does to ship them to England. Indeed, countries in the southern hemisphere have exploded onto the wine export market, with Australia, Argentina, Chile and South Africa among the top six exporters of wine worldwide.

These matters weigh heavily in California, where grapes – destined for wine and juice – are the state's second-leading farm product. The annual economic impact of the wine industry in California totals $45 billion, according to the Wine Institute, the public policy advocacy association of California wineries. Although California accounts for about 90 percent of the wines produced in the United States, vineyards flourish in other places, including Washington, Oregon, New York, Colorado, Michigan, Missouri and Arkansas, so the interest in staying competitive extends throughout the country.

"We need to cut costs to try to compete with foreign wineries," Ashby said.

While the mechanization results look promising, the technology is still new. OXBO has test blocks in other vineyards.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Talbott said the producers will make their own determination as to the quality of the grapes grown with mechanical manipulation.

"This will be adapted. It will just take time," Talbott said.

The machines vary greatly in their uses, but the basic outline of most resembles a go-cart with large, mechanical wings flanking it. The "go-cart" portion must be narrow enough to fit between rows, while the "wings" contain the machinery that performs the task at hand: pruning, shoot thinning, fruit thinning, leaf cutting – all designed to create the proper balance of sugar in the fruit necessary to produce a fine wine.


photo submited

Grape leaves need light for photosynthesis, which creates the energy required to produce sugar in the grapes. In addition, the developing canes that produce the next year's fruit need light as well. However, too many competing canes and leaves produce lesser-quality fruit, so careful pruning ensures quality. Too dense a canopy creates too much shade and not enough air circulation around the grapes. Too thin a canopy means not enough leaves for photosynthesis to produce healthy fruit.

To bathe the plants in sun, grape growers have created trellis systems that use posts and wires in various combinations. The systems vary from simple vertical poles to a lyre system that features a U-shaped trellis, allowing the grapes to fan out to each side of a row. These systems share the same objective: to maximize the plant's exposure to the sun.

The majority of vineyard owners worldwide use one of 12 different types of trellising systems. Morris and Oldridge designed their machinery to work with these different types of trellises.

Using the Morris-Oldridge system, which has more than 40 machines and attachments, grape growers should be able to prune, thin, pluck and cut on the different types of standard trellises.

Now that Morris has created a successful mechanization system, his thoughts have turned to timing. In grape production, timing is everything, and timing vineyard operations is complicated by nature. A hot spring, a late frost, a rainy summer…all of these variations change the timing of the procedures required to bring a grape from blossom to fruit.

"Even the time of day can make a big difference," Ashby said. In the morning, the small shoots retain more water and are more easily thinned by machine. But as the plant loses water in the midday sun, the shoots become rubbery and harder to thin.

Despite the challenges, Ashby said the vineyard mechanization system is viable.

"There's a lot of interest in the grape-growing community," he said.

The University's enology program grew from a history of grape growing in the region. Arkansas is the oldest and largest grape growing and wine producing state in the South. A colony of German-Swiss immigrants settled in a community near Altus in the 1870s, and today the area's four wineries produce more than 1.2 million gallons of wine a year.

Grape production also began in the University's back yard in the 1800s. A group of Italian immigrants, led by a Catholic priest from New York, founded Tontitown in the late 1800s and began to grow Concord grapes as well as hardy wine grapes. Welch's Food built a grape juice production plant in nearby Springdale in 1922.

While developing the system, Morris and his colleagues worked with the National Grape Cooperative in New York and with the Arkansas Agricultural Experiment Station in Fayetteville to test differences in yield and grape quality using machine-farming versus hand-farming techniques. They found that grape quality and quantity were nearly identical for both methods.

During his career, Morris has examined almost every aspect of grape cultivation imaginable. He has written papers on rootstock, cultivars and irrigation. He has looked at thinning, pruning, harvest timing, transportation and storage. He has contemplated grape yield and quality. He has pondered the acidity, color and maturity of wine and juice grapes.

Morris has published more than 340 articles during the course of his career. His work has been recognized by numerous groups, including the American Wine Society and the American Society for Enology and Viticulture, and he earned the University of Arkansas Faculty Distinguished Achievement Award for Research and Public Service. Some of the awards line the walls of his office. A glance around his office also reveals grapes everywhere – grape stained glass, a grape frieze and some wine magnets. More prominent still are bottles and jars displayed near his desk, samples that former students bring him when they visit. ■


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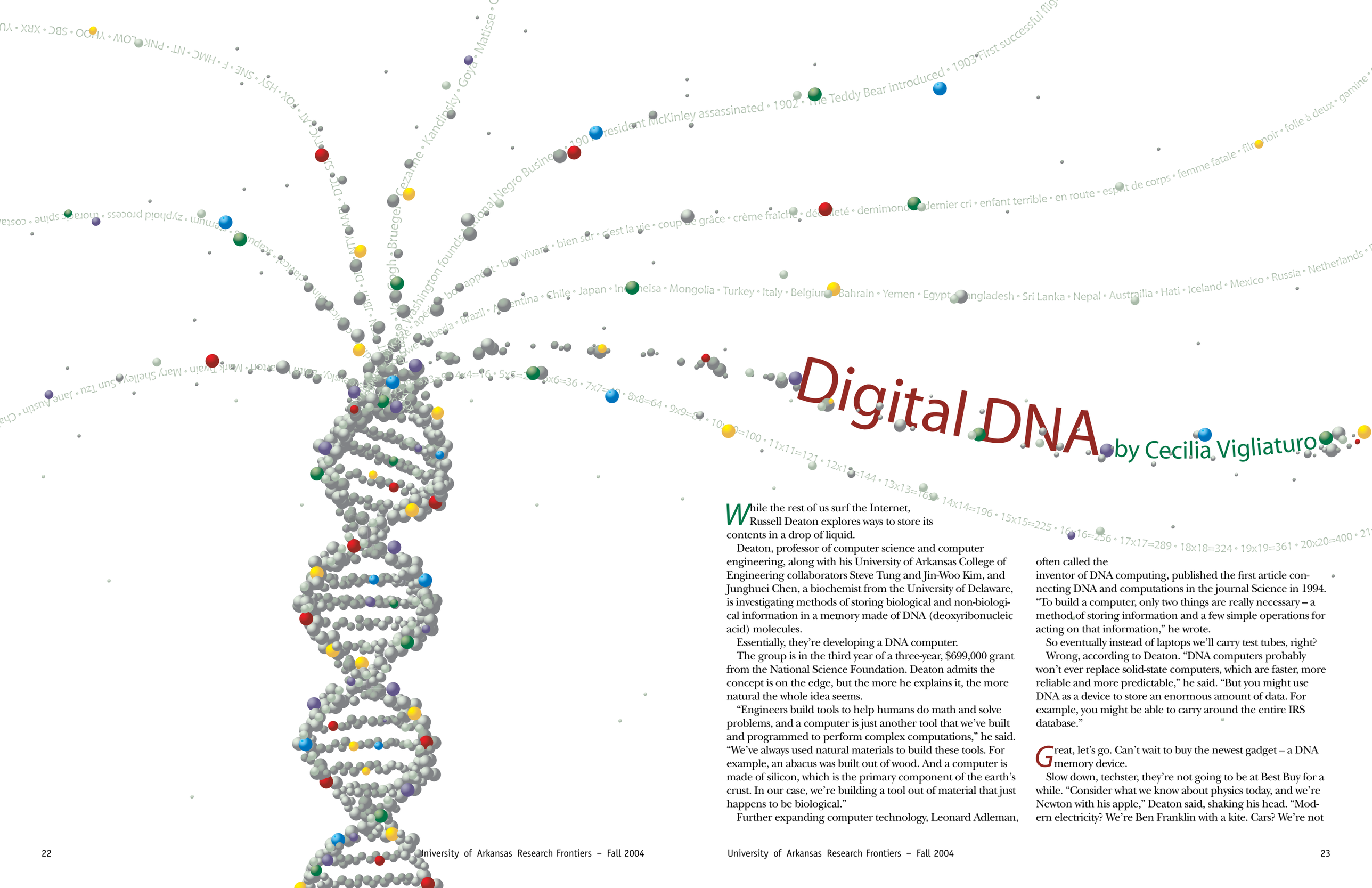
Justin Morris, Distinguished Professor of food science, examines grapes grown on a farm at the University of Arkansas campus. Morris has worked for more than 30 years to develop a vineyard mechanization system for total care of grapes, from pruning and shoot positioning to grape harvesting. The patented equipment, now being licensed and produced by OXBO International Corporation, uses more than 40 different machines and attachments, some of which are shown on the facing page.



While the rest of us surf the Internet, Russell Deaton explores ways to store its contents in a drop of liquid.

Deaton, professor of computer science and computer engineering, along with his University of Arkansas College of Engineering collaborators Steve Tung and Jin-Woo Kim, and Junghuei Chen, a biochemist from the University of Delaware, is investigating methods of storing biological and non-biological information in a memory made of DNA (deoxyribonucleic acid) molecules.

Essentially, they're developing a DNA computer.

The group is in the third year of a three-year, $699,000 grant from the National Science Foundation. Deaton admits the concept is on the edge, but the more he explains it, the more natural the whole idea seems.

"Engineers build tools to help humans do math and solve problems, and a computer is just another tool that we've built and programmed to perform complex computations," he said. "We've always used natural materials to build these tools. For example, an abacus was built out of wood. And a computer is made of silicon, which is the primary component of the earth's crust. In our case, we're building a tool out of material that just happens to be biological."

Further expanding computer technology, Leonard Adleman, often called the inventor of DNA computing, published the first article connecting DNA and computations in the journal Science in 1994. "To build a computer, only two things are really necessary – a method of storing information and a few simple operations for acting on that information," he wrote.

So eventually instead of laptops we'll carry test tubes, right?

Wrong, according to Deaton. "DNA computers probably won't ever replace solid-state computers, which are faster, more reliable and more predictable," he said. "But you might use DNA as a device to store an enormous amount of data. For example, you might be able to carry around the entire IRS database."

Great, let's go. Can't wait to buy the newest gadget – a DNA memory device.

Slow down, techster, they're not going to be at Best Buy for a while. "Consider what we know about physics today, and we're Newton with his apple," Deaton said, shaking his head. "Modern electricity? We're Ben Franklin with a kite. Cars? We're not

even Henry Ford, we're inventing the wheel.

"It's a little frustrating, but how often do you get the chance to play a part in the founding of a whole new field?"

A New Twist on the Double Helix

Why are roughly 100 to 150 researchers in the world establishing the field of DNA computing at all? What's the lure? Most important, what's in it for us, the impatient computing public?

The most pressing reason to search for alternative methods of processing information is the sheer volume of the information we're processing. "Humans produce about 10^{18} bytes of information every year, which completely boggles my mind," said Deaton. "That includes books, newspapers, magazines, Web sites, blogs – you name it. We have to find better ways to deal with this information avalanche – to store it, search it and retrieve it."

And DNA computing promises the potential of much better ways to do exactly that.

The Power of Density

The possibility of storing vast amounts of data in a small space is probably the most alluring benefit of DNA computing. Think of how much information is stored in the individual DNA of every human. After all, you're unique – just like the other six billion people on the planet.

So how much non-biological data might be stored? "One DNA sequence might represent one byte of information," said Deaton. "You can store potentially an exabyte (10^{18}) of information in a drop of water. The sheer density of what you can store is exciting, to say the least."

Adleman puts it another way when he writes, "One gram of DNA, which when dry would occupy a volume of approximately one cubic centimeter, can store as much information as approximately one trillion CDs."

Indeed, the entire contents of the Internet actually could be stored in a drop of water.

The Power of Energy

With great technological marvels have come great demands on the electrical supply. DNA computing offers the hope of a remarkably energy efficient machine, more than a million times more efficient than a PC.

Adleman writes that in principle, one joule is sufficient for approximately 2×10^{19} ligation operations using DNA. Existing supercomputers now execute, at most, 109 operations per joule.

The Power of Endurance

Remember the last crime show you watched? The detectives probably used a tiny strand of hair or even an old sample of DNA to crack the case.

"Scientists like to say that DNA is robust," said Tung, assistant professor of mechanical engineering. "You can extract it from old bones and still test it. That toughness makes it very appealing from a materials standpoint."

Photo By Russell Cothren

From left, Jin-Woo Kim, assistant professor of biological engineering, Russell Deaton, professor of computer science and computer engineering and Steve Tung, assistant professor of mechanical engineering, all work toward the same goal: creating a computer from DNA.

The Power of Parallel Processing

A traditional computer stores information as sequences of zeros and ones in memory, then manipulates that information with the operations available on the processor chip. Because most electronic computers operate on a sequential basis, they essentially perform tasks one at a time, albeit very quickly. DNA computers, however, offer a much more intriguing reality: massively parallel processing.

In the cell, DNA is biochemically modified by a variety of enzymes – tiny protein machines – that read and process DNA, manipulating it on the molecular level. Some enzymes, for example, cut DNA, and others paste it back together. Other enzymes function as copiers or repair units. We can now perform many of these cellular functions in the test tube. And in the test tube, these enzymes can work on many DNA molecules simultaneously.

Which means DNA strands can produce billions of potential answers simultaneously, making DNA computers incredibly well-suited for solving problems that require searching for solutions among a massive number of possibilities.

Imagine searching the Internet with one click, looking based on content instead of address. The research group also is exploring massive DNA memories that store and search information based upon meaning, or semantics.

"The operations on DNA molecules occur in parallel, so searching and retrieving data based upon both content as well as context is possible," said Chen, associate professor of biochemistry at the University of Delaware.

Memories with Meaning

A human DNA molecule is about a meter long and a twenty-millionth meter wide, or the width of 20 hydrogen atoms. The famous double helix shape is like a twisted ladder, and each rung is made up of four nucleotides – adenine (A), thymine (T), cytosine (C) or guanine (G). The DNA code is then expressed in combinations of those letters.

By mapping data onto sequences of nucleotides, information is stored in DNA. That information can then be retrieved by placing the Watson-Crick complement in the test tube. The Watson-Crick complement – which replaces A with T and G with C – then matches with the sequence representing the information you want. This base-pairing, template-matching reaction, which pairs up Watson-Crick complementary sequences, is called DNA hybridization.

"The DNA molecules are floating around and they want to pair up," said Deaton. "Our goal is to make those DNA sequences have meaning. We could build a DNA dictionary of words to create a library of DNA sequences that would store information. Then we'd use the base-pairing mechanism to do a search."

If the team can create a library of sequences that's controllable, predictable and well-behaved, then instead of conducting an Internet search by address, you could eventually conduct an Internet search by both context and content.

Take these two sentences:

"I sat on the bank of the river."
"I cashed my check at the bank."

They could be stored in DNA by having each word represented by a DNA sequence. For example, "bank" could be "AGATGC," and "river" could be "CCGTGA." In the test tube, these DNA words could be combined into one molecule representing the sentence. So all sentences with the word "bank" could be retrieved by hybridizing with its complement "TCTACG."

But you may have noticed the word "bank" has two different meanings in these sentences. Which meaning is which is determined by the context, or the other words in the sentence. "We can search for the first sentence and extract out all banks associated with checks, for example," said Deaton. "Or use the other context and retrieve banks associated with rivers by biochemically searching for molecules that contain the relevant DNA sequences."

So DNA memory doesn't work like the memory in your typical desktop computer, which stores information at specific addresses. Information is instead retrieved by content, or the DNA sequences that represent the information.

Of course, the DNA sequences that are used have to be designed to allow reliable and error-free information processing. "It always comes down to a word design problem," Deaton said. "In DNA computing, things that are not a problem for biologists are definitely a problem for us," he said. "Like achieving the required level of control and reliability over what's going on in the test tube."

Molecular Mathematics

Enter Jin-Woo Kim, assistant professor of biological engineering, who looks for the solution within solutions.

"I implement computation in the test tube given many different assumptions and conditions," he said. "Writing code is a prediction. I simulate and verify that prediction under real biological conditions."

That verification is vital because, unlike genetic DNA, the biotic DNA used for computing does not contain enzymes to automatically correct mistakes. "Each sequence might contain thousands of A-T-C-G base pairs," said Kim. "One change in one base pair makes the entire outcome totally different."

Ensuring that the information in the DNA solution is absolutely correct is simply the starting point of Kim's work. "How can we see what's going on in the test tube?" asks Kim.

The current method, gel electrophoresis, involves placing a solution of heterogenous DNA molecules on one end of a slab of gel and applying a current. The negatively-charged DNA molecules move toward the anode. Because shorter strands move quicker than longer ones, the DNA is separated by length. Using fluorescent dyes, a chemical wash and ultraviolet light, you can see bands in the gel where the DNA molecules of different lengths have come to rest.

Kim also uses microarray technology, which involves putting a DNA sample on a slide, then adding another, using a chemical wash and then a high-resolution scanner to determine what's happening. But this method has many disadvantages, as well.

"It requires a very sophisticated, expensive and large machine," said Kim.

Kim, working with Tung and Deaton, is trying to discover a way to detect the DNA reaction in real-time. "We're working on a highly-sensitive, electrically-addressable, real-time, DNA-based carbon nanotube-wire sensor. Within five years, we'll have something that we can use."

Molecular Mechanics

Steve Tung, assistant professor of mechanical engineering, spends his days building nanomachines and making them work. "My part of this research is building a platform for a DNA computer to operate," he said. In other words, he's developing a nanomachine to retrieve the information the other researchers are storing and searching.

How big is a nanomachine, anyway?

If you can spare one, pull a hair from your head (hey, no one ever said science didn't hurt). A nanometer is about a thousandth of the width of your hair, or one billionth of a meter. Put another popular way, if we measured the earth in nanometers instead of meters, it would fit in a shot glass.

"A nanotube generally has a diameter ranging from one to tens of nanometers, and its length is of the order of one micrometer," said Tung. "An exact size depends on the individual nanotube."

Weird things happen with materials that small.

"Conventional methods just don't work at that level," said Tung. "Materials with certain properties take on totally different characteristics. For example, we can't predict how molecules will align themselves, how they'll react with other molecules or whether they'll stick together."

This stickiness issue is quite, well, sticky. "The smaller the size, the more things stick together," Tung explains. "Think of a golf ball on your car. If you drive away, it will come off. But think of particles of dust on your car. They stick to it.

"As it is, DNA exists in a mixture or in suspension and it's hard to manipulate. We're working on chemically binding the DNA onto the carbon nanotubes," said Tung. "The simplest way to explain our device is that we use the change in electronic properties of nanotubes to monitor the behavior of DNA. First, we record the electronic properties of 'bare' nanotubes. Then, we attach single-stranded DNA to the nanotubes and record any change in the electronic properties of the nanotubes. Finally, we attach 'matching' single-stranded DNAs to the hybridized DNAs that are on the nanotubes and record the electronic properties again. Based on these results, we can build a hybrid nanotube/DNA device and use it to detect the presence of matching DNAs in a medium by monitoring the electronic properties of the nanotubes."

Whew. But one wonders a rather basic question: How do you engineer a machine too tiny to see without a microscope?

So far, there are basically two processes. The "top down" methods take a larger piece of material and make it smaller. The "bottom up" techniques involve building the material atom by atom. The two approaches carry over to mixing molecules. "You can mix it as is, which is like putting marbles in milk and stirring," said Tung. "Or you can be more precise and direct heat to change the direction of the polymers."

But why use carbon nanotubes?

"Carbon is inert and it's solid," said Tung. "It's the vanilla of all the elements. You can change it to strawberry or tutti-frutti or rocky road.

"In the '80s, the computer revolution hit the world. In the '90s, the Internet changed everything," said Tung. "I believe the groundbreaking technology in 10 years could be carbon nanotubes."

Complex Simplicity

"Wouldn't it be neat to design a computer out of a living thing?" thought Deaton as an undergrad in biology class. His interest was renewed after he read Adleman's groundbreaking article as a professor. A recent $100,000 NSF grant, with Kim and John Lusth, associate professor, computer science and computer engineering, will help him pass along that interest to undergraduate students in the College of Engineering at the University of Arkansas.

"Undergraduate programming texts are pretty dry," said Deaton. "I think most students would be more excited to learn those basic skills while doing work for DNA computing."

As amazing as the concept of DNA computing is, Kim remains most amazed by the elegance of DNA itself. "Here is the basis for our bodies, the basis for everything – the source of life itself," said Kim. "Yet the material is so simple. And there is so much potential and so many more mysteries."

Exploring those mysteries excites Tung, who sees a bit of irony in his work. "Whatever we do, we're trying to mimic nature, but on a much smaller scale. So you can't predict what's going to happen in the lab. And not knowing is the fun of research."

Research as fun? Most definitely, according to Deaton, who has an undergraduate degree in English and advanced degrees in electrical engineering. "I'm learning new things every day, which are not necessarily in my area of expertise. And I told myself that if I was going to be in academia, I was going to make sure that I would work on something that was challenging and fun. DNA computing is fun." ■

The "Traveling Salesman" Problem: Solved in Solution

In 1994, Leonard Adleman showed that it was possible to use DNA to solve complex mathematical problems. He focused his work on a well-known mathematical problem, known as the "directed Hamilton Path problem" which is related to the well-known "traveling salesman" problem. (Jeopardy! fact: The problem is named after Sir William Rowan Hamilton, 1805-1865, Ireland's most famous mathematician.)

The goal is to find a route among a number of cities, while traveling through each city only once. The more cities involved, the more difficult the solution, because the number of possible routes becomes very large. For his experiment, Adleman, a computer scientist at the University of Southern California, chose to discover a route among seven cities.

It took seven days for Adleman to come up with a specific solution, though his early DNA computer quickly created a large group of possible answers. But his work proved for the first time that DNA can be used to calculate complex mathematical problems.

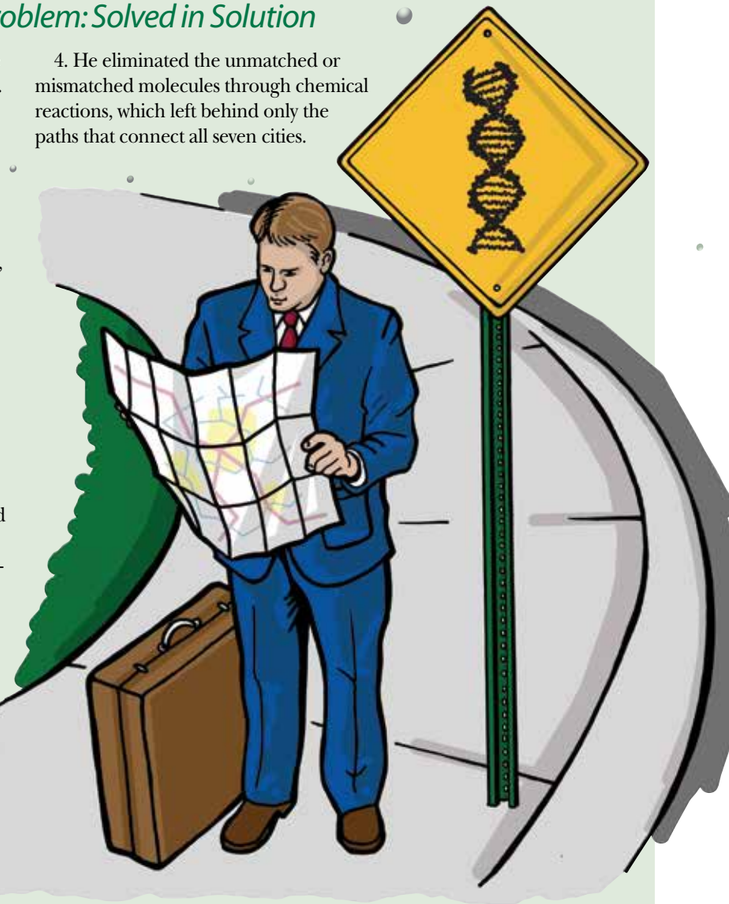
Adleman took the following steps to solve the Hamilton Path problem with his DNA computer:

1. Genetic coding is represented by the letters A, T, C and G. Strands of DNA represent the seven cities. Sequences of A, T, C and G represent each city and each possible path between them.

2. He mixed the molecules in a test tube, with some DNA strands sticking together. A chain of these strands represents a possible route.

3. Within a few seconds, Adleman had all of the possible combinations of DNA strands – which represent possible answers – created in the test tube.

4. He eliminated the unmatched or mismatched molecules through chemical reactions, which left behind only the paths that connect all seven cities.



The Future is Now:

UA Researcher Helps Industry Adopt Newest Product Tracking Technology

By Brad Lawless

Replaced by younger and more efficient devices, technologies once ubiquitous in society litter the dustbin of history. Barcoding, used to identify and track things in warehouses and convenience stores alike, now faces its likely replacement in the form of radio frequency identification (RFID). The long-term future of RFID envisions a tag on every product sitting in a store, potentially enabling a harried mother with kids in tow to check out merely by pushing her shopping cart through an RFID reader area and waving her RFID-enabled keychain at the register to debit her checking account. While this Jetsonian future may be years away, companies like Wal-Mart and its partners will soon realize the benefits of using RFID to reduce costs and give them detailed real-time visibility into their supply chains.

In the 30 years since their creation, barcodes have become such an entrenched part of modern business processes, particularly in the world of retail sales, that the transition away from them could prove expensive if not properly managed. Bill Hardgrave, an information systems professor in the Sam M. Walton College of Business, is working to help businesses understand and navigate the issues concerning RFID adoption.

Last year, Wal-Mart announced that it would require its top 100 vendors to implement RFID tracking on pallets and cases by January 2005. Hardgrave, who is also executive director of the Walton College's Information Technology Research Center, recently joined Wal-Mart's RFID team as an independent researcher to help find implementation synergies between the various links in the retail supply chain.

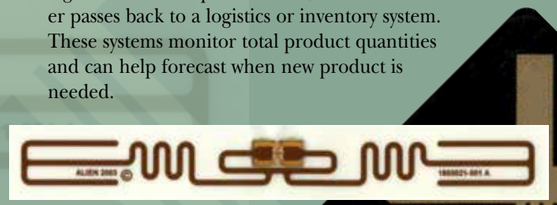
"Different businesses view the costs and benefits associated with RFID differently. Retailers have one viewpoint. Suppliers have another, and transportation companies have yet another," he said. Retailers see RFID as their best tool for monitoring on-hand inventory and optimizing the amount of product they have sitting in a warehouse for any length of time, while suppliers seem to focus more on the added cost that RFID technology will add to product packaging. Transportation companies sit between the two, trying to balance the retailer and supplier requirements in a way that will improve their service while minimizing added costs.

"Despite their different perspectives, each type of company also shares common RFID issues with the other two," Hardgrave said. "My job is to work with all three of these constituents in the implementation process to help them realize the value in focusing on their common goals first. When retailers, suppliers and transporters leverage and coordinate their efforts they can multiply the immediate benefits realized in the adoption of RFID."

At its simplest, RFID consists of a read/write device called a "reader" that is networked to a computer system and one or more tags. A reader can identify more than one tagged object at one time. Tags contain a computer chip and an antenna embedded into a substrate material. The substrate varies depending on the intended use of the tag. Tags operating in harsh conditions – extreme heat or cold – may encase the chip in hard plastic. Tags meant for general tagging of cardboard cases likely will resemble a regular label with the RFID components sandwiched between two layers of paper.

Tags may be passive, active or battery-assisted. Passive tags receive their operational energy from the radio waves sent by the reader to communicate with them. Active tags contain a small battery to boost the tags' effective range. Battery-assisted tags utilize a battery to power tag electronics but not to transmit RF-energy. Lacking the need for external power, a battery-assisted tag reflects the maximum amount of RF-energy back to the reader to increase tag readability.

Tags also may be read-only or read/write. Read-only tags contain a unique identifier, which the RFID-reader passes back to a logistics or inventory system. These systems monitor total product quantities and can help forecast when new product is needed.



An RFID-reader positioned near a stockroom door could identify a case of soap when that case goes out to the store floor. Another reader installed above a box crusher could confirm when that case is destroyed. Following these confirmations, the inventory system would interpolate that all the soap has been stocked and would change the status on that product from warehoused to stocked, triggering an automatic order for another case of soap.

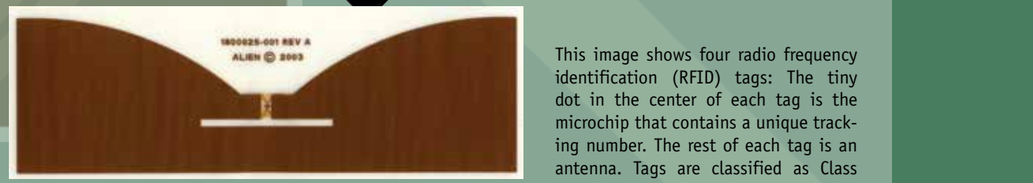
Read/write tags may contain specific information about the object in addition to the unique identifier number. For example, a read/write tag on a case of frozen beef might record product temperatures during transit to provide a record for food safety inspectors.

While filled with promise, RFID technology does have limitations. The radio waves used to communicate between readers and tags attenuate in the presence of certain materials, such as dense liquids, which absorb the waves, and metals, which reflect them.

"Frozen meats, liquid laundry detergent and cans of coffee all present problems for RFID readers," said Hardgrave. "Velveeta and canned soda, both liquids encased by metal, are especially problematic."

Privacy advocates worry about the potential for companies or others to misuse the data collected from RFID-enabled products. Hardgrave believes he can help allay some of these concerns by dispelling popular myths about RFID.

"Much of the information concerning RFID in the popular press is misleading or simply not true," he said. "These tags communicate only over very short distances and can easily be disabled. The idea of driving down the street and reading the contents of someone's home is fiction." ■



This image shows four radio frequency identification (RFID) tags: The tiny dot in the center of each tag is the microchip that contains a unique tracking number. The rest of each tag is an antenna. Tags are classified as Class 0 – "read only" or Class 1 – "write once, read many times." Clockwise from left, a Class 1 "Squiggle" tag from Alien Technologies, a Class 0 tag from Matrics, a Class 1 "I" tag and a Class 1 "M" tag, both from Alien.

With

By Donald Harington

Toby Press

In his most recent novel, art professor Donald Harington creates a world from the perspective of a missing child, telling the sometimes harrowing, sometimes inspiring tale of the decade she spent growing up on a mountain with only animals and a spirit to keep her company.

"With," published by Toby Press, tells the story of seven-year-old Robin Kerr's abduction by former policeman Sugrue (Sog) Alan. Sog takes Robin to his secluded hideout on Madewell Mountain and tries to make her his child-wife. After Robin manages to shoot Sog, she finds herself trapped on the mountain for the next 10 years.

Harington's book, the 12th in a series of books about the fictional Ozark town Stay More, follows Robin through her years on Madewell Mountain. There she befriends a menagerie of forest animals and the spirit of former resident Adam Madewell. Adam lived on the mountain before he and his family moved to California when he was 12. Since then, his 12-year-old spirit has haunted the old home as an "in-habit."

"With" has received praises from Publishers Weekly, Kirkus Reviews, Booklist and the Washington Post Book World Review Service. ■

The Dictator and the Tramp

Edited by Frank Scheide

University of California Press

He was a music hall comic, a famous but lonely tramp, an artist who mocked Hitler and a suspected communist. Controversy and acclaim followed the life and art of Charlie Chaplin, the subject of a new series of books edited by professor of communication Frank Scheide.

During his career, detractors charged that Chaplin was a communist degenerate while supporters countered that he was a comic genius and a victim of McCarthyism.

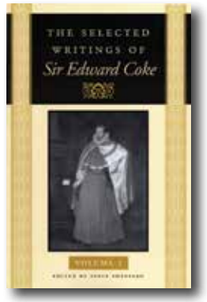
Today, scholars and film critics consider Chaplin one of the major filmmakers and artists of the 20th century. In the book series, contributors place him in a contemporary historical perspective.

The first volume in the new series, "Chaplin: The Dictator and the Tramp," features essays by several authorities on Chaplin and early film. They examine "The Great Dictator," a 1940 Chaplin film recently re-released internationally on DVD, as well as "The Tramp and the Dictator," a recent documentary about the movie by filmmaker Kevin Brownlow.

Contributors include co-editor Hooman Mehran; Glenn Mitchell, author of "The Chaplin Encyclopedia," and David Robinson, Chaplin's principal biographer.

Chaplin's film "Limelight" will be the focus of the next book in the series, due out in April 2005.

For more information, visit the Web site at www.chaplinreview.com. ■



The Selected Writings of Sir Edward Coke

Edited by Steve Sheppard

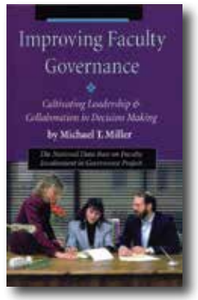
Liberty Fund

For the first time ever, judges, legal scholars, attorneys, historians and students of all sorts can read an anthologized version of the works of the founder of the common law system that paved the way for the U.S. Constitution.

Law professor Steve Sheppard spent the last 12 years researching, compiling and translating original material for "The Selected Writings of Sir Edward Coke," an anthology that showcases the original works of a man who was chief justice, Parliament leader and adviser to Queen Elizabeth I and King James I. Coke lived during a turbulent time, when feudal practices were giving way to a merchant-based economy, and European nations were colonizing far away lands.

Coke wrote legal treatises on topics that continue to have modern-day relevance, including environmental issues, monopolies and private property. He was the first lawyer to argue that the law protects people's rights against the state and that law cannot be overridden by the king, even during war time. For centuries, the world has read Sir Francis Bacon, a contemporary of Coke's who Sheppard concedes may have written more accessible prose.

"But he didn't change the world as much as Coke did," he said. ■



Improving Faculty Governance: Cultivating Leadership and Collaboration in Decision-Making

By Michael T. Miller

New Forums Press

In "Improving Faculty Governance" Michael T. Miller, associate professor of higher education in the College of Education and Health Professions, asks the question, "Can faculty governance survive and thrive in this new world of corporate-structured higher education?"

He examines the first-ever seven-year longitudinal study of how to improve faculty governance. The National Database on Faculty Involvement in Governance project surveyed 5,000 faculty members and resulted in nearly 50 academic articles and presentations.

Miller discusses the state of faculty involvement in governance in light both of the history of the faculty role in decision-making and of the results of the national database study. He concludes with 12 recommendations to assist faculty governance bodies and the faculty and administrators who lead and work closely with them. Recommendations include steps such as "Make a Commitment to Representative Training," "Foster Good Senatorship" and "Commit Time to Transitions."

Miller argues that it is "paramount to the history and future of higher education for there to be a forum to defend academic integrity and the mission of higher learning…." He concludes with a call to college and university faculty to create a history of faculty governance today that will empower future scholars. ■

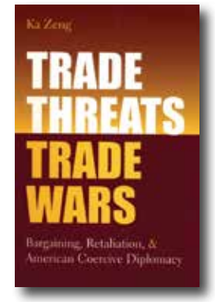
SmarterArchitecture: Energy-Efficient Communities, Building Designs, Construction Techniques and Materials in Arkansas

Edited by David Glasser and Sevinç Yavuz

Arkansas Department of Economic Development/Arkansas Energy Office

Our grandparents knew what architects are rediscovering: solidly constructed, thoughtfully sited buildings and compact, walkable cities save energy. "SmarterArchitecture" demonstrates how Arkansas architects, landscape architects and urban planners have combined old-time common sense with new technologies to develop energy-efficient buildings and communities across the state. The first book to showcase sustainable design in Arkansas presents 23 case studies that range from invisible upgrades, such as the comprehensive plan to monitor and control energy use on the University of Arkansas campus, to high-profile projects such as the Clinton Presidential Library and Heifer International's corporate headquarters, both in Little Rock. A separate section highlights community projects carried out by the UA Community Design Center and demonstrates the impact of thoughtful urban planning in creating communities where energy efficiency occurs naturally.

Numerous full-color maps, diagrams, photographs and renderings assist the clearly written text in conveying complex concepts. This book was edited by former UACDC director David Evan Glasser and former architecture professor Sevinç Yavuz. ■



Trade Threats, Trade Wars

By Ka Zeng

University of Michigan Press

A book by political science professor Ka Zeng examines domestic trade politics and how they determine responses to the threat of trade sanctions. "Trade Threats, Trade Wars" explores the driving forces behind trade disputes, the reasons U.S. coercive trade diplomacy has been more successful in opening markets in some of its trading partners rather than others, and the reasons trade wars more often take place between two democratic trading partners rather than between a democratic partner and an authoritarian one.

Competitive trade partners, Zeng explains, produce a similar range of commodities. In a complementary trade relationship, however, each partner produces a different set of commodities.

Zeng found that when the U.S. threatens sanctions on a trade partner, support from domestic interests influences the outcome of the situation. The degree of support is determined by whether the relationship is competitive or complementary.

In the case of a competitive trade relationship, both export-seeking and import-competing interests are likely to support trade sanctions. In a complementary trade relationship, however, domestic support comes only from the export-seeking interests, resulting in democratic trade wars. ■

Problem

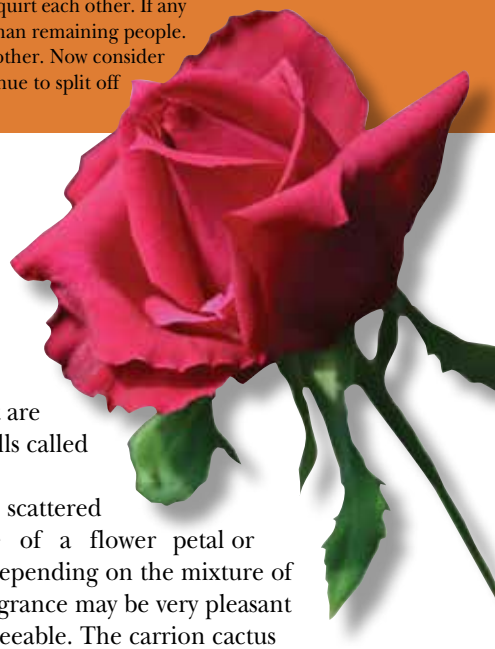
On a large, flat field, an odd number of odd people are milling about with water pistols. At a signal, everyone turns and squirts the closest person! We may assume, since they are just milling about randomly, there is a unique closest person to squirt. Show that there will always be at least one person left dry.

Photo By Russell Cothren

Answer

The following solution was given by Jonathan Schisler and Hieu T. Nguyen: The two absolute closest people will squirt each other. If any of the remaining people squirt either of these two, one of them will remain dry, since there will be fewer remaining squirts than remaining people. On the other hand, if all the remaining people squirt at each other, then the two closest remaining people will squirt each other. Now consider the remaining people not in this pair. Repeating the argument, we either will eventually produce a dry person, or will continue to split off pairs of people squirting each other, eventually leaving one person the odd one out.

Question: Why do flowers have a scent?



Gerald Klingaman, professor and extension specialist in the department of horticulture, replies:

Plants persist because they have developed an array of strategies to produce seeds. Attracting pollinators is an important part of the flower's job, and it may achieve this attraction by the shape of the flower, its color or by its smell. Some species use only one of these methods; others use all three.

For example, some orchids use fragrance to signal pollinating insects that a receptive flower is in the vicinity. Then, as the insect gets close, the color of the flower will attract it still closer.

In some species, the orchid flower may have a peculiar shape that is marked just like a female of the species. The compounds causing scent are specific blends of highly volatile chemicals such as terpenes, esters and oxygenated carotenoids that are released from specialized cells called osmophores.

These special cells may be scattered evenly across the surface of a flower petal or concentrated in one area. Depending on the mixture of chemicals produced, the fragrance may be very pleasant and agreeable or very disagreeable. The carrion cactus of South Africa and the voodoo lily of Indonesia are pollinated by blow flies and smell like decaying flesh. Many flowers that are pollinated by bees have a fragrance only during the early morning hours when bees are active, while flowers pollinated by moths often have fragrance only in the evening. ■