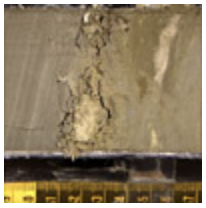
2005

Quantum: Research, Scholarship & Creative Works at the University of New Mexico, 2005

Office of the Vice President for Research

Quantum 2005

Research, Scholarship and Creative Works at the University of New Mexico



The Complexity of Poverty
Richard Santos works on the problem and possible solutions to poverty among Hispanics.
by Frank D. Martínez

Breaking From Tradition
Joan Bybee pushes beyond traditional concepts of linguistics.
by Steve Carr

Empowering Communities
The New Mexico Center for Environmental Health Sciences addresses regionally relevant environmental public health issues.
by Luke Frank

Building Stronger Teachers
Science, Technology and Mathematics Teacher Academies help to prepare highly qualified teachers.
by Larry Walsh

The 3/4 Power Law
James Brown and Bruce Milne explain a fundamental law of nature.
by Russell Moore

Quantum Briefs
:: Inspiring Native American Students
by Laurie Mellas Ramirez

:: From History to Mystery
by Carolyn Gonzales

:: Bilingual Medicine
by Cindy Foster

:: A Common Language for Diversity
by Carolyn Gonzales

:: Softening the Edges of Hospital Life
by Cindy Foster

Water Library
Professor of Art and Art History Basia Irland explores the phenomenon of water.
by Valerie Roybal

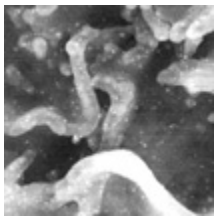
Saving the Silvery Minnow
Tom Turner helps to repopulate the Rio Grande with the minnow.
by Steve Carr

Preventive Diplomacy
The Utton Transboundary Resources Center helps resolve conflicts regarding natural resources.
by Laurie Mellas Ramirez

Discoveries of the El Mirón Cave
Lawrence Straus and student researchers find Cro-Magnon art in northern Spain.
by Karen Wentworth

Women's Work
Susan Tiano discusses the feminization of labor in the global manufacturing industries.
by Carolyn Gonzales

Reconstructing the Tree of Life
Researchers build an essential and powerful organizing tool for the future of biology.
by Greg Johnston



Small is Beautiful
UNM professors and collaborators conduct cancer research at the molecular level.
by Cindy Foster

Hot Off the Press
UNM Press celebrates it's 75th Anniversary.
by Valerie Roybal and Russell Moore

Masthead

Quantum 2004

Images at the top of the page, left image: Satellite image of the Valles Caldera and surrounding area, image courtesy of the Earth Data Analysis Center; top right: photo taken at the Science Academy, photo by John Sumrow; bottom right: top view of the Basia Irland's rainwater harvesting project at the northwest corner of the Student Union Building, UNM campus, photo by John Sumrow.

 Quantum is published once each year by the University of New Mexico, Albuquerque, New Mexico.

Send all correspondence to the Editor, Office of the Vice Provost for Research, MSC05 3180, 102 Scholes Hall, The University of New Mexico, Albuquerque, New Mexico, 87131.

Any comments or questions regarding this site can be addressed to: Valerie Roybal, valr@unm.edu

Research, Scholarship, & Creative Works at the University of New Mexico

UNM is A Carnegie Research University/Very High

Volume 24, 2008
research.unm.edu/quantum

John Sumrow

Contributors
Steve Carr, Lauren Cruse, Cindy Foster, Luke Frank, Carolyn Gonzales, Sari Krosinsky, Laurie Mellas, Valerie Roybal, Diana Sanchez, Matt Suhre, Karen Wentworth, Larry Walsh

Quantum is published once each year by the University of New Mexico, Albuquerque, New Mexico.

Send all correspondence to the Editor,
Office of the Vice President for Research and Economic Development, MSC05 3180, The University of New Mexico, Albuquerque, New Mexico 87131, or call 505/277-2256.

To the Reader

We invite you to learn more about the exciting research and creative endeavors that are happening at the University of New Mexico. One of our greatest resources is our people, who bring their talents and passions to push and extend beyond boundaries near and far, and who have aprofound impact upon our local, state, and international communities.

UNM continues to grow and support a robust environment where research and scholarship can flourish. The University was awarded $278.4 million in sponsored funding in contract and grants in fiscal year 2004. This represents an increase of $22.7 million over the previous fiscal year.

The University of New Mexico remains committed to supporting our faculty and researchers in the pursuit of discovery and knowledge. This issue of *Quantum* highlights a number of areas including geology, nanotechnology, teacher education, environmental health, the arts, water policy, and computational science. Join us in celebrating these achievements.

Terry L. Yates, *Vice President for Research and Economic Development*

Secrets of the Valles Caldera

UNM Geologists Peter Fawcett and John Geissman study sediment samples of an ancient lake bed to gain insight on the Earth's climate history.

by Robert Julyan

About 1.25 million years ago, a large erupting volcano, whose ash and lava formed much of the Jemez Mountains, collapsed. With its magma chamber depleted, it left a giant depression in the Earth, a caldera. Today it is known as the Valles Caldera, a beautiful scenic basin of grassland and forest, which in 2000 became the Valles Caldera National Preserve.

But it's what happened between those two geological moments—explosive volcanism and tranquil grasslands—that has captured the interest of many geologists, including Associate Professor Peter Fawcett and Professor John Geissman at UNM's Department of Earth and Planetary Sciences. For most of its history, the Valles Caldera was neither volcano nor grassland, but a lake.

According to Fawcett and Geissman, it was an extraordinary lake, because it may have existed for a very long time. Geologically, lakes are usually ephemeral features. Even New Mexico's huge Pleistocene-era lakes lasted little more than ten thousand years. But the Valles Caldera lake likely existed for hundreds of thousands of years.


Photo courtesy of Peter Fawcett.

And therein lies its appeal to researchers interested in the Earth's climate history. As Geissman says, "We don't have the opportunity to look at materials of this age very often."

The materials to which Geissman refers are core samples of lake sediments retrieved in May 2004, at a drill site at the southeast corner of the Valles Caldera. There, a team that included Fawcett, Geissman, and researcher Fraser Goff from Los Alamos National Laboratory, LANL, drilled 80 meters (approximately 260 feet) into the former lake bed. Fawcett and colleague Tim Wawrzyniec brought the samples to the National Lacustrine Core Repository at the University of Minnesota. At the Repository, parts of the samples were archived, while other parts were returned to UNM to be studied extensively.

Geissman specializes in paleomagnetism, which he defines as "the study of Earth's magnetic field, as recorded in geologic materials." It's a field that in recent decades has attracted considerable attention, due in part to the discovery that Earth's magnetic field has reversed itself (imagine a compass needle pointing south instead of north) numerous times in the geologic past.

But in the Valles Caldera lake deposits, Fawcett and Geissman are not looking for evidence of reversals so much as possible correlations with climatic variations.

When the ancient lake existed, runoff from storms and annual snowmelt carried particles of soil and minerals into the lake, where they settled onto its bed, building up layer by layer over time. Some of the mineral grains were iron oxides, which retained a record of Earth's magnetic field at the time. The iron-bearing particles were deposited as sediment and maintained their magnetic orientation. Ultimately, these sediments give clues about the Earth's climate history.

Photo courtesy of Peter Fawcett.

And therein lies its appeal to researchers interested in the Earth's climate history. As Geissman says, "We don't have the opportunity to look at materials of this age very often."

The materials to which Geissman refers are core samples of lake sediments retrieved in May 2004, at a drill site at the southeast corner of the Valles Caldera. There, a team that included Fawcett, Geissman, and researcher Fraser Goff from Los Alamos National Laboratory, LANL, drilled 80 meters (approximately 260 feet) into the former lake bed. Fawcett and colleague Tim Wawrzyniec brought the samples to the National Lacustrine Core Repository at the University of Minnesota. At the Repository, parts of the samples were archived, while other parts were returned to UNM to be studied extensively.

In the Paleomagnetism Laboratory in UNM's Northrop Hall, Geissman patiently inserts core samples into a superconducting rock magnetometer. This instrument cancels the influence of the Earth's current magnetic field and allows the sample's permanent magnetism to be detected and measured with great sensitivity and accuracy. It's a slow, repetitive, meticulous process. "There's a lot of tedium in this field," Geissman says good-humoredly, "but the potential payoffs are worth it.

"What these records might provide are short-term directional and intensity variations of the field that we lump under the term 'paleosecular variations.'"

Because the Valles Caldera lasted so long, he explains, the core samples should enable scientists to track these variations over a long period time. What's more, the variations in types and quantities of the magnetic particles can serve as proxies for evaluating current changes in climate.

Fawcett, a sedimentologist and paleoclimatologist who has worked with Geissman on other projects, studies the core samples from a different perspective.

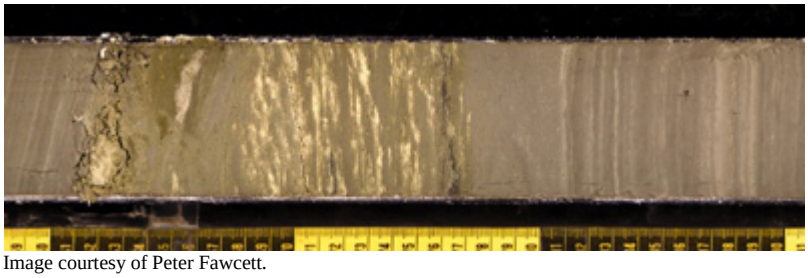


Image courtesy of Peter Fawcett.

And therein lies its appeal to researchers interested in the Earth's climate history. As Geissman says, "We don't have the opportunity to look at materials of this age very often."

The materials to which Geissman refers are core samples of lake sediments retrieved in May 2004, at a drill site at the southeast corner of the Valles Caldera. There, a team that included Fawcett, Geissman, and researcher Fraser Goff from Los Alamos National Laboratory, LANL, drilled 80 meters (approximately 260 feet) into the

former lake bed. Fawcett and colleague Tim Wawrzyniec brought the samples to the National Lacustrine Core Repository at the University of Minnesota. At the Repository, parts of the samples were archived, while other parts were returned to UNM to be studied extensively.

Fawcett lays out a carefully protected core sample from the bed of the ancient lake on a table in his Northrop Hall office. This segment of the full eighty-meter core is only about a meter long, but with sediments deposited at the rate of approximately one millimeter a year, the sample represents a thousand years of deposition. To the untrained eye, the sample resembles a two-centimeter-diameter tube filled with dirt. In a sense it is, but in the dirt, Fawcett sees much more.

“What we’re finding are some fine-scale laminations,” he says. “That means nothing has disturbed the deposits.” (Bottom-dwelling organisms can wreak havoc with sedimentary layers by burrowing into them.) Larger grains in the core indicate relatively shallow waters; finer grains accumulated in deeper, stiller waters.

“We can definitely see changes in water depth by looking at the sedimentary structure,” says Fawcett. “We should also be able to detect times when the lake was dry.”

By looking at the sediments, researchers hope to answer some other questions. They would like to find out if and when the lake dried up, or whether it emptied when a dam that formed from the debris of younger volcanic eruptions was breached.

Pointing to what appears to be an anomalous splotch of lighter color in the otherwise gray core, Fawcett speculates that it could be the remains of a bloom of algae in the lake, which would have significance for climate at the time.
Such observations will be correlated with the work of other scientists studying the materials. One researcher will look at the fossil remains of diatoms in the sample; different species of these single-celled organisms indicate different water temperatures.

Similarly, a researcher at the University of Northern Arizona will examine pollen grains in the sample to learn what plants were growing around the former lake, again with climatic implications. And a scientist at LANL will use variations in carbon isotope values to track climatic changes.

In the meantime, readings of rock magnetism obtained by Geissman and UNM colleagues Linda Donohoo and Tim Wawrzyniec will serve as markers for climatic variations.

“If this lake is as old as we think it is, it will tell us about the climate over an entire glacial-interglacial cycle,” Fawcett says.

Geissman adds, “I don’t have a clue as to what kind of information this research will reveal, but there’s the potential for some very interesting results.”

The Complexity of Poverty

Richard Santos works on the problem of and possible solutions to poverty among Hispanics.

by Frank D. Martínez

There is no simple explanation for the high poverty rates plaguing the nation's Hispanic population, says Richard Santos, associate dean of the University of New Mexico College of Arts and Sciences. Although the problem is indeed complicated, it is clear to Santos that American leaders need to recognize it as a national problem to be addressed at a national level. It is only then that the complexity of the issue can be dealt with in a meaningful way.

Santos holds joint appointments as an associate professor in the Department of Economics and the College of Pharmacy, and he has a research appointment at the Southwest Hispanic Research Institute. He hopes work he and his colleagues are doing will lead to a broader appreciation of the problem and its possible solutions.

"It's not the traditional poverty where you have people without jobs. You have poverty with people who are working, and they're working full-time hours. That to me is the biggest paradox—that in this economy we have individuals who are working full-time and whose earnings are below the poverty level," he says.

Numerous factors complicate the picture, Santos explains. Education and training, healthcare, collective bargaining, and equal employment opportunities, as well as availability of well-paying jobs, hiring practices, discrimination, the nation's economic policies, and the rapidly growing and mobile Hispanic population are among these factors.

In terms of education, for example, Santos points to the fact that 25 percent of Hispanic youth do not have high school diplomas. Many of those who do then go on to community colleges.

"That's not to deny the importance of community colleges, except that those students are more likely to go to school part-time. Very few then actually go from a two-year community college to a four-year college." A degree from a four-year institution is key to obtaining a job that provides a middle-class standard of living in today's economy, Santos explains.

"Pre-market discrimination" is another example Santos points to, which results from, in part, the "residential segregation" of Hispanics. "What you've got is individuals who go to certain schools, and there is an inequality of opportunity to education and training, and other kinds of social skills."

This means Hispanic Americans enter the labor market with unequal skills compounded by "market discrimination." Santos cites a national study showing that African American and Hispanic job applicants

with similar qualifications as white applicants were “more likely to get rejected” by prospective employers.

Additionally, Hispanic women have fewer employment opportunities, Santos says, and are over-represented in jobs such as those in the service and low-wage manufacturing sectors. “Adding to the problem is the fact that these are jobs that are in decline and that have been affected by trade policies.”

Public programs, such as the New Mexico Lottery Scholarship, Social Security, and Medicare, provide some relief, “but a lot of people don’t realize that when you have people making low wages, it hurts the economy as a whole. People who live in poverty and discrimination do not go out and buy automobiles. They don’t go out and buy houses; they don’t go out and shop.”

Ultimately, Santos says, these issues have implications for the entire nation. “Having people included in the overall economic policy is going to be good for them and good for the economy as a whole.”

Breaking from Tradition

Professor of Linguistics Joan Bybee pushes beyond traditional concepts of linguistics.

by Steve Carr


Photo of Joan Bybeee by John Sumrow.

For some people, human language is simply a means of conveying content or information. For others, however, it's a fascinating system, the structure and components of which are endlessly compelling. University of New Mexico Regents' Professor of Linguistics Joan Bybee belongs to the latter group.

Bybee, who was named UNM's Forty-ninth Annual Research Lecturer in 2004, has been passionate about linguistics since the late 1960s. A degree requirement at the University of Texas at Austin introduced her to the field.

"I was getting a teaching certificate for English and Spanish, and in order to do that, you had to take some linguistics courses. When I took these courses, it was as if all the lights came on. I had found what I really wanted to study," says Bybee.

For more than thirty years, linguistics has been the focus of Bybee's work. It is a subject that is not widely understood by people outside of the discipline.

"Linguistics is not prescriptive," explains Bybee, who is also the president of the Linguistic Society of America. "Linguists don't tell people how they should talk. We study how they do talk.

"Linguists study the systemic aspects of language that allow speakers to understand each other and to recognize which utterances that they hear belong to their own language and which ones belong to some other language. All speakers, no matter what their education or literacy level, use language systematically. It is that system that is the object of our study."
On reaching graduate school, Bybee realized that what was traditionally included in the field was pretty narrow. The traditional structure of linguistics includes phonology (sound system), morphology (word structure), and syntax (sentence structure). Bybee questioned whether it was a good idea to exclude meaning and usage from the realm of linguistic study.

"From the beginning, I wondered whether linguistic matters were as cut and dry as the training I was given suggested. It seemed that it wasn't that easy to exclude meaning and usage when considering linguistic structure," she says.

In 1970, Bybee collaborated on a paper with mentor Sandra Thompson, one of her graduate professors at the

University of California, Los Angeles, about a set of constructions that seemed more attuned to the context of discourse than to structural criteria. The paper raised a few questions in their minds. Why do languages have grammar? Why does language take the form it does?

Well-known linguist Noam Chomsky says certain linguistic structures are innate, but that's not a complete explanation, says Bybee. She began to explore how and why languages change. Bybee was also curious to find out whether categories such as "past tense" meant the same thing in all languages.

"These were questions that weren't easily approached at the time within this context,"
she explains.

She sought to discover more. "I conducted a study of the morphological categories of verbs in fifty languages and found remarkable similarities in both meaning and structure," says Bybee. "Since verbs describe situations that take place in time, categories that deal with time, such as aspect and tense, are highly relevant to the verb's meaning and thus highly likely to appear as affixes on verbs." This study demonstrated the influence of meaning on structure.

Her further studies and research have led her to conclude that frequency of use also has a bearing on the structure of language.

"I think the finding that the frequency of use of words and phrases changes language has lots of far-reaching consequences," Bybee says. "During the twentieth century, linguists were mostly interested in abstract structure and not in how people really use language. Since it turns out that frequency of use has an impact on that structure, we have to start incorporating usage factors into our theories."

Empowering Communities

The New Mexico Center for Environmental Health Sciences addresses regionally relevant environmental public health issues.

by Luke Frank

Though people are usually intrigued by medical research, they sometimes question the everyday, practical value of certain medical discoveries. Before pondering the larger, looming questions of science and health, they first want to know why Jimmy suffers from chronic bronchitis or why Susie recently began experiencing debilitating headaches at school.

Enter Scott Burchiel, associate dean for research at the University of New Mexico College of Pharmacy, who directs the New Mexico Center for Environmental Health Sciences. The Center, established in 2003 and operated through UNM's Department of Internal Medicine, performs translational research addressing regionally relevant environmental public health issues. The Center's initial fuel comes from a four-year, four-million-dollar grant from the National Institute of Environmental Health Sciences and a diverse team of researchers and community partners.

"We advance community-based, participatory research," Burchiel explains. "The community determines the issue and we partner with it in conducting interactive studies addressing practical problems and solutions."

An example of how the Center empowers communities on local issues is its recent work with the San Juan Citizens' Alliance. The Office of Community Outreach and Education Program, COEP, a component of the Center, fielded a phone call from the Alliance, which was concerned about air quality issues in the Four Corners area and the impact on local asthma sufferers.

"There's a lot of gas and oil refinery activity in the area, and the Alliance's chief concern was that high ozone levels in the area would exceed federal compliance levels," says Johnnye Lewis, COEP director. "Naturally, they were concerned about the health consequences, but also about falling out of compliance and taking an economic blow."

The group wanted to protect the region's health and economics, but was unsure how to proceed. A COEP-Alliance team was established, and its first project was developing a brochure focused on minimizing activities and risks that can exacerbate asthma.

To further this new sense of unity, the team gathered and integrated both environmental and health data in the region through the Center's Environmental and Toxicology and Population Health research programs. "Frankly, the data was sparse for the Four Corners area specifically," Lewis says. "The community wanted more comprehensive and accurate health and environmental monitoring. They wanted more information on which to act."

This is where COEP and the Center play an important role. “Using tobacco settlement money to create data on respiratory issues, we were able to provide ozone monitors to the Alliance,” says Lewis. “We then trained the community to collect and deliver the data to the Lovelace Respiratory Research Institute, an affiliated facility, to be analyzed through additional Center facilities.”

According to Lewis, the data collected tracked the ozone plume’s movement and intensity and showed evidence that the plume was affecting some areas more seriously than others. “Did we solve the community’s problems? No, but we greatly improved the community’s capacity to handle its own problems. The people are better informed, and they now know the questions to ask that address air-quality issues affecting their region,”
says Lewis.

Over the past year and a half, the Center has examined community-specific issues ranging from the impact of uranium mining near Native American reservations to air quality around the New Mexico-Texas-Mexico border. By assisting groups in identifying and evaluating issues, they can support funding efforts and research methodologies.
The Center also offers a Community Outreach and Education Program that provides educational resources on environmental health topics.

To date, the Center’s work involving eighty funded investigators has focused on numerous environmental issues, including ultraviolet, arsenic, wood smoke, and diesel-exhaust exposures, as they relate to community health. The Center also has partnered with Native American communities statewide to examine environmental health issues of uranium mining, jewelry making, and air quality.

Says Burchiel, “these communities are provided the tools and guidance to conduct internal research that might or might not confirm systemic health issues caused by any number of environmental inputs. This is very gratifying for everyone involved.

Building Stronger Teachers

UNM's Science, Technology and Mathematics Teacher Academies help to prepare highly qualified teachers.

by Larry Walsh

Quincy Spurlin, Rick Kitchen, and Jonathan Brinkerhoff may not appear to be movers and shakers in the business community. They are not invited to chamber of commerce meetings or profiled in business journals. Investors do not hang on their every word. Yet, these University of New Mexico College of Education faculty members may end up having a more profound impact on the economic development of New Mexico than many entrepreneurs.

Over the last twenty-five years, the United States has transformed into a knowledge economy, in which information itself is considered a resource. Technology and science are the engines of this economic revolution, demanding an increasingly well-educated workforce. It is a revolution that threatens to leave New Mexico behind.

New Mexico ranks low among the states in student achievement in mathematics and science. This has a direct impact on UNM as well. In the 2003 spring semester, over 1,900 students had to take basic math classes to develop necessary skills they did not learn in high school. Once behind in the sequence of mathematics courses, students have a difficult time achieving dreams of becoming scientists or engineers.

Spurlin, Brinkerhoff, and Kitchen are attacking this problem by helping teachers increase their knowledge of subjects and teaching skills through a series of intensive science, mathematics, and technology teacher academies. Over the last four years, these academies have garnered over $2.5 million in grants from the U.S. Department of Education.

Teachers at the academies participate in an intensive three-week, eight-hour-a-day institute during the summer, and also attend several all-day sessions during the regular school year. “The academies focus on increasing teachers’ content knowledge and modeling innovative ways of teaching and assessment,” explains Rick Kitchen, an associate professor of educational specialties.

While all three academies share the goal of preparing highly qualified teachers, none has a cookie-cutter approach to professional development. Each academy targets specific impediments to effective teaching and student achievement within that discipline.

In the Science Teacher Academy, Quincy Spurlin, an associate professor of elementary school science, focuses on elementary school teachers who work in classes with a high percentage of minority, rural, and low-income students. New Mexico’s low ranking in math and science is not the result of a poor overall performance, as seventy-five percent of the state’s fourth grade students actually performed at or above the national average. Rather, the problem is the remaining twenty-five percent of students—the majority of whom are from low-income, rural, or minority communities—who scored significantly below average.

“Content is always important,” says Spurlin, “because elementary teachers don’t have strong backgrounds in science; but more importantly, we use this content to model and teach the process of science: questioning, data collection, analysis, inference, and uncovering connections.”

Photo by John Sumrow.

Cecilia Lucero, an elementary teacher in Laguna, says, “I really like how Professor Spurlin has organized the academy. We actually go out and do the science in the environment. It’s the kind of curriculum that actually makes sense to the student. It’s a hands-on experience that students can actually see and experience, rather than just depending on the textbook."

Spurlin confirms this. “The overriding theme of the academy,” she says, “is showing how everything is connected to everything else. The bedrock is related to the soil. The soil determines the kind of plants that grow, which determines what animals there are. Everything is connected to life. At the same time, there is a cultural connection which determines how we view and exploit the environment.”

Connections are crucial in the Mathematics Teacher Academy, too. Rick Kitchen’s overriding goal for this academy is to build a network of leaders in math education throughout the state. “Teaching can be a very isolated job,” he says. “Usually, there is little chance to talk to or work with other teachers. We need to create a learning community of both students and teachers if we are to improve math education.”

Designed for secondary school teachers, the math academy requires a two-year commitment from the teachers. Its participants are a mix of new participants and returning teachers who had attended a previous session. This mix promotes the sharing of knowledge about what works and what doesn’t work in the classroom.

Havens Levitt, a veteran math teacher at Del Norte High School in Albuquerque, contends, “the most important aspect of the academy is changing how we think about mathematics. We need to create experiences for students where they can discover ideas and learn applications in real contexts, as opposed to textbook problems. We focus on the process of problem solving, not just the answers.”

The process of teaching strong problem solving skills begins by recognizing a student’s own mathematical knowledge, says Kitchen, whose research has focused on math education and low-income communities. “We need to build upon their strengths, not focus on their deficits.”

Assistant Professor Jonathan Brinkerhoff takes a different approach in the Technology Teacher Academy. In order to build teacher skills in different schools, he recruits teachers who are not

effective technology users, so their eventual successes become models for all teachers in their schools.

“Technology is not an end in itself. It is a means to make other instruction more effective. The question is how to integrate it into English, math, science, and history so that it promotes high levels of engagement and thinking,” Brinkerhoff says.

Lette Galvez, a fifth grade English as a Second Language teacher at Apache Elementary in Albuquerque, says, “when I first started the academy last year, I felt incompetent as far as my technology skills were concerned. The practical experience I gained at the academy has allowed me to create projects that engage all of my students, despite the fact that they come from several different countries and backgrounds.”

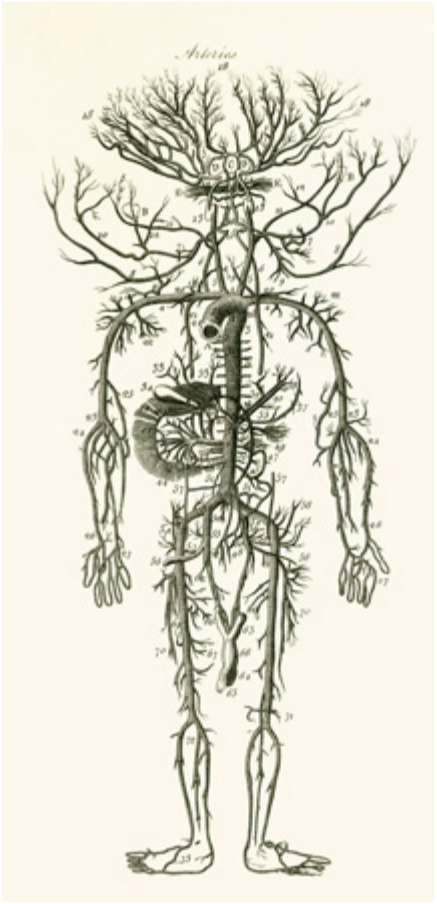
The Technology Teacher Academy builds both knowledge and confidence through a series of projects, which has included producing virtual reality presentations, digital videos, and a Web page for the UNM Maxwell Museum of Anthropology. “These projects allow teachers to practice the skills they have learned in the academy by modeling student learning,” says Brinkerhoff.

While these teacher academies may never make headlines in the business journals, their efforts to help teachers become more effective will have a lasting impact on New Mexicans competing in the knowledge economy.

The 3/4 Power Law

Biology professor James Brown explains how this fundamental law is helping scientists make predictions about organisms' behaviors, lifespans, and other characteristics.

by Russell Moore



Look at a bottle of aspirin. The dosage information will likely suggest giving a fifty pound child about half as much aspirin as a hundred pound child, who in turn is advised to take about half as much as an adult man. That's a linear dosage scale: twice the body size, twice the dose.

But that's not the right way to determine dosage, says UNM Professor of Biology James Brown. Metabolic rate, not body mass, determines how much of a drug—or food, or any substance—an organism needs or can handle.

Aspirin isn't a particularly dangerous drug. But what about antibiotics? Painkillers? Anesthetics? Over- or under-dosing can make a drug therapy program useless at best—and possibly even fatal.

Brown is investigating these and other implications of new research and theories. A recent discovery of why every animal's metabolic rate equals its mass raised to the 3/4 power ($M^{3/4}$) is helping scientists make new predictions about organisms' behaviors, lifespans, and other characteristics.

In 1997, Brown and two colleagues published a short paper that all but silenced critics of the 3/4 power law, which was first discovered in the 1930s. By finally showing why the 3/4 rule exists, the team was simultaneously able to explain deviation from the rule and enable scientists to compare varying forms of life.

Put simply, blood vessels have a finite amount of space to fill, so they do so in the most efficient way possible: as a fractal network of vessels branching out in diminishing size from the heart all the way to the capillaries.
(A fractal is a structure or pattern that is self-similar at different resolutions; for example, a deciduous tree's branches are the same size and shape relative to the bigger limbs as the limbs are to the trunk. Break off a small piece from the end of a branch, and you'll see the same structure.)

Complex math is involved, but the paper proposes that since heart rate, aorta size, and time of blood circulation all follow quarter-scaling patterns, metabolic rate must scale by 3/4.

The smallest level in a circulatory system, the capillary, is the same size in all animals. “We don’t use giant doorknobs or electrical outlets when we build skyscrapers,” Brown says. The ends of the network are always the same size.

Organisms aren’t the only things whose scale can be amplified or minimized in a predictable way. Professor of Biology Bruce Milne is examining how streams branch within a watershed—like blood vessels, in a fractal pattern. And like metabolic rate, the amount of runoff in a watershed is scaled exponentially. Furthermore, the point at which the amount of runoff shifts from a negative exponent to a positive one—also the point at which an area’s designation shifts from arid to humid—is believed to be where the most efficient plants grow: plants that maximize their conversion of water and solar radiation to plant mass.

Brown points out that his team’s explanation of why the 3/4 law exists also helps to show why not every animal displays a metabolic rate that follows the law exactly. Think of gravity, he says: the theory of gravity tells us that any two objects, regardless of size, will fall at exactly the same rate. But go outside with a hammer and a feather, and you’ll quickly see that they don’t hit the ground at the same time. External factors—air pressure, wind resistance—must be controlled or eliminated. For this experiment to uphold a law that we all accept, it must take place in a vacuum.

But life doesn’t exist in a vacuum, and we don’t know what external forces we must control in order to make the 3/4 law work, Brown says. He believes that if we could control environments the way we can control a vacuum, every single organism would display a metabolic rate exactly equal to $M^{3/4}$.

Brown explains metabolic rate is a “first-order predictor” of a huge range of behaviors. Lifespan, rates of evolution, even mating calls can all be determined once scientists know an animal’s size and temperature. These and other behaviors “are direct expressions of metabolic rate,” he says.

Since the 3/4 law appears to exist throughout biology, Brown says, it should be considered one of a few known fundamental unifying theories of life. He says the law is further evidence of a common ancestor, and additional support for Darwin’s theory of evolution.

Quantum Briefs

Inspiring Native Students
by Laurie Mellas Ramirez

How does higher education influence Native American students' desire to serve their community? Are native studies programs crucial to this development? Do they promote leadership and service-oriented goals?

Researcher Tiffany S. Lee is determined to find the answers to these questions.

Lee, who is Diné (Navajo) and Lakota, is teaching in the Native American Studies Department at the University of New Mexico and is completing a three-year post-doctoral fellowship, awarded by the American Educational Research Association and Institute for Education Sciences.

"Native people's inherent sovereignty has consistently been challenged throughout history, and it continues to be challenged today. It is imperative that we inspire native students to protect their communities' interests and sovereign rights," Lee says.
Lee first emerged as a scholar in 1986. The Navajo tribe awarded her the Chief Manuelito Scholarship to complete undergraduate work at Pomona College in California. She has received numerous other scholarships, grants, fellowships, and research awards.

In 1994, Lee joined UNM as a teaching assistant. She later taught high school social studies and language arts for the Navajo Nation and at Santa Fe Indian School.

She received her Ph.D. from Stanford University's School of Education in Social Sciences, Policy, and Educational Practice in 1999.

Accumulating expertise in identity development and socialization, she is making her mark as a Native American studies instructor, research consultant, and evaluator for the American Indian College Fund and Packard Foundation.

From History to Mystery

by Carolyn Gonzales

By day, Virginia Scharff is an associate professor and a scholar of history. She teaches a variety of courses at the University of New Mexico, including the history of women in the United States and the American West, environmental history, social theory, and writing as a historian.

She also directs the UNM Center for the Southwest, which sponsors programs and events that bring scholars and the public together to promote understanding of Southwestern history, culture, landscape, and environment.

She was recently named fellow of the Society of American Historians and serves as chair of Women of the West program at the Autry National Center in Los Angeles, where she helps to communicate Western women's history to the public and build women's programs.

By night however, Scharff is a mystery writer under the *nom de plume* Virginia Swift. Her third book, *Bye, Bye, Love,* (Harper Collins, 2004) brings back character "Mustang" Sally Alder, a college professor and sometime sleuth, to help solve the murder of a musician's ex-wife.

Praised by critics for her "lively characters and surprising plot twists," (*Booklist*), and "good local color," (*Library Journal*), Virginia Swift has created a fast-paced, clever tale of murder and mayhem, sure to keep readers enthralled.

Bilingual Medicine

by Cindy Foster

After spending an evening in the emergency room when his wife was suddenly taken ill, Bonifacio Contreras was inspired. "I found myself spending hours translating for other patients," he says. This experience prompted him to collaborate with University of New Mexico Health Sciences Center physicians to publish a dictionary that helps medical professionals communicate with Spanish-speaking patients.

Contreras took a unique approach with *Salud: Medical Spanish Dictionary and Phrase Book.* Sections include medical topics such as cardiology, diet, and nutrition. Thus, non-Spanish speaking physicians can turn to the "headache" or "sore throat" listing in the book to find key phrases to help them make more accurate medical assessments.

Among those using the book are doulas, volunteers who accompany pregnant women into labor and delivery. "The dictionary allows them to aid in the communication between a Spanish-speaking patient and the provider team, using terms they are familiar with," says B.J. Ciesielski, outreach education coordinator at the UNM Hospital Maternity and Infant Care Program. Ultimately, Contreras' dictionary will help make sure that more people get the best heathcare treatment possible.

A Common Language for Diversity

by Carolyn Gonzales

The 2003 U.S. Supreme Court's ruling on affirmative action in higher education has pushed colleges and universities "toward creating a new paradigm for diversity in the twenty-first century," says Roberto Ibarra, the University of New Mexico's special assistant for diversity. It is this push that resulted in Ibarra's hosting a recent national symposium called "Multicontextuality, Unity, and Diversity in a Pluralistic Society." This symposium examined ways in which higher education needs to respond to the changes in its consumers.

The symposium included ideas for developing the next generation of scholarship and programs on campus diversity. It also looked at ways to formulate strategies and practices for reframing and enhancing the culture of the academy to respond to the current socio-political, demographic, and economic conditions for developing new diversity models.
The symposium was funded by the Ford Foundation, which also helped Ibarra establish and lead a consortium of four southwestern universities in a project aimed at enhancing academic culture through increased campus diversity. UNM's partners in the consortium are New Mexico State University, Arizona State University, and Northern Arizona University.

Ibarra is also working on two campus projects, the Freshman Academic Choice Program and the Rural Health Interdisciplinary Program.

Says Ibarra, "we need to begin the discussion for framing a new social consensus and developing a new common language for diversity."

Martin Facey, "Fire-Red Phone," oil on canvas, 1981. This piece is part of HSC's extensive art collection.

Softening the Edges of Hospital Life

by Cindy Foster

When people think of a healthcare environment, they would e nurses, examining tables, and medical equipment. Visitors to t Mexico Health Sciences Center, HSC, however, will also find collection hanging throughout the center, valued at more than

In 1991, UNM Professor of Cardiology Jonathan Abrams beg Hospital, UNMH, officials acquire art for their newly expande Center, which houses out-patient clinics and faculty offices. T art resonated with staff, artists, and donors. Now, what began and donations has grown to a collection of some seven hundre

Today, Abrams and Christina Fenton, HSC arts director, curat the UNM Hospital Gallery, a space which has hosted more tha featuring New Mexican artists.

It's clear why a health sciences center and hospital needs doct why does this environment need art?

"People realize that interesting and beautiful artworks mean th committed to humanizing and softening the often hard edges c Abrams. "The collection is not 'needed' in the same way that are, but it is an extra bonus suggesting UNMH is more than th

Water Library

Professor of Art and Art History Basia Irland explores the phenomenon of water.

by Valerie Roybal

Desert Fountain, a sculpture at the Albuquerque Museum, by Basia Irland. Photo by John Sumrow.

Water is essential; it flows, carries, contains, and feeds. Water is mysterious and sacred; it is a conveyer of ideas and elements; and it is a holder and inscriber of histories. At the most basic level, water is a crucial element of life; however, the importance of water is often overlooked or taken for granted.

It is the unseen and overlooked qualities of water that have captivated Professor of Art and Art History Basia Irland. For over twenty-five years, Irland has made artistic and practical investigations into the diverse and fascinating aspects of water, with a strong commitment to local and international water issues.

“Irland’s work engages critical issues surrounding the use and abuse of water sources throughout the world. She is an artist working at the intersection of environmental issues, governmental policy, human rights, and natural science, always informed by an awareness of the spiritual dimensions of water,” describes Kathleen Howe, director of the Pomona College Museum of Art in California.

Irland has organized her pursuits into a body of work called *Water Library, A Sculptor’s Research Into the Phenomenon of Water.* A record of this body of work will be published as a book by the same title by the University of New Mexico Press. This library includes seven chapters with essays, art works, and projects.
The first chapter, “Inscriptions, Stars, Tides, and Ice,” explores the ways in which water engraves its presence. “Hydrolibros,” the next chapter, contains mixed-media sculptures that serve as archives, encyclopedias, and log books reflecting Irland’s water research.

“A Natural History of Salt,” the third chapter, grew from the artist’s investigations of this marine evaporate. The following chapter, “A Gathering of Waters: Rio Grande, Source to Sea,” was a five-year long grassroots project developed to increase awareness of the plight of the Rio Grande/Rio Bravo and connect people along the 1,875 mile length of the river. The resulting sculpture and video documentary served to raise consciousness about the rich cultural diversity that exists among the communities along the river and to establish a dialogue and common ground for discussion on water issues.

"Walkerton Life Vest, 2002," by Basia Irland. The vest contains water samples, front-page newspaper reports, sample testing kits forbacteria, carved wooden boat and paddle given to the artist by a long time Walkerton resident, and the names of the seven who died etched into a birch-bark scroll. Photo courtesy of Basia Irland.

"Holy Water," the fifth chapter, looks at the sacredness of water when it is blessed by priests, collected from holy and healing sites, used for baptisms, and left as offerings.

Irland describes the next chapter, "Waterborne Disease and Non-potable Agua," as an ongoing series of international projects focusing on the pathogens and pollutants that find their way into world water systems and are frequent causes of illness and death. The investigation was inspired by Irland's personal experience of being diagnosed with giardia, a parasite she contracted while doing research in Java on a Senior Fulbright Research Fellowship. An exhibition of her work in Bath, England, 2001, showed enlarged images of water-borne bacteria known to cause illness and death.

Three years ago, seven inhabitants of Walkerton, Ontario, Canada, died and half of the small population of four thousand became ill because their main source of drinking water became contaminated with fecal matter, exposing them to two primary bacterial agents. For the second anniversary of the tragedy, the community invited Irland to create work in remembrance of those who died. For the project, photos of the pathogens were heat-transferred onto hospital bed sheets given to Irland by local medical centers. She also wrote an essay about the project published in *The New Quarterly, New Directions in Canadian Writing*.

In the summer of 2004, Irland was invited by the University of the Pacific in Stockton, California to create a project about the Calaveras River, where water was tested for high levels of chemical pesticides. The project resulted in Clandestine Calaveras, which included images of river views overlaid with scientific images (gas chromatography and mass spectrometer chromatograms) of the chemical pesticides found in the water. She also commissioned a composer to write a score for mezzosoprano and cello as accompaniment to the images. The mezzosoprano sings the names for the chemical pesticides found in the Calaveras River.

Recently Irland has received funding to conduct research in India and create artwork about the diseases found in the stepwells and in the Ganges River.

Basia Irland's rainwater harvesting project at the northwest corner of the Student Union Building, UNM campus. Photo by John Sumrow.

With the final chapter of the library, “Receiving Rain,” Irland has created several site-specific projects designed to harvest water that is then distributed to fountains and gardens. Because the fountains and gardens only receive water collected from rainfall, the projects make visible the arid conditions in the desert Southwest.

Desert Fountain is an outdoor sculpture at the Albuquerque Museum consisting of three sets of cast bronze arms designed to carry water from one set to another into a stone basin. “Because I did not want to use river or aquifer water, I placed a stock tank on the roof of the museum that retains water when it rains. When the fountain is dry it says just as much as when it flows,” explains Irland.

Overview of Basia Irland's rainwater harvesting project at the northwest corner of the Student Union Building. UNM campus. Photo by John Sumrow.

Several of her rainwater harvestin
reside on the UNM campus. “The
for the pieces came from the dism
when water would end up on the s
after a heavy rain. I realized that w
be harvested and used to feed xeri
areas,” she says. One project is a
contemplation garden residing on
of the Museum of Southwestern B
swale resembling a natural creek b
to catch water for feeding plants. A
installation is on the northwest cor
recently renovated Student Union
This installation consists of a cove
garden and is lined with tiles conta
three different words for water, inc
American Sign Language, Swahili
and numerous Native American la

Describing the project, one of the tiles reads: "Harvested on the roof scarce rainfall flows into a subterranean drip system. Overflow circles the xeric fragrance garden in a stone swale and drains to the Rio Grande."

Irland recently completed another project behind the Jonson Gallery with students from her Art and Ecology class. "After gallery showings, people would gather in a barren asphalt parking lot. We wanted to create an arbor where people could relax in the shade," says Irland. The space is landscaped with stone benches and plants fed with rainwater harvested from the gallery roof.

Irland has also collaborated with Beverly Singer, associate professor in the Departments of Anthropology and Native American Studies, on a rainwater harvesting project at the Isleta Pueblo south of Albuquerque, resulting in a large xeric garden and video documentary of the project.

Irland believes in the importance of collaboration and cross-disciplinary dialogue and often works with colleagues from other departments across campus. This includes team-teaching "The Culture of Water" with Michael Campana of the Water Resources Program, José Rivera of Architecture and Planning and Public Administration, and Marilyn O'Leary of the Utton Law Center.

With her work, Irland is making connections: between the environmental, natural, spiritual, and artistic characteristics of water; and between people and disciplines in recognizing the importance of water. According to Irland, "all the works, projects, and chapters are interconnected like a river in a delta flowing into the ocean, forming a larger picture about the significance of water."

Saving the Silvery Minnow

Biologist Tom Turner helps to repopulate the fish with conservation genetics.

by Steve Carr

University of New Mexico Associate Professor of Biology Tom Turner has a fish story. However, it's not about the big one that got away. Instead, it's about a small fish on the verge of extinction. Turner is using conservation genetics to help save and repopulate the endangered silvery minnow.

Turner's work is funded through the Middle Rio Grande Endangered Species Collaborative Program, which was established to help save the species from extinction while maintaining the water supply to users in the Rio Grande valley.

"The thing that is most consistent with the Endangered Species Act is to maintain a self-sustaining population of silvery minnow in the river," Turner says. "The best thing is to have the fish living in the wild. What the Program wants to do during drought years is raise fish in hatcheries and use those fish for two purposes: to augment the natural population, and develop a brood stock for propagation."

But there are drawbacks to the hatchery plan.

"If you're feeding the fish prepared food and you have them on a daily regimen living with a certain lighting environment—or non-wild conditions—the fish are no longer wild," he explains. "This isn't the best idea because it would be like throwing a domesticated dog out in the woods and expecting him to make it on his own."

Since 1999, Turner and his group have been trying to ensure that hatchery fish look, genetically speaking, like wild Rio Grande silvery minnow so that the hatchery-raised fish have a better chance at survival in the wild. By taking a small tissue sample from the fin, they are able to genotype, or determine the genetic makeup of, wild fish for comparison to those raised in the hatchery.

"We look at the wild population and see what the genetic diversity looks like," said Turner. "We want to know how much total diversity there is—and to help hatchery managers maintain similar levels of genetic diversity in the hatchery."

Turner discovered that there is actually lower genetic diversity than expected based on the total number of fish from the test site. He hypothesizes that dams and diversions in the river have created a "highly fragmented" system that produces lower genetic values.

Turner elaborates. "Fish spawn in the water, and they go through the diversion and are basically lost. We think certain breeding pairs have a higher probability of leaving their eggs in that stretch of the river." Thus, the number of successful progeny are coming from a limited pool of adults.

"The idea," Turner says, "is to try and restore the river to allow these fish to persist through natural processes." If Turner's work is successful, this will be the story about the fish that didn't get away.

Preventive Diplomacy

The Utton Transboundary Resources Center helps resolve conflicts regarding water rights and other natural resources.

by Laurie Mellas Ramirez

Photo of Marilyn O'Leary by John Sumrow.

Sustaining the ways of the West—raising healthy crops and animals and attracting big business and industry—requires vast quantities of water, a resource as valued and contested as oil. In the Old West, disputes over such assets were often settled by gunfight on a dusty trail. Today, combatants contest ownership rights in a court of law.

The Utton Transboundary Resources Center at the UNM School of Law was created in 2000 to help those with shared interests manage the use of water supplies and avoid litigation.

“We understand there is no one better to come up with a management plan than the people using the resource. If you leave it to a judge, people often don’t like the result,” says Center Director and Research Professor Marilyn O’Leary, who brings twenty years of experience in water and utility law to the position.

The Center is named for the late UNM Professor of Law Albert E. Utton, a Rhodes scholar who gained an international reputation by using multidisciplinary scholarship to address complex resource issues, primarily along the Rio Grande/Rio Bravo and United States border.

Using impartial “preventive diplomacy,” a facilitative tactic Utton honed, the Center helps resolve various issues related to transboundary resources—natural resources intersected by political boundaries.

Initially funded with $1.4 million, the Center takes a dual approach to transboundary issues: research and scholarship and field action.

Water has become the Center's key resource concern.

"Water is the most important resource issue that we have right now, and it's the one I know the best," O'Leary says. "The mission of the Center is to bring together scientists, lawyers, and policy makers. We also use preventive diplomacy to create fact-based, sustainable resource-management plans."

New Mexico is constantly grappling with a multitude of water issues, making it an ideal laboratory for field projects and research with worldwide applications, O'Leary explains. The state is party to eight interstate water compacts, is semi-arid, and is dependent on ground water supplies; additionally, it has a market in water rights, is home to indigenous cultures, and has an international border.

Futhermore, the state is currently dealing with a multi-year drought. Other issues the state faces include: treating surface water for municipal use, dealing with neighbors who do not regulate groundwater pumping and deplete aquifers, and water-rights adjudication and conservation.

The Utton Center has been involved with them all.

"Natural resources have no intrinsic social, economic, or political boundaries, yet they are very much bounded and crisscrossed by competing governmental authority and claims from diverse interest groups with differing values," O'Leary says. "Parties must learn to collaborate and accommodate one another in order to protect and sustain resources."

But when it comes to a person's livelihood and his or her personal and cultural values, emotions run high. How does the Utton Center foster peaceful negotiations where others have failed?

O'Leary explains that concentrating on the resource rather than the conflict keeps the Center above the fray.

Utton Center Assistant Director Susan Kelly, a former water-rights manager for the City of Albuquerque, concurs. "We help those involved in a dispute develop relationships so there is a respect for one another, even if they have opposing views."
The Center received state funding in 2003 to help Governor Bill Richardson bring together border governors from the U.S. and Mexico. The leaders will tackle management of shared water resources.

O'Leary is frequently invited to make presentations on transboundary water issues and has been appointed by the Governor to the New Mexico/Chihuahua Commission.

Working with the New Mexico State Engineer and the Interstate Stream Commission, Utton Center faculty researched and wrote a report on the Colorado Water Court System to measure its applicability in New Mexico.

"Our recommendations were substantially followed by Governor Richardson in his action designating water judges in each judicial district," says O'Leary, who now provides training for the judges through UNM's Judicial Education Center.
The Center also worked with the Interstate Stream Commission to analyze and synthesize hundreds of comments received at public meetings on the State Water Plan.

Bringing people together across boundaries—geographical, disciplinary, cultural, and political—seems to be what the Utton Center does best.

In early 2004, two scientists—UNM Professor Emeritus of Biology Cliff Crawford and Sterling Grogan, biologist and planner for New Mexico's Middle Rio Grande Conservancy District—developed a proposal for restoring the bosque, a riparian forest along the Rio Grande with cottonwood, willow, salt cedar, and Russian olive trees.

Wildfire and water depletion along the bosque are issues of increasing concern. Crawford and Grogan proposed that altering the landscape to resemble its historic mosaic of native trees and open spaces would reduce fires and conserve water.
Dozens of others interested in restoring the riverbank had their own theories.

The Utton Center offered to organize a workshop to examine the issue. This well-attended event brought together concerned individuals and representatives from agencies and non-governmental organizations.

"The workshop focused on major questions, such as, what degree of alteration is needed, and who is going to do what?" Crawford said. "The Utton Center hired a facilitator and a note taker for each of the meetings and breakout sessions. There was a tremendous amount of exchange going on. All of this information was later incorporated into a document and a revised proposal."

The resulting documents were shared and the participants arrived at an agreement on how to proceed with restoration.
"Without them, this process could have gone on for four to five years. The Center expedited everything," Crawford says. "It was a huge step toward integrated management of the bosque."

Washington lawmakers are becoming increasingly aware of the nation's water concerns and the Utton Center's successes. Last spring, Senator Pete Domenici helped officially dedicate the Center. In July 2004, he and a bipartisan group of lawmakers introduced multi-million dollar legislation for a new national water plan. The bill proposed a National Water Supply Law and Policy Institute within the Utton Center.

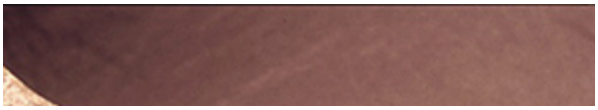
“The Utton Center would very much like to be a resource for New Mexico, but also for other states and the federal government,” says O’Leary. “We are very excited about this proposal.”

She sought to discover more. “I conducted a study of the morphological categories of verbs in fifty languages and found remarkable similarities in both meaning and structure,” says Bybee. “Since verbs describe situations that take place in time, categories that deal with time, such as aspect and tense, are highly relevant to the verb’s meaning and thus highly likely to appear as affixes on verbs.” This study demonstrated the influence of meaning on structure.

Her further studies and research have led her to conclude that frequency of use also has a bearing on the structure of language.

“I think the finding that the frequency of use of words and phrases changes language has lots of far-reaching consequences,” Bybee says. “During the twentieth century, linguists were mostly interested in abstract structure and not in how people really use language. Since it turns out that frequency of use has an impact on that structure, we have to start incorporating usage factors into our theories.”

Discoveries of the



El Mirón Cave

Lawrence Straus and researchers find Cro-Magnon art in Northern Spain.

by Karen Wentworth

This summer, a shoulder blade of a red deer was found engraved, shaded, and bearing part of a three-dimensional image of a hind. Lawrence Straus knows from radiocarbon dating that the bone is about 15,700 years old—art from a time when Cro-Magnon hunters lived in an ice age environment in northern Spain.

For nine summers, University of New Mexico Professor of Anthropology Lawrence Straus has taken undergraduate and graduate students to dig in El Mirón cave. During the most recent dig, two undergraduates, Kait Knauber-Ferriegel and Matthew Dawson, found the engraved scapula as they excavated a trench near the cave entranceValles Caldera National Preserve.

Straus says this art form is typical of the region and the period in which it was created. But the context in which it was found is puzzling. It took time and talent to craft the piece, but it was found in the garbage—along with other bones, spear points, and stone tools. “It’s amazing to me how one of the most spectacular finds of my career was apparently considered disposable trash by the ice age hunters,” says Straus.


Photo courtesy of Lawrence Straus.

For nearly thirty years, Lawrence St
anthropology at UNM and has beco
leading experts on the Upper Paleoli
He has published fifteen books, writ
academic papers, edited a scholarly
spent his summers taking students i
the past.

In 1996, Straus and archeologist Ma
of the University of Cantabria, Santa
excavate El Mirón in the Cantabrian
first seen the cave in 1973 and knew
archeologists dismissed it, believing
filled outer chamber had been too di
herders to offer much that was intac
González Morales thought the cave
worthwhile and decided to excavate

They have found and radiocarbon-dated bones, artifacts, and engravings on rock. With funding from the National Science Foundation, the Leakey Foundation, the National Geographic Foundation, Fundacíon Botin, and regional and national governments in Spain, they began to document a story of Neanderthals and Cro-Magnons who hunted in the mountains and spent time in this cave between 41,000 and 10,000 years ago during the late Paleolithic period.

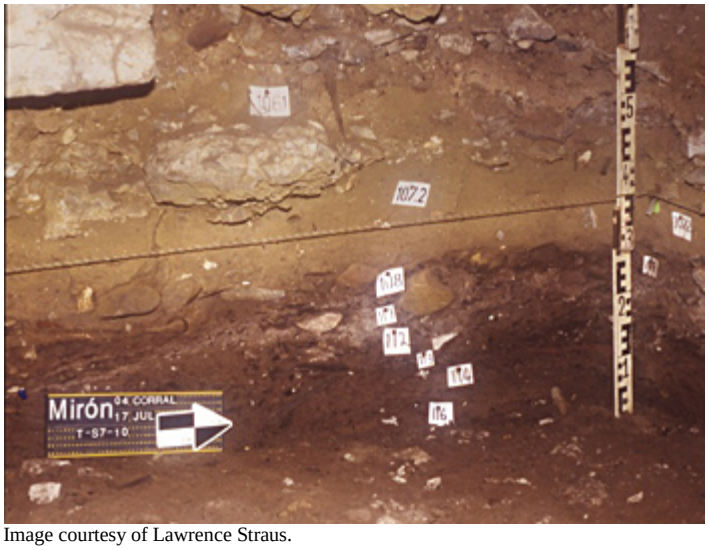


Image courtesy of Lawrence Straus.

In addition to these discoveries, Straus and González have been able to prove that the Mesolithic foragers o Cantabrian coast didn't begin to farm, domesticate an use pottery until 5,700 years ago—about 800 years af nearby groups just over the mountains in the Mediterr draining Ebro River Valley. As it is, El Mirón has yie oldest evidence for agriculture in northern Atlantic Sp Because of this, Straus and fellow researchers have w why it took the mobile foragers so long to adapt to an lifestyle.

Straus thinks the thick forests that separated the moun from the coast 10,000 years ago could have been a ma barrier between the two groups, but the large time gap puzzles him. This and other questions posed by excav the El Mirón cave are complex, and for Straus and his students, the hunt for the answers continues.

Discoveries of the El Mirón Cave

Lawrence Straus and researchers find Cro-Magnon art in Northern Spain.

by Karen Wentworth

This summer, a shoulder blade of a red deer was found engraved, shaded, and bearing part of a three-dimensional image of a hind. Lawrence Straus knows from radiocarbon dating that the bone is about 15,700 years old—art from a time when Cro-Magnon hunters lived in an ice age environment in northern Spain.

For nine summers, University of New Mexico Professor of Anthropology Lawrence Straus has taken undergraduate and graduate students to dig in El Mirón cave. During the most recent dig, two undergraduates, Kait Knauber-Ferriegel and Matthew Dawson, found the engraved scapula as they excavated a trench near the cave entranceValles Caldera National Preserve.

Straus says this art form is typical of the region and the period in which it was created. But the context in which it was found is puzzling. It took time and talent to craft the piece, but it was found in the garbage—along with other bones, spear points, and stone tools. “It’s amazing to me how one of the most spectacular finds of my career was apparently considered disposable trash by the ice age hunters,” says Straus.


Photo courtesy of Lawrence Straus.

For nearly thirty years, Lawrence Straus has taught anthropology at UNM and has become one of the world’s leading experts on the Upper Paleolithic period in Europe He has published fifteen books, written nearly four hundred academic papers, edited a scholarl national journal, and has spent his summers taking students into the field to dig into the past.

In 1996, Straus and archeologist Manuel González Morales of the University of Cantabria, Santande Spain, began to excavate El Mirón in the Cantabrian Mountains. Strau had first seen the cave in 1973 and knew that many archeologists dismissed it, believing the rubble and silt-filled outer chamber had been too disturbed by looters and herders to offer much that was intact. However, Straus and González Morales thought the cav might hold something worthwhile and decided to excavate.

They have found and radiocarbon-dated bones, artifacts, and engravings on rock. With funding from the National Science Foundation, the Leakey Foundation, the National Geographic Foundation, Fundacíon Botin, and regional and national governments in Spain, they began to document a story of Neanderthals and Cro-Magnons who hunted in the mountains and spent time in this cave between 41,000 and 10,000 years ago during the late Paleolithic period.

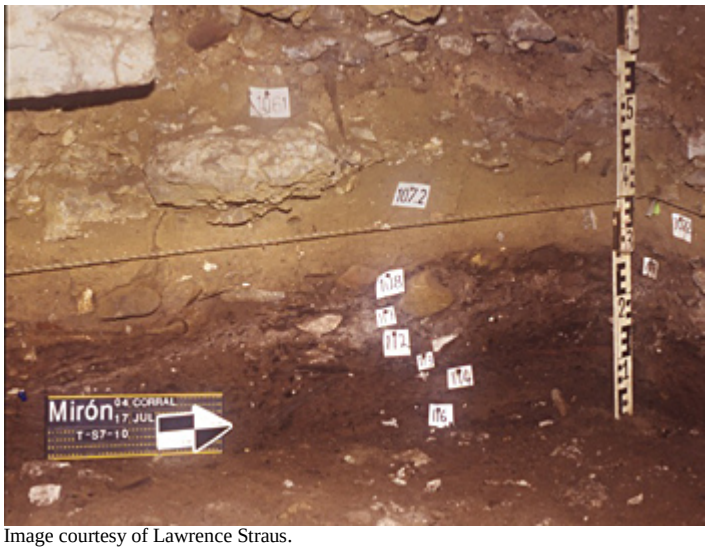


Image courtesy of Lawrence Straus.

In addition to these discoveries, Str
have been able to prove that the M
Cantabrian coast didn't begin to fa
use pottery until 5,700 years ago—
nearby groups just over the mounta
draining Ebro River Valley. As it is
oldest evidence for agriculture in n
Because of this, Straus and fellow
why it took the mobile foragers so
lifestyle.

Straus thinks the thick forests that
from the coast 10,000 years ago co
barrier between the two groups, bu
puzzles him. This and other questio
the El Mirón cave are complex, an
students, the hunt for the answers c

Women's Work

Professor of Sociology Susan Tiano discusses the feminization of labor in the global manufacturing industries.

by Carolyn Gonzales

Photo of Susan Tiano by John Sumrow

“Low wages with no job security and no autonomy.” This description captures the working conditions of the majority of women employed in manufacturing jobs in Mexico, China, and other low-wage countries, says University of New Mexico Professor of Sociology Susan Tiano.

The U.S. export of manufacturing jobs to these areas of the globe has resulted in an increase in the number of women working in these industries. However, this feminization of labor, says Tiano, has not necessarily resulted in across-the-board benefits for women workers.

Discrimination is prevalent. The feminization of labor means that the manufacturing jobs have come to be seen as “women’s work.” Men won’t take the jobs unless they are desperate. From the perspective of the multinationals, this perception can make for a more desirable labor force, as women have historically worked for lower wages and have been less likely to organize. “About 80 percent of the employees of global multinationals are women,” says Tiano.

Targeting young, single women through stringent recruitment criteria is a multinational practice. Employers “indicate that the work requires ‘nimble fingers,’ or that it is ‘monotonous’ work requiring ‘adroit fine motor coordination,’” she explains.

Mexico typifies the dramatic rise in the number of women in the labor force. Between 1960 and 2000, representation of women in the work force jumped from 16 to 34 percent. This growth leveled off between the 60s and 80s, Tiano notes, but it took off again in the 1990s when NAFTA stimulated investment in Mexico’s export sector.

In 1964, the Mexican government declared a 12.5-mile stretch along the border as an export zone to attract foreign manufacturing companies, maquiladoras.

“It was a way to promote investment without taxes and tariffs,” says Tiano. “The goods assembled in Mexico were then re-exported for sale to global consumers.”

Although the *maquila* industry grew slowly in the 1960s, she says that “by the 1980s there were 300,000 maquila workers, and by 2000 there were 1.3 million.” But the recession after 2001 caused about 300,000 maquila workers to lose their jobs.

“This has caused hardship for Mexican households, stimulating migration to the United States. Households must decide who leaves home in search of work and who is left behind. Daughters are often sent to agri-business and to the *maquilas*,” Tiano explains.

The *maquilas* are no exception to discrimination. They want women who have few children. “It’s a motivator to not have many babies,” Tiano says.

At the same time, a shift has taken place in terms of the Mexican maquila workforce.

Men now represent 52 percent of the workforce and women represent 48 percent. “The *maquila* sector has upgraded, shifting from low-paying assembly jobs to higher-paying manufacturing jobs. Men are moving into the better jobs and women are becoming marginalized,” Tiano says.

Women across the globe are also affected by multinational firms’ pursuit of cheap labor sources. Manufacturing investment is shifting away from Mexico and Puerto Rico toward places like China and Bangladesh, where an even less expensive labor force can be found.

Tiano sees more women drawn into the global service sector now. “We see well-educated women from the Philippines, where there are few employment opportunities, serving as caregivers anywhere from New York to Italy to Israel.”

The result is “transnational mothering,” she says, as women leave for better-paying jobs in a foreign country and send home money to someone who cares for their children.

Women have enjoyed some benefits through increased employment, including greater reproductive rights and the ability to escape bad home situations by earning their own money, Tiano concedes.

However, many issues still need to be addressed. Working conditions need to be regulated, exploitation eliminated, and women need assistance with childcare and family leave.

“Globalization doesn’t care about people. It’s all about the bottom line,” says Tiano. The fact that so many women’s lives are affected by globalization, however, makes it necessary to focus on these important issues.

Reconstructing the Tree of Life

Researchers build an essential organizing tool for the future
of biology.

by Greg Johnston

Illustration by Greg Tucker.

Biologist Terry Yates distinctly remembers a question posed in 2000, when he served as director of the Division of Environmental Biology at the National Science Foundation, NSF. About a month after he started his work at NSF in Arlington, Virginia, Director Rita Colwell called a division directors' retreat to pose a challenge: "Give me your craziest idea that would represent a major unmet need for the nation or the world."

Yates, now vice president for research and economic development at the University of New Mexico, responded. "I said, 'I think it's about time we try to assemble a universal Tree of Life, from microbes to mammals.' I thought I'd get laughed out of the place until I heard responses like 'I think that's a good idea. Our program can't go any further because we don't know what organisms to sequence next.'" By reconstructing the Tree of Life, researchers and scientists would have a clearer picture of how life has evolved and continues to evolve.

There are an estimated 1.7 million known species of life on Earth. "This tree can be a pretty powerful predictive tool," says Yates. "But there is a whole computational infrastructure that has to be done—not just the machines, but also software that is more efficient and faster. To assemble a tree that has 1.7 million branches on it, computationally and in any sensible way, is going to take enormous computer power."

Yates' idea gave rise to the NSF "Assembling the Tree of Life" research program, which funds the collection and analysis of extensive data on modern and fossil species. NSF also ran the Information Technology Research, ITR, program, a goal of which was to foster large-scale applications of information technology to new areas of science.
At the UNM School of Engineering, Professor Bernard Moret and Associate Professor David Bader had already received several ITR grants to support their work in computational

phylogenetics—algorithms to reconstruct evolutionary trees such as the Tree of Life. Moret and Bader each hold joint appointments in the Departments of Computer Science and Electrical and Computer Engineering. Collaborating with Professor Tandy Warnow at the University of Texas-Austin, they led a group of biologists and computer scientists in a proposal to ITR to build a program called Cyber Infrastructure for Phylogenetic Research, CIPRES, needed to support the reconstruction of the Tree of Life.

In September 2003, NSF announced that CIPRES, one of only seven proposals funded out of more than seventy submitted, would receive a five-year, $11.6 million grant. CIPRES is a collaboration of thirteen institutions, including three museums. Lead institutions are UNM, UT-Austin, University of California at Berkeley, University of California at San Diego, and Florida State University.

Moret, director of the CIPRES project, is known primarily for his work in algorithm engineering. He has gained extensive expertise in recent years in computational biology. For the Tree of Life, Moret leads a team of over thirty-five computer scientists, biologists, and mathematicians, including students and postdoctoral researchers.

“What the Table of Elements did for chemistry, the Tree of Life will do for biology,” says Moret. “It’s a fundamental organizing tool. Thus, while the Tree of Life is an abstract pursuit, it will help develop a deep understanding of mechanisms and models that are going to be used everywhere in biology and medicine.”

Moret’s closest collaborator at UNM is David Bader. Bader’s research interests lie in computational biology, genomics, high-performance computing, and parallel computation. Bader is teamed with Fran Berman, director of the San Diego Supercomputing Center, which is the physical location for the computational infrastructure. Bader and Berman will lead the CIPRES efforts in high-performance computing.

Moret and Bader have already achieved spectacular results by applying algorithm engineering and parallel computing to problems in phylogeny. In 2000, a team including Professor Robert Jansen from UT-Austin reconstructed the phylogeny of thirteen members of the bluebell family of flowering plants, an adaptable family found throughout the world.

At the time, existing approaches would have required several centuries of computation on a high-powered workstation to reconstruct the evolution. However, Moret and Bader developed new code and used a UNM computing cluster of 512 processors at the Center for High Performance Computing to carry out the analysis in just one pass. Continuous refinement of the code at UNM now enables the same analysis to be run in thirty minutes on a laptop, a tremendous improvement for a process that must examine nearly fourteen billion candidate trees.
The research focused on only thirteen plants. Biologists estimate that there are anywhere from ten to a hundred million undescribed species beyond the identified 1.7 million known species of living organisms. “We will need to run billions of trillions times faster than we can run today,” says Moret, “and that cannot be done through hardware technology alone.”

“Building the Tree of Life is a problem for the next few decades,” explains Bader. “So many computing cycles and so much research are directed at this problem because it has direct impact on our future, but it will take time to accumulate the data and the know-how.”

The effort will be international: CIPRES has collaborators in Europe, Asia, Oceania, and South America. For the Tree of Life to be successful, extensive collaboration will also need to occur between computer scientists and biologists. “We want to make sure that what we deliver over the next five years is of direct use to biologists—an infrastructure that has been thoroughly tested,” Moret says. “We must understand in detail the performance characteristics of our algorithms, not just in terms of running time—that’s the easy part—but more importantly in terms of accuracy under the models of evolution that the biologists are interested in. There is only one Tree of Life—we must get it right.”

By the end of the five-year grant cycle, Bader says CIPRES will have built a computer platform allowing biologists worldwide to go to a Web site, enter data, select methods, and have their analysis carried out. The more computing-oriented scientists can choose to download the software package and run it on their own machines.
Yates uses an analogy to describe the collaboration between two scientific communities. “Mother Nature has given us almost two billion years of free research and development. These are time-tested and thoroughly validated software packages. All we have to do now is run them through the computer and they will tell us what to do.”

Small is Beautiful

UNM Researchers collaborate on nanotechnology with Sandia National Laboratories.

by Cindy Foster

"I've always wanted to be where the action is," says Professor of Pathology Janet Oliver, at the University of New Mexico Health Sciences Center's School of Medicine. And in basic cancer research, "the action" is at the molecular level. There, the bits and pieces requisite to life travel between and into cells every second of every day, signaling and interacting with each other in a frenzy of transactions called signaling cascades.

This is the *small is beautiful* in nanotechnology, a world almost too diminutive for the mind to grasp. A nanometer is a mere one-billionth of a meter, and proteins—the main components in signaling networks—measure only one to a few nanometers in size.

Researchers now know that hundreds of different proteins are implicated or involved in intracellular and intercellular signaling cascades as cancer develops and is treated. And in any given cell—at any given moment—hundreds of transactions are taking place. So many interactions, in fact, that examining the signaling within and between twenty cells for twenty seconds can provide an extraordinary amount of data.

"The pathways are very complicated. It has taken twenty years of biochemistry research to find out that the 'actors' are proteins and lipids, and to understand the chemical modifications that convert them between resting and activated states," says co-researcher Bridget Wilson, associate professor of pathology.

"Medical nanotechnology" refers to the interaction of cellular and molecular components with engineered materials. However, medical researchers aren't the only ones entranced with nanotechnology. Scientists in many disciplines are asking questions about what goes on at the molecular level. As different theories have advanced, researchers have found that their efforts often run into pragmatic barriers. How can something so small be measured? How can equipment be miniaturized to function at that level?
Those questions are leading to a fundamental shift in biosignaling research. The focus has shifted from single-investigator studies to studies by teams and programs.

At UNM, expertise for these studies is not hard to find. Faculty in the departments of Mathematics and Statistics, Computer Science, and Electrical and Computer Engineering

have been working independently and in collaboration on problems involving analysis of the enormous volumes of image data that the research can generate. Led by Stan Steinberg, professor in the UNM Department of Mathematics and Statistics, teams of mathematics, statistics, computer science, and engineering students are working with School of Medicine teams on new ways to extract and analyze quantitative data from microscopic images.

UNM is lucky to have another collaborator nearby. Sandia National Laboratories, SNL, is a world leader in nanotechnology tool making. This partnership has led to a series of joint funding initiatives between Health Sciences Center biologists and clinicians with SNL and UNM main campus technology and computing teams.

“Our teams of biologists, chemists, engineers, physical scientists, and mathematicians speak very different scientific languages. Our shared dream of making a difference in cancer is what motivates us to find common ground,” says Oliver.

Grant Heffelfinger, deputy director for Material Science and Technology, Materials, and Process Science Center at Sandia, has been instrumental in matching UNM researchers with investigators helping to solve two of the great challenges of studying the nano-sized universe—the inability of conventional microscopes to follow the signaling and interchanges that occur between cells and the need for probes small enough to interact with proteins.

At Sandia’s Advanced Materials Laboratory, scientists Hongyou Fan and Tim Boyle, along with UNM’s Jeff Brinker of the Center for Micro-Engineered Materials, have created “quantum dots,” tiny semiconductor nanocrystals that can be synthesized in sizes from 2 to 20 nanometers. These nanocrystals absorb light of one wavelength and give off light of a longer wavelength, so that tiny changes in their sizes lead to dramatic changes in their color.

But to see the probes, researchers need to be able to see the full spectrum of color.

This need leads to the second major problem—traditional microscopes can pick up only three wavelengths of color: blue, green, and red.

At the UNM chemistry lab of David Haaland, researchers are completing the creation of a hyper–spectral microscope that can capture the entire light spectrum and allow the probes to be tracked as the proteins cascade between cells. This microscope is opening up another world for cancer researchers to explore.

“Oliver’s Center represents what is possible when one combines the expertise at Sandia National Labs with the nationally recognized scientists here at UNM,” says Paul Roth, dean of the UNM School of Medicine.

Cheryl Willman, director of the UNM Cancer Research and Treatment Center, agrees. “We have a unique ability to integrate powerful communities of biologists, physical scientists, and engineers around important biomedical challenges,” she says. “Such collaborations mean we should see breakthroughs in cancer diagnosis and treatment in the next twenty years that were

unthinkable to physicians even ten years ago.”

Hot Off the Press

UNM Press Celebrates its Seventy-fifth Anniversary

by Russell Moore and Valerie Roybal

In the summer of 2004, UNM Press began celebrating its seventy-fifth anniversary. Since its establishment in 1929, the Press has set out to serve the University of New Mexico, and the peoples and cultures of the region by publishing books on a full range of subjects including anthropology, art, history, Chicano/Chicana studies, and the Southwest.

Publishing eighty titles per year, UNM Press is the largest book publisher in the state. The current catalog consists of over six hundred books in print, including *The Education of Little Tree* by Forrest Carter, the Press' best-selling title of all time. The Press has published books by a number of acclaimed authors including M. Scott Momaday and one of the founders of modern Chicano literature, Rudolfo Anaya. Additionally, UNM Press publishes a great number of books by local authors and UNM staff and faculty. The following are some classic and recent books by UNM faculty.

The Lore of New Mexico
Second edition, abridged and revised
Marta Weigle, Professor of Anthropology and American Studies; and Peter White, Professor of English and American Studies and Dean of University College

A study of the state's rich folklore and arts is intertwined with an examination of historical material and narrative. Different storytellers, their personal histories, and the stories they were known for are all incorporated into a chronology of the state's development. From creation mythologies to water divination to traditional music, New Mexico's customs—and the people and places of which they are born—are shown to be a vital part of what the area is today.

Chicana Voices: Intersections of Class, Race, and Gender
Edited by Christine M. Sierra, Associate Professor of Political Science; Teresa Cordova, Associate Professor of Architecture and Planning; Norma Elia Cantu; Gilberto Cardenas; and Juan Garcia

A collection of essays from a Chicano studies conference, "Voces de la Mujer," (Voices of the Women), deals with sexism and exclusion of women from Chicano studies and from society

through many different but unified lenses. Minority women are often considered minorities first and women second, so their exclusion as women from academic and liberation movements is considered valid because the men in their minority group are also oppressed. Though highly critical of the status quo in the Chicano studies field, the book is a hopeful one and offers solutions to help dismantle sex discrimination.

Constance DeJong: Metal

Constance DeJong, Professor of Art and Art History; and Arden Reed

Constance DeJong:Metal provides a retrospective look at DeJong's work beginning with her 1978 "Steel Drawings" and concluding with her "Four/Three" series in 2002. With a striking balance between painting and sculpture, DeJong's work involves the use of metals such as steel, aluminum, and copper, and surface treatments such as stains, paint, sulfur, and nitrate. The result is works that are austere, refined, and mysterious. Stunning photographs of the artist's work highlight this book with Arden Reed providing commentary about the work, and an interview with the artist conducted by the late Gus Blaisdell.

The Myth of Santa Fe

Chris Wilson, Professor of Architecture and Planning and J.B. Jackson Professor of Cultural Landscape Studies

In this book, Wilson attempts to demystify some of the stereotypes and accepted ideas regarding the culture, architecture, and ethnic identities surrounding Santa Fe. Broken into two parts, "Part One: Santa Fe Before it Became a Style," and "Part Two: Modern Santa Fe," Wilson defines the cultural characteristics of the city and seeks to understand how the city became inaccurately represented both internally and externally.

Research, Scholarship, & Creative Works at the University of New Mexico

A Carnegie Doctoral/ResearchUniversity-Extensive

Volume 21, 2005

Quantum is published once each year by the University of New Mexico, Albuquerque, New Mexico.

Send all correspondence to the Editor, Office of the Vice President for Research and Economic Development, MSC05 3180, The University of New Mexico, Albuquerque, New Mexico 87131, or call 505/277-2256.

The University of New Mexico is an Affirmative Action/Equal Opportunity institution. This publication is available in alternate formats upon request.

.....
.....