2003

Quantum: Research, Scholarship & Creative Works at the University of New Mexico, 2003

Office of the Vice President for Research

RESEARCH, SCHOLARSHIP & CREATIVE WORKS 2003

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AT THE UNIVERSITY OF NEW MEXICO

Very Small, Very Efficient, Very Reliable
By Robert Julyan
Marek Osinski and his team investigate the basic principles of optoelectronic devices.

Land Arts of the American West
By Valerie Roybal
A field-based studio art and design program takes students out of the classroom and into the landscape.

Keeping Science Exciting
By Steve Carr
Laura Crossey tries to capture the excitement of scientific research and interpreting geology.

The Human Factor
By Frank D. Martínez

Timothy E. Goldsmith aims to help minimize human error in airline accidents.

Literary Interest
By Carolyn Gonzales
English Professor Gary Scharnhorst studies the life and work of Bret Harte.

Blurring the Boundaries
By Ellen Ashcraft
The Hewlett Interdisciplinary Clusters link disparate disciplines.

Translating Ideals
By Melinda Rogers
Laura Roberts at the Institute for Ethics aims to go beyond the boundaries of medicine by translating ethical ideals into optimal practices.

The Art and Life of the Kuna
By Michael Padilla
Mari Lyn Salvador explores the artistic world of the Kuna of Panama.

Making Connections
By Cindy Foster
A group of researchers with an interest in a rare form of muscular dystrophy discovered each other and the largest cluster of Hispanics suffering from the disease.

Diffusion, Saturation and the Digital Divide
By Frank D. Martínez
Everett M. Rogers studies the spread and consequences of the Internet.

Understanding the Lives of Cells
By Larry Walsh
Margaret Werner-Washburne is working to further understand the lives of cells and develop important practical applications with microarrays.> > >

Going Deeper
By Maya Allen-Gallegos
Roli Varma is finding answers to questions regarding cross-gender and cross-ethnic populations in relation to information technology education and the workforce.

Beyond the Limits

Image at top of page: Land Arts of the American West inspires students to learn new ways of seeing and experiencing their environment. Blake Gibson, UNM art studio graduate student, at El Vado Lake, New Mexico, fall 2002. Photo by Chris Taylor.

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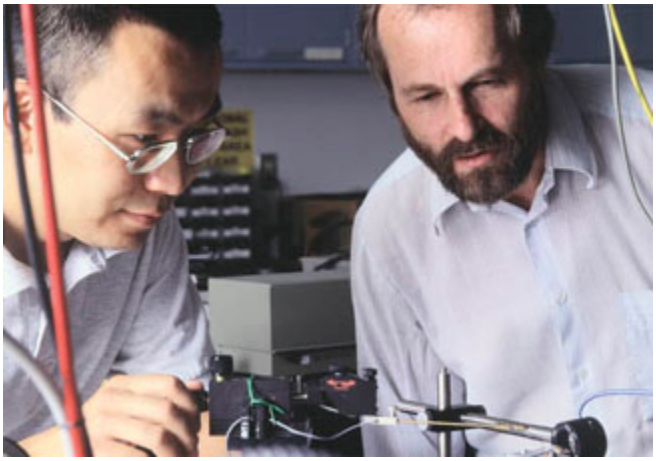
Very Small, Very Efficient, Very Reliable

Marek Osinski and his team at the Center for High Technology Materials investigates the basic principles of optoelectronic devices.

By Robert Julyan



Hongjun Cao, a doctoral student, and Marek Osinski at the Center for High Technology Materials design and test materials used in creating semiconductor lasers. Photo by Michael Mouchette.

I remember my first laser. It was 1970, I was a grad student living on an old farm in upstate New York. Lasers had been in the news lately, and a friend working on his doctorate in physics brought one to our home one evening. It didn't look like much, a bunch of gadgetry slightly larger than a shoebox, and it was quirky to operate. But when my friend finally got it working, it projected a beam of red light at our barn, about 50 yards away. At the box, the beam was about the diameter of a fat pencil, and when I went to the barn, there was an eerie red dot, with the same diameter.

I was impressed.

Not long ago, Marek Osinski showed me my second laser. We were in a laboratory at the University of New Mexico Center for High Technology Materials (CHTM), where one of Osinki's students was working amidst a clutter of machinery and instruments, designing and testing materials used in creating semiconductor lasers.

He pointed to a small piece of apparatus, slightly smaller than a matchbook, with several tiny leads projecting outward, like flattened stubs of pins. "Those are lasers," he said. And while they, like that barn laser, still transmit light, that light isn't visible, and the lasers' real purpose is to transmit information, sometimes lots of information, very rapidly.

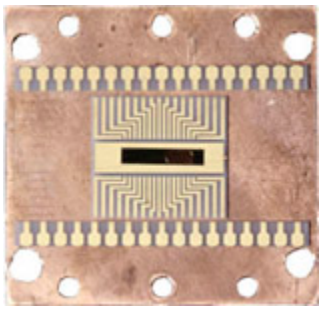
Again, I was impressed.

But while the size of laser devices has shrunk, their role in modern society has expanded exponentially until they've become common in daily life-CD-drives in computers and CD players, DVD players, telecommunications, cancer research and treatment, on and on. "Few people know that they have a semiconductor laser in their CD player," Osinski says. "Optics have become so pervasive that it's almost hard to find an area where they don't have an application."

The first semiconductor laser appeared in 1962. At that time, Osinski was a youth in his native

Poland. Semiconductor lasers were still quite exotic in Polish universities, so Osinski did his master's degree on elementary particle theory. But his interest remained piqued by this new technology, so he did his Ph.D. on optoelectronics. The early 1980s found Osinski in England, and he stayed there when Poland declared martial law in 1981. In 1985 he came to the United States and UNM. He holds appointments in the departments of electrical and computer engineering, physics and astronomy, and computer science.

But most of the time he is found at CHTM, working on semiconductor lasers.



Integrated semiconductor optoelectronic circuit (center dark rectangular chip). Photo by Michael Mouchette.

Semiconductor lasers have compelling advantages over conventional lasers, Osinski says. "They're very small, very efficient, very reliable, easy to operate, and very inexpensive."

And potentially very difficult to create, as scientists push the limits of laser technology.

"I was very happy when my first semiconductor laser worked," says Hongjun Cao, a doctoral student in Osinski's group. "Making a semiconductor laser is different from making other lasers."

At UNM, all semiconductor lasers begin with thin wafers, which are grown at CHTM. They are grown on thin substrates sliced from a single crystal. Lasers fabricated from these wafers are then processed using photolithography (a process not unlike exposing black-and-white film), etching, metallization, and so forth.

Processing semiconductor lasers requires exceptional purity, so in special "clean rooms," students and faculty don sealed suits and use a scanning electron microscope to inspect their samples for defects. It's an exacting, often frustrating process.

"I get excited, but sometimes I feel disappointed when something breaks right at the end," Cao says. "The ups and downs are magnified in the fabrication."

"Fabrication is the most difficult part. It's a good character-building process," Osinski adds.

"It's not just the fabrication," says Cao. "You have to think about the design, how to make it work. It's full of challenges, and that's why many students want to concentrate on this project."

Cao is Chinese. He came to the United States in 1999 and joined Osinski's group in 2001 to concentrate on semiconductor lasers.

"Before I came to Dr. Osinski's group I had a very strong background in solid state lasers, but semiconductor lasers are unique. They have a very broad range of applications."

Osinski says, "We do not work on applications at CHTM per se. We're investigating basic principles. We focus on optoelectronic devices rather than on the systems that would apply them.

But we do need to know what these devices are likely to be used for so we can channel our efforts in the right direction."

One important use is aircraft navigation. The main stabilizing device in a modern airplane is a gyroscope, but this is expensive and bulky. With a $1 million grant from NASA, Osinski and his students are working to create a semiconductor laser-driven gyro, about the size of a computer chip, far smaller and lighter and requiring far less power than a conventional gyroscope. Satellites are another obvious application of semiconductor laser gyros, but Osinski predicts cars, and even toys, will also use them one day. They could help in navigating a car based on a map encoded inside an on-board computer.

Projects such as the semiconductor laser gyro are available to students enrolled in the new master's degree program in optical science and engineering at UNM. Osinski and Physics and Astronomy Professor Sudhakar Prasad led the effort to create the program, which began in fall 2002. UNM has offered a doctorate in optical sciences since 1983. Now, UNM is one of only five universities nationwide to offer a master's degree in optics.

I still sometimes think about my first laser and what a strange, futuristic experience it was. Now, some 30 years later, I'm surrounded by many, far more sophisticated lasers-and I'm not even aware of them. Perhaps that's the strangest, most futuristic experience of all.

Land Arts of the American West

A field-based studio art and design program takes students out of the classroom and into the landscape to investigate artistic practices old and new.

By Valerie Roybal

Blake Gibson, UNM art studio graduate student, at El Vado Lake, New Mexico, fall 2002. Photo by Chris Taylor.

"Two nights closer to the full moon and it is getting bright. Mild here as I write by moonlight...I am camped, sleeping outside of my tent, in a protected flat spot among the rocks and debris: gray and black rounded lumps backed by an immense land all red, brown, yellow, and green but now colored by the moon's silver smoke of dreams."

Peter Voshefski (written at Horshoe Canyon, Utah), Land Arts of the American West student, fall 2000.

Out into the open, without the distractions of modern everyday life, art studio and design students learn new ways of seeing, experiencing and interacting with their environment.

Taking themselves out of the traditional confines of studio and classroom, they embark on a journey to places known and unknown. They live on the land for weeks at a time, moving seamlessly through the landscape investigating artistic traditions old and new.

This is Land Arts of the American West, an interdisciplinary, field-based, studio art and design program inspired by some of the unique resources embedded in the physical landscape of the Southwest.

Land Arts began in 2000 with a grant from the Lannan Foundation. Professor Bill Gilbert and Associate Professor John Wenger at the University of New Mexico led the initial offering. Land Arts subsequently received a three-year pilot program grant from Lannan to pursue a collaboration with the Design Division of the Department of Art and Art History at the University of Texas at Austin. UNM's Gilbert and UT at Austin's Assistant Professor of Design Chris Taylor are co-directing the three-year duration of the pilot program.

In Land Arts, students engage their surroundings, themselves and each other in a different way. Students are challenged to develop new and altered sensibilities and to "create connections to larger structures beyond themselves," says Taylor.

Land Arts aims to provide students with the opportunity to investigate the potential of environmentally based art and design practices. It also provides students with the experience of community building and collaboration.

Through three extensive journeys, students are exposed to a wide range of cultural interventions and sites in the landscape of the American West.

"We are focused on getting the students out of the institution and into direct physical contact with unique places," says Gilbert. "We plan the journeys so that there is a significant cultural and ecological shift from one site to the next.

"We ask our students to come to terms with where they are, what they are seeing: to consider the influence the environment has had on their predecessors and to experiment on defining an art practice for themselves," says Gilbert.

"We find it important to go to places that are as remote as possible, in a sense of physical space and time," he says. "We try to create a fundamentally different quality of education and experience, to lose the pressure of time and the confines of a classroom setting. Students can then translate these different qualities of time and space into the making of art.

Students Jessica Murray (UT-Austin) and Jeff Beekman (UNM) with potter Mary Lewis Garcia. Photo by Chris Taylor.

"It is really amazing to see how students respond to the circumstances of this program. One student 'nested' every place that we set up base camp. With available materials at each site, she literally built a home-like nest for herself," says Gilbert.

On the fall 2002 itinerary, the program participants traveled on three journeys that reflected the directions and travel patterns of ancient nomadic people.

The first journey took the students north to Grand Gulch on Cedar Mesa in Utah, to see Ancestral Puebloan (Anasazi) ruins; to Horseshoe Canyon in Utah, to see the Holy Ghost pictographs of the Fremont Culture; and to Blue Notch Canyon at Lake Powell, Nevada, to examine the relationship of water and culture in the American West.

The second journey took them west to Acoma Pueblo in New Mexico to study indigenous ceramics with a well-known traditional potter, Mary Lewis Garcia; to Chaco Canyon, New Mexico, to learn about celestial orientation in ancient Puebloan architecture with UNM professor emeritus J.J. Brody; and to Roden Crater, Arizona, where light artist James Turrell is transforming the crater into a large-scale artwork that connects to the surrounding environment of sky, land and culture. The

western journey concluded at Lake Mead, and with a visit to "Double Negative," artist Michael Heizer's seminal earthwork outside of Overton, Nevada.

Land Arts students set up base camp at Goblin Valley, Utah, fall 2002. Photo by Liz Hunt.

On the third journey the participants headed south to the Cebolla Wilderness in central New Mexico, south of the Malpais lava flow where they set up base camp for visits to the Very Large Array (VLA) astronomical radio observatory and Walter di Maria's Lightning Field earthwork near Quemado, New Mexico. From Cebolla they traveled to the Bosque del Apache to explore the Piro ruins along the Rio Grande with archaeologist Henry Walt, and to conduct a collaborative project and seminar with well-known cultural critic Lucy Lippard. The journey concluded with a stay in Marfa, Texas, where students encountered the work of Donald Judd and the collections of the Chinati Foundation. (The collections at Marfa include permanent installation works from such artists as Dan Flavin, Roni Horn and Russian artist Ilya Kabakov in addition to the works of Judd.)

At Marfa, the students prepared an open house to exhibit their work and begin the process of presenting it to the public. The students returned to their respective schools and ended their semester by working to conclude their projects and prepare for more formal exhibitions of their work in Albuquerque in December 2002 and Austin in January 2003.

Coursework for the program included a site-specific sculpture class that placed contemporary site work in the context of a continuous tradition of landscape-based art-making that is thousands of years old. The students also experimented with the use of native materials gathered on-site to make, decorate and fire vessels related to the functional and ritual needs of the group in a course called "Indigenous Ceramics". A site-specific shelter course investigated issues of inhabitation and the record of life in the landscape, and asked students to construct, detail and document site-based shelters. In a course called "Documents: Body, Landscape, Memory," students explored the question of mapping within the landscape and the relation of the body to site and landscape. The students kept visual and written records of the events and circumstances surrounding the program.

"The documentation aspect of the program is extremely important because when we are creating site-specific work with materials at the site, it is our operating ethic to leave little or no trace of our activities. As we leave a site, we try to erase ourselves to minimize our impact. The only record of our being there is the documentation," says Gilbert.

"The documentation will eventually become part of a book that we plan to publish that will capture the intent of the program through the relationships between the student work, land art, and the landscape of the Southwest," says Taylor.

Pottery fire pit, fall 2000. Photo by Tammy Marinuzzi.

"The initial phase of the program has been very successful. Now we are working towards developing a permanent program with its own funding and curriculum. As we go forward, we intend to make land arts more interdisciplinary than it already is," says Gilbert, "by including other disciplines such as archaeology, geography and geology from both campuses."

"With this program we hope to confirm the idea that if you bring the students out into the world instead of the world into the classroom, you can fundamentally change how students learn, create and view their surroundings," says Taylor. "We believe that in this context they will make deeper and more precise connections within their work and be inspired to create work that makes broader connections outside themselves."

Keeping Science Exciting

Laura Corssey tries to capture the excitement of scientific research and interpreting geology.

By Steve Carr

OhhAhh Point, along the Kaibab Trail, Grand Canyon, during Hewlett Cluster "Trail of Time" class field trip, August 2002.

"We are always learning new things about old rocks. For geoscience, the present is the key to the past, so we do a lot of process-related research. This can be very interesting, even to an introductory student, so I try to incorporate that into my teaching," says Laura Crossey, assistant chair and professor in the University of New Mexico Department of Earth and Planetary Sciences.

Whether it's rafting down the Grand Canyon to gather data for geoscience interpretation, or implementing new ideas in the classroom, Crossey does whatever is necessary to integrate teaching and research.

"In my teaching, I try to incorporate research and the idea that science is dynamic-especially in the geosciences, where we're talking about something as ancient as the Earth," she says.

Crossey's interest in science developed when she was a young girl going on nature walks. Today, her interests emphasize the interaction between water and Earth materials. She has one of the most spectacular examples of the geosciences nearby-the Grand Canyon-as a natural laboratory.

Along with UNM colleague Karl Karlstrom, professor of structural geology, Crossey is involved in providing a comprehensive geoscience interpretation program for the Grand Canyon National Park through a study called the "Trail of Time." They were recently funded by the National Science Foundation to work with the park to provide interpretation, which is based on combined research efforts in the park during the past 15 years.

The "Trail of Time" is also part of a UNM curriculum program called the Hewlett Core Clusters. This new teaching concept involves three freshman classes taught together by faculty in different departments. Crossey and Karlstrom are teaching with Chip Wills of the Department of Anthropology and Virginia Scharff of the Department of History. Time is the underlying idea of this cluster, with three scales represented: geological, human and historical.

Professors of the "Trail of Time" class, fall 2002: Karl Karlstrom, Laura Crossey, Wirt 'Chip" Wills, and Virginia Scharff.

It's one of the new ways in which Crossey is keeping science exciting for students.

"The ongoing research is very dynamic. People stand there at the rim and look at one of the most spectacular examples of the geosciences. We want to try and capture the excitement of scientific research, in addition to interpreting the geology."

Finding ways to get students engaged is a continuing process-the research and learning never stop.

"Research pays off in what we are able to show the students," Crossey says. "We have them pick individual projects that are questions they can begin to narrow down for future research. It gives them an active role in what is going on, and it's always more fun to learn in that kind of environment."

The Human Factor

Timothy E. Goldsmith aims to help minimize human error in airline accidents by looking at pilot evaluation issues.

By Frank D. Martínez

Human error, not mechanical failure, is the cause of most airline accidents. And, with much being said about airline safety lately, one area of focus continues to be the skill and competency levels of commercial airline pilots. But, one might ask, while pilots are rigorously and routinely evaluated on their skills and competencies, who's evaluating the evaluators?

"Our work is primarily aimed at improving training and assessment. Our concern is making sure that pilots receive the best training and that their assessments are valid and reliable," says University of New Mexico Associate Professor of Psychology Timothy E. Goldsmith. With recurring funding exceeding $1 million from the Federal Aviation Administration (FAA) since 1994, Goldsmith and other department faculty and graduate students have conducted basic and applied research centered on pilot evaluation issues.

"Airlines have a number of trained evaluators who assess the pilots and are pilots themselves," he says. "One of the questions that the FAA has-and the airlines, too-is how good of a job are these evaluators doing? Are the evaluations fair? Are they reliable? Are they valid? A large part of our effort has been to apply basic psychometric [measurements of mental traits, abilities and processes] principles to commercial aviation.

"If we're going to make headway and further reductions in the error rate, we've got to look at the human factor, by looking at the pilot and crew and by trying to come up with ways of minimizing human error," Goldsmith says.

The reduction of the error rate in the past was due to technical advances, he says. The modern jet aircraft used by the industry since the 1960s "are extremely reliable pieces of equipment. If you look at the accident histories of major commercial airlines, roughly 70 percent are due to human error of some sort, as opposed to mechanical failure."

A part of Goldsmith's work focuses on an area called Crew Resource Management (CRM). CRM, he says, "is a category of skills and knowledge that is primarily cognitive and social, so it includes things like workload management, situational awareness, communication skills, and how a captain establishes a climate within a cockpit. Planning, problem-solving, decision-making-these are all what I would consider to be higher order cognitive or social skills."

What kinds of mistakes do pilots make that result in accidents? Rarely, Goldsmith says, are there technical errors, such as a pilot flipping the wrong switch or misreading a gauge.

"A lot of the accidents are traced to CRM types of problems-poor planning, failure of communication, or maybe not managing workload very well during an approach with deteriorating weather," he says. "So, if the pilot is deficient in workload management, as defined by some performance item, then you might want to give that pilot additional training in that particular category."

Working with major carriers, the efforts of Goldsmith and his colleagues have resulted in the production and continued refinement of computer software "that allows the airlines to run the evaluators through what we call 'training calibration sessions'," he says. For example, evaluators, who are certified flight pilots participating in such a session might view a flight, a portion of a flight, or a particular maneuver. Then, on a grade scale of one to four, these experts might have deemed that the pilot's performance was a three. The obvious question is how well do they agree with one another? How well do they agree with the true grade?"

Photo of Timothy E. Goldsmith by Matt Suhre.

The goal of the sessions, he adds, is to define what the true performance level is. "We want to ensure that the pilots are given the right grade. We give the evaluators feedback on how well they're doing, and if they need subsequent training on evaluation, then the training is provided," Goldsmith says.

"Findings show there are certain evaluators who are somewhat 'deviant.' Maybe they give all threes on a four-point scale rather than showing some variability in their grading. Or maybe you find an evaluator who's consistently giving grades that are too high, maybe all fours or threes and fours, when most evaluators will give ones and twos," he explains.

Evaluators who are found to be more deviant are required to participate in the calibration sessions so that they will see they are not grading like their peers and will be motivated to change.

Thus, the evaluations of pilot performance "are inherently subjective, even for the grading of technical skills, but particularly for grading CRM performance," says Goldsmith. The intent of the software and statistical feedback is to help make the process as objective as possible.

"We have developed new statistics-summary indices of evaluator performance-that provide evaluators with feedback on their grading performance. These statistics are incorporated into the software package that we developed," he explains.

The importance of the evaluations cannot be overstated, Goldsmith says. "Pilots are probably the most evaluated profession of any. If you think about lawyers or engineers, once they get their degrees and their certifications, they're out there practicing. It is rare for them to be tested or evaluated on their competencies and skills again. But airline pilots are evaluated on a regular basis. Their jobs are on the line, so it's a serious endeavor. It is quite critical that the evaluation be done fairly. At the same time, you don't want pilots flying who aren't qualified, so the FAA in its regulatory capacity wants to ensure that the evaluations are done correctly."

The effects of 9/11 have had an impact on the work of Goldsmith and his team. "What has changed is the opportunity to get access to the airlines," he notes. "One of the difficult aspects of this work is establishing relationships with the airline personnel-gaining their confidence. Although our work is FAA-funded, it's not like we can walk in and demand access to the airline data. There are relationships that have to be established and fostered, but after 9/11, the airlines are scrambling to make ends meet, and their priorities have changed somewhat."

Thus, one change that Goldsmith has to deal with is the fact that some individuals in the airline industry lost their jobs following 9/11, "so in some cases we're starting all over again," he says.

Another issue Goldsmith is considering is the general growth in air travel. "The airplane accident rate decreased dramatically in the late 50s and early 60s and is now very low and stable," Goldsmith says. "However, the number of flights has consistently increased over the decades. When you combine even a very low error rate with a large number of flights, the actual number of accidents becomes high.

"I've heard people speculate that in 2020, we might expect there will be a major commercial airline accident once a week. Is that going to be acceptable? Probably not, so the question is what can we do to reduce the error rate even more?"

Literary Interest

English Professor Gary Scharnhorst studies the life and work of Bret Harte and serves as the chair of the MLA's literature section.

By Carolyn Gonzales

Photo of Gary Scharnhorst by Matt Suhre.

The day the Albuquerque Journal reported that University of New Mexico English Professor Gary Scharnhorst had been elected the 2002 Chair of the Modern Language Association's (MLA) literature section-the highest office for an American literature professor-the news was published under a notice about a holiday delay in garbage pick-up. "It keeps you humble," he says.

Scharnhorst has probably logged many hours with his nose in newsprint or scanning reels of microfilmed papers because he is an authority on Bret Harte, 19th-century author, diplomat and journalist. Best known for his tales of frontier California, Harte published "The Luck of Roaring Camp" in 1868 and "The Outcasts of Poker Flat" in 1869 in the Overland Monthly, of which he was founding editor. Harte was appointed U.S. consul in Germany in 1878.

Like Harte, Scharnhorst has spent considerable time in Germany, most recently in the summer of 2002, where he took part in a Fulbright German Studies seminar focusing on issues of immigration and nationality.

Currently, Scharnhorst's research and writing focuses on the relationship between Bret Harte and Mark Twain. "Theirs was a vexed relationship. They wrote a play together in 1877 called 'Ah Sin.' It is about a Chinese laundryman and addresses what was then-called 'The Yellow Peril.'" Scharnhorst says the writing and collaboration was painful for the two writers. "It was the greatest debacle in American letters," he tells his students.

Harte was definitely the lesser known of the two writers, which makes Harte the kind of writer that interests Scharnhorst. "He was marginal, a non-canonical writer," Scharnhorst says. Much of Scharnhorst's work has been retrieval and recovery of Harte's work. "I read all 25 volumes of his collected writings in one summer."

Since then, Scharnhorst has worked to find uncollected materials, to determine the first publication dates of Harte's material, and to construct a chronology of his work. Additionally, he edited a

collection of Harte's letters. "Naturally, then, I had the material to write a biography," he says.

"I dreaded writing the final pages about his death. I was reading references to a sore throat, seeing the dentist. In his final letters, he's conscious that his death is imminent. He died of throat cancer in 1902," he says.

Now, 100 years after Harte's death, Scharnhorst says Harte is considered the first important western writer. "His career illustrates the professionalization of American literature. From the middle of 1871 to the middle of '72, he was the highest paid writer in America at a time when his publisher had the exclusive rights to Hawthorne, Stowe and others. Harte was being paid $10,000 for everything he wrote in that period. He was commercially successful," says Scharnhorst. From the 1880s until the end of his life, Harte was writing a book of fiction a year.

Scharnhorst has published Bret Harte: a Bibliography, and Bret Harte: Opening the American Literary West, for which he received the Western Literature Association Thomas J. Lyon Award for "Outstanding Book in Western American Literary Criticism," published by the University of Oklahoma Press in 2000.

But Scharnhorst hasn't focused exclusively on Harte. He is working on a biography of 19th-century American writer Kate Field, the model for character Henrietta Stackpole in Henry James's Portrait of a Lady. To conduct research on Field, Scharnhorst spent time at the Feminist Research Institute at the American Antiquarian Society in Worcester, Massachusetts. "It is the Nirvana of libraries," he says.

As chair of the literature section of the MLA, Scharnhorst helps to provide opportunities for members to share scholarly findings and teaching experiences with colleagues and to discuss trends in the academy.

"My election as chair of the section is a great honor. I trust it reflects well upon the tradition of American literature scholars who have taught at UNM, including George Arms, Bob Fleming, Hamlin Hill, Jim Barbour and Leon Howard," says Scharnhorst.

He recently presided over the section meetings of the MLA in New York and is currently editing "American Literary Scholarship," a Duke University Press publication of the MLA American literature section.

Blurring the Boundaries

The Hewlett Interdisciplinary Clusters link disparate disciplines under an interconnected theme.

By Ellen K. Ashcraft

Nancy Uscher, UNM professor of music and associate provost for academic affairs, conceived a fresh approach to curriculum with the Hewlett Interdisciplinary Clusters. Photo by Michael Mouchette.

"As someone in the arts, I've always thought that it was very important for disciplines to be integrated in important ways," explains Nancy Uscher, University of New Mexico professor of music and associate provost for academic affairs. In this role, she has been making a unique contribution to undergraduate education at UNM.

Conceiving a fresh approach to curriculum for first- and second-year students, Uscher obtained a $150,000 William and Flora Hewlett Foundation grant for three-year funding of a program called the Hewlett Interdisciplinary Clusters. "This project is taking curriculum to a level where the core disciplines of the University have the opportunity to be integrated," she says.

The curriculum was first offered in fall 2001. Each cluster links three courses under a broad interdisciplinary theme, each course satisfying a core requirement. Three senior faculty members develop and teach each course cluster. The clusters feature out-of-classroom learning experiences. For example, students in a cluster called "Trail of Time" studied United States history, geology and anthropology on a field trip to the Grand Canyon.

Uscher emphasizes that the clusters let students experience knowledge in a way different from acquiring facts via disparate disciplines. "Life is about the integration of knowledge across all kinds of knowledge bases and spheres of learning. In each cluster, the theme is directing the inquiry of what will be learned and what the quality of learning will be. We're trying very hard to blur the boundaries between the disciplines."

Students respond favorably to the clusters. Having just 15 to 30 students per cluster emboldens

them to approach their professor. "One criticism of UNM has been that students drop out because freshman lecture classes are too large," explains Uscher. "However, our retention rate has been excellent in these clusters. One asset has been that the students felt they could have a dialogue with the professors. They could get to know the professors and other students by going to cultural events as a class."

That enriched sense of community also benefits the professors. "It's easy in a large university with 1,500 faculty for people not to know each other. This is a way of making the University smaller, by people having a chance to get acquainted with and really celebrate each other's work," says Uscher.

William Gross, former dean and professor emeritus of mechanical engineering, Paul Nathanson, director of the Institute of Public Law, and Everett M. Rogers, Regents' professor of communication and journalism, taught a cluster in fall 2002. "Technology and Social Change" explored how new technologies affect social change and vice versa. The cluster blended introductory courses in American politics (civics), conceptual physics and public speaking. "Technology and marketing push society; society pulls technology," comments Gross.

The professors opened the course by exploring the Segway Human Transporter (a first of its kind self-balancing, personal transportation device that's designed to operate in a pedestrian environment), a prime example of an emergent technology. Gross examined the physics principles that govern how the Segway works. Rogers discussed the diffusion of innovation-the way that new ideas spread. Nathanson showed students how civics affects a technology's success. For example, the Segway's creator is involved in the political process. "He needs it to be declared a non-motorized vehicle, because if it's motorized, you can't ride it on the sidewalks," explains Nathanson. "He is presently lobbying in every state legislature and the congress. I want to use that as an example of how he's working the system, so students learn about the legislative process."

In a similar fashion, the course will focus on energy, transportation and computers and the Internet. In addition, the professors invited Diane Wax, a visiting lecturer from the National Institutes of Health, to address the health ramifications of new technologies. Eager to include an international element in their cluster, they chose teaching assistant Thomas McOwiti, a second-year master's student from Kenya. McOwiti had a lengthy journalism career and could impart how technologies might be viewed in different cultural settings and developing countries. "We would like to help students get rid of the ethnocentricity that is so widespread in our country," says Gross.

Uscher says a paramount question is how the clusters are going to help the William and Flora Hewlett Foundation's knowledge base regarding interdisciplinary studies and teaching general education in a research university environment. "It's very likely that one of our conclusions will be that when you try to cover uncharted territory, when you do something that's experimental, and when you find a way for colleagues to interact through teaching, a distinctive research component may emerge. What we learn from this project will contribute to a national body of research on best practices in university general education. And that is very powerful."

Powerful, too, is the impact on the undergraduate experience. "When I look globally at the curriculum, I think all of these new ways of teaching and thinking about knowledge will inspire students to be original in their own lives and to feel valued," Uscher says. "I think that's also one of the best messages we can give to students and members of our faculty-that they matter, they're

valued, they're original, they have a great contribution to make, and their contribution is recognized."

Translating Ideals

Laura Roberts at the UNM Institute for Ethics aims to go beyond the boundaries of medicine by translating ethical ideals into optimal practices.

By Melinda Rogers

Ethics is both lofty and earthy. Ethics is the set of enduring ideals that we aspire to, but it finds its meaning and expression in the thoughts, beliefs and practices that we live out in ordinary ways each day.

In medicine, ethical ideals translate into the relief of suffering, the treatment of disease, and the honoring of the dignity and the rights of each patient. For Laura Roberts, University of New Mexico professor of psychiatry and director of the new UNM Health Sciences Center Institute for Ethics, the ethical principle of "respect for persons" is at the heart of the profession of medicine. Respect for persons calls for clinicians to put themselves in their patients' "shoes," building relationships based on genuine regard, compassion, empathy and appreciation for the experiences of the patients.

"It is more than the 'golden rule' of treating others as one would like to be treated," comments Roberts. "Respect for persons means becoming aware of the patient as a full person-as a person who has lived, laughed, loved and been loved, a person who harbors hopes and who has survived disappointments. A person who, like you, has had fevers, hiccups, growing pains, moments of panic and moments of joy. But, most importantly, it means remembering that a patient is a person who has entrusted a physician with his or her health."

The newly opened Institute for Ethics, led by Roberts with colleagues Joan Gibson, John Gluck and Teddy Warner, will serve as a center for ethics education, scholarship and consultative services for the state of New Mexico and for the United States. "We are engaged in work that stretches well beyond the usual boundaries of medicine, helping to translate ethical ideals into optimal practices and policies for our institution, our state and our country."

The institute is comprised of more than 25 core faculty and staff who come from diverse disciplines such as medicine, philosophy, psychology, nursing, sociology, theology, anthropology and public health and is launching initiatives in education, research, clinical service, policy consultation and community outreach.

The institute places emphasis on ethics and special populations. This focus makes it unique throughout the world, but is particularly valuable to our state. "Many New Mexico residents are members of special populations," says Roberts. "This includes seriously physically and mentally ill people, for example, as well as people who live in

rural areas and children and elders who come from diverse cultures and life experiences. Being attuned to the perspectives, needs and concerns of individuals with these distinct backgrounds is a responsibility of great importance for our institution."

Roberts is a NIH-funded career scientist, the editor of a national education journal, and the vice chair for administration in her department. She came to UNM for her clinical training in 1989, and she has devoted her professional life to improving our understanding of ethical issues in clinical care, education and research.

The Art and Life of the Kuna

Anthropologist Mari Lyn Salvador explores the artistic world of the Kuna women of Panama.

By Michael Padilla

Berta Alicia Avila, a Kuna woman from Suitupu, 1997. Photo by Mari Lyn Salvador.

Aesthetics and beauty in relationship to artistic expression and thought is the focus of Mari Lyn Salvador's lifelong research. Her work with the Kuna women of Panama and their traditional dress has led to interest in Kuna verbal and visual arts, cultural knowledge and the importance of education as a way of maintaining autonomy.

Salvador, an associate professor in the University of New Mexico Department of Anthropology and chief curator of UNM's Maxwell Museum of Anthropology, is known for her work with contemporary santeros (artisans who make paintings and carvings of saints) in Northern New Mexico, her research on the aesthetics of ritual performance, and her work with the Kuna. She balances teaching and research with her work as a museum professional.

The Kuna Indians live in the Comarca de Kuna Yala, in a region along the Caribbean coast of Panama including a group of 360 tiny islands, called the San Blas, and a strip of coastal land. They also live in Colón and Panama City. Kuna Yala has been a semi-autonomous territory within Panama since 1925. The Kuna have struggled for hundreds of years to protect their land and coastal seas from outside exploitation and from their own overuse.

Care of the environment is an integral part of their belief system, and the Kuna go to great lengths to educate the outside world as to the importance of their work and cultural knowledge. "One of the things that I have learned over the past 30 years is that the Kuna feel strongly about education-within their own communities and with outsiders," says Salvador.

Salvador's work centers on *molas*, Kuna women's traditional blouses, which serve as canvases of expression revealing their daily life, rituals and mythology. *Molas* are intricately hand-sewn textile panels made from layers of cloth using an appliqué-like technique unique to Kuna women. Each mola is different and carefully created to express a woman's personal identity. Some *molas* tell a story or illustrate events: one mola may depict an earthquake that occurred in Panama in 1951, while others may be inspired by religious beliefs, a young girl's puberty ceremony, politics, or even a boxing match. Illustrations from books, greeting cards, political posters, cereal boxes, or anything that is found in tiendas (stores) are often turned into mola designs.

Zucaritas (Kellogg's Frosted Flakes) cereal box with the image that inspired the mola on the right. [Private collection.]

Image of Tony the Tiger wiht broad smile and whiskers re-created in a mola, a traditional blouse of a Kuna woman. [UCLA Fowler Museum of Cultural History.] Photos by Don Cole.

Salvador's research began 35 years ago when she was a Peace Corps volunteer charged with developing a marketing plan for arts and crafts in Panama. During training in Puerto Rico, she was asked to make chicken coops, but was not satisfied with her assignment. She wanted to work with people and spent most of her training studying with researchers at the Puerto Rican Institute of Culture. In Panama, she continued to learn by working in an artisan cooperative with traditional artists throughout the country. The cooperative is now the Mola Co-op and has 1,500 Kuna women as members.

Back in the United States in 1973, she did her dissertation research at University of California, Berkeley on women's art. She conducted an ethnoaesthetic study of molas to better understand artistic criteria from the artists' perspective. She discussed the molas each woman made for herself and then worked with a standard set of 12 molas that represented a range of styles, motifs, colors and sewing skills.

In the 1980s, Salvador added several new molas to the standard set to get a sense of changes in artistic criteria. It was at that time that women began to talk about mugan, or grandmother molas, with early designs. This led to research on historic molas in the collections of museums in the United States and Europe.

Over the years, her ongoing study of Kuna molas has revealed new insights. "Every time I go back, there is a new challenge and a new level of understanding is introduced," she says. "Stories come out when the women are sitting around in their homes working on their molas. They talk about their families, their molas, and news of the day."

A group of Kuna women working on molas, Suitupi, 1997. Photo by Mari Lyn Salvador.

Salvador's first experience with research and exhibitions goes back to her time in the Peace Corps, when she was asked by the minister of culture in Panama to do an exhibition about Kuna culture in Panama City. Prior to exhibition, Salvador presented the project in the gathering house on the island of Tupile. The community embraced the project, made decisions about what was important to include, selected objects for exhibition, provided interpretation, and directed Salvador's photography. Salvador gained information by visiting several homes in the community.

"They welcomed me and taught me about Kuna culture," she recalls. "This is when I began to learn about the Kuna interest in beauty and how a concern for form guides the way Kuna speak, discuss their lives, think about their world, build their homes, organize village life, make molas, chant, and hold public meetings."

The Kuna believe that the more outsiders understand Kuna culture, environment and history, the more likely it is that they will support Kuna efforts to maintain their cultural and political autonomy. To help sustain that autonomy, the Kuna have been working with scientists and scholars for many years. They have been successful in their efforts to expand their territory and establish it as a research reserve, protecting it from encroachment by developers and cattle ranchers. The Kuna strongly believe in preserving their own culture and are equally interested in understanding the history and culture of other communities.

"Carlos Lopez, first chief of the Kuna General Congress, and other Kuna cultural specialists visited the National Museum of the American Indian in New York in 1996 to document Kuna collections in the museum. They found themselves teaching while working with the museum staff, and they wanted to learn as much as possible about New York-including baseball," says Salvador.

Salvador's work with Lopez inspired her to continue to learn. Her first years working with the Kuna became the basis for everything she does now. "It was a grounding experience for an anthropologist," she says. "I learned to listen carefully, to consider research as a partnership, and to make my research available to the communities I work with."

Now head of the interpretation division at the Maxwell Museum of Anthropology, Salvador works with museum staff to make anthropological research accessible to the public by developing exhibitions as well as education and public programs. She is one of the founders of the new Alfonso Ortiz Center for Intercultural Studies at UNM and is co-principal investigator of the National Endowment for the Humanities (NEH) Challenge Grant that established the center.

Two Kuna women circa 1902-1906. Photo by Frederick Oliver. Courtesy of the National Anthropological Archive.

Two Kuna women, a mother and daughter, wearing traditional mola blouse and skirt. Aligandi, 1986. Photo by Mari Lyn Salvador.

The Art of Being Kuna, based on field research by anthropologists over the past 30 years, including the work of Salvador, is on display at the Maxwell Museum. The exhibit showcases Kuna ideas about the environment and their beliefs regarding creation and the responsibility of care for the earth. The exhibit also demonstrates their thoughts about aesthetics and the relationship of beauty and form to political and social organization, family structure and hospitality, ritual and healing, as well as personal expression.

The exhibit, funded by the NEH and developed by the UCLA Fowler Museum of Cultural History, draws upon rich collections, including research and photographic archives at the Ethnographic Museum in Göteborg, Sweden, the Smithsonian Institution in Washington, D.C., and the National Museum of the American Indian in New York City.

A book, edited by Salvador, has been published as a companion to the exhibition. It provides an in-depth written and photographic record of Kuna life.

The second phase of the exhibit, to be unveiled this April, will include healing, ritual and dance, as well as molas that include images from outside of Kuna Yala.

A new NEH grant will allow Salvador to conduct further research on the collections in Panama, Europe and the United States. She will prepare images and research materials for the Kuna Research Archive in Panama City and for the Maxwell Museum Center for Anthropological Research at UNM. While the exhibit is at the Maxwell, distinguished Kuna visitors will participate in activities at the museum and work with Salvador on research materials. In November 2002, four of these visitors were in Albuquerque for the opening celebration of the exhibition.

"I've always felt that exhibitions provide a wonderful context to communicate to the public what we, as anthropologists, learn in the field," says Salvador.

Making Connections

A group of researchers with an interest in a rare form of muscular dystrophy discovered each other and the largest cluster of Hispanics suffering from the disease.

By Cindy Foster

Researchers know that often the initial spark, the event that brings together a group of passionate investigators, may begin with a serendipitous event-a chance remark here or there, an accident that leads to a synergy one never dreamed could have existed.

Such was the case at the University of New Mexico Health Sciences Center when a handful of people with an interest in a rare disease discovered each other, leading to the identification of the largest cluster of Hispanics suffering from oculopharyngeal muscular dystrophy (OPMD) in the United States-and one of the largest clusters in the world.

Muscular dystrophy (MD) is a set of neuromuscular diseases that progressively attack and weaken the muscles. OPMD differs from the more common forms of MD (Ducheune and Becker) in several major ways. Traditionally, these forms of MD develop in the young, are characterized by increasing muscular weakness throughout the body, and cut life short. Until recently MD patients rarely lived into their 20s.

In contrast, OPMD strikes later in life: symptoms begin in a person's 40s and 50s, usually with droopy eyelids (known as bilateral ptosis), and trouble swallowing (known as dysphagia). The effects vary from patient to patient, yet OPMD usually doesn't shorten a person's life span. Patients have been known to live into their 80s.

OPMD is a rare disease that has turned up in less than three dozen countries around the globe. In New Mexico, however, researchers found a cluster of Hispanic-Americans, most of them living in the northern part of the state, who suffer from OPMD in such large numbers that, until recently, symptoms were seen as a family trait more than a health problem.

The research results are striking. The process of how the researchers came together and began is an equally striking tale of a series of accidents and chance encounters.

David Bear, professor and chair of the UNM Department of Cell Biology and Physiology, became interested in molecular biology as a teenager during a summer lab program. As a basic science

researcher, he has studied a protein called PABP2 for a decade. In the spring of 1998, a research group in Quebec discovered that a group of French Canadians with OPMD carried a mutation in the gene coding for PABP2. Bear suddenly found himself studying a disease.

The following year, Bear obtained a grant from the Muscular Dystrophy Association to study OPMD-PABP2.

Associate Professor of Neurology Leslie Morrison and Professor and Chairman of Cell Biology and Physiology David Bear discovered they had a common interest in a rare disease.
Photo by Matt Suhre.

Bear was discussing his work at a meeting sponsored by Los Alamos National Laboratory (LANL) when Michael Altherr, a LANL genome researcher, mentioned that with his interest in OPMD, Bear must know Leslie Morrison, in the UNM neurology department, who had a number of OPMD patients.

OPMD in New Mexico?

"I was stunned," says Bear. "I couldn't get on the phone fast enough when I got back to the University."

Morrison told him that UNM neurologists had long known that they were seeing OPMD patients with a frequency disproportionate to what they would normally expect to find with such a rare disease. She said Joseph Bicknell, former chair of the UNM neurology department, had become interested in OPMD in New Mexico in 1969 and had interviewed a number of families at that time. Larry Davis, UNM Department of Neurology, had a number of patients at the Veteran Affairs Medical Center (VAMC) in Albuquerque. He had collected DNA samples to obtain the genetic makeup of the disease. Morrison herself had tried to begin a study at UNM that had been dropped, but not before she had met with Altherr at LANL. Within a week a group was meeting to plan a collaborative study of the New Mexico OPMD population.

The group combined the VAMC and UNM findings. Research questions attracted the expertise of others. Mark Becher, UNM Department of Pathology, developed a way to stain muscle cells for the PABP2 protein. The task of developing and maintaining a database fell to Molly King, Department of Neurology at VAMC. Other team members have included Claire Bartolo in the UNM Department of Pathology, and Wusi Maki and technician Brian Reinert from the UNM Department of Cell Biology and Physiology, as well as a small army of undergraduate and medical students that continues to grow, says Bear.

What the researchers found was that a large population of New Mexicans with OPMD have a specific mutational change in the gene encoding PABP2. When it mutates, as in the case of OPMD, PABP2 aggregates (gathers) in the nuclei of muscle cells. UNM scientists believe there may be a link between the formation of the aggregates and damage to the muscles in OPMD patients.

In November 2001, the group published an article in the Journal of the American Medical Association

and identified 216 OPMD-affected individuals, some with a family history going back four generations. The number of cases has grown monthly since UNM began holding a clinic devoted to evaluating patients for the disease. Researchers also believe the disease is likely to be vastly underreported, with many patients seeing the droopy eyelids and swallowing difficulties as unavoidable family traits.

The disease is autosomal dominant, meaning that if one parent carries the gene, a child has a 50 percent chance of inheriting it, and a carrier has a 100 percent chance of developing OPMD by the time he or she reaches middle age.

Many OPMD patients are in denial and ignore early signs and symptoms. Often, family members will know a person is affected even before the patient becomes aware they have it, says Morrison. "People talk about how someone will begin to clear their throat often. You can see people in family photos standing with their eyebrows arched up (the better to keep the skin from folding over the pupil of the eye) and standing with their heads tilted slightly backward."

While the disease doesn't shorten life spans, it can severely degrade the quality of life of those who suffer from it. As it becomes more difficult to keep the eyelids up, people begin to develop severe chronic neck and shoulder pain as they tilt their heads backward, desperate to see enough in front of them to get through their day. Eating becomes more and more problematic. "They learn to avoid dry foods," says Morrison. French fries, tortillas-foods that most people never associate with being difficult to swallow-are removed from the personal menus as the process of eating becomes more arduous. "It can take two hours to eat a meal," says Morrison. Some patients have literally wasted away, dying of starvation. Today they can be given a feeding tube. Patients also sometimes experience progressive weakness in their shoulders, upper arms and legs until they are wheelchair bound.

"Many people think there is no need to be evaluated because there is no cure, but we are finding new options to treat their symptoms," says Morrison. "This is a disease that affects more than an individual, it affects families in a vertical way from grandparents to children."

Bear says "ethical landmines" occur frequently as researchers, clinicians and patients struggle with how to utilize the genetic information that is currently available.

"How much and what should be told to the patient? When is the knowledge a benefit and when is it a detriment?" he says. "The families have been wonderfully cooperative, primarily in an effort to help us learn things that can assist others who may develop the disease, but there is a point where some of them turn to us and say, 'You are telling me more than I want to know.'"

More basic research questions remain, says Bear, such as: why does the disease focus on these particular groups of muscles and not others? Why is the onset of illness so late in life? How does an abnormal protein cause only muscle disease when the abnormal protein is located in all cells?

Grants from the Muscular Dystrophy Association have allowed continuing research through special projects and studies, and the group is pursuing funding for a clinical research project.

"We know that there are several things that might be going on," says Morrison. "Maybe there are things that we could do to delay the impact of the onset of symptoms, or perhaps this could be

something that will respond to nutritional or vitamin therapy. Can exercising help slow down symptoms, or will it speed up the onset of the disease? We need to know the answers to these questions. We also need to help people find specialists who understand their problem."

The ethical issues make a case to have patient involvement in all research, she says. Research in the French Canadian OPMD cluster has actually traced the genealogy of the disease back to sisters who immigrated to Quebec in the 1600s. Morrison's patients are also interested in the genealogy of the disease. They want to know who might be related to whom, how it came to New Mexico. "Some of them would love to see a statewide conference where they could all meet," she says.

Diffusion, Saturation, and the Digital Divide

Everett M. Rogers studies the spread and consequences of the Internet.

By Frank D. Martínez

"The Internet really is diffusing very rapidly," says University of New Mexico Regents' Professor of Communication and Journalism Everett M. Rogers, who was selected as the University's 47th Annual Research Lecturer in 2002, the highest honor UNM bestows upon its faculty.

"The latest estimates of the number of Internet users have taken another big jump, as they do every six months," he says. "As of July 2002, there were an estimated 544 million Internet users. That's about nine percent of the world's population. At the rate that Internet usage is increasing, the best estimate is that by 2005, we'll be up to about 15.5 percent of the world's population. That represents a tremendous increase in the next three years," adds Rogers, whose research on the diffusion of innovations and, most recently, the spread and consequences of the Internet, continues to garner international attention.

"However, the large growth is no longer occurring in the United States. We're already at about 71 percent of adults regularly using the Internet, so we're starting to slow down, by necessity, because we're getting closer to 100 percent; we're reaching saturation."

The main growth is occurring in Asia, most of all in the Peoples' Republic of China, Rogers notes. Conversely, he says, the slowest area of growth is on the African continent, "the primary reasons being poverty and lack of infrastructure, lack of good telephone systems, and lack of computers."

Western Europe, with the exception of France, is another area of the world where the Internet is rapidly diffusing. "France is a strange case," Rogers observes. "The explanation is language. The French language is so important to the French that, because Internet content is predominantly (69 percent) in English, the French government has tried to encourage French users of the Internet to make Web pages in French, but it just hasn't happened. The percent of adults in France using the Internet is around 18 to 20 percent. So you see this strange anomaly of one country in Europe with a relatively low percent of Internet use."

"France is a relatively wealthy country and on other communication technologies they're quite advanced," he says. Lack of Internet usage, however, "means they're missing out on a lot of useful information. It means that French businesses are somewhat disadvantaged in the world market. So you see the effect of what's called the 'digital divide.'"

The digital divide separates those who have Internet access from those who do not, he says.

The implications of the diffusion of the Internet are indeed astounding. Rogers suggests, for example, the Internet will pose new challenges for Communist regimes-such as China-where

information flow is largely monitored and controlled.

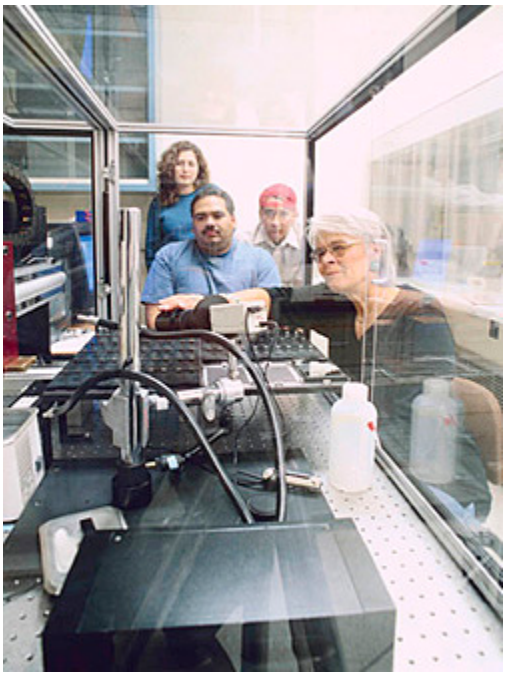
In New Mexico, parts of Taos County have lagged in obtaining access. Now, more concerted efforts are underway to provide Internet access to residents, much to their benefit. Increasingly, residents there are able to access information that is relevant to them, Rogers says, such as health and nutrition Web sites and other sites with local information.

Rogers says another communication technology-the cell phone-is now diffusing as rapidly as the Internet. In fact, new technologies that will have profound impacts are evolving very quickly, he says, with promises to intensify the already clamorous cacophony of cyber-chatter in our ever-shrinking planet.

Understanding the Lives of Cells

Biologist Margaret Werner-Washburne is working to further understand the lives of cells with a tool called microarrays.

By Larry Walsh



Juanita Martinez, Anthony Aragon, Jose Weber and Margaret Werner-Washburne in her laboratory, where microarrays are used as tools to take snapshots of the activities of every gene in a particular cell. Photo by Michael Mouchette.

Biology is in the midst of a revolution of knowledge that is comparable to the explosive advances in physics in the early 20th century. This revolution is in large part the result of the invention of new tools, which allow biologists to see and manipulate life on a molecular level. For example, DNA sequencing is less than 20 years old but has already changed our basic understanding of the processes of life, diseases, paternity and forensics.

Consequently, University of New Mexico biologist Margaret Werner-Washburne's work to perfect a tool that promises yet another quantum leap in knowledge is creating national and international attention. The new tool is called a microarray (see sidebar on page 32), which allows biologists to take snapshots of the most intimate moments of a cell's life by recording the activity of every gene in a cell at the same time.

"Microarrays allow us to see a visible slice of what all of the genes in a cell are doing at any given time," Werner-Washburne explains. "The great advantage is that, by combining snapshots over time, we can see how cells function as a whole."

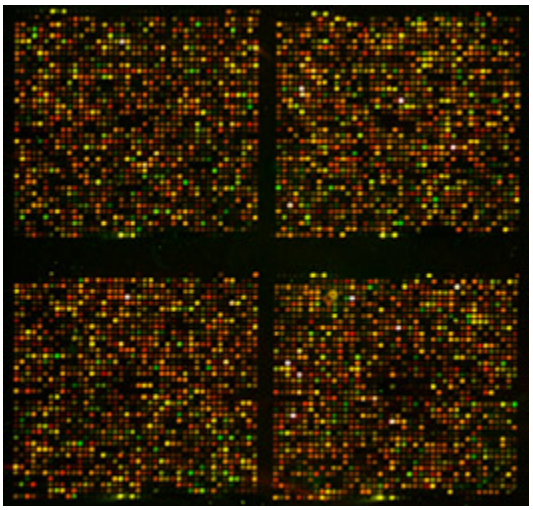
As collaborator Gregory Petsko, Tauber Professor of Biochemistry and Chemistry at Brandeis University, puts it, "The value of microarrays is that they allow one to assess the impact of any change-mutation, change in growth conditions, exposure to a drug, etc.-on the expression of all the genes in a genome. They represent the major driving force taking biology from a reductionist science to a more holistic one, one that considers the interplay of many genes at the level of the cell, organ or organism."

Werner-Washburne, the first Hispanic female to be named full professor in the sciences at UNM, points out that, in addition to tremendous advances in understanding the lives of cells, microarrays have important practical applications.

"One of my collaborations is with the biosensor group at Sandia National Laboratories," she says. "We're using microarrays to enable detection of chemicals, bacteria, viruses, drugs, organisms, etc. These biosensors could be used to measure water quality or identify a biothreat like anthrax."

But Werner-Washburne's first love is understanding one of the basic processes of the cell: the change between growing cells and quiescent cells, which are waiting in suspended animation for the right signal to begin growing. Most cells, including those in our own bodies, are in this quiescent phase. The uncontrolled growth of cells can lead to cancer.

Werner-Washburne uses yeast cells to study quiescence. Yeast cells can survive in this state for hundreds of years until the right conditions present themselves, and they begin growing again.



Scanned images of microarray analysis of gene expression.

"There are 6,000 genes in yeast," Werner-Washburne notes, "so the microarray has 6,000 individual spots. A single array experiment produces 12,000 data points. Our data sets are large enough to be interesting to researchers at Sandia. We had to develop new ways to analyze the data." Her collaboration with Sandia's Computer Science Group led to the development of cutting-edge software.

"Maggie [Werner-Washburne] is using microarrays to approach one of the most interesting questions in biology," states Petsko. "Although the cell cycle of the growth phase has been studied extensively, almost nothing has been done in comparison on quiescent cells. Maggie's work is changing all that."

Ideas for using yeast genomics to enable biosensors generated another collaboration with UNM's Department of Chemical and Nuclear Engineering, resulting in the first ever chemical engineering student to get a masters degree working in a biology lab.

Werner-Washburne has recently been awarded more than $1.75 million from the National Science Foundation and the National Institutes of Health to pursue her work on stationary phase (quiescence for single cells) and on the use of microarrays.

Perfecting the use of microarrays, however, has not been an easy task. For the last three years, it has entailed an intense interdisciplinary collaboration with researchers in computer science, material science, and other disciplines, forging a working partnership with Sandia National Laboratories, and working with biologists across the United States, Israel, Mexico and Austria.

With the hard work of perfecting a new tool in biology comes a payoff that is enormous. Microarrays are a breakthrough, and Werner-Washburne is on the leading edge of the revolution.

Going Deeper

Roli Varma is finding answers to questions regarding cross-gender and cross-ethnic populations in relation to information technology education and the workforce.

By Maya Allen-Gallegos

In 1975 Roli Varma immigrated to Montreal, Canada, and saw a world very different from her native India. The contrast between India and Canada made her think, "This country is doing well because of science and technology. I want to understand how society can transform itself by using science and technology." Though she had planned to become a biologist, she decided to pursue degrees first in political science and later in science and technology studies.

She joined the faculty of the University of New Mexico in January of 1999, and is now an associate professor of public administration. Her commitment to several interrelated research areas has been rewarded with several grants.

A grant from the Alfred P. Sloan Foundation supported a study on recruitment and retention of undergraduate minorities in information technology (IT). Varma conducted ethnographic interviews with students in computer science and computer engineering and students who had dropped out and moved on to different fields. "I found out how they became interested or disinterested in the field-their reasons for attachment or detachment."

Now in its final stages of data analysis, this study focused on the UNM student population. However, her next project funded by the National Science Foundation (NSF) allowed her to take a much wider data sample. She is searching for the answer as to why there are so few women in the field of IT.

Since Varma is interested in cross-gender and cross-ethnic populations in relation to IT education and the workforce, she makes comparisons between genders and ethnic groups. She conducted many local interviews and visited other colleges and universities as well. "I found that you can't make generalizations about women as a group. For example, I've found that Asian women students who have never been exposed to computers don't hesitate, whereas white women question their choices more, asking: 'Do I belong in this field?'"

The NSF-funded study applies to women across the country, which gives its results national importance. Varma hopes that through her research "some changes will take place in policies to encourage women and minorities. People are asking me to share this information."

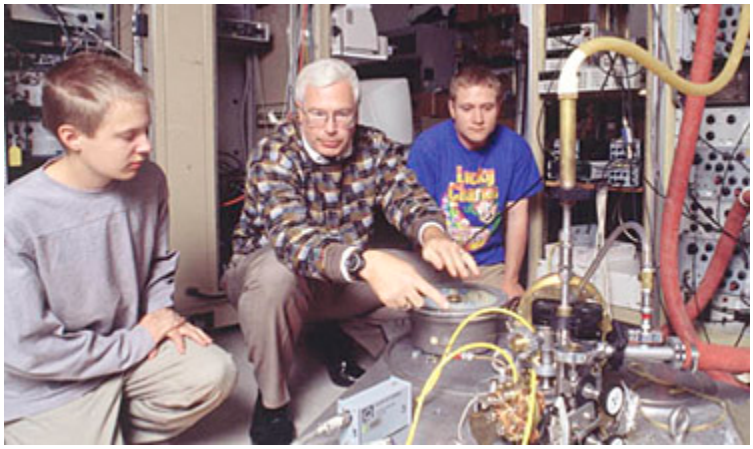
Varma is also working on another NSF-funded project to study new immigrants in science and engineering in the United States. She says, "I am from India, and I thought it would be interesting to study Asian immigrants who are scientists and engineers in this country. We know a lot about Asian immigrants because they have become part of the science and engineering workforce, but we know nothing about what happens after they join. I think if you go deeper you will find that they are really concentrated as scientists and engineers, but they are not in top positions."

As Varma continues her research, she teaches courses in research methods, public policy and technology in society, and feels that the three should not be separated. "I think teaching should not be abstract. Teaching should be related to real situations. And the students prefer that. They like contemporary issues."

Beyond the Limits

Physics Professor Robert Duncan is working to turn helium into a superfluid in outer space and push measurement science beyond anything previously possible.

By Robert Julyan



Junior high school student Tom Dimiduk and UNM Mechanical Engineering student Colin Green working with Rob Duncan (center) on the DYNAMX project. Photo by Michael Mouchette.

"Don't do easy things; always do very hard things."
Robert Duncan

Consider helium. To most people it's the lighter-than-air gaseous element that causes a balloon to escape a toddler's hand and float away. But to study it simply as a gas would be, well,easy, so what about cooling helium down almost to absolute zero and making it a liquid?

Heat causes the random motion of particles. When motion slows, a substance becomes cooler, and at absolute zero we would expect motion to stop entirely. (Actually, because of quantum physics some minute motion remains, which physicists call "zero point energy.")

Absolute zero is at minus 459 degrees Fahrenheit and minus 273 degrees on the Celsius scale, but physicists often use the Kelvin scale, which starts at absolute zero and rises from there.

And helium, explains University of New Mexico Professor of Physics Robert Duncan, displays some remarkable properties when cooled almost to absolute zero. For one thing, it never freezes. "At absolute zero helium is still not a solid. It's the only element that has this property."

But at 4.2 degrees Kelvin, helium does become a liquid-and then things get really weird. Because at one point, as cooling proceeds, when a threshold is reached at 2.1768 Kelvin, normal fluid helium suddenly becomes a "superfluid."

As Duncan explains, "normal liquid helium is a very bad conductor of heat, while superfluid helium is a perfect heat conductor." It's like someone putting a match to a mile-long iron rod-and you suddenly feel the heat at the other end. "The amazing thing is that at these temperatures helium atoms are indistinguishable from one another. They act as one big quantum entity, kind of like one huge helium

super-molecule."

Normal liquid helium suddenly becoming superfluid helium is called a "quantum phase transition," and Duncan says, "Our understanding of many other things in nature, such as superconductors, neutron stars, and maybe even our early universe will be elucidated, at least in part, by better understanding these quantum-phase transitions."

But studying the transition from trillions of atoms to "one huge molecule" is not easy. The problem is that Earth's gravity creates minute pressure variations in the samples so that one part remains normal liquid helium while the rest is superfluid helium. If only the transition could be studied in a weightless laboratory. Such as in space? And at this point, Duncan is in the realm of "very hard things" he seeks.

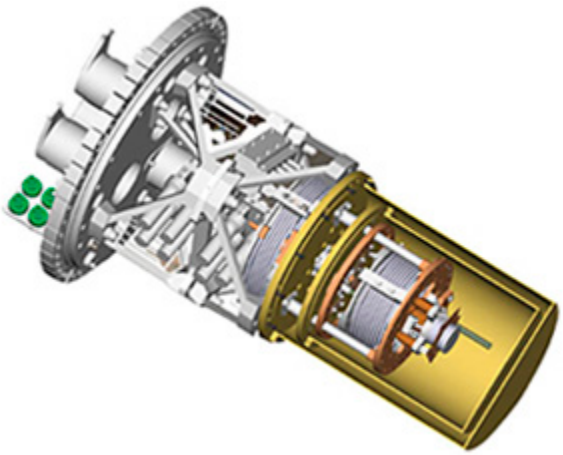


Figure of the DX/CQ flight apparatus, a superfluid helium module that will be aboard an International Space Station flight in 2005. Graphic prepared by Steve Boyd and Alex Babkin.

In 1992, in a project funded by NASA, Duncan joined with Sandia National Laboratories and the NASA Jet Propulsion Laboratory to create a superfluid helium module that will be aboard an International Space Station flight in 2005. "For the first time in history we'll see the phase transition uninhibited by the weight of the helium column. It's a rare opportunity to work at the absolute forefront of what we know."

The project is known as Critical Dynamics in Microgravity, but more often it goes by the name DYNAMX (pronounced Dy-na-max). At UNM, DYNAMX has enlisted a team, headed by Duncan, that includes research professors Steve Boyd and Alex Babkin, senior physicist and software developer Dimitri Sergatskov, experiment manager T.D. McCarson, mechanical engineer Alexander Churilov, administrative assistant Sandra Ortiz, graduate students and even undergraduates. In laboratories in UNM's Department of Physics and Astronomy, they design and test the module that will house the experiments.

But of potentially greater significance are the instruments DYNAMX has developed for measuring temperature. Because the scientists want to know the precise temperature at which superfluidity occurs-and because they also want to observe the first appearance of a temperature difference across the liquid helium where its superfluidity fails abruptly-the thermometer must be faster and more accurate than any thermometer now existing. It must be able to detect temperature differences as small as 100 pico-Kelvin (a pico-Kelvin is one-trillionth of a Kelvin).

"It's an incredible challenge for us all, especially postdoctoral students," says Duncan, "because, frankly, the work is so hard. I take pride that everyone who works on this advances his or her career

very rapidly."

One of the undergraduates in the project is senior Anthony Riggins. He's studied martial arts since childhood and has won gold and silver medals in national and international Kung Fu competitions. Thus, he feels a natural kinship with the "only do hard things" philosophy of Duncan, who runs ultramarathons for recreation and has participated in several 100-mile runs over extremely difficult terrain. Riggins laughs when he says of Duncan, "I've always been a hardcore athlete, but this guy's even crazier than I am."

Riggins knew even in high school that he wanted to be a physicist, and at UNM he has participated in co-op programs at General Electric, Sandia and NASA's Langley Research Center.

But when he reached his senior year at UNM, he hadn't found a senior thesis, so he asked Duncan if he had any appropriate projects. "Dr. Duncan had a lot of great ideas. A lot of what I'm doing now is working with Dr. Boyd on a related experiment that he successfully proposed to NASA. The goal is to make an even faster thermometer."

Duncan concurs. "We've had to develop genuinely new technology to discover new science."

Duncan projects enthusiasm and thrives on big challenges. He was recently appointed associate dean for research in the College of Arts and Sciences. As such, he will join deans and associate deans from all other UNM colleges and schools, the vice provost for research and individual faculty members in promoting sponsored research that in 11 years has gone from $80 million to the present $247.6 million.

At Duncan's appointment, Arts and Sciences Dean Reed Dasenbrock said, "I think it would be fair to say that one of the most exciting developments at UNM in the past decade has been the rapid rise in externally funded research. I expect Rob to work effectively across campus in order to continue the upward trajectory."

Back in his office, Duncan repeats his credo, "'always do very hard things.' I think that should apply to administration as well as to science." He pauses. "And to ultramarathoning."

With DYNAMX as with an ultramarathon, there is a finish line to be reached. It's the year 2005. Then, when the first fundamental physics mission to the International Space Station takes off, DYNAMX will be on board. Once the shuttle is in orbit, electronic signals from Earth will complete a cooling that will take the helium down to the superfluid transition temperature and stabilize it there to within 0.0000000001 Kelvin. Then, the helium will suddenly change to a superfluid, not in some parts of the sample but in all of it, all at once. And observing and measuring that "all of it, all at once," with a precision far beyond anything previously possible, will be instruments designed, tested and built at UNM.

"The last decade has been spent pushing measurement science beyond the limits that existed 10 years ago," says Duncan. "It's exciting."

Consider helium. This time that balloon isn't going to float away.

No Greater Calling

Cheryl L. Willman, Director of the UNM Cancer Research and Treatment Center, is focused on conquering cancer through research.

By Harriet Kraye

Photo of Cheryl Willman by Matt Suhre.

"It begins with outstanding basic scientific research and culminates with better drug therapies that we can give our patients in our clinic. We must translate our knowledge into treatments that are less toxic and far more effective," says Cheryl L. Willman, Director of the University of New Mexico Cancer Research and Treatment Center (UNM CRTC) and Professor of Pathology and Medicine in the UNM School of Medicine.

As one of the world's leading leukemia researchers, Willman is working to provide the citizens of New Mexico and all people with the very best cancer care and is committed to conquering cancer through research.

The core of her leukemia research focuses on genomics, which involves looking at the genetic basis of human cancer. In 2000, the W.M. Keck Foundation awarded the UNM Health Sciences Center a $1 million grant to support cancer research studies that take advantage of tools developed through the Human Genome Project.

Through the project, Willman and her research team are looking at which genes are active in leukemia cells. The technologies use tiny microarray chips that contain the order or sequence of each gene. These chips can then be used to determine which genes are expressed in normal cells versus cancer cells. By comparing the genes that are activated in a sick person to the genes in a healthy person, scientists can develop better treatments.

Willman's leukemia research group is one of 17 groups in the United States to receive the National Cancer Institute's Director's Challenge Grant for Molecular Classification of Pediatric and Adult Acute Leukemia. The goal of this research is to identify systematic gene expression

profiles not only for the diagnosis of leukemia, but also for the prediction of therapeutic response and resistance.

Part of Willman's research involves the study of leukemia tissue samples from all over the United States. The UNM CRTC has the nation's largest bank of leukemia tissue samples. Willman and her colleagues perform genetic analysis of these leukemia tissue samples and send information to doctors about which specific mutation is involved in each particular leukemia. This information can help doctors to know if particular leukemias are curable, and help them to decide how to tailor treatments. Researchers at the Center also look at whether the mutations associated with leukemia turn other genes on or off. Changes in the other genes may affect how the cells work and possibly lead to cancer. By looking at these changes, more targeted treatments can be developed.

Because of the tremendous amount of data that is generated, the Center uses high performance computers, allowing scientists to look at the more than 30,000 genes in each sample and correlate genetic changes to a number of factors such as patient age, treatment, etc. Scientists at Sandia National Laboratories have worked with UNM CRTC researchers and assisted in developing sophisticated computer programs to make colorful visual depictions of these genetic changes.

"An important area of concern to me is understanding cancer in our state's multiethnic population," says Willman. "By looking at genetic differences and studying why certain groups have a higher incidence of one particular cancer is a major focus of our research at the center. For example, Hispanic women have a higher rate of breast cancer, and the rate is increasing. We don't know why, but looking at this may hold the answer to many of our questions."

"To increase access to improved cancer care for all groups of people, we must have more treatment research studies," says Willman. "Prior to 1955, almost all of the children who were diagnosed with cancer died. Since 1955, 80 to 90 percent of children with cancer have participated in treatment research studies and their cure rate has skyrocketed to 70 percent. Unfortunately, only four percent of adults with cancer in the United States are on these studies and the cure rate is just under 30 percent. I want to improve these numbers and make these studies available to all New Mexicans."

To accomplish this, Willman, with an acute understanding that no one person or institution can do this alone, has embarked on two important projects. One is to achieve National Cancer Institute (NCI) Comprehensive Cancer Center designation for the UNM CRTC. The NCI is the major funding source and sponsor of patient treatment studies in the United States. By becoming designated, the UNM Health Sciences Center will have increased access to the very best and latest treatments for cancer. Receiving designation will take several years and is a rigorous process, but Willman is committed to it. She has hired 14 new top-notch oncology specialists, many of whom are the only specialists of their kind in the state.

The second project that Willman is cultivating is the New Mexico Cancer Care Alliance, a joint venture between the major healthcare institutions and private oncology practitioners and surgeons in Bernalillo county. This partnership has been formed to help the UNM CRTC become an NCI-designated Comprehensive Cancer Center, and to accelerate the development of new

cancer prevention and treatment agents through the use of basic, translational and clinical research. By pooling resources and information, patients will benefit from the combined knowledge of this coalition.

At a New Mexico Governor's Prayer Breakfast in 2002, Willman delivered a speech in which she closed by saying: "New Mexico is our home, our community. Together, we are the stewards of this house and its people. We must open our hearts, we must be inspired. There is no greater calling."

Influencing Generations

The Diné Project at UNM-Gallup is designed to boost the number of Native Americans earning degrees in early childhood multicultural education.

By Laurie Mellas-Ramirez

Armed with glue guns, child-safe scissors, colorful construction paper, great expectations and a culturally inclusive program, two dozen Native American women on the UNM-Gallup campus piece together their futures in education.

The Diné Project, designed to boost the number of Native Americans earning degrees in early childhood multicultural education, is directed by Helen Zongolowicz, a veteran teacher of pre-school to graduate school students. Zongolowicz, or "Dr. Zee," as she is known to her students, developed the project in response to a nationwide teacher shortage and increasingly tough state and federal regulations. She says that attracting new teachers is difficult with postings that read, "Wanted: educator/child counselor/family therapist. Low pay, long hours, with intrinsic rewards."

The project is funded by a three-year, $870,000 Department of Education grant, with some tuition support from the Navajo Nation. This funding fuels scholarships for tuition, monthly living stipends, and childcare and transportation expenses so students can attend school full-time and complete requirements within two years. The goal is for students to "walk in," a local term for attending graduation.

The Gallup-McKinley School District and Bureau of Indian Affairs schools will provide student-teaching sites and teacher mentors for the third year.

At UNM since 1993, Zongolowicz runs the project with the firm and loving hand of a former catechism teacher. First in her family to graduate from high school, she later taught while earning a bachelor's degree-a decade long journey. At age 39, she returned to school to earn her doctorate.

The average age of a student enrolled at UNM-Gallup through the Diné Project is 37. "I've been there, done that. If you really want it, you have to pony up," says Zongolowicz.

By 2003, 50 percent of Head Start teachers will be required to have an associate's degree in early childhood education. Teacher's assistants must now complete at least 60 credit hours, obtain an associate's degree, or pass a state-approved test.

Most of Zongolowicz's students achieved some credentials early on, but needed an extra push in the form of financial assistance to finish a degree that leads to a teaching license.

"There is a shortage of Native American teachers who can function as role models. You see Native

American teaching assistants, but you don't see a lot of Native American teachers," she says.

The project will influence generations of New Mexicans.

"Together the 22 who become teachers will teach 440 kids a year. If they each work 20 years they will reach 8,800 kids who wouldn't have had a Native American teacher," Zongolowicz says.

Teachers-in-waiting are frank about what they will bring to the classroom and how the project has helped realize their dreams.

Alta Yazzie, a Head Start teacher on the Navajo Reservation for 15 years, says, "I have a heart for children. I have five of my own and three grandbabies." Fluent in Navajo, Yazzie is a full-fledged elementary school teacher who will bring her culture to bear in the K-3 classroom.

Graduates of the Diné Project will teach in area schools populated with more than a 70 percent Native American student body. The majority of teachers in Gallup-McKinley County classrooms have little or no native language skills. Studies show that students who have language barriers suffer from subtle bias in the classroom.

"A native teacher allows for better communication with native children about their own culture and language," Yazzie says, adding that hands-on activities in the bachelor's program helped hone skills in writing and mathematics.

Navajo Serena Willie, sole provider and mother of four, worked full-time with special education preschool children throughout the program. She completed her course requirements during the summer semester and began student teaching in August.

"I've worked since I was 16. I got pregnant in high school. I took classes on and off until now. This program was a big incentive to return full-time and finish my degree. There is no way I could have afforded to pay for tuition or books," she says.

UNM courses in child development taught her "to redirect and work with kids who have behavioral problems. I have more of an understanding now of why kids act the way they do," she says. "I can be more of an advocate for kids and make sure they're not put in special education for language issues."

Willie is a first-generation college graduate. "I wanted to show my kids I could do it," she says.

Claudine Wayco of Zuni Pueblo learned from her grandfather that in order to maneuver in two worlds, she would have to be educated.

A former diesel mechanic who works as an early childhood intervention specialist, she attends school full-time while raising two children.

Wayco subscribes to the theory that when children are born they are blank slates. They are in need

of positive stimulation to promote optimal learning.

"If a car sputters, you give it a major overhaul and it goes for another 100,000 miles. When you work with kids, you have to wire them to go for a hundred years," she says.

Although she sacrifices precious time with her young family, Wayco says the scholarship and a job promotion when she graduates supply motivation.

"I have to finish. I would fail not only myself but also the program that helped me," she says. "It's always been my dream-and I've hung on to it."

All three students say the structure of the project provided a support system. Bonds formed during the two-year program will last far into their careers.

Willie notes, "My best friends are from college now. We've had three to four semesters of classes together, and even though we are from different parts of the county, I think it will be the same when we graduate."

Wayco, who also graduated last summer, says the sacrifice has been worth it.

"It's been a challenge and sometimes a struggle," she says. "The degree is something to my name that I accomplished for myself. It's like climbing a mountainsometimes you fall, but then you get up and go for it."