Getting to the top
Nanotechnology at UCR
Dear friends and supporters of UC Riverside, Happy New Year! On behalf of all of us in the campus community I want to extend our best wishes to you and offer our sincere hope for a New Year filled with good friends and good fortune, enriching experiences, and many opportunities.

In this issue we have focused on the exciting, emerging field of nanoscience. From the Greek word for “dwarf,” a nano (pronounced nan-o) indicates one-billionth of something. As you’ll see from our cover photo, Distinguished Professor Robert Haddon is leading the UC Riverside nanoscience effort as the founding director of the Center for Nanoscale Science and Engineering. We are extremely proud and pleased to have a scientist of Dr. Haddon’s caliber at the helm, and we are excited about the many research possibilities his studies offer our students and faculty.

This may be an issue you’ll want to hold on to for future reference (especially the Glossary on page 27). I am sure we will all be hearing and learning much more about the significant advances in the fields of engineering, medicine and computer science, which will be made possible through the development of nanotechnology. It may even come in handy if you tackle Michael Crichton’s new novel Prey, a nanoscience thriller currently collecting rave reviews.

I’d also like to make special note of our 13 faculty members named as 2002 Fellows of the American Association for the Advancement of Science (AAAS) for their work of scientific or social distinction. This is a great honor for the campus and again makes us the leading campus for the highest number of AAAS inductees. Thirteen fellows is also the new record for UC Riverside, breaking our previous record of 12 inductees in 1997. Sadly, we lost one of the 13 recently with the untimely death of Dr. Lung-Wen Tsai, professor of mechanical engineering. Dr. Tsai will be sorely missed by our campus community.

I hope you enjoy this issue of Fiat Lux. If you see me on campus or around town, please say “hello” – I would love to hear from you!

France A. Córdova
Chancellor
Fiat Lux, Latin for “Let there be light,” is the motto of the University of California. It is also an ancient biblical reference that announced the coming of light into the world, and with it knowledge, the power of perception and the hope for wisdom.

Awards and Honors

The Book Pages

Advancing the Cause

UCR Salons – Coming to a City Near You!

Henry Coil gets 2002 extraordinary service award

Mea culpa

In the Fall 2002 issue, a word was misspelled in a poem written by Maurya Simon, a professor of creative writing. A line in the poem headed “The Creation of the Question Mark” should have read: “It did not form itself from Adam’s mouth.”
Twelve faculty members were named as 2002 Fellows of the American Association for the Advancement of Science (AAAS), the highest number of fellows a single institution has received this year.

Twelve fellows is also the new record for UC Riverside. The university’s previous record was 12 AAAS Fellows in 1997.

The AAAS, founded in 1848, is the world’s largest, general scientific organization. It represents more than 138,000 members and 272 affiliated societies in the world, and conducts programs in science policy, education and international scientific cooperation. It publishes the prestigious peer-reviewed journal Science.

A total of 291 scientists in the world became AAAS Fellows this year. In 2001, UC Riverside employed 593 full-time-equivalent professors. With this year’s 12 fellows, a total of 102 UC Riverside faculty are now elected to AAAS fellowship, or 17.2% of the faculty.

This is the eighth year in a row that UC Riverside has been in first or second position with the greatest number of new AAAS Fellows. Among the UC campuses, UC Berkeley ranked next this year with six AAAS Fellows.

The 13 new AAAS Fellows at UC Riverside are:

**Janet Arey**, professor of atmospheric chemistry. Her research includes gas-phase atmospheric chemistry and air pollution. **Citation:** For research identifying the products of atmospheric reactions of volatile organic compounds and particularly of polycyclic aromatic hydrocarbons.

**Mary Ann Baker**, professor of biomedical sciences. She researches neural and hormonal factors controlling body temperature in mammals. **Citation:** For research in the physiology of mammalian thermoregulation and for excellence in teaching.

**Laxmi N. Bhuyan**, professor of computer science. His research addresses computer architecture, interconnection networks, Internet routers, performance evaluation and parallel and distributed computing. **Citation:** For research in high-performance computer architecture and parallel processing.

**Alexander Raikhel**, professor of entomology. His research includes molecular endocrinology, molecular immunology, transcriptional control, biomedical research and molecular biology of insect disease vectors. **Citation:** In recognition of pioneering research that defined the hormonal and molecular genetic pathways for mosquito vitellogenesis and led to generation of the first transgenic mosquitoes refractory to plasmodium transmissions.

**Derek A. Roff**, professor of biology. He is an evolutionary population ecologist with wide-ranging interests in population and quantitative genetics, life history, and the biology and ecology of dispersal and migration. **Citation:** For contributions to evolutionary biology in the area of life history evolution and quantitative genetics, especially with regard to advancing theory by empirical tests.

**John T. Rotenberg**, professor of biology. He studies community ecology and conservation biology, particularly how environmental factors interact to determine species diversity and community composition and how the relative importance of those factors varies. **Citation:** For research on how spatial and temporal patterns of environmental heterogeneity affect the distribution and abundance of birds and for service in ornithology and conservation.

**Michael E. Adams**, professor of entomology. His research interests span molecular and cellular physiology of chemical signaling, pharmacology of ion channels and peptides and behavior. **Citation:** For pioneering contributions to our knowledge of the biological chemistry and actions of ion channel-specific toxins from venoms and discovery of edeysis-triggering hormones in insects.

**Michael K. Rust**, professor of entomology. He studies insects and arthropods associated with people in cities. He explores the basic biology of pests that attack stored foods, museum objects, fiber, structures, and pets and develops integrated pest management strategies. **Citation:** In recognition of seminal contributions to our understanding of the biology and control of major fleas, and for outstanding administrative service.

**Prudence Talbot**, professor of cell biology. She studies reproductive biology using mammalian systems, including hamsters, mice and humans. **Citation:** For research in the field of reproductive biology and the effects of environmental toxicants on reproduction.

**S. Nelson Thompson**, professor of entomology. He specializes in biochemical and nutritional parasitology and also the interactions of parasites with their hosts. **Citation:** For pioneering research on the nutrition and nutritional biochemistry of parasites and parasite-invertebrate host interactions involving parasitic Hymenoptera, insect parasitic nematodes and schistosomes.

**Lung-Wen Tsai**, professor of mechanical engineering. His research interests include geomechanics and dynamics of mechanisms, machine design, design theory and design automation, automotive engineering, robot manipulators, micro-mechanical systems and other intelligent servomechanisms. **Citation:** For research in mechanisms and machine theory and robotics and automotive engineering and electromechanical systems.

**Mark S. Springer**, professor of biology, focuses on molecular evolution and molecular systematics, with an emphasis on...
the use of molecules to unravel mammalian evolutionary history. Citation: For fundamental studies of mammalian evolution, particularly for molecular phylogenetic studies that reveal the major groups of placental mammals and their historical biography.

Kambiz Vafai, professor of mechanical engineering. His current research interests include transport through porous media, multiphase transport, natural convection in complex configurations, analysis of porous insulations, heat flux applications, free surface flows, unconventional heat pipes and power electronics. Citation: For pioneering work for phenomenological description, modeling and analysis for single and multiphase transport through porous media and original, in-depth analysis of buoyancy induced flows.

The UCR/California Museum of Photography has received a grant of $500,000 to provide state-of-the-art seismic isolation and storage system for its extensive Keystone-Mast collection of stereographs.

The 250,000 glass-plate negatives and related prints constitute one of the most fabled collections in the history of photography, showing in 3-D the world as it existed from the mid-19th century through the early 20th century. While UCR/CMP has carefully maintained the collection, made it widely accessible and has begun to catalog and digitize its images, in its current storage units it remains vulnerable to great damage as it sits at the center of three of the most active earthquake faults in America.

The half-million-dollar grant is one of 80 projects in 36 states, the District of Columbia and Puerto Rico that will receive funding for critically needed repairs and restoration efforts for some of the nation’s most threatened historic places, archives, and artifacts.

UC Riverside’s Distinguished Professor Guy Bertrand was elected to the Academia Europaea. Membership to the academy is by invitation only, following a peer review selection process, and is considered a high honor. The Academia Europaea is a European, nongovernmental association acting as an academy. Its members are scientists and scholars who collectively aim to promote learning, education and research.

Bertrand is an internationally renowned scientist who emigrated in July 2001 from France’s national research agency, the Centre National de la Recherche Scientifique (CNRS). He is the director of the UCR-CNRS Joint Research Chemistry Laboratory, a partnership that allows chemists from France to make UC Riverside their permanent home while maintaining their CNRS affiliation. It is the first permanent French science laboratory in the United States.

Baseball Coach Jack Smitheran received the Spirit of The Dove Award for his involvement with the youth of the community.

The award comes from ARC Riverside, a private, nonprofit organization that, for the last 50 years, has provided services to individuals with developmental disabilities and to their families in western Riverside County. “Recognition from a group like ARC is a tremendous honor, mostly because of the wonderful work they do for the disabled and their families,” Smitheran said.

Distinguished Professor of Botany and University Professor Arturo Gómez-Pompa received two honors: the “Honorary Researcher Award” from the Institute of Ecology in Veracruz, the largest institute in Mexico devoted to the study of ecology, and the “Gold Medal Merit Award” from the University of Veracruz, Mexico, one of the most prestigious state universities in the country.

At the awards ceremonies, Gómez-Pompa, who has been at UC Riverside for 17 years and has collaborated over the years with numerous colleagues in Mexico, was also recognized for his recent work in connection with the Maya region in that country and for his efforts in establishing a research program at El Eden Ecological Reserve in the state of Quintana Roo, Mexico.

The El Eden protected area was created as a reserve that will be managed to protect, restore and enrich its existing biodiversity by manipulation of its ecosystems. Established in 1990, El Eden is the first privately owned protected area dedicated to research in biological conservation in Mexico. The area was founded by a group of scientists and conservationists led by Gómez-Pompa. The group is interested in the conservation and management of the biodiversity of this northeastern region of the Yucatan Peninsula in Mexico.

The library will receive one of 27 prestigious National Leadership Grants for Libraries. The grant will help improve the INFOMINE search engine, which was created at UC Riverside. The library will receive a $249,581 federal grant, which the campus will match, according to UC Riverside officials and the Institute of Museum and Library Services, a federal agency that supports the nation’s libraries and museums.

The UC Riverside Library developed INFOMINE in 1994. Its growth has been a collaborative effort with librarians at other UC campuses, the California State University, Wake Forest University, the University of Detroit and others. INFOMINE contains more than 40,000 links to academically valuable resources worldwide.

Robert Graham, professor of soil mineralogy in the department of environmental sciences at UC Riverside, was elected Fellow of the Soil Science Society at the national
William L. Belser, Professor Emeritus, died in November. Dr. Belser joined the UCR community in 1962 as Assistant Professor of Microbiology; he retired emeritus in 1991.

His work was broad in scope. One area of his research focused on the organization of the bacteria Serratia, a soil and water microbe, and how it related to the E.coli bacterium; a second area of research involved the mutagenesis of microbes to detect the presence of atmospheric hydrocarbons that are harmful to humans. Dr. Belser also collaborated with Professor Noel Keen to clone genes from plant-pathogenic microbes that can devastate economically important crop plants.

Professor Belser helped develop the early foundations of a microbiology curriculum on campus and the first lab courses to teach undergraduates about recombinant DNA technology.

Outside the classroom, he had a passion for breeding orchids and was working to develop a blue orchid not found in nature. Professor Belser is fondly remembered by his faculty and staff colleagues and his students as a kind, generous and deeply analytical scientist. He is survived by his wife, Nao Okuda, a former staff research associate with the Department of Nematology.

Steffi San Buenaventura
talked to UC Davis officials about the need to gather archive materials about ethnic community history. She encouraged students to collect oral history interviews in the Filipino-American and other ethnic communities around Davis and worked closely with community groups.

In Riverside she worked with Joe Virata, director of Asian Pacific student programs, and Katipunan, the Filipino student union on campus, to bring speakers to campus to address issues of identity and ethnicity, helped connect students to their Filipino roots and brought in filmmakers familiar with the Filipino-American experience.

She is survived by a daughter, Michelle Peixinho; two grandchildren; her mother, Sylvia Salumbides; and a sister, Nona Posadas.
Lung-Wen Tsai, professor of mechanical engineering, died in November at his home in Riverside. Tsai, who was born in Taipei, Taiwan, received his Ph.D. in mechanical engineering from Stanford University in 1973. Before joining the Bourns College of Engineering faculty in 2000, he was a professor for more than 14 years at the University of Maryland, College Park, where he established world-renowned research and education programs in robotics and mechanisms.

Tsai’s research interests were in robotics, mechanisms and machine theory, design methodology, automotive engineering and microelectromechanical systems. He was a Fellow of the American Association for the Advancement of Science, a Fellow of the American Society of Mechanical Engineers and a member of the Society of Automotive Engineers. He held numerous U.S. patents and was the author of two textbooks, 68 archival journal papers and 95 conference papers.


Both Sides of the Border: Transboundary Environmental Management Issues Facing Mexico and the United States
edited by Linda Fernandez and Richard T. Carson

The border towns of the U.S. and Mexico are more united in their shared environmental problems than divided. They must grapple with the characteristic and unique problems of economic disparity and quality of life: despite linked economies, Ciudad Juarez is the second-richest city in Mexico, but its complement, El Paso, is the fourth-poorest city in the U.S. Cooperation is necessary for solving border pollution problems on the local and international scale.

This book contains important information for academics, policymakers and politicians. Its chapters include contributions by professors Carlos Velez-Ibañez, Richard Minnich and Linda Fernandez and other border environmental experts, providing natural and social science insights into the use of shared water, air and land resources. The contributors offer analysis and useful ways to solve the problems of pollution, industrial production, urban growth, transportation and biodiversity resources (marine aquatic and terrestrial forest and insect species).

Pandora’s Picnic Basket: The Potential and Hazards of Genetically Modified Foods
by Alan McHughen
Oxford University Press, October 2000: 288 pages

Genetically modified (GM) food has emerged in a relatively short time as one of the most controversial topics of public debate. Alan McHughen, Cooperative Extension faculty in the department of botany and plant sciences, discusses the potential and hazards of GM foods in his book and explains the science behind genetic engineering with the general reader in mind.

“Everyone, it seems, is concerned about GM food,” he writes, “but most admit they don’t really know much about it.” McHughen addresses important questions in the book, such as “Is genetically engineered food safe?” and “Will GM organisms harm the environment?” The book covers a wide range of today’s genetic engineering issues, from food labels to wider environmental concerns. It also provides much-needed, accurate information for the public debate about genetically engineered foods.

Amidst the many ethical, safety, environmental and regulatory questions now being raised by recent advances in genetic technology, McHughen provides an insider’s account of the science that is often misunderstood or misrepresented in the popular media. He exposes the risks, benefits and myths surrounding genetic technology and provides a voice of reason that will help readers make sense of the controversy and enable informed choices at their local grocery stores.

The book was the winner of the 2000 Book of the Year award from the Canadian Science Writers Association.

The Archaeology of the Olympics: The Olympics and Other Festivals in Antiquity
edited by Wendy J. Raschke
University of Wisconsin Press, March 2002: 312 pages

The book is a collection of essays about the traditions of the ancient Olympics, published in its paperback edition by the University of Wisconsin Press.

Edited by Wendy J. Raschke, a lecturer in the Department of Comparative Literature and Foreign Languages, this collection of essays was originally published in 1988. The book allows historians, archaeologists and classicists to re-examine the evidence and explain how the reality of the ancient games compares with our modern images of them. The book is part of the Wisconsin Studies in Classics series. It includes a preface from Raschke updating the subject for the new edition.
Transnational Latina/o Communities: Politics, Processes and Cultures
edited by Carlos G. Vélez-Ibáñez
Rowman & Littlefield, October 2002: 336 pages

Carlos G. Vélez-Ibáñez, a professor of anthropology and the director of the Ernesto Galarza Applied Research Center, has co-edited a new book of essays that explores politics, trade and immigration between the U.S. and Mexico.

The co-editors are Anna Sampaio, assistant professor of political science at the University of Colorado, Denver and Manolo Gonzalez-Estay, a UC Riverside graduate student in anthropology. Vélez-Ibáñez founded and directed the Bureau of Applied Research in Anthropology at the University of Arizona, before coming to UC Riverside as dean of the College of Humanities, Arts and Social Sciences in 1994.

The Ernesto Galarza Applied Research Center carries out applied research projects and programs that improve the physical and mental health of women, the learning and educational success of Latina/o people, the formation of healthy communities and programs that close the digital divide among underserved populations.

Vélez-Ibáñez is the 2003 recipient of the Bronislaw Malinowski Award of the Society for Applied Anthropology.

James Joyce's “Fraustuff”
by Kimberly J. Devlin
University Press of Florida, March 2002: 201 pages

Kimberly J. Devlin, professor of English, is the author of “James Joyce's Fraustuff.” She traces the concepts of “fraudulence” in the works of Joyce, showing his increasing interest and experimentation with the theatrical props that support identity. Devlin is also the author of “Wandering and Return in Finnegans Wake: An Integrative Approach to Joyce's Fictions” (June 1991) and co-editor of "Ulysses En-Gendered Perspectives" (June 1999).

Dear Paramount Pictures
by Iqbal Pittalwala
Southern Methodist University Press, September 2002: 184 pages

Iqbal Pittalwala, campus communications officer for science and engineering in the Office of Marketing and Media Relations, has published his first collection of short stories that detail the lives of ordinary South Asians in contemporary India and the United States, giving voice to people usually denied a say. Interweaving the joys and sorrows of men and women, the eleven stories in “Dear Paramount Pictures” reveal universal truths recognizable to readers everywhere.

The title story is a rambling letter to a major studio in Hollywood from an aging Indian woman who is positive she has just met James Dean in Bombay. Other stories tell about a father’s pangs of conscience because of the suicide of his “slow” daughter; or the visit of an elderly widow from Bombay to her son in America, where she asserts her independence with an ill-fated, but entertaining, trip to the shopping mall.

A native of Bombay, Pittalwala earned his Ph.D. in atmospheric science in 1993 from the State University of New York at Stony Brook. In 1995, he earned a Master of Fine Arts degree in creative writing from the Iowa Writers’ Workshop, the University of Iowa. His stories have appeared in the Seattle Review, Blue Mesa Review, Confrontation, Trikone, and other magazines.

777 Mathematical Conversation Starters
by John E. de Pillis
Mathematical Association of America, November 2002: 368 pages

“777 Mathematical Conversation Starters” by John E. de Pillis, emeritus professor of mathematics, shows that there are few degrees of separation between mathematics and topics that provoke interesting conversations.

The topics presented in this unique book are accessible to mathematicians and non-mathematicians alike. They include thought-provoking conversation starters, such as: the value of fame; why language matters; the anatomy of thought; how we know what we know; how the Pythagorean theorem (with very little physics) shows that Einstein was correct about time dilation and distance contraction; and, how mathematics produces intuition-defying examples.

The crossover book presents material that is of interest to the curious reader who may or may not have advanced mathematical training. There is material for those who choose to explore special relativity at an elementary level, while those who wish to delve more deeply are provided with detailed equations and explanations.

Examples of talking points covered in the book are: How does the dry spot under a car after a rain illustrate the difference between induction and deduction? Why was Monty Hall upset when mathematicians analyzed the Monty Hall problem? When does one bite of a potato become a life-altering experience? How can a finite amount of ink paint an infinite surface? And what is often referred to as “the weirdest result” in mathematics?

Hearts Kept Waiting
by Julianne Elliott '89 Teaching Credential

“Hearts Kept Waiting” is a contemporary romance novel set in the Central Valley of California.

When New York photojournalist Melissa Lagomarsino flies to the valley to dispose of her late aunt’s walnut orchard, she doesn’t plan on staying more than a few days, a week at the most – until she meets Justin Noviello. He is a San Francisco attorney whose family has owned the neighboring ranch for generations, a man trapped in a loveless marriage who is determined to make a fresh start and return to the farming life.


Elliott resides in California with her two children and two dogs. She teaches, reads romance novels and writes when she finds time.

A Cat Named Darwin; How a Stray Cat Changed a Man into a Human Being
by William Jordan ’66

Bill Jordan’s life changed forever the day a stray cat, nesting under his bougainvillea, bit him on the hand. A reformed biologist,
Jordan had no particular love for animals and felt vaguely contemptuous of those who did — until the cat, beckoning with a wink and a yawn, led him on a journey to exotic lands, strange cultures and fascinating discoveries. As their bond deepened, the cat’s health began to fail, leading Jordan into a commitment more devoted and sincere than he had known.

Puzzling through his own feelings, he came to some remarkable conclusions: that those we love live in the synapses and molecules of memory and that, as long as we exist, they exist as part of our brain. It doesn’t matter to the neurons whether the loved one is an animal or a human.

The mechanism is the same. Even so, the two relationships are quite different. A cat is a creature with which one shares solitude; in a relationship with a human being, on the other hand, solitude often means failure. And while communion with animals is usually considered inferior to communication with human beings, the truth is that the need for companionship is a human trait.

In the absence of other companions, the human mind will grow around any living thing like a vine. Bill Jordan learned that the first time your mind grows around a cat, you don’t realize you have fallen in love until it’s too late.

Jordan is the author of the book “Divorce Among the Gulls: An Uncommon Look at Human Nature” (March 1991). He has a Ph.D. in entomology from the University of California, Berkeley and lives in Culver City.

Amelia Earhart’s Shoes: Is the Mystery Solved?
by Thomas King ’76 Ph.D. (editor), Randall Jacobson, Karen Ramey Burns, Kenton Spading
Altamira Press, October 2001: 256 pages

Can modern science tell us what happened to Amelia Earhart? A team of renowned scientists — members of TIGHAR’s (The International Group of Historic Aircraft Recovery) Amelia Earhart Project — has spent 15 years searching for Amelia, using everything from archival research and archaeological survey to side-scan sonar and the analysis of radio wave propagation.

In this spellbinding book, these scholars offer tantalizing evidence that the First Lady of the Air and her copilot, Fred Noonan, landed on a remote Pacific island but perished before they could be rescued. The world’s most famous airplane mystery, deserted tropical islands, unparalleled detective work, sprinkled with an adventurous search reminiscent of Indiana Jones — all combine to create a tale that is impossible to put down.

Do we have Amelia’s shoes? Part of her airplane? Are her bones tucked away in a hospital in Fiji? Come join the fascinating expedition and examine the proof for yourself.

King is a well-known archaeological consultant, specializing in the protection of cultural resources. He is the author of five books and the archaeologist on the Amelia Earhart Project.

The Library Corner

“We are only at the first stammerings of science; the next century will laugh at us.” So declares one of the heroes of a century that the 20th century would laugh at us. “So uncannily apt vision of the future, only one fact is certain: for good or ill, the “sovereign power” of science is unstoppable.

The Eaton Collection of Science Fiction, Fantasy, Horror and Utopian Literature is the world’s largest such collection. To maintain our “sovereign power” in this field, however, we need the assistance of our friends and supporters. For information on contributing to the Eaton Endowment, call 909-787-3233 or Melissa.Conway@ucr.edu.
Nanotechnology: defined
By JUDY CHAPPELL

What is nanotechnology? In the simplest of terms, it is manufacturing things one atom or one molecule at a time.

If nanoscale is defined as between 0.1 to 100 nanometers in size, how big, or rather how small, is a nanometer? The diameter of a human hair is 100,000 times wider. Only three to six atoms can fit inside a nanometer.

The prospect of working at the nano level is not new. Nobel Laureate Richard Feynman proposed the idea of nanotechnology at California Institute of Technology in 1959, in a famous talk entitled "There's Plenty of Room at the Bottom."

"The principles of physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom. It is not an attempt to violate any laws; it is something, in principle, that can be done; but in practice, it has not been done because we are too big," said Feynman.

Although humans can't shrink themselves, they have the ability to create and shrink machines to handle such tasks, and they are well on their way to realizing Feynman's vision. As Small Times Magazine puts it, "There are big things happening
in the world of small technology.” Researchers worldwide, including a group at UC Riverside, are now able to make nanoscale building blocks that can be used to create nanostructures.

“Nanotechnology represents the final frontier in miniaturization, at least on the surface of the planet,” said Robert Haddon, director of the Bourns College of Engineering Center for Nanoscale Science and Engineering. “To go beyond the nanometer length scale (to the picometer), requires energies beyond our comfort level, that is, the energy for nuclear fission.”

We have all witnessed the shrinking of technological devices. Remember those days of yore when you saw your first transistor radio? At the time it seemed such a wondrous device, a machine that a person could carry in a pocket yet be able to use to listen to the radio!

Then came the personal computer, a device that did not need a special air-conditioned room and that would fit on a desktop. Science continued to march forward and the Dick Tracy-esque invention, the cell phone, was introduced to consumers.

And there is the calculator. Once a large desktop contraption with a lever, it is now as small as a credit card. Yes, technology is headed smaller, and devices have become less costly, more efficient and easier to handle. They require less raw materials to produce, are manufactured more precisely with less unnecessary parts and take advantage of technological developments.

How will this new technology affect our daily lives? When we gain the ability to build things from the atom or the molecule up, we will also be able to rearrange matter with atomic precision. The benefits are many: a dramatic decrease in waste, production expense, pollutants, use of non-renewable natural resources. Parts will fit perfectly with less friction, meaning they will last much longer.

“It is well-known that very few materials perform at anything approaching their theoretical strength,” said Haddon. “For example, the normal imperfections present in most metals significantly reduce their strength from what would be expected in a perfect material that is free of such imperfections. Thus, steel and aluminum may be replaced by stronger and more flexible materials, such as carbon nanotubes that are already being produced and that can, in principle, be manufactured without defects. The raw materials are easier to obtain: carbon, oxygen and nitrogen. But perfection comes at a high price: impure carbon nanotubes

**Nanotechnology offers improvement of our lives in any area that would benefit from the development of better, faster, stronger, smaller and cheaper systems**
Nanotechnology offers improvement of our lives in any area that would benefit from the development of better, faster, stronger, smaller and cheaper systems:

- Manufacturing – precision on the atomic scale will result in enormous flexibility in the types and quantity of things we may build, while simultaneously reducing the cost associated with manufacturing products.
- Medical – small computers, or nanorobots, would be able to travel through the circulatory system, cleaning the arteries, tracking down and destroying cancer cells and tumors, repairing or replacing injured tissue.
- Ecology – filtration systems could be created that would remove toxins from the air or hazardous organisms from drinking water. Factories would create little or no waste and use easily available raw materials.
- Space exploration – equipment of smaller size and greater functionality would be easier to place in space. Biological nanotechnology might even allow us to adapt our bodies for survival in space or on other worlds.
- Agriculture – efficient use of resources, disease control and genetic engineering would give us the capacity to grow sufficient food to alleviate world hunger.

“Nanotechnology is not confined to a particular field. It encompasses all of the scientific disciplines including chemistry, engineering, physics, biology, computers and medicine,” Haddon said. “Thus, nanotechnology serves as a vehicle to create teams of scientists and engineers around a particular problem rather than focusing on what can be accomplished within a particular discipline. This comes about because the focus in nanotechnology is on the basic building blocks of matter – atoms and molecules – and at that level all of the disciplines have a common starting point.”

Early computer manufacturers did not envision the Internet. Early developers of electrical technology did not envision telephones, television or computers. These modern communication systems have changed our lives, giving us access to every corner of the world.

With nanotechnology we are entering a new realm of the fundamental workings of biology and the fundamental properties of matter, and its effect is expected to be profound.

How small is a nanometer?

The standard measure in nanotechnology is a nanometer, which is one billionth of a meter.

Think of it this way: a nanometer is to one inch what one inch is to 400 miles. Or, another way to visualize the size, the diameter of a quarter compared to the driving distance between Los Angeles and San Francisco.
Tiny medical robots could someday roam the bloodstream delivering medicines directly into red blood cells.
“They have found universes in grains of sand.” – “Blood Music” by Greg Bear

A new frontier is at hand, but on such a small scale that it is nearly invisible. Scientists are actively pursuing research that would result in working devices measured in a few thousandths of a human hair, bringing faster and more portable computers, clothing that can protect against poison gas and tiny repair robots that can swim inside a human body and clear the gunk out of arterial pathways.

Hinted at for decades in science fiction stories such as “Fantastic Voyage” – a 1966 film that portrays humans shrunk to explore human arteries in tiny submarines – thinking small, very small, is the world’s latest future fixation.

It was 1959 when Cal Tech physicist Richard Feynman declared “There’s Plenty of Room at the Bottom,” as he talked about nanotechnology, or maneuvering at the atomic scale. These infinitesimally small inventions, made up of gears and enzymes and chemical reactions, would do actual work. Perhaps they would manufacture enzymes to gobble up an oil spill safely or enable a layer of paint to include millions of solar collectors for household energy production. The basic research that would permit thousands of viable uses of nanoscience is in laboratories all over the world today, funded with a sudden influx of public and private research dollars.

IBM, Fujitsu and Intel are pouring money into research. So
are public and private foundations. The Bush administration has earmarked $710 million for nanoscience research this year, a 17 percent increase over last year. The National Science Foundation predicts a $1 trillion market for nanotechnology products by 2015.

“If you look at it from the applications viewpoint, the computers, the devices, they are all getting very, very small,” said Satish Tripathi, dean of the Bourns College of Engineering and an expert in computer science. “We need to study materials at the nano level for us to manipulate at the atomic level. This is a natural progression from where we are in materials science, biological sciences and information sciences. In order to stay relevant, we have to invest in this.”

Whether major research breakthroughs are five years or 20 years or 50 years out, the potential changes wrought by nanoscience are likely to affect us all. Just beneath the surface of the basic science under way are potential applications in medicine, in the environment, in our national defense and in computers and other consumer products.

**Medicine**

Just as in many areas of technology, science fiction has helped explore the idea of making tiny medical robots, mechanical and/or biological in nature, that manufacture and repair injuries.

The main character in “Blood Music,” by Greg Bear, is a scientist whose body is physically reconfigured by tiny biological robots swimming inside. In the recent futuristic spy thriller, “Ecks vs. Sever,” a tiny robot needle swims in to deliver a few molecules of a poison to one of the main characters: not enough to realistically kill anyone, but it makes for a good plot twist.

Back in the real world, researchers are looking for ways to tunnel out clogged arteries before the patient suffers a stroke or heart attack. Drug delivery systems might use nanoparticles small enough to gain entrance through the pores of a cancerous tumor. Or perhaps tumors can be found and removed while they are still only a group of a few cells, rather than a few million.

Commercial drug companies, a $380 billion annual industry worldwide, are major players in finding ways to make nanoscience join with the biological world of DNA strands, enzymes and proteins. The U.S. accounts for 40 percent of the world drug market.

“We already inject people with chemicals, and many medical functions work at the cellular level,” said Robert Heath, a botany professor who also has an interest in the uses of science in science fiction literature. “What we are just starting to do is to combine the biological with the mechanical. That is the next step.”

As an example, Heath cited a NASA project that changes a gene from a single-celled organism that lives in near-boiling acid mud to add instructions on how to make a protein that sticks to gold or semiconductors. Since cells and proteins are already programmed to replicate themselves, they make the perfect medium for attaching metals or chip components.

Just think about the cosmetic uses of nanoscience and the money they would bring in our appearance-obsessed society. Hair color can go from dark to light with nanomachines that change the amounts of melanocytes in hair follicles. And those robots swimming through the arterial lines? Wouldn’t they, on their way, process some of the excess body fat?

**Consumer Goods**

On shelves of sporting goods stores, consumers can already find tennis rackets made from materials mixed with carbon nanotubes, for strength without weight. On the next aisle over sits sunscreen, with particles of zinc oxide that are so small they no longer reflect a visible light spectrum. Consumers get the protection from solar radiation without the white, gloppy mess.

The step-up platform in the GMC Safari SUV and the Chevrolet Astro minivan contain nanoparticles. For the most part, these applications do not call attention to themselves. But more could be coming that will be more visible. Or maybe invisible.

When Jackie Chan hides in plain sight in “The Tuxedo,” it is a demonstration of one nanotechnology possibility: digital ink on clothing that would use millions of tiny electrical contacts to show or hide pigments, literally making the wearer a fabric-covered chameleon. In the movie, the clothing also controls the actions of the wearer, a concept that at this point is still much more fantastical than realistic.

And the movie’s claim that a tux like that costs $2 billion? That’s a low estimate. Since nanotubes have not yet been mass produced, a gram of nanotubes costs more than the same amount of gold or platinum.

It’s not all science fiction. MIT has an Institute for Soldier Nanotechnologies, funded by the U.S. Army, which is working on developing lightweight armor or clothing that detect and protect against biohazards on the battlefield.

Approximately 1,000 companies currently have nano-related products in the marketplace. A little less than a quarter of those are profitable at this point, according to NanoBusiness Alliance, a trade group in New York.

Wilson tennis balls, for instance, have nanoparticles in the coating of the inner core. Eddie Bauer right now offers
The Environment

Nanotechnology might be able to do all this, while still keeping the planet green and clean. Devices to eat impurities from smokestacks, or oil from the oceans, or bacteria and chemicals from the drinking water, would help the earth support more people without massive industrial pollution.

At the end of their useful lives, these nano machines take up much less room in the trash bin, saving people from becoming overwhelmed by their own technological waste.

Imagine solar power cells so small they can be painted on with a layer of light sensitive paint on the outside of a house. Solar power for homes and businesses would be nearly invisible and clean. Cars might be made from lighter and stronger materials, thereby needing less energy to power them down the road.

The National Science Foundation’s senior adviser on nanotechnology, Mihail Roco, said the market for nanocomponents will reach $1 trillion a year, especially in computer chips, pharmaceuticals and chemical catalysts.

Computer science, already expanding more quickly than most people can update their systems, will advance even more quickly with the tools of nano science. IBM researchers have come upon a concept that may take us back to the future.

“Millipede,” the code name for its research project, uses sharp tips to punch indentations into a thin plastic film. The result is more like the punch cards of the 1950s than the electrical on and off switches of our current computers. Because it is so small and the distances are so minuscule, Millipede can store a trillion bits of information on one square inch, 20 times more than today’s available technology. That equates to 25 million printed pages on something the size of a postage stamp.

Nanotechnology may clean the environment on a global scale by fabricating tiny devices that eat impurities.

What we are just starting to do is to combine the biological with the mechanical. That is the next step.

Philosophy and Religion

One thing that science fiction does best is raise ethical questions. For instance, how are we going to regard these devices that are part pulley and part chemical reaction? At what point do the boundaries slip between the biological and the mechanical?

“Soon we will be breeding machines instead of making them,” said George Slusser, professor of comparative literature and the curator of UC Riverside’s extensive collection of science fiction and fantasy. “In the end, will we have to hand over the world to a higher entity?” he asked.

Heath, Slusser’s teaching partner in a course on the scientific ideas in science fiction, asked the age-old question of who decides whether a person’s brain needs an overhaul. “If someone is psychotic, do you cure that? Or is that the part of them that might be tremendously creative?”

“Blood Music,” the story cited previously, graphically details how a scientist experiments on himself, by injecting tiny biological devices that make repairs and improvements to bone and muscle and brain. It is, however, a cautionary tale. The scientist is transformed from the inside out. In the end, however, the bots themselves, as a new sentient life form, spread to other people and overwhelm human kind.

“But how realistic is this notion of a self-replicating nanobot?” asked Richard E. Smalley, a Nobel prize winner who founded the Center for Biological and Environmental Nanotechnology at Rice University. In a Scientific American article from 2001, he outlined two fundamental problems with the idea of self-replicating nanobots, the kind that might “take over.”

With comparisons to “fat fingers” and “sticky fingers,” Smalley declared that self-replicating nanobots are no more than a “futurist’s daydream,” a comment that seems almost prescient in light of the December release of Michael Crichton’s book “Prey” that imagines nanobots that fly in hordes and become threats to mankind.

Other great inventions have changed the world. Think about the first written language, curing plagues, the introduction of the printing press, discovering penicillin, the invention of the computer and harnessing atomic power. Mapping the human genome and biotechnology are two more scientific fields that have huge potential and risk, at the same time.

As James Burke pointed out in his public television series, “The Day the Universe Changed,” there are certain inescapable realities of progress. Change brings both good and ill. And we are the ones who will determine the end of this tale.
By IQBAL PITTALWALA

Science and technology are zooming in on the nanoscale, resulting in the rise of several relatively new fields including nanoengineering, which represents the extension of engineering into the nanoscale realm, and nanotechnology, which deals with the design and manufacture of very small electronic circuits and machines.

The new fields are inherently interdisciplinary in nature, lending themselves well to research-intensive universities, such as UC Riverside, where scientists in the forefront of their disciplines can collaborate on and advance nanoscience and nanoengineering research.

While a congeniality among UC Riverside faculty members facilitated the formation of two nanoscience centers on campus, forming the nanoscience team still presented a challenge, akin to piecing a puzzle together to form the larger emerging research picture. That picture is now more clearly defined and the university is boldly visible on the world’s nanoscience map because of its two centers: the Center for Nanoscale Science and Engineering and the Center for Nanoscience Innovation for Defense.

**The Center for Nanoscale Science and Engineering**

At present, nearly 25 faculty members, hailing from engineering, cell biology and neuroscience, chemistry and physics, constitute the research team at the Center for Nanoscale Science and Engineering (CNSE) on campus, headed by Robert C. Haddon, Distinguished Professor of Chemistry and Chemical & Environmental Engineering. Haddon came to UC Riverside less than two years ago to found the center.

“A nanometer is interesting and special because it is the size of a molecule,” he explained. “Many processes operate at the nanometer level, those in biology offering an obvious example. The cells of our bodies are nanostructures. Drugs ultimately work at the molecular level. Using nanoscience, treatment can be administered more effectively at this molecular level, and one can envision, too, repair of the human body at this level.”

But to understand these molecular processes more than we now do, special tools that can both image and direct single molecules or atoms need to be developed. This is where nanotechnology steps in, uniting engineering and science disciplines at the bottommost, molecular level.

Christopher Reed, Distinguished Professor of Chemistry, was instrumental in bringing Haddon to campus. “UC Riverside could not afford to move into the 21st century without some stake in nanoscale science,” Reed said. “Haddon is an outstanding scientist and also a nice guy. I want UC Riverside to become known as a place where both scholarship and collegiality always go together. Prima donna behavior has ruined many a department and university.”

Reed was fully confident, too, that Haddon could build strong bridges among the department of chemistry, the various departments in the College of Engineering and the department of physics.

“I knew that his connections with physical chemists and...
physicists would help in attracting more good people to UC Riverside, he said. “With Haddon and Ludwig Bartels on the chemistry side of things and momentum to build in engineering, physics and biology, we have the nucleus to stake a claim. The value of that claim will depend on the success of the individuals we hire and how well they work together for the common good.”

The Center for Nanoscience Innovation for Defense

In addition to the campus center, UC Riverside joined two other UC institutions in July 2002 to form the Center for Nanoscience Innovation for Defense (CNID), an alliance created to facilitate a rapid transition of research innovation in the nanosciences into applications for the defense sector.

The University of California, Santa Barbara (UCSB) and the University of California, Los Angeles (UCLA) are the other two institutions. The three UC institutions will equally share U.S. government allocations of about $20 million.

The motivation for CNID arose from discussions in federal research agencies, which recognized a problem emerging with the diminution of basic research in the nation’s major industrial laboratories, such as Bell Labs. It was decided, as an experiment, to back a group of universities, where faculty were experienced in both working with industry and doing fundamental science, in order to form a network to keep companies informed of the latest developments in science and technology.

Broadly speaking, the experiment focuses on knowledge transfer in the form of information and human expertise to American companies – knowledge particularly relevant to national defense. By joining UCSB and UCLA in the CNID effort, UC Riverside, under Haddon’s leadership, will rapidly ramp up facilities and research in nanotechnology. Because the nanotechnology effort at Riverside is still in its beginning stages, CNID funds will be used for the basic infrastructure for research and to fund projects of relevance to the CNID mission.

Funding CNID

The Defense Advanced Research Project Agency (DARPA) and Defense MicroElectronics Activity (DMEA) sponsor the three-campus CNID. The center aims at the control and understanding of nanoscale materials, with applications in information and communications technology.

In concert with DARPA and DMEA, the center will serve as a hub facilitating the exchange of ideas, scientific discoveries and technologies. It will also couple the strength of the existing research programs at the three campuses with commercial and national defense industries (Boeing, DuPont, Hewlett Packard, Hughes Research Laboratories, Motorola, NanoSys, Northrop Grumman, Rockwell Scientific, Raytheon and TRW) and with national laboratories, particularly Los Alamos.

“Currently, the CNID money is being used to equip the facilities at the three UC institutions..."
with state-of-the-art high-tech instrumentation,” said Haddon. “The funds are also being used to support graduate fellowships aimed to enable the three campuses to compete for and attract the best graduate students worldwide to advance nanoscience and nanotechnology research.”

CNID offers unique opportunities for graduate student researchers to gain industrial research experience through collaborative projects and summer internships, both within the center and through industrial and university partners. These students are intended not only to be the nanoscience university researchers of the future but also the nanotechnology talent for high-tech American businesses.

Thus, by serving as a conduit through which industrial partners can recruit highly trained students in the areas of nanoscale science and engineering, CNID allows students to obtain contact with “real world” research and development in the private sector.

**UCR’s CNID Program**

At UC Riverside, CNID researchers plan to develop the control of charge, spin and light in nanoscale architectures to create a new set of electronic, photonic, spintronic and mechanical devices and systems. The scientists will also develop a palette of fabrication tools, many of which will involve solid state, chemical and biological pathways, templates and precursors.

“The research at UC Riverside is focused on the preparation of nanomaterials that will eventually be fabricated into nanodevices when the University Nanofabrication and Clean Room facilities are completed this year,” Haddon said.

The UC Riverside effort includes the preparation and construction of devices based on multiporphyrins, carbon nanotubes and neutral radical conductors. The university also has a project designed to study the interaction between carbon nanotubes and neurons – both of which transport charges over conducting channels that are of submicron dimensions. In recognition of the importance of homeland defense, there is also a strong component of work on sensors that is expected to have defense applications.

“California is leading the way in nanotechnology,” said Haddon. “While semiconductor research was led essentially by industry, nanotechnology research is being spearheaded by universities. It’s terrific that three UC campuses have come together to form a partnership for a common project with a common goal.”

**Building UCR’s Nano Team**

**Robert Haddon,** Distinguished Professor of Chemistry and Chemical & Environmental Engineering. Ph.D., 1971, Pennsylvania State University. Haddon grew up in Longford, Tasmania, and received his B.S. from Melbourne University in 1966. A recipient of many awards, he was recruited to UC Riverside by former Chancellor Raymond Orbach.

In 1998, Haddon’s research group prepared the first soluble single-walled carbon nanotubes, allowing the study of carbon metals and semiconductors in solution. The group demonstrated both ionic and covalent solution phase chemistry, with concomitant modulation of the electronic band structure. In 1999 the group synthesized and characterized the first phenaleny1-based neutral radical molecular conductors.

**David Bocian,** professor, chemistry. Ph.D., 1976, University of California, Berkeley. Bocian received his B.S. from North Carolina State University in 1972. He is an internationally recognized expert in the area of spectroscopic (vibrational, electronic, magnetic) and electrochemical studies of the tetrapyrrolic systems with applications for both biological and materials chemistry. An Alfred P. Sloan Fellow from 1982-1988, he studies how photosynthesis functions at a molecular level. Bocian’s research interests include the study of energy-transducing systems and the characterization of structural, electronic and magnetic properties of various transition metal complexes. Bocian’s nanotechnology role is to characterize the basic properties of molecules, a required step before molecules can be used in devices.


Kawakami was a double major at his undergraduate school, the University of Pennsylvania, and received degrees in physics and electrical engineering in 1992. His honors include a 1999 David A. Shirley Award of the Advanced Light Source from Lawrence Berkeley National Laboratory and a 1997 Leo Falcov Award from the American Vacuum Society.

Kawakami is a leading researcher in the emerging field of spintronics electronics, based on the spinning motion of electrons. He studies the properties of spin in novel materials and nanostructures, using advanced synthesis techniques and time-resolved magneto-optics. His research in experimental condensed matter physics seeks to develop a fundamental understanding of electron spin in solids and to utilize this knowledge for technological applications.

**Roger Lake,** professor, electrical engineering. Ph.D., 1992, Purdue University. Lake was a member of the Nanoelectronics Branch of Texas Instrument’s Corporate Research Laboratory in Dallas from 1993 to 1997 when he developed the theory underlying the Nanotechnology Engineering Modeling program. The Nanoelectronics Branch became part of Raytheon’s Applied Research Lab in 1997 where Lake designed the first VLSI (Very Large Scale Integration) compatible Si/SiGe (Si = silicon; Ge = germanium) resonant interband tunnel diode, THz (terahertz) sources and detectors and low power memory devices. Lake joined the department of electrical engineering at UC Riverside in 2000.

He is investigating a physical implementation of a quantum computer using molecular quantum gates. Working with Raytheon, he is designing devices for millimeter wave and THz applications. His awards include the Semiconductor Research Corporation Fellowship, 1988-1992, and Senior Member, IEEE, 2001-present.

**Umar Mohideen,** professor, physics. Ph.D., 1992, Columbia University. Mohideen received his Bachelor of Technology degree in 1983 from Banaras Hindu University in India. He has made extensive contributions to such subjects as the measurement of nanoscale forces, the optical properties of micron and nanometer sized particles, high intensity short pulse lasers and their interactions with atoms and solids, laser produced plasmas, recombination type X-ray lasers and picosecond X-ray pump-probe spectroscopy of atoms.

Mohideen is studying how long molecules keep information in different environments, such as air, vacuum and solution.

**Ashok Mulchandani,** professor, chemical engineering. Ph.D., 1985, McGill University. Mulchandani received his Bachelor of Technology degree in chemical engineering in 1976 from the Laxminarayan Institute of Technology, Nagpur, India. Biosensors and biodetoxification
are two primary thrust areas of Mulchandani’s research program. In the nanotechnology project, Mulchandani is involved in two group projects looking at the development of biosensors for rapid sensitive and selective detection and quantification of chemical and biological warfare agents.


Ozkan is helping set up the Nanofabrication Facility. His current research is focused on self-assembly of structures and nanofabrication in semiconductors and polymers and fabrication of micro- and nano-electromechanical systems for biosensing and mechanical testing. His awards include a Ph.D. Fellowship from the North Atlantic Treaty Organization. Ozkan came to UC Riverside from the Applied Micro Circuits Corporation in San Diego, California, where he worked as a senior development engineer from 1997 through 2001.


Originally from Turkey, Ozkan received her Bachelor of Science degree in metallurgical engineering in 1988 from the Middle East Technical University in Ankara. She is the recipient of several awards, including the Regents’ Faculty Award in 2002.

Ozkan’s contribution to the development of high throughput cellular microarrays opens opportunities in bioengineering applications, including tissue engineering and drug discovery. Her research interests include the development of novel biomedical microdevices and applications of nanotechnology for future developments in bioengineering. She will be concentrating on developing new nanoprobe for better imaging, nanoelectronic devices and nanoscaffolds.


Parpura was born and raised in Split, Croatia. He received his M.D. degree from the University of Zagreb in 1989.

Parpura won the 1988 Rector’s Award at the University of Zagreb. He also won the Nikola Tesla Award from the Yugoslav Academy of Science and Arts in 1988. In 1995-1996, Parpura was a Research Fellow for the Mayo Foundation. His research deals with glia-neuron signaling. For the nanotechnology project at UC Riverside, Parpura is studying the interactions between neurons and nanotubes.

Yushan Yan, associate professor, chemical engineering. Ph.D., 1996, California Institute of Technology.

Yan received his Bachelor of Science degree from the University of Science and Technology of China in 1988. He is the recipient of the Regents’ Faculty Development Award, 2001, and the Regents’ Faculty Fellowship, 2000, University of California. In 1990, Yan won the President Scholarship Excellence Award from the Chinese Academy of Sciences. He has lived in the United States since 1992, coming to this country from Jilin Province, China. He joined UC Riverside in 1998.

Yan’s research interests include zeolites, fuel cells and nanostructured materials. His involvement in the nanotechnology project involves the development of nanostructured fuel cells and the fabrication of nanosensors for chemical and biological agents.

UCR’s CNID Research

The CNID research program aims at understanding, and thereby controlling, nanometer-scale systems for advanced technology.

UC Riverside’s five areas of CNID research focus on:

- nanoscale electronic devices
- spintronic devices – both organic and inorganic
- multiporphyrin molecular memories
- neurons and nanotubes
- sensors

Nanoscale Electronics Devices

Nanoscale electronic devices are devices that have at least one representative dimension in the nanometer scale, and they exhibit unprecedented physical, chemical and electrical properties. Research in this area involves the synthesis of nanomaterials with unconventional nanostructures (tailed grain boundaries, interfaces, tunneling effects, enhanced mobility, for example).

The behavior at the nanoscale is not necessarily observable from the larger scales, and most changes are due to phenomena, including quantum mechanics, predominance of interfacial phenomena and size confinement. Current technologies for the fabrication of nanodevices include electron beam lithography, molecular beam epitaxy and self assembly.

Cengiz Ozkan is focusing on nanoscale devices made from carbon nanotubes and quantum dots, biosensing devices and nanoelectromechanical systems. The challenges his research faces include synthesizing three-dimensional nanostructured systems, integration of these nanostructures at larger length scales and forming the interface between the nanodevices and the outside world.

“Once it becomes possible to control the size and morphology of the nanostructures and devices, it will then also be possible to enhance the material properties and functionality of the devices,” Ozkan said. “As the fabrication process matures and more unknowns are eliminated, this will become a clearer picture.”

Nanoscale electronic devices have opened up a new dimension in the area of nano-fabrication with new research avenues being generated by the day. “We have new opportunities in the industry, too,” Ozkan said. “The next wave in the Silicon Valley will be centered around nanotechnology and bio-nanotechnology, including the development of devices and systems for drug delivery, bio-sensing, hybrid nano-bio electronics and nanoassembly processing for fabricating hierarchical multi-layered systems.”

Other faculty involved in nanoscale electronic devices are:

- Alexander Balandin, associate professor of electrical engineering, who is carrying out research aimed at the development of novel electronic and thermoelectric devices based on nanostructured materials.
- Ludwig Bartels, assistant professor of chemistry, whose research group performs high-resolution scanning tunneling microscopy on nano-size objects and structures.
- Ward Beyermann, associate professor of physics, who is interested in the physical properties, including charge transport, of DNA, with implications for nanoscale electronic devices.
- Mikhail Itkis, senior development engineer, who works on the synthesis of carbon nanotubes and their characterization.
- Alexander Korotkov, associate professor of electrical engineering, who is working on the fundamental problem of continuous quantum measurement by nanoscale devices and on practical problems, such as the calculation of the ultimate sensitivity of a radio-frequency single-electron transistor.
- Jianlin Liu, recently graduated from UCLA and a new hire in CNSE, who will work on photodetectors, light emitting sources, single electron transistors and quantum dot flash memories.
- Michael J. Marsella, assistant professor of chemistry, who is designing and synthesizing well-defined organic materials for application in nanoscale organic electronic devices.
Spintronic Devices - Organic and Inorganic

Spintronics is an emerging class of electronics that utilizes the spin of electrons for significantly enhanced or fundamentally new device functionality. The existing applications include ultra-high capacity disk drives and computer memories, while long-term goals include spin-based quantum computers. The main challenges of this research are developing new materials and mixed organic/inorganic nanostructures for controlling spin and developing experimental techniques for measuring the behavior of spin within these structures.

Spintronics is based on inorganic materials and nanostructures, such as magnetic metals and semiconductors (e.g., those found in computers, CD players, or hard disks) and atomically engineered multilayer films. A new frontier is the incorporation of organic (chemically synthesized) materials into spintronic devices based on the possibility of enhanced performance and/or new functionality associated with these materials.

A key thrust of spintronics is to understand how to store the quantum mechanical information of an electron spin for longer and longer times, how to alter it and how to retrieve it. For this purpose, UC Riverside scientists will be developing new materials and structures, including magnetic semiconductors, ferromagnet/semiconductor junctions and ferromagnet/organic junctions.

To measure the behavior of spin in these systems, Roland Kawakami is developing new device geometries and ultrafast optical techniques to measure the dynamics of spin on very fast time scales – on the order of picoseconds (one trillionth of a second).

Kawakami expects the following challenges in his research:

- learning how to improve the transport of spin from one environment to another without loss of information.
- learning how to change more efficiently the quantum mechanical spin-state of an electron in a controllable manner.

“Nothing is stranger than nature itself, and it is exciting to uncover what nature has in store for us,” he said. His group will closely interact with physicists and engineers in the semiconductor spintronics and quantum computation program at UC Santa Barbara.

The study of spin is a direct manifestation of quantum mechanics. Kawakami noted that it is difficult to predict how spin behaves in nanostructures where distinctly quantum mechanical behavior dominates. “Investigation of spin in nanostructures has led to many surprising discoveries over the past several years, and the creation of new materials and structures promises even more discoveries in the future,” he said.

Due to its intrinsic quantum mechanical nature, spin is becoming more and more important in nanostructures where quantum mechanics dominates. “Nothing is stranger than nature itself, and it is exciting to uncover what nature has in store for us,” he added.

Other researchers at UC Riverside working on spintronic devices are Michael J. Marsella, Mikhail Itkis, and Ludwig Bartels. Leonard J. Mueller, assistant professor of chemistry, is working in the area of quantum information processing. Ward Beyermann is doing research in the area of magnetoresistance, specifically on intermetallic oxides and intercalated zeolites.

Multiporphyrin Molecular Membranes

Porphyrrins are molecules that are stable in air and capable of storing a charge. UC Riverside scientists are studying how long these molecules retain information in different environments, such as air, vacuum and solution. “The goal here is to use single molecules to store information,” said Umar Mohideen. He explained that in traditional computers, information storage is accomplished through the use of instruments called capacitors, which take up considerable space.

“Single molecule devices, including memories, would be ultimate in achieving high device-densities,” said Mohideen. “But understanding the science of manipulating single molecules is necessary to achieve this promise.”

“Going to single molecule memories would substantially increase the capacity of memory elements,” said David Bocian. He noted that it is a challenge to come up with the right measurement technique to measure the single charge that each molecule stores.

Neurons and Nanotubes

The neuron, also called a nerve cell, is a specialized, impulse-conducting cell that is the functional unit of the nervous system, consisting of the cell body and its processes, called neurites. Neurons communicate with one another by forming synapses that transmit information from one neuron to another. At synapse, electrical signals carrying the information are transformed into chemical signals. The extension of a growth cone of immature neurons controls the pattern of synapse formation. Additionally, in a mature neuron, following an injury of processes, the growth cone plays a role in neurite regeneration.

“We are attempting to define whether nanotubes – minute tubes made out of carbon – could be used as prosthetics devices in the process of neuronal regeneration after injury,” said Vladimir Parpura. His group and Robert Haddon’s group have collaborated to investigate neuronal growth on multi-walled nanotubes.
(MWNTs). They have found that MWNTs are permissive substratum, allowing neurite outgrowth.

At present, Haddad and Parpura are exploring whether the organization/patterning of MWNT substratum could affect neuronal growth and neurite outgrowth and whether the attachment of different chemicals to the nanotubes surfaces can affect neuronal growth.

"It appears possible to use chemical modification of carbon nanotubes to achieve control of neuronal process outgrowth," Haddad said. He noted that the challenges are manipulating neuron growth and using carbon nanotubes to electrically stimulate neurons.

"This research could lead to the development of neural prostheses and has potential clinical applications," said Parpura. "It could help us pave the way for nanomedicine at UC Riverside. It’s not inconceivable that one day a physician might ask a patient, 'Have you had your nanomedicine lately?'"

Mihri Ozkan is trying to assemble neurons into array format on micro- and nanoelectronic devices. Her laboratory is focusing on the formation of neural networks using electrical fields and nano-assembly. The applications for this hybrid system include biosensing and a tool to explore how the brain functions.

"For this, the major challenges are keeping the neurons’ environment sterile and viable for long-term analysis, that is, about two to three weeks," she said. "This work is revolutionary. Working at the interface of biology and nanotechnology is one of the highly emphasized areas of research by many institutions and academia."

Cengiz Ozkan is designing a biocompatible device platform for the directed assembly of neurons. His group is involved in optimizing the architecture of these and other microfluidic devices and fabricating them using soft lithography methods. "The ultimate goal is to integrate microfluidic distribution, object manipulation, temperature modulation, detection and control electronics on a single chip platform," he said.

Sensors
Sensors are used to detect different chemical and biological components that are hazardous or that are responsible for certain diseases. An example is the detection of the prostate-specific antigen responsible for prostate cancer. These detections can also illustrate certain biological phenomena, such as the hybridization of different DNA strands.

Kambiz Vafai, professor of mechanical engineering, is developing a microcantilever biosensor/biochip that will have large detection capabilities through the use of different microcantilever assemblies.

One of his research agendas focuses on collaborating with the UC Riverside nanotechnology team to grow patterns of aligned nanotubes on various substrates by using the chemical vapor deposition technique. This will allow the fabrication of biochips or biosensor microelectrodes. The research can be used for early detection of various diseases so that patients can have a better chance of recovery.

Vafai noted that a challenge in this research area is increasing the sensitivity of the sensor so that it can detect lower target molecule concentration. Another challenge is to find receptors for different detected molecules. Still another challenge is to have sensors with minimum manufacturing and operating costs.

Vladimir Parpura is also working on sensors. If light is used as an example of a stimulus, then the eye’s retina functions like a sensor for light, converting light into neural activity. Along with Umar Mohideen, Parpura is exploring different biological structures for use as sensors interfaced with a computer rather than the brain.

“We propose to develop a testing procedure based on nanomechanics that will enable us to detect the presence of botulinum toxin in a specimen, such as human material or potentially contaminated food/water, with sensitivity down to a single toxin molecule," Parpura said.

“Measuring single molecule interactions would, however, be a challenge.”

Besides addressing some of the basic neuroscience questions, Parpura’s research group is also developing devices that will help detect biological weapons, such as botulinum toxin. Moreover, his group will develop diagnostic kits to check on future nanomedicine prescriptions.

“Let us imagine for a moment that we can develop nanomachines,” he said. “We can then think of ‘plaque mops’ that can be administered to the blood stream in order to remove cholesterol plaques from the walls of the blood vessels.”

Other UC Riverside faculty working on sensors are:

• Wilfred Chen, professor of chemical and environmental engineering, who is developing enzyme and microbial biosensors for selective, rapid, and direct monitoring of organophosphate pesticides and nerve agents. He is also developing novel DNA-probes for monitoring pathogens, viruses and pesticides in drinking water.

• Harry Tom, professor of physics, who is developing a new signal transduction scheme whereby the attachment of a bioagent to an antibody produces a detectable change on a pixel of a digital camera array. The goal of this research is to enable production of field compatible sensors that can rapidly screen thousands of bioagents using tens of antibody-bioagent pair tests on a single device.

These examples of research are representative of the five target CNID areas at UC Riverside, but the areas themselves include many more research projects. What the examples do show is the pace and scope of discovery and innovation in nanoscience and nanoelectronics. CNID exists as an experiment to bring that knowledge and human expertise to America’s industries for the purpose of defense.

Nina Mufleh, a student intern in the Office of Marketing and Media Relations, assisted with the faculty profiles for this article.

Nano Facts

What is a neuron?

Our body’s central nervous system is composed of two kinds of specialized cells: neurons and glia. Without them, we would lack brain function or body movements.

Neurons are the basic information processing structures. Their function is to receive input information from other neurons, to process the information, and then to send information as output to other neurons. Because of this information flow, we are able to move, see, hear, smell, taste, touch, reason, think, dream, plan, remember, and do everything else we do with our minds.

The brain alone has about 200 billion neurons. Each of them is connected to between 5,000 and 200,000 other neurons.

There are as many as 50 times more glia than neurons. Glia, which are cells that support neurons, provide the structural framework that allows networks of neurons to remain connected in much the same way that the foundation, framework, walls, and roof of a house provide the structure through which run various electric, cable, and telephone lines.

This work is revolutionary. Working at the interface of biology and nanotechnology is one of the highly emphasized areas of research by many institutions and academia.
Robert C. Haddon is the lead faculty member in UC Riverside’s nanotechnology research. He is Distinguished Professor of Chemistry and Chemical & Environmental Engineering as well as the head of the Center for Nanoscale Science and Engineering on campus.

Q. When did you get started in nanotechnology?
A. In the early 1990s, when I was at Bell Labs, my colleagues and I were building new types of electronic devices and we started to research fullerenes – large carbon-cage molecules. In the process, we discovered superconductivity in alkali-doped fullerenes and went on to develop fullerene-based field effect transistors. That’s how I got thinking of nanoscale materials and devices.

Q. Why is UCR a good place for nanotechnology research?
A. The impetus for nanotechnology has been building in science and engineering for some time. At the same time, UCR has been developing into a major research university, and is now perfectly positioned to seize the opportunities and challenges associated with this new area of research.

Nanotechnology involves the physical sciences, biology and engineering. One couldn’t ask for a better subject area with which to unite the campus in a research enterprise. Traditionally, UCR has not had many research centers. But the university is experiencing tremendous growth. It has recognized that nanotechnology represents an excellent opportunity to create a thrust that is right at the cutting edge of engineering and science. The university has already committed resources to nanotechnology and demonstrated strong support. Both former Chancellor Ray Orbach and Chancellor France Córdova are strong backers of nanotechnology at UCR.

Q. Are there broader implications to UCR’s leadership in nanotechnology research?
A. The opportunities afforded by the nanotechnology initiative should not be confined to the campus. It should be seen as an opportunity for UCR to reach out to the community and to help define the future of the Inland Empire beyond the region’s current image as a bedroom community for Orange County and other points west. The Inland Empire is at a juncture where it needs to develop a unique personality. Wisely, UCR has seized the initiative and is leading the effort to uniquely define the Inland Empire, and define it with its own brand of high technology, including nanotechnology and nanomedicine. In
the near future, we should be able to provide a vision for health care along these lines as well.

Q. How might the Inland Empire benefit from nanotechnology at UCR?

A. We think that the effort that UCR is mounting in nanotechnology and its outreach in the Inland Empire will start to catalyze the location of high-tech industry in the Inland Empire. We need to see this sort of high-tech development in our own backyard, not just along the California coast from San Francisco to San Diego.

The Inland Empire is a blank slate waiting to be written on. We need to make sure that UCR wields the pen by exporting high technology from the campus to the community. The university can be a catalyst for the creation of highly paid careers in the Inland Empire so that the local populace will not have to commute to Orange Country and Los Angeles for challenging jobs in high technology.

Q. What are some of the immediate concerns and challenges?

A. We need more first-rate faculty and students who are interested in applying nanotechnology in physics, chemistry, biology, medicine and engineering. We need funds to put the infrastructure in place. We need equipment, some of which can cost millions of dollars. Many universities in California have been in the business for 10-20 years, so they have a head start. While we can get good faculty and students, the most important item at the moment is the availability of shared laboratory space in the amount of about 10,000 sq. ft. We have to put in place clean room facilities and material science facilities that support semiconductor processing and nanofabrication.

We’ll see a big development when we have the nanofabrication facility, which would allow us to fabricate nanoelectronic and nanophotonic devices on campus.

Q. How did you get a team together at UCR?

A. We had a number of key players on campus even before the Center for Nanoscale Science and Engineering started. The grant for the Center for Nanoscience Innovation for Defense, or CNID, provided a theme and mission for our work. The money it provided worked as a glue to bring some of the key people together. We hired more new faculty, like Roland Kawakami and Jianlin Liu, to help fill the gaps we had in our team. They came to us from our partners – UCSB and UCLA – in CNID. We are advertising for more faculty in physics and in the engineering disciplines so that we can further strengthen our team. Our work, from building the nanotechnology team at UCR to identifying the Inland Empire with high technology, is far from over, but we’re on our way.
According to a recent article in the Chicago Tribune, the National Science Foundation estimates the market for materials and devices engineered on a very tiny scale, the nano scale, will be $1 trillion by 2015.

Numerous applications of nanotechnology already exist. Nanotechnology created the ever-smaller grains of silver in the film emulsion that allow greater sharpness in print quality in the film you load in your camera. For every gallon of gas in a car, nanotechnology created a higher level of refinement for the fuel, and tires on the same car are now capable of getting 50- to 60,000 miles worth of wear, thanks to manufactured nanocarbons that increase their usable lifespan.

Nanotechnology can be both the size of something – a tiny something, less than one – thousandth the thickness of a human hair – and also the ability to observe, measure and control matter and its interactions on the nano-dimension scale.

For example, carbon nanotubes are lighter than plastic and are much stronger than steel. They can actually be more durable than diamonds, which also are carbon, and are touted as having the ability to revolutionize computer technology, perhaps as a main element of computers that replaces silicon.

John Kelly, IBM senior vice
government and the states are all engaged. There are similar initiatives by European and Asian countries,” he said.

“In the most basic of human needs – health, food, shelter and communications, for example – nanotechnology will affect business in each area. It’s a very broad and very pervasive kind of science. There’s not much that will be untouched,” Starkovich continued.

He also predicted development of much more efficient motors for air conditioning and electrical lighting, saying there is a significant amount of power wasted in generating visible light.

Starkovich explained that businesses are looking at using the nano scale to find new solutions for new problems. A business opportunity for example, lies in developing the technology for bioremediation of polluted soils and water, such as those contaminated by pesticides or noxious chemicals.

In his specific area of electronics at TRW, Starkovich said, “Right now, we’re trying to figure out how nano fits in our mission and products. We’re looking at space structures and space propulsion, electronics and photonics – fiber optics, light cables, trying to replace electronics – for things that require less power and have higher speed. When we shrink the size of something, we get incredibly more memory, functionality and portability in our devices, things like super computers in a suitcase.”

Starkovich credited the power of business relationships with universities in developing the nano science and establishing partnerships. “In the future there could be some collaboration with UC Riverside. We’re just getting started,” he said. (TRW is already active in other areas at the Bourns College of Engineering: participation in the advisory council, financial support, research, grants, equipment donations, employees who are lecturers and interest in hiring graduates.) “Nanotechnology is like a wave that will affect us all. There are many opportunities for students to get involved, particularly at the universities, which will be the source of much of the science and technical development.”

Starkovich commented, “The pace of development is what’s been surprising. It looks like it’s slow from outside, but in point of fact, it is a feverish pitch and it’s accelerating!”

Chief Engineer David Naiditch, of the El Segundo Division of Raytheon, considers nanotechnology through two academic points of view. His initial college training was as a mathematician, but he returned to earn a master’s degree in philosophy.

In addition to his “day job,” Naiditch lectures on cutting-edge technologies at colleges, including UCLA Extension, groups at Caltech, the Navy and UC Riverside Extension. He designs his talks to foster excitement about the future, a virtual whack on the right side of the brain to challenge engineers, scientists and inventors to think creatively.

When asked what industry expects from nanoscience, Naiditch referred to an article in Business Week from last spring. He said “…It could make the advent of the Internet seem like a minor adjustment in the way we do things. A lot of people say this is going to be the next industrial revolution. Eventually, nanotechnology could change the way almost anything is manufactured by assembling things one molecule or one atom at a time to get the things we want.”

That manufacturing would require a huge number of nanobots, the new artificially intelligent and programmed universal assembler. He described nanobots as incredibly tiny robots that could replicate themselves and build products. This may never happen, but an ultimate goal would be to teach the nanobots to build things with the raw materials that they are given.

Naiditch, now wearing his philosopher’s hat, warns that the problem with business applications is that there’s a lot of hype. He cautioned, “You’ve got to be careful. Some of these people are making it sound too easy when nanotechnology could take many decades – or many centuries – to be fully exploited.”

Additionally, there is the ethical consideration of what is manufactured atom by atom. “People like to hear about putting nanobots through a body – they are the size of viruses – to zap viruses that are harmful or clean plaque from our arteries. They could destroy cancer cells, but can we trust them?” He continued, “With any very, very powerful technology, there’s [potentially] a lot of good and a lot of harm.”

Naiditch’s company, Raytheon, is involved with some major nanotechnology programs. “Engineers are taking it very, very seriously,” he said. “We are funding it because people think it’s going to be a major industry – almost every company is interested, to some degree, in nanotechnology. It’s one of the best-funded government disciplines right now, second only to medical science.”

John Starkovich, TRW

David Naiditch, Raytheon
Nanotechnology: The next generation

By RICARDO DURAN

Mathematics is the basis of all science, no matter what area you go into.

How do you prepare today’s secondary school students for the nanoscientific careers of the future?

The answer is simple — get really good at doing mathematics, says Pamela Clute, a lecturer in mathematics at the Graduate School of Education and the executive director of the ALPHA Center.

The problem for educators is that many students lose their interest in mathematics when they reach middle school. Once the subject loses its luster, there’s little the schools currently do to revive it.

“Mathematics is the basis of all science, no matter what area you go into,” Clute said. “We’ve got to keep it relevant to the lives of students by showing them the scientific applications of the mathematics concepts they are learning.”

Clute is working at finding solutions to the “math is boring” syndrome afflicting so many students who would, otherwise, make fine future scientists.

She is a co-director with several colleagues in the sciences on a National Science Foundation-supported initiative to develop new ways of teaching public school teachers how to keep their students interested in mathematics. The goal is to keep students on track to progress into the sciences. The $5 million grant, which supports the work, is part of a national emphasis on rethinking the way mathematics and science are taught in the public schools.

“So here at UC Riverside, we do three things,” Clute said. “We teach the children directly, we prepare the teachers who teach the children and we make sure the curriculum is up to date and relevant.”

And because the world of nanotechnology is, even today, affecting our lives in profound ways, Robert Haddon, the director of the Center for Nanoscale Science and Engineering at UC Riverside, believes it is important for young people to learn about it.

He also is committed to educating teachers, the general public and students about the exciting research opportunities and careers they can have in nanoscience and technology, said Linda O’Neill, director of the Office of Special Programs at the Bourns College of Engineering.

How do you teach people about something so small that it cannot be seen by the naked eye? O’Neill said there are two approaches: use computers or use Lego building blocks to construct three-dimensional models of the physical and chemical principals related to nanoscale science.

Academically, it boils down to developing what Clute calls “numbers sense” and a grasp of basic computational facts, such as scientific notation, very large numbers and, as in nanoscience, very small numbers.

In either case, whether making a presentation about nanoscience or teaching mathematical principles to young people, there must be visual elements to illustrate what is being discussed and a scientific application to make it relevant.

Who cares about biomolecular nanotechnology, anyway? Because from it may come synthetic molecular devices that guide a cancer drug directly to attack a tumor without harming surrounding tissue or the need to cut a patient open. That would make cancer surgery and toxic chemotherapy less common, if not unnecessary.

Why should anyone care about a carbon nanotube? Because from it may come tomorrow’s replacement to the silicon microchip. That may make today’s desktop and laptop computers tomorrow’s old clunkers.

So what role should a university play in helping the
public schools produce mathematically and scientifically accomplished graduates? They play pivotal roles in teaching students and teachers, but also in bringing the latest nanoscientific findings to the secondary school curriculum.

“We can’t educate students in the latest technologies just by using textbooks, which are typically 10 to 15 years behind the times when they are published,” said Clute.

Keeping curricula current and meaningful will require that schools become partners with universities, who can present them the latest cutting-edge findings to fill in the gaps left by text books, she added.

“Mathematics, science and technology dominate the world,” Clute said. “The countries whose citizens become accomplished in these areas will be at a distinct advantage.”

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**Nanotechnology: A glossary**

**Clean room:** A room virtually free of contaminants used in laboratory work and in small tech production.

**Microarray:** A tool used in biotechnology research to analyze DNA or proteins. Used for diagnostics and drug discovery.

**Micron:** One-millionth of a meter. Also known as a micrometer.

**Angstrom:** One ten billionth of a meter. Atoms are measured in angstroms.

**Nanotechnology:** The creation, use or manipulation of objects at the nanoscale, usually in the 0.1 to 100 nanometer range.

**Sensor:** A device that measures a property of the physical world.

**MEMS:** Microelectromechanical systems. Refers to the fabrication approaches to making three-dimensional devices with features between 1 and 100 microns that combine electrical and mechanical parts that detect or respond to thermal, biological, chemical or optical information. The most common methods of making MEMS are surface and bulk micromachining, but new and hybrid methods have emerged, depending upon the type of device and its intended application. Also referred to as microsystems, microstructure technology and microchamaines.

**MOEMS:** Micro-opto-electromechanical systems. MEMS devices that include optic components, such as micromirrors.

**Bulk Micromachining:** A fabrication process of creating structures by etching into (and through) silicon wafers.

**Deep Reactive Ion Etching (DRIE):** A form of bulk micromachining in which ions are blasted at a wafer’s surface. Creates deep-walled MEMS products.

**Etching:** Removal of material from a surface. Wet etching of silicon uses a chemical bath (usually potassium hydroxide). Dry etching uses gas, plasma or the blasting of particles.

**LIGA:** An acronym from the German words for lithography, electroplating and molding, a micromachining technique popular in Europe used to create very tall, straight-walled structures with extremely small features.

**Lithography:** The process of copying a pattern onto a surface using light, electron beams or X-rays.

**Mask:** The pattern used in lithography which determines which areas are exposed and which are not.

**Surface Micromachining:** The MEMS fabrication process based on standard CMOS (complementary metal oxide semiconductor) processes. MEMS structures are photolithographically patterned in alternating layers of deposited polysilicon and silicon dioxide, and then are “released” by dissolving away the silicon dioxide layers.

**Buckminsterfullerene:** A molecule of 60 carbon atoms that form into a hollow soccer ball shape. Also known as buckyballs, they were discovered in 1985 and named after Buckminster Fuller, whose geodesic dome design resembles their structure. Harry Kroto of England and Robert Curl and Richard Smalley of Texas shared the 1996 Nobel Prize in chemistry for the discovery.

**Carbon nanotube:** A tubular carbon molecule that resembles a rolled up sheet of graphite and has numerous advantageous properties. They form in two types — metallic and semiconducting — and can be a single tube (single-wall carbon nanotubes) or tubes inside tubes (multiwall carbon nanotubes). Sumio Iijima of NEC Corp. in Japan identified carbon nanotubes in 1991.

**Dendrimer:** Short for dendritic polymer, a molecule that has a hub with many radiating branches.

**Nanotube:** Any tubular structure with a very narrow diameter. Carbon nanotubes, for instance, can have a diameter of 1.4 nanometers, and some researchers have reported making tubes with even smaller diameters.

**Quantum Dot:** Bits of materials that are so small that adding or removing an electron alters their properties.

**Atoms:** The smallest form of an element. Each atom contains a nucleus of protons and neutrons surrounded by a cloud of electrons.

**Conductor:** A material or object through which electricity can flow with little resistance. Conductance quantization: Electron transport at the nanoscale. At the nanoscale, electrons travel through conductors in discrete packets, or quanta, instead of a steady flow.

**Molecular switches:** Molecules that allow or block the conductance of electrons when a voltage is applied.

**Molecular wires:** A molecule that can carry a current.
UCR salons – coming to a city near you!

By BARBARA BRINK, CATHY GRAHAM and JUDY LEHR

Imagine yourself surrounded by fellow alums, boosters and parents of current students – in a champagne cellar, on an elegant yacht or in the living room of a restored Victorian home. Whatever the site, envision learning from UC Riverside’s experts about the human happiness response, the “shrinking business” of nanotechnology or the creation and production of art. You may hear a student jazz combo or an author reading from a recent novel, discover where the campus is heading in the next few years or celebrate once again UC Riverside’s national leadership in fellows named to the American Association for the Advancement of Science.

Imagine no more. UCR is doing all of these things through a new program, UCR Salons, when we take the campus beyond the campus to create friend-expanding experiences.

To re-energize relationships across the country, the university decided to “take the campus on the road.” Last year, it began hosting salons so that small groups of alumni, parents and friends could meet informally and chat with leading faculty and senior administrators about today’s UCR.

To date, UCR Salons have visited St. Louis, Dallas, Houston, Atlanta, Oakland, Los Gatos, Oxnard, Temecula, Los Angeles and, of course, Riverside. These intimate events have provided new and old friends an opportunity to learn more about the cutting-edge research that is transforming the world, how business and industry are connecting with the university’s academic and research agendas and how alumni and friends can reconnect by sharing time, expertise and financial support.

Alumni and friends who have joined us include:

• In Atlanta, John and Sandra Glover, whose son Jeffrey is a doctoral student in anthropology, hosted the salon at the Piedmont Driving Club.
• In Dallas, Cindy Anthony (’74, French), daughter of former Dean Leland Shannon, and her husband, Jay Anthony.
• In Houston, Michael and Teresa Baker, generous contributors to Mayan archeological research in Mexico’s Yucatan Peninsula.
• In Los Gatos, John Fox (’73, Political Science), a partner with Fenwick & West, LLP.
• In Oakland, Kirk Miller (’73, Political Science), Brent Barnhart (’65, Political Science) and Dan Lantry (’88, Economics) who provide legal counsel for Kaiser Permanente.
• In St. Louis, Dr. Wayne Barnes (’69, Chemistry), son of Professor Emeritus Martin Barnes.

Henry Coil gets 2002 extraordinary service award

By JUDY LEHR

Were the 300 guests at the 2002 Evening of Recognition surprised when Henry W. Coil, Jr. was presented the Trustees Award for Extraordinary Service? Not at all, but the standing ovation indicated that he was certainly the right choice.

In many ways Coil’s list of involvement reflects the growth and change of the institution over the past decade. He has been a member of the UC Riverside Foundation Board of Trustees for two decades, having served steadily and actively since 1982. During his term as chair, he encouraged tremendous changes to the structure and function of the board. Most significantly, the organization’s by-laws were revised, trustee terms were adopted and committee structures were put in place. Today, the board is a working body with clear responsibilities and expectations.

As a photographer and collector of photographic works, Coil has been an enduring supporter of the UCR/California Museum of Photography, donating valuable equipment and generous gifts.

He did the same with the Sweeney Art Gallery where he served as chairman of the advisory board for 10 years, guiding it, by example and with encouragement.

For example, in 1996, when the Associated Students of UCR put its Art Lending Library on sale, Coil recognized the value of the collection and purchased all 180 fine art prints, ranging in dates from the 17th century to the mid-1970s. He then donated the entire collection to the Sweeney Art Gallery.

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Most recently, UCR Foundation Trustee Richard Reinis and his wife, Lois, hosted a salon in their Brentwood home. Dean Patricia O’Brien brought guests up-to-date on the College of Humanities, Arts, and Social Sciences. Gluck Fellow Monte Fleming, a first-year graduate student, discussed the development of classical music, playing defining excerpts of Bach, Beethoven, Chopin and Shastacovich on the Reinis’ grand piano.

Guests included some members of the Board of Maxwell H. Gluck Foundation – Muriel Gluck, Jon and Rosa Kaswick, and Betty Shellhamer -- as well as Mark and Pamela Rubin, Kathy Jungsoon Seung, and Steve and Wendy Schall whose son is currently a UCR student.


For more information about the upcoming salons – to attend or to host -- contact Barbara Brink at 909-787-2404 or Barbara.Brink@ucr.edu.

the Sweeney Art Gallery, planting the seeds of the museum’s growing permanent collection, which includes original works by Daumier, Steinlen, Shahn, Renoir and Siquieros.

Coil is chair of the College of Humanities, Arts, and Social Sciences Comprehensive Campaign Committee and serves on the College’s Board of Visitors.

He is the third person recognized for his contributions. The Honorable John G. Gabbert and Jacques S. Yeager, Sr. have also received the award.

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Charitable gift annuities offer the option of receiving annuity payments immediately or deferring them.

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Bob and Louise Ratcliffe are receiving income for life because they made the smart choice to establish several immediate charitable gift annuities with UC Riverside. Bob says, “Charitable gift annuities make a lot of sense for my wife and me. By contributing some of our low-interest rate assets to UC Riverside, we get a number of tax breaks as well as income guaranteed for our lifetimes. We like the increased income and the security. Our son attended UC Riverside and loved his courses in creative writing. We wanted to help future students at UC Riverside with our gift.”

Ultimately, their gifts will benefit the UC Riverside Botanical Gardens, the Creative Writing program and will establish a scholarship endowment.

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Under 65? Ask about the UC Retirement Gift Annuity to supplement your retirement income.

By delaying your payments until your retirement, you can supplement some of your retirement income with a secure fixed stream of income. By making your gift now, you receive an immediate income tax deduction while you are in a higher income tax bracket. And, you will receive a higher annuity payment and higher deduction by deferring your payments, than you would receive if you waited until age 65 to set up your annuity.

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• Support UC Riverside!

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By delaying your payments until your retirement, you can supplement some of your retirement income with a secure fixed stream of income. By making your gift now, you receive an immediate income tax deduction while you are in a higher income tax bracket. And, you will receive a higher annuity payment and higher deduction by deferring your payments, than you would receive if you waited until age 65 to set up your annuity.
17th Annual UCR Alumni Association Awards of Distinction Banquet

Kick off the celebration on January 31 with the 17th Annual UCR Alumni Association Awards of Distinction Banquet from 6-9 p.m. in the Commons Dining Room. The five distinguished graduates listed below will be honored for their professional, personal and community achievements:

- Distinguished Alumnus, Oliver A. Ryder, ’68 B.A. Biology
- Alumni University Service, Lee C. McDougal, ’74 B.A.
- Alumni Public Service, Christopher E. Angelo, ’72 B.A. Social Sciences
- Alumni Community Service, Benita B. Roberts, ’68 B.A. Social Sciences
- Outstanding Young Alumnus, Rigoberto Gonzalez, ’92 B.S. Humanities and Social Sciences Interdisciplinary (English/Creative Writing)

The Alumni Association will also recognize UC Riverside's 13 researchers who were recently elected fellows of the American Association for the Advancement of Science.

Tickets for the event are $40 for Alumni Association members and $50 for guests and non-members. Contact the Alumni Association for reservations.

The homecoming basketball game between UC Riverside and Cal State Northridge on Feb. 1 begins at 7 p.m. in the Student Recreation Center. For more information about the basketball game, contact the Athletics Department at (909) 787-4292.

Reunions and Gatherings

The following groups and organizations are having reunions and gatherings. Don’t miss out on this opportunity to meet with friends and return to your alma mater. Don’t see a reunion? Interested in hosting a reunion for next year? Contact the Alumni Association.

- African American Alumni/African Student Programs Reunion kick-off at 6 p.m. on Friday, January 31 at the Riverside Brewing Company for an informal get-together. Come visit with old friends and meet new ones. At 5:30 p.m. on Saturday, February 1, there will be a reception at the Student Recreation Center prior to the homecoming basketball game. Contact Ken Simons (’83) or Dr. E.M. Abdulmumin at (909) 787-4576.

- Associated Students of UCR Informal dinner and walking tour of campus on Saturday, February 1 starting at 4:15 p.m. before the homecoming basketball game. Contact Laurie Sinclair at (909) 787-3621.

- Biomedical Sciences Alumni It’s time to BBQ! Saturday, February 1 at 1 p.m. Bring your families and your friends as we all get together. Contact Richard Jarvis at (909) 787-3027.

- College of Engineering Alumni COE graduated its 1,000th student last year and the 2002-2003 academic year marks the 10th anniversary of the college’s first graduating class. Engineering Homecoming Reception will include dinner and socializing before the game on February 1. Contact David Iyall at (909) 787-2354.

- Men’s Basketball Reunion Pre-dinner reception before the big homecoming game begins at 4 p.m. at the Student Recreation Center. Reserved seating at the game, half time reception and post game wrap up with the coaching staff. Contact Dawn Saenz at (909) 787-4511.

How to contact the UCR Alumni Association

Web site: www.alumni.ucr.edu
E-mail: ucralumni@citrus.ucr.edu
Phone: (909) 787-4511 or (800) 426-ALUM (2586)
2003 Alumni Awards of Distinction

Since 1986, the UCR Alumni Association has recognized alumni who have distinguished themselves through personal, professional and community achievements. Five awards are presented annually at the Alumni Awards of Distinction Banquet, which will be held on Friday, January 31, in conjunction with Homecoming Week.

Distinguished Alumnus Award

Oliver A. Ryder (’68) is a geneticist and the recipient of the Kleberg Genetics Chair at the Center for Reproduction of Endangered Species, Zoological Society of San Diego. A world leader in the application of genetics to the field of wildlife biology, he is one of the first geneticists dedicated to protecting endangered animals and has pioneered the links now bridging zoological parks and those working in the field to conserve natural populations.

In addition to his involvement in preservation efforts involving such species as the California condor, Ryder has also studied such local threatened animal species as bighorn sheep, endangered toads of Southern California and pronghorn antelope of Baja California.

His international efforts include research and collaborations around the globe, focusing on such animals as the African rhino, Przewalski’s horse, giant pandas and gorillas. By studying the DNA profiles of these species, scientists can learn much about the social organization of an animal species, its migration pattern and other information relevant to conserving gene pools. This knowledge, according to Ryder, will help those who breed endangered animals in captivity to introduce them more effectively into the wild and to help conserve wild populations before they reach critically endangered status.

Ryder was the first Distinguished Speaker for the Conservation Biology Colloquium series, inaugurating UCR’s undergraduate program in Conservation Biology in 1997. He currently serves as a member of Specialist Groups of the Species Survival Commission of World Conservation Union, Equid Specialist Group, Captive Breeding Specialist Group and Re-introduction Specialists Group.

Ryder also holds an appointment as adjunct professor of biology at UC San Diego and is an associate editor of the Journal of Heredity. He received his bachelor’s degree in biology from UC Riverside and his Ph.D. from UC San Diego in 1975. He is a Fellow of the San Diego Society of Natural History and a Scientific Fellow of The New York Zoological Society.

In addition to his research, Ryder has authored or co-authored over 200 publications, including research and popular articles, books, book chapters, monographs and abstracts. He has consulted for various organizations, including the United Nations Food and Agriculture Organization; the National Geographic Society; the National Commission for Wildlife and Conservation Development, Kingdom of Saudi Arabia; Sultanate of Oman, Office of the Advisor for Conservation of the Environment; the United States Congress, Office of Technology Assessment; and the Sierra Club Legal Defense Fund.

Alumni University Service Award

Lee C. McDougal (’74) was selected as the Alumni University Service Award recipient in recognition of his long-time support. He served on the UCR Alumni Association Board of Directors for 21 years and is a two-time president of the Association (1987-1989 and 1996-1998). As association president, McDougal also served as UC Riverside’s representative to the Alumni Associations of the University of California, an umbrella organization that links all of the University’s alumni and friends for one primary purpose: to promote the welfare of UC by fostering goodwill among public officials and the general public.

McDougal currently serves on the Association’s Alumni and Visitors Center Committee and on the UC Riverside Foundation Board of Trustees. For many years, he served as a delegate for the annual UC Day in Sacramento to advocate on behalf of the University and UC Riverside in particular.

McDougal has also participated in numerous student recruitment activities and served on several Alumni Association scholarship panels in an effort to recruit top quality students. As a student-athlete himself on the men’s basketball team, McDougal was named All
Division CCAA Most Valuable Player for 1972-1973. He was inducted into the UCR Athletic Hall of Fame in 1998.

McDougal is currently city manager for Montclair and executive director of the Montclair Redevelopment Agency. As city manager, he directs and coordinates all of the city’s services. He joined the city of Montclair in 1976 as housing coordinator, overseeing the city’s Community Development Block Grant Program.

During his third year, he became the director of housing and redevelopment, charged with administration of the city’s Redevelopment Community Development Block Grant and Code Enforcement programs. In 1984, he was promoted to director of administrative services/redevelopment, serving in this capacity until being appointed as city manager by the Montclair City Council in 1992.

McDougal is a member of the Chaffey College Governing Board and serves as chairman of the West End Communications Authority. He is an active community member, devoting much of his time to service organizations, including the Mt. Baldy United Way, Boy Scouts of America, Old Baldy Council and Habitat for Humanity.

McDougal received bachelor degrees in urban studies and Black Studies from UC Riverside in 1974.

Alumni Public Service Award

Christopher E. Angelo (’72) has made a lifelong mission of protecting the innocent and children. He has a special empathy for disabled children and has made it his goal to see that these children’s rights are secured. Angelo was the co-founder of The Christopher Sampson Nonprofit Foundation for the Catastrophically Injured, the only charitable organization in the country dedicated to extending monetary benefits to victims of accidents faced with serious medical needs and where insurance or government programs are either inadequate or non-existent.

Angelo serves as a pro bono advisor for the Bet Tzedek Legal Aid Foundation, the UCLA/NPI Early Childhood Partial Hospitalization Program and to parents of cognitively challenged children relative to protecting major medical benefits.

After receiving his law degree from Loyola University School of Law in 1975, he represented vehicle and other product manufacturers against claims of defective design, insurance companies against claims of bad faith, corporations against claims of unfair competition and hospitals/physicians against claims of corporate negligence and malpractice.

Since 1983, when he “switched sides,” Angelo has specialized in representing only seriously injured plaintiffs. Many of his cases have involved or have established a wide range of cutting-edge theories of liability and responsibilities in such areas as accident prevention, legal duties, insurance bad faith, HMO torts, products liability law, environmental torts, spoliation (evidence destruction) and professional liability.

Angelo was a founding partner of the law firm of Mazursky, Schwartz & Angelo. For 14 years the firm was dedicated to advocating for consumers’ rights and was recognized as one of the top personal injury and tort firms in California. Challenging cases handled by the firm have led to changes in the law for the enhancement of consumer rights and the betterment of society as a whole. In December 2002, Angelo formed the law firm of Angelo and Di Monda in Manhattan Beach, near where he lives and continues to maintain the same type of practice.

While attending UCR on a scholar-athlete scholarship, he participated in football, as well as track and field, before graduating with honors in social science. Angelo has served on the UC Riverside Foundation Board of Trustees since 1998.

Alumni Community Service Award

Benita B. Roberts (’68) has served children and the educational community for over 33 years. After graduating, she began working as an elementary school teacher. Following a brief stint at the Riverside County Office of Education, she returned to Jurupa to teach English and social studies at Mission Middle School.

She moved up the ranks at Jurupa Unified School District from an instructional coordinator, project director, director of instruction and assistant superintendent for educational services to superintendent.

As superintendent, she led a community and staff committee to develop a Five Year Facilities Master Plan to accommodate growth. She retired in 2001, after serving as superintendent for eight years.

Roberts’ community involvement encompasses a wide range of activities. She currently serves or has served on the boards of directors for the Jurupa Mountains Cultural Center, the Rotary Club of Jurupa, the Jurupa Valley Chamber of Commerce, United Way of the Inland Valleys, American Heart Association of the Inland Area and the Riverside YMCA; is a former member of the board of trustees for the Riverside Children’s Museum; and currently serves as a member of the Riverside African American Historical Society, the Riverside Art Alliance and the Planning Committee for Riverside Community College’s 2004 Passport to College Celebration.

She served on the planning committee (1999) and as co-chair (2000) for the Inland Area Woman’s Health Conference. Roberts also served on the Riverside County Training Task Force for the California Reading Initiative and on former Assemblyman Rod Pacheco’s Educational Advisory Committee.

Her contributions to education and her community have been recognized by numerous organizations. In 1997, she won the prestigious “Woman of Achievement” award for education from the Riverside County YWCA. That same year, the Jurupa Chamber of Commerce named her “Member of the Year” for her work in developing goals for the organization.

Roberts has also received an Honorary Service Award from the Jurupa Council PTA and was named a Woman of Achievement by the Riverside County Board of Supervisors.

In addition to her community service Roberts co-authored the book, “Eight at the Top: A View Inside Public Education,” which was published in early 2002. Roberts recently became a partner in an educational consulting firm. She received her bachelor’s degree from UC Riverside in social science and earned an M.A. in elementary education from California State University, San Bernardino.
Outstanding Young Alumnus Award

At the age of 32, Rigoberto González (‘92) has already made a name for himself as one of America’s foremost young Chicano writers. In 1998, he won the most prestigious poetry competition in the country, the National Poetry Series Open Competition, for So Often the Pitcher Goes to Water Until It Breaks.

He was awarded a Guggenheim Memorial Fellowship in Creative Writing in 2000. He has numerous other literary honors and distinctions including a University Award from the Academy of American Poets (1992); the John Guyon Prize for Literary Nonfiction, Crab Orchard Review (1999); Pushcart Prize Nominations; Best American Essays shortlist for "Our Secret Other Worlds" (2000); Fundación Valparaiso Artist Residency, Spain (2001); Fundação Sacatar Artist Residency, Brazil (2001-2002).

He has or will have published five books that are due to be released in the next few years. These works include a "creative biography" of Tomás Rivera; a children’s book, “Soledad Sigh-Sighs”; and, a novel, “Crossing Vines.”

González is a visiting professor at Eugene Lang College of The New School for Social Research in New York. He also serves as a book reviewer with El Paso Times, writing a bimonthly column on U.S. Latino literature.

Born in Bakersfield, California and raised in Michoacán, Mexico, the son and grandson of migrant farm workers, González also dedicates himself to numerous literacy programs both in California and New York. He graduated with a degree in Humanities and Social Sciences.

2002-2003 alumni scholars

The UCR Alumni Association honored 20 scholars this year in its ongoing tradition of recognizing excellence through its competitive program of freshman and continuing student scholarships.

One scholarship recipient wrote, “I have discovered that the University of California, Riverside is the perfect place for me to achieve my goals.” Indeed, this must be true for a lot of Californians with close to 16,000 students on campus this fall. UC Riverside experienced another record-shattering year in terms of student enrollment and projections estimate student enrollment at 21,000 by 2010.

The Alumni Association disbursed over $78,000 to new and current students based on merit or financial need. Parents, alumni, volunteers, scholarship donors and campus administrators recognized these scholars at a special reception on November 14.

In addition to the UCRAA Freshman Scholarship, the association also administers awards for the George Beattie Memorial Scholarship, the Leon Braddock Athletic Scholarship, the Brithinee Continuing Student Scholarship, the Burrtce Waste Industries, Inc. Scholarship and the Reentry Scholarship.

Each of the 12 UCR Alumni Association Freshman Scholarship recipients received $4,000. To qualify for this merit-based scholarship, the student must have at least a 3.65 high school GPA and a minimum SAT I score of 1250.

The recipients are:

- Jana Borja, biomedical sciences, Chino
- Christopher Cunningham, political science/law and society, Corona
- Amber Landers, psychology, Moreno Valley
- Sybil Leung, biomedical sciences, Rowland Heights
- Allison Johnson, English, Moreno Valley
- Kimberly Murphy, undeclared, San Diego
- Matthew Nelson, English, Rancho Cucamonga
- Jacqueline Newton, biomedical sciences, Costa Mesa
- Ester Oh, biomedical sciences, Cerritos
- Daniel Orkin, computer engineering, Northridge
- Denise Torbert, biomedical sciences, Moreno Valley
- Victoria Vo, biomedical sciences, Riverside
- Amber Landers, psychology, Corona
- Christopher Cunningham, political science/law and society, Corona
- James Robertson, computer engineering, Northridge
- Amy Runion, sociology, Corona
- James Robertson, computer engineering, Riverside
- Ester Oh, biomedical sciences, Cerritos
- Matthew Nelson, English, Rancho Cucamonga
- Jacqueline Newton, biomedical sciences, Costa Mesa
- Ester Oh, biomedical sciences, Cerritos
- K y m b e r l y  M u r p h y , undeclared, San Diego
- Allison Johnson, English, Moreno Valley
- Victoria Vo, biomedical sciences, Riverside

The George Beattie Memorial Scholarship honors the late UCR Alumni Association board member George Beattie (’58) who passed away while serving on the Board. The Beattie Scholarship recipient this year is Eric Yauger (’02). He graduated last spring with a bachelor’s degree in political science and is now earning his teaching credential at the Graduate School of Education.

The Leon Braddock Athletic Scholarship honors the late Leon Braddock (’73) for his service and contribution to the principles of higher education. This year’s recipient of the scholarship is Trecha Ann Kennedy, a transfer student from Cowley County Community College. She is studying business and is a guard on the women’s basketball team.

The Brithinee Continuing Student Scholarship was established in 1988 with the generosity of Donald Brithinee (’68, ’70 M.A., ’71 Ph.D.) and Wallace Brithinee (’68, ’70 M.A., ’71 Ph.D.). Over the past 10 years, together they have funded $62,000 for continuing Alumni Freshman Scholars. The four recipients of the 2002-2003 Brithinee Continuing Student Scholarship are:

- Nelly Tan, biomedical sciences, El Monte
- Derek Kwan, biomedical sciences, Rowland Heights
- Amy Runion, sociology, Corona
- James Robertson, computer engineering, Riverside

A $6,000 Burrtce Waste Industries, Inc. Scholarship was established last year. Burrtce Waste Industries, Inc., its sister
Company EDCO Disposal Corporation and other Burrtec affiliated companies, collectively make up the largest privately held solid waste management organization in California.

The recipient for the Burrtec Waste Industries Scholarship is James Robertson from Riverside. In addition to his academic success, Robertson competed in the 2002 World Computer Chess Championships in the Netherlands. His computer program took 12th place in this international competition, and he was selected to write the official report on the event, which was published in the September issue of the “International Computer Games Association” journal.

In 1985, three women – Joyce Vickery (’74, ’76 M.A.), Barbara Moore (’78, ’83 M.A.), and Peggy Voss – established the Reentry Scholarship to provide assistance to mature students whose education was interrupted by two or more years. This volunteer-driven effort has raised an endowment of more than $40,000.

Reentry Scholarships were awarded to Shana VanCleave, a junior in the College of Natural and Agricultural Sciences, and Gabriela Arroyo, a junior majoring in sociology.

Scholarship funding comes directly from membership dues and donations. The UCR Alumni Association Scholarship Program would not be possible without the continued support of alumni.

Alumni interested in serving on a local scholarship committee to help select recipients for 2003-2004 or donating to the UCR Alumni Association Scholarship fund should contact the association. More information on the UCR Alumni Association Scholarship program is available on the web at www.alumni.ucr.edu.

The UCR Alumni Association Travel Program provides opportunities to broaden your cultural horizons while sharing the magic of discovery and adventure with other UCR alumni and friends.

The association’s travel programs are selected to provide variety in travel destinations and in cost. Each tour offers not only social and cultural activities but provides memorable learning experiences as well. Local private guides impart insight into the lifestyles of historic communities, while carefully chosen activities allow travelers to have the most enriching experience possible.

Tour participants, whether alumni or friends, must be members of the UCR Alumni Association. Each member may bring a spouse and children under 18 or one guest. Contact the Alumni Association to request a brochure or to be placed on the association's travel list.

Alumni leadership opportunity

The UCR Alumni Association (UCRAA) is now accepting nominations and applications to its board of directors for two-year terms beginning July 1.

The UCRAA supports campus activities and events and assists current students in their academic and career pursuits. The Association provides alumni opportunities to promote the growth and prestige of UC Riverside through its various programs, such as student recruitment, legislative advocacy, scholarship selection and networking activities.

In 2002, the UCRAA provided more than $78,000 in freshman, continuing and reentry student scholarships. Alumni also participated in the annual UC Day in Sacramento to show support for the University of California, served as speakers at career conferences sponsored by the Student Alumni Association and attended recruitment events to bring top-notch students to UCR.

To serve on the board of directors, individuals must be graduates of UC Riverside and current members of the UCRAA. Although board volunteers have diverse professional backgrounds, they all have the common interest of serving their alma mater.

Alumni interested in serving on the board or submitting a nomination may contact the Alumni Association to request a board of director’s nomination packet. All applications and nominations must be received by January 23.

Travel the globe and expand your horizons

Travel Presentation by Collette Tours
7 p.m., Monday, February 24
200 Highlander Hall
Contact the UCR Alumni Association for reservations and information.
Opportunities to connect with current Highlanders

By DAVID M. GUTIERREZ

The UCR Student Alumni Association (SAA) is a student organization sponsored by the UCR Alumni Association with a mission of connecting current UCR students and alumni in order to share experiences and successes. Under the guidance of a student board of directors, SAA plans events to assist current students in career and life guidance.

The career conferences are one of the most important activities that the Student Alumni Association coordinates annually. Each conference focuses on a specific profession and provides opportunities for alumni to share their experiences with current students.

The hard work and success of the Student Alumni Association in this program has not gone without notice. The Council for Advancement and Support of Education U.C. District VII awarded the Student Alumni Association’s career conferences Best Student Program for the 2002 Award of Distinction in Alumni Relations. CASE is a national organization for educational professionals in the areas of alumni relations, development, public relations and communications. SAA hosted a medical career conference in October and will be hosting career conferences in law, education, marketing and accounting. The Dinners with Alumni program allows students the chance to interact with alumni over a meal to gain insight about their future career field.

Alumni who are interested in serving as mentors or who want to participate in other SAA activities, such as Dinners with Alumni or career conferences, can contact the Student Alumni Association through the Alumni Association.

Alumni and Constituent Relations
Calendar

January

31 17th Annual UCR Alumni Association Awards of Distinction Banquet, 6 - 9 p.m., Commons Dining Room. Reservations required.

February

1 UCR Homecoming 2003, various times and events. Call for more details.

8 UCR Parents Association Board Meeting, 8:30 a.m. - 12 p.m., Pentland Hills Residence Halls. Reservations required.

20 UCR Alumni Association Executive Committee Meeting, 1:30 - 3 p.m., Pentland Hills C104. UCR Alumni Association Board Meeting, 3 - 6 p.m., Pentland Hills B107.

24 UCR Alumni Association Travel Program Presentation, 7 p.m., 200 Highlander Hall.

March

3 UCR Alumni Association Sacramento Dinner, 6 - 9 p.m., Hyatt Regency, Sacramento. Reservations required.

April

24 UCR Alumni Association Executive Committee Meeting, 1:30 - 3 p.m., Pentland Hills C104. UCR Alumni Association Board Meeting, 3 - 6 p.m., Pentland Hills B107.

UCR Retirees’ Association

March 21; UCR Retirees’ Luncheon; 11:30 a.m. - 1:00 p.m.; For reservations and information, contact Betty Morton (909) 689-4381 or themortons@aol.com

Investment Club, 1 p.m., Human Resources Employee Development Center, UCR. Cost: $100 initial fee, $25 monthly. Information contact: Sal Martino, (714) 854-0220 or sal.m@adelphia.net

Meetings: Feb. 5, Mar. 5, Apr. 2

Bridge Club, 11:30 a.m.; Elks Club, 6166 Brockton Ave., Riverside. Cost: Lunch purchase. Information: Marti Orth, (909) 242-5297 or mbtime@prodigy.net

Meetings: Jan. 20, Feb. 17, Mar. 17, Apr. 21

Computer Workshop, 1 p.m., Room 122, Science Library, UCR. Cost: Free. Information: Sal Martino (714) 854-0220 or sal.m@adelphia.net

Meetings: Jan. 16, Mar. 20
The UCR Alumni Association gets questions all the time from alumni trying to find their old classmates, roommates and friends with whom they have inadvertently lost touch.

To make it easier for alumni to connect, the Alumni Association is pleased to announce that work has begun on the University of California, Riverside, Alumni Directory – 50th Anniversary Edition. Both print and CD-ROM editions will be available in Fall 2003 to kick off the campus celebration of its 50th year in 2004. The Bernard Harris Publishing Company will publish these special editions. They will attempt to contact all alumni to let them know about the directory publication and give them the opportunity to update their information.

The listing in the directory is free. The directory will have editorial information covering 50 years of UCR history (including the building of the campus) and its alumni. At approximately 800 pages, the directory will offer the following sections:

- Biographical
- Class year
- Geographical
- Career networking and email addresses.

The directory will be published in both hardcover and softbound versions (9 1/4” x 6 1/8”). It is anticipated that the directory will be available in both hardcover and CD-ROM.

New membership offer

In celebration of this 50th anniversary edition, the Alumni Association has a new and special membership offer. With its combination of good discounts and free alumni gifts, this is the best membership offer in recent memory! For more information about the directory project or to learn more about the special membership offer, visit www.alumni.ucr.edu or call Jocelyn Whitfield at (909) 787-4511 or (800) 426-ALUM.

2002 Alumni Association Life Members

The UCR Alumni Association proudly welcomes all who have chosen to become life members in 2002. Life membership ensures a constant connection to UCR and fellow alumni and friends. Welcome Home!

Shoshona L.S. Albright ’02
Alejandro Alvarez ’95
Jessica A. Alves ’02
Judith Amaya ’01
Joseph M. Andrews ’73
Ryan G. Bacacca ’02
Alisha L. Barnes ’90
Joanne C. Bash ’74
Stephen R. Bash ’73
Alicya Benson ’90
Natasha K. Billeb ’02
Amanda Bonales ’91
Pamela J. Brady-White ’95
Sandra-Kaye Brower ’73
Pamela D. Brown ’70
Sandra-Kaye Brower ’73
Pamela J. Brady-White ’95
Alisha L. Barnes ’02
Alejandro Alvarez ’95
Shoshona L.S. Albright ’02
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’58 James Greenfield was awarded the Henry A. Rosso Medal “for lifetime achievement in ethical fund raising” by the national Center on Philanthropy at Indiana University. He has written and edited many books about fundraising and philanthropy.

’60 Robert Melsh was a contender for California’s 64th Assembly District seat in November. Robert is currently a college instructor.

’61 William Taylor (’63 M.A., ’66 Ph.D.) was named a 2001-2002 Outstanding Professor by California State University, Los Angeles, at the University’s Fall Faculty Day. This award was created primarily for excellence in teaching, but significant achievements are expected in scholarly inquiry or creativity, professional activities and service to the campus and community.

’64 Carol Wilson Spigner received the Pioneer in Adoption award from the Child Welfare League of America. Carol is a professor in the school of social work at the University of Pennsylvania. She has served as the associate commissioner of the Children’s Bureau at the U.S. Department of Health and Human Services during the Clinton administration where she was responsible for administering federal child-welfare programs. She has also received awards from the University of Southern California, the National Association of Black Social Workers and the National Association of Public Child Welfare Administrators.

’66 Gary Swaim retired from North Lake College in Irving, Texas in May 2002. He had served as a professor of philosophy and creative writing and was founding director for the North Lake Community Center for Writers. He has since joined the University of Texas at Dallas where he is a professor of literary studies and playwriting. He continues his own work on a new play, a collection of poems and a cycle of short stories.

’70 Judith Valles (M.A.), mayor of San Bernardino, was honored at the Latino ImPACt recognition dinner in San Bernardino. The event focused on the many contributions she has made to the Latino community. Latino ImPACt is a political action committee.

’71 Mary Ann Shappi has been married for over 26 years. Her son, AJ, a sophomore chemistry major at UCR, pitches for the Highlander baseball team.

’72 Tom Kennedy and Susan Pascoe Kennedy (’69) are the proud parents of Adam Kennedy, an infielder for the world champion Anaheim Angels. Adam recently joined Babe Ruth, Reggie Jackson and George Brett, among others, in hitting three
home runs in a postseason game. Tom played baseball for the Highlanders and now teaches high school while Susan teaches elementary school.

'73 Richard Carey (Ph.D.) and a partner opened a new winery in Lancaster County, Pennsylvania. Richard is a winemaker and has operated a winery since the late 1970s and early 1980s. Richard is also a consultant to the wine industry, training winemakers on a one-on-one basis, working with them to solve problems with their wine. This involves analyzing samples of the wine … Sylvia Martin-James (M.A.) was appointed by the board of directors for the League of Women Voters of California as their representative on the California Commission on Access to Justice. Sylvia will explore and expand ways of increasing access to civil justice for poor and moderate-income persons in California. The term for her appointment will end on June 30, 2004.

'74 Dean Alger (M.A., '78 Ph.D.) was the Independence Party candidate for Minnesota's secretary of state. He taught political science at Minnesota State University, Moorhead for 10 years and was chosen as a fellow in the Shorenstein Center on Press & Politics in Harvard University's Kennedy School of Government. Dean has authored several books on the American political process.

'75 Craig Warden lives in Davis with his wife, Nancy Schönfeld-Warden ('76), and his two daughters, Julianne and Elizabeth. Craig is a tenured associate professor of genetics at UC Davis.

'79 Leslie Erganian was a contributing writer to the Phaidon Press release of the architectural monograph “Raphael Soriano.” Leslie became engaged to the author of “Raphael Soriano,” architect Wolfgang Wagener … Dawn Madden is vice president of marketing for ACLARA BioSciences. Dawn came to ACLARA from Applied Biosystems where she managed the genomic applications marketing group.

80s

'80 Tim Bates is the vice president of operations for HyperSpace Communications, Inc. He has been with the company since January 2002, when he joined HyperSpace as director of systems engineering. Tim is involved in the community and provides technical resources and group leadership for Colorado's Ocean Journey aquarium … Charles and Madge Griffing ('80 M.A.) created "Temeculi, Temecula," a historical musical comedy play, which celebrates its 20th anniversary this year. The play highlights and parodies 200 years of Temecula's history.

'83 Mike Ramos was elected district attorney for San Bernardino County. Mike earned his law degree from Citrus Belt Law School in Riverside and worked for the San Bernardino County Probation Department. Mike is also a member of the Redlands Unified School District Board. '85 Tod Burnett joined President Bush's administration as senior advisor to the assistant administrator for the United States Environmental Protection Agency's Office of Solid Waste and Emergency Response located in Washington, D.C. Prior to joining the administration, Tod served as a commissioner for the City of Los Angeles Board of Public Works and was a founder of the Los Angeles Water Science Education Center.

... Sylvia Deporto was promoted to deputy director of operations in the children sciences division for the Riverside County Department of Public Social Services in July 2002 … Mary Harris (M.A.) is curator of the new $9.6 million Christina Reiman Butterfly Wing at Iowa State University’s Reiman Gardens. The facility is home to 435 species of butterflies from all over the world.

'86 Catherine Dackerman is the director of customer service for EnviroSystems, Inc., an emerging leader in the discovery and development of environmentally friendly infection control products. Catherine was previously the director of customer support and sales administration at Laserscope … Michael Ross is the chief of logistics for "Space Based Infrared Surveillance Systems Low" at the Mission Defense Agency in Washington, D.C.

'87 Marcia Kipp and her family are happy to announce the birth of their new baby girl, Emily Rose. She was born on May 10, 2002, in Poway.

'88 Richard Horak was promoted on September 1, 2002 to senior deputy probation officer for the Yuba County Probation Department.

'89 Corrine R. Colgan married Kevin Rojda in Rochester, New York. The couple made their home in Washington, D.C.
90s

’90 Troy Percival is a pitcher for the world champion Anaheim Angels. He played baseball for the Highlanders from 1987 to 1990.

’91 Megan (McGuire) Ellena was married in August in New York. She is currently a certified coding specialist at Irvine Medical Center and teaches part time at a community college. She resides in Aliso Viejo with her husband, Mark.

’92 Mike Bergler (’95 M.S.) and Lisa (Gracey) Bergler (’93) proudly announce the arrival of their second child and first son. Jonathan Patrick Bergler joined big sister Natalie in early October. The family lives in Irvine … Ken Chamberlain is the director of electronic publishing for the National Mental Health Association … Rosita Hamidi is now enrolled in science prerequisites as she pursues dental school … Amy Howell (Ph.D.) recently published a study suggesting that the consumption of cranberry juice may offer protection against both sensitive and resistant strains of P-fimbriated E. coli by a mechanism that is not likely to increase selective pressures associated with antibiotic resistance. The study appeared in the Journal of the American Medical Association in June 2002 … Nicole Cherie Meyer Horning married Jeffrey Horning on September 28, 1996. The couple has a daughter Kiriana Faith who was born on March 23, 2002.

’93 Paran Johar is the general manager for Tribal DDB Los Angeles. Paran is responsible for overseeing all of the Los Angeles operations and management … Jason Revland is married and living outside Philadelphia, working for a large hedge fund company. He has lost touch with many friends and invites them to drop him an email. Please contact the UCR Alumni Association for Jason’s information.

’94 Greg Bulmash became engaged in June of 2002. For more information about Greg and his bride-to-be, visit www.gregandlisa.com … Kimberly (Collins) Mennuti and her husband, Rich, welcomed their second child, Julie Christine, born August 26, 2002 … Vince Moses is the director of Riverside’s Municipal Museum. Vince joined the City of Riverside in 1979 and was previously the museum’s senior curator of history.

’95 Andrew Ragone was the recipient of the 1998 San Francisco Critics Circle Award for his role as Joseph, the principal actor in the musical “Joseph and the Amazing Technicolor Dreamcoat.” Andrew was also a nominee in the 1999 San Francisco Critics Circle for his role as principal actor in the musical “The Hot Mikado.”

’97 Emily Teipe was appointed chair of the history department at Fullerton College … Darren Doskocil was one of 22 professional baseball players from independent leagues selected to represent the United States at the 2002 American Series Championships September 27- October 6 in Monterey, Mexico.

’98 Jon Jamieson finished writing a book, “Raw Sewage to Reclaimed Water: The History of Sewage Systems in the Metropolitan San Diego-Tijuana Region” which was based on his undergraduate thesis paper. Jon ran for the Otay Water District board of directors. In addition, he is also the historian for the California Water Environment Association in San Diego.

’99 Alberto Roman was a contender for the Rialto City Council. He is a political consultant.

00s

’00 Gennie Slobe was a curator for the “Deaf Awareness Is Community Awareness” exhibit at the Riverside Municipal Museum. The exhibit was one of several events held throughout the city, which has one of the nation’s largest deaf communities … Karla Mercedes Toruno married Marc Allen Troast (’00). The couple is at home in Moreno Valley. Karla is currently pursuing a master’s degree in counseling at California State University, San Bernardino. Marc is the regional political director for the California Republican Party in Burbank.

’02 John Babick received his commission as a naval officer after completing officer candidate school at Naval Aviation Schools Command, Naval Air Station, Pensacola, Fla. John received extensive instruction on a variety of specialized subjects including navigation, ship handling, engineering, naval warfare and management … Christopher Cook has begun studies at Southwestern University School of Law. He is enrolled in the school’s day program, a three-year course of study leading to the juris doctor degree … Jesica Garcia is now training to be a teacher … Erin (Hartline) Phillips married Mark Phillips in August, 2002. Both are UC Riverside employees. Erin is working in the Office of Alumni and Constituent Relations while Mark works for the Art and Art History Department. The couple is living in Riverside … Sarah Stanford participated on an excavation team at San Elio Lagoon in San Diego. The San Elijo Lagoon offers a rich research opportunity for students in the archaeology field.
Alumni Update & Membership Application

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I am proud to be a member of the Alumni Association, as it provides several benefits to its members. In addition, Fiat Lux provides information on university activities, member highlights and other pertinent information. As a member, I receive information on travel opportunities all over the world. The association is a great organization and truly cares about UCR alumni.

Zack Earp ’76
Board of Education
 Alvord Unified School District
 and Proud Association Member
1. The prospect of working at the nano level was first suggest by Richard Feyman in what year _____________________?

2. Nano is from the Greek word for _____________________.

3. A nano indicates one- ______________ of something.

4. How many Centers has UC Riverside established for the study of nanotechnology ____________________?

5. Our bodies central nervous system is composed of two kinds of specialized cells ______________ and ______________.

6. UC Riverside joined two other UC institutions to form the Center for Nanoscience Innovation for Defense. They are UC ______________ and UC ______________.

7. The market for nano materials and devices is estimated to be $ ______________ by the year 2015.

8. UC Riverside’s nano effort is under the leadership of ______________.

9. IBM’s “Millipede” project can store a trillion bits of information on ______________.

10. A nanometer is to one inch what one inch is to ______________ miles.

10 correct answers – Congratulations! You are “nano proficient.”
9 correct answers – Nano Excellent!
8 correct answers – Very nano good!
7 correct answers – Pretty nano good (this is tough to get on a first try).
6 correct answers – Bordering on nano good (but hang in there).
5 correct answers – OK (maybe you just flipped through the nano photos)
4 correct answers – Hmmmm, maybe if the test had been multiple choice...
3 correct answers – Definitely, true/false questions would have been better.
2 correct answers – Try again, maybe you’ll do better on your second try.
1 correct answer – Ouch! Hope it was one of the hard questions. Better check on doing some extra credit.
Abigail Wyant begins each day with the Bible and prayers. An active member of the Campus Crusade for Christ, she plans on being a missionary doctor one day. When she learned that nanotechnology holds promise for people paralyzed from spinal cord injuries, her interest in the field grew. “Nanotechnology’s applications in the medical field appeal very much to me,” she says. “If someone broke his back, we could help heal it. Nanotubes could potentially be used as a template to guide neuron growth in the spine, allowing impulses to be conducted. The person could walk again.”

At CNSE, Wyant, a junior, works on purifying nanotubes. When first produced, carbon nanotubes are impure, she explains. “One must remove the amorphous carbon and other nanoparticles. One also needs to take out the catalyst used in the production of the nanotubes.”

Born and raised in Alta Loma, Wyant chose UC Riverside for its encouragement of undergraduate research. “I’d heard the faculty here are approachable and available with their time, that they’re attentive to undergraduate research. Moreover, the university has a good reputation in science.”

Her organic chemistry class, which Robert Haddon taught in fall 1999, convinced Wyant that nanotechnology research is her calling. She is convinced, too, that the field will spawn more applications in the medical field.

“I’ve already done exciting research with a faculty member here who is working to put nanotubes on neurons so that the two grow together,” she says.

A quick learner, Wyant is artistic and altruistic. She plays the piano and composes music in her free time. She enjoys reaching out into the community to promote fellowship and spiritual growth. After graduation, she will take a mission trip overseas for a year. “Upon returning home, I will enter the medical field,” she says. “Nanotechnology may become a household word by then. I’m sure the experience I’m gaining in the lab today will serve me well tomorrow.”

Daniel Perea

By IQBAL PITTALWALA

Deeply devoted to research, Daniel Perea has become a role model to his siblings and cousins. While this playful senior will not be the first in his family to acquire a bachelor’s degree (spring 2003), he admits he is the most vocal at home about the value of higher education.

Born in East Los Angeles, Perea moved to Fontana with his family in 1987 when he was in fourth grade. This pivotal decision, he believes, opened up rich academic possibilities for him. “I came into contact with excellent instructors,” he says. “Many became my mentors. That changed the course of my life.”

A serendipitous turn of events cast Perea on the shores of nanotechnology. One day in January 2002, while waiting in Pierce Hall to speak with a faculty member about research projects in chemistry (she happened to be busy), he wandered down the hallway only to find Robert Haddon in his office. A brief conversation ensued, and soon thereafter Perea began working as a researcher in the Center for Nanoscale Science and Engineering (CNSE). Perea’s research involves manufacturing carbon nanotubes in a stainless steel chamber called the arc. “Nanotubes are light and strong and can enhance the properties of other materials,” he says. “They are used, therefore, to make composites. For example, nanotube-impregnated plastic retains the flexibility of plastic and has very high strength.”

When he isn’t hiking or playing his guitar, Perea spends his free time poring through science magazines. Driven by research, he plans to attend graduate school for a doctorate in engineering or chemistry. But after obtaining his B.S., he will first take a year off, which is when his wife, Mary, will complete her master’s degree in education. The newlyweds will then decide where the future will take them.

“I will pursue research in nanotechnology,” Perea says, thinking years ahead. “Why wouldn’t I? The field is young and exciting, and there’s plenty of room for creativity.”

Abigail Wyant