Well, here I am again. Many of you know that I retired at the end of the last academic year, after 40 years of faculty service. After broad consultation with the college faculty, Chancellor Berdahl announced the appointment of Professor Charles B. Harris as my successor— but not until July 1, 2005! Charles is currently chair of the chemistry department, a position he has held only for one year, and he is doing such an outstanding job guiding the department that we were all unwilling to give up his leadership after just one year. Therefore, even though I am retired, I agreed to be “recalled” as dean for one more year. In essence, I am a rent-a-dean.

The fall semester is in full swing and the campus has the usual hustle and bustle of a new academic year. Enrollments are up again, we have several new faculty members, and a number of improvements to our infrastructure are underway.

Chem Bio attracting students

Undergraduate enrollments are up dramatically—the total number of undergraduate majors in the college is a record high of 794 this semester, compared to 697 a year ago. The main reason for this 14 percent increase is the popularity of our new chemical biology program, which was initiated two years ago on a trial basis and approved by the Academic Senate last year. At the May commencement I conferred the first six Bachelor of Science in Chemical Biology degrees. The chemical biology undergraduate program now has 138 students, compared to 391 in chemical engineering and 255 in chemistry. The increase of about 100 College of Chemistry majors, relative to last year, is a result of a somewhat larger entering freshman class and a significant increase in the number of students who transferred into the College of Chemistry, mostly from the College of Letters & Science.

Faculty additions

Since last fall we have added three new faculty members to the college: Professor Rachel Segalman in chemical engineering and Professors Christopher Chang and Richmond Sarpong in chemistry. Because of the weak budget situation during the past year, we delayed several other faculty searches. At the moment, we have two active searches, both in chemical engineering. One of these appointments will be at the senior level and one at the junior level.

Looking ahead, we have been given a new faculty “target,” which will permit us to appoint four additional faculty members over the next three or four years.

Money issues

The budget situation in California seems to have stabilized somewhat and after another hard year, we expect things to improve in 2005-2006. For the current year, in addition to delaying three new faculty appointments, we have made a 2.25 percent permanent budget cut.
In Praise of Lewis and Seaborg

Continuing his quest to educate the world about the accomplishments of G. N. Lewis, Harold Paretchan has informed us that he received a very complimentary letter from John Marburger, Director of the U.S. Office of Science and Technology Policy. Noted Marburger, “Gilbert Lewis is considered by many to be the greatest and most influential of American chemists. Lewis made outstanding contributions to thermodynamics and its relationship to chemical equilibrium, the electron-pair bonding theory of atoms and molecules, isotopes, and the interaction of light with matter. But in many ways, his most important contribution was his vision for the conduct of research…Lewis believed that a chemistry department should simultaneously teach science and advance it.”

Marburger goes on to praise the work of Glenn Seaborg, who “followed his mentor in making significant contributions to science and society. In 1944, he developed the ‘actinide concept’ of heavy element electronic structure, probably his single greatest contribution to science. This concept predicted that the heaviest naturally occurring elements,...together with the synthetic transuranium elements, would form a transition series of ‘actinides’ analogous to the rare-earth series of ‘lanthanides.’ His insight led to the most significant restructuring of the periodic table since the table was devised in 1869 by Dmitri Mendeleev.”

by relinquishing several vacant staff positions and by recharging grants and contracts for some of our research support service that was formerly funded by the state.

In hard economic times for the state, the support of our alumni and other private donors is doubly important. I am pleased to report that we are currently engaged in several major renovation projects, all funded with private monies. One of these projects, recently completed, is a new state-of-the-art undergraduate biotech laboratory that will serve Biochemical Engineering 170L and eventually will play a major role in the laboratory curriculum for students in the Chemistry Department’s chemical biology major. A second major renovation project will provide laboratory space for 14 graduate student researchers on the sixth floor of Latimer Hall. Yet a third project, scheduled to begin in January 2005, will give us new laboratory space for 10 graduate student researchers on the eighth floor of Latimer Hall. Further renovations, also financed by gifts from private donors, will be launched in the summer of 2005.

New campus leaders

You have probably read that the campus has a new chancellor—physicist Robert Birgeneau, and that the Lawrence Berkeley National Laboratory (LBNL) has a new director—physicist (and Berkeley alumnus and Nobel laureate) Steven Chu. We are all excited by the vision that these two leaders bring to Berkeley, and we look forward to a bright era in which the College of Chemistry will cooperate to a greater degree than even now with biology, physics, engineering and LBNL in interdisciplinary initiatives such as nanotechnology and chemical biology.
The fall semester has begun with its usual excitement as new and returning students fill our classrooms and laboratories. We currently have 391 undergraduate students enrolled in chemical engineering. The entering graduate class has twenty of the world’s brightest young chemical engineers, bringing our total graduate student enrollment to 110. These numbers indicate that your department continues to be attractive to the best young minds in our discipline.

Budgets are still tight

I am sure you have all heard about the challenging budgetary situation, and indeed, it has been grim. However, our staff, faculty, and students have worked very hard to minimize the impact of the budget cuts on our academic program. I believe that, so far, we have succeeded in this effort. A major challenge has been in continuing to develop infrastructure for education and research. Even in this regard, thanks to your help and support from the administration, we have made some progress. We have just completed a major renovation project that has resulted in a state-of-the-art teaching laboratory for our senior elective in biochemical engineering. We are now striving to create a similar modern laboratory facility for our mandatory undergraduate laboratory course on transport phenomena.

Faculty recruiting news

We are also continuing our efforts to recruit new faculty. Our newest member, Professor Rachel Segalman, arrived on campus in February. Already her laboratory is a hub of excitement, and she is teaching her first class this semester. We hope to complete our recruitment of a senior person for the Hubbard Howe Distinguished Professorship by the end of this calendar year. We have also started a recruitment effort that aims to add at least one new assistant professor to the faculty. These additions will enhance the breadth of educational opportunities for both undergraduate and graduate students in the department.

We are very excited about another new faculty appointment that has just been approved by the administration. In 1962, Professor Andreas Acrivos left Berkeley to join the Stanford faculty. I am happy to report that we have now corrected this situation. Andy is coming back home, and is going to be an adjunct professor in our department starting in 2005. With Andy and John Prausnitz both here to advise us, we will have two of the profession’s leading figures to provide us with visionary perspectives.

Leading interdisciplinary efforts

In recent years, the campus and Lawrence Berkeley News from Chemical Engineering CONTINUING by Arup Chakraborty, Chair

... with our mission... With Andy and John Prausnitz both here to advise us, we will have two of the profession’s leading figures to provide us with visionary perspectives.

Jay Keasling and Roya Maboudian are leading campus efforts in interdisciplinary education and research.
National Laboratory have established new interdisciplinary efforts with a mission to carry out fundamental and applied research on important societal problems. Examples include the QB3 Institute, which aims to bring engineering, physical and chemical sciences, and medical research together to address major health-related issues; CITRIS, which is attempting to use computing and nanotechnology to alleviate societal problems; the Molecular Foundry, which will create a unique facility for nanotechnology research; and an effort in Synthetic Biology, with the goal of taking lessons from nature to create high-impact products—for instance, inexpensive drugs for diseases such as malaria. Faculty members from the Department of Chemical Engineering are playing leading roles in these campus-wide efforts. For example, Jay Keasling leads the effort on synthetic biology, Roya Maboudian has a key role in nanotechnology research, and I am the department head of computational and theoretical biology for LBNL. It is not surprising that chemical engineering is the nexus of many of these multidisciplinary efforts, because our discipline integrates information from molecular to macroscopic scales like no other; thinking across a wide spectrum of length and time scales is crucial for the success of the initiatives noted above.

Faculty awards

Our faculty members continue to receive acclaim for their scholarship. Enrique Iglesia has received the prestigious George A. Olah Award in Hydrocarbon Chemistry from the ACS. The award is given to recognize, encourage, and stimulate outstanding research achievements in hydrocarbon or petroleum chemistry. Congratulations to Enrique! I was fortunate to receive the Professional Progress Award of the AIChE, given to an engineer below the age of 45.

AIChE reception in Austin

As we go to press, we are about to host what should be a fun reception for alumni and friends on November 9 at the AIChE annual meeting in Austin, Texas. Also, as always, we enjoy visits and news from our alumni and count on your advice and help to make your department better.

Size Matters in Catalysis

How small is too small? A question posed for decades in the context of heterogeneous catalysts is being answered by several projects in the research group of chemical engineering professor Enrique Iglesia. His group continues to probe the structure and catalytic function of small domains of metals and metal oxides using emerging spectroscopy methods and increasingly sophisticated chemical probes. “Changes in the size and structure of minuscule domains, sometimes no larger than a few metal atoms, alter the electronic properties of these materials and hence their catalytic function,” he said.

A recent detailed study by the Iglesia group explored the catalytic and electronic properties of protonated tungsten oxide domains anchored on other oxides for isomerization and dehydration reactions. They prepared a range of catalyst samples in which tungsten oxide structures ranged from isolated monomers to polytungstate two-dimensional monolayers to crystalline nanometer-sized clusters.

Tungsten surface concentrations of about 10 atoms per nm$^2$ gave much higher catalytic rates than those with higher or lower tungsten densities. A range of spectroscopic methods showed that the most active structures consist of two-dimensional monolayers containing W-O-W bonds, absent in isolated tungstate monomers and different in reactivity from those present in crystalline tungsten oxides.

“Isolated species are accessible to the reagents, but they are unreactive because they are too small to delocalize the charge, which allows them to stabilize the acidic protons needed for these reactions,” he explained. Larger nanometer-sized clusters are ineffective as catalysts because potential active centers lie at inaccessible position within crystallites and because these crystallites become oxygen-deficient and unable to delocalize the required negative charge.

The work was presented as a keynote lecture in a special symposium dealing with nanotechnology applications in catalysts at the ACS Meeting in Philadelphia this summer. These findings were highlighted in a feature article covering this symposium in a recent issue of Chemical and Engineering News.
The long days of summer have yielded to the busy days of fall. The department is pleased to have an exceptional crop of new students eager to begin their degree programs. We are consistently ranked at the top of national surveys, including that of the US News and World Report. This is due in large measure to the high quality of our students.

**Thanks to Shank**

I would like to take this opportunity to thank outgoing Director Charles V. Shank for all of the support LBNL has given to the chemistry department through his fifteen-year tenure. He weathered a period of extraordinary growth and changes with intelligent policies that have placed LBNL and our department on the cutting-edge of research. We are honored that he has chosen to be a full-time member of our department, with joint appointments in physics and EECS. He is currently on sabbatical leave for a year and will be back to resume his research in 2005. Shank has been a pioneer using short laser pulses to study ultrafast events that occur in a millionth of a billionth of a second. He contributed to fiber optic communications with the invention of the distributed feedback laser, a component in high data rate transmission systems.

An important part of Shank’s legacy is his initiation of the femtosecond x-ray source at the LBNL. This x-ray source can be used to produce ultrafast soft x-rays for the study of molecular dynamics and chemical transformations. One use of this source is to produce a stable and reliable source of ultrafast photons up to 100 eV in energy that can be used to remove electrons from inner shells of atoms or from the outer bonding and non-bonding orbitals. Scientists then use the femtosecond x-rays as a “camera” to study ultrafast processes involving the ejection of electrons during chemical transformations. Relatively few groups have been able to utilize ultrafast pulses of soft x-rays for experiments. In the chemistry department, Professor Stephen Leone’s work on small molecule dynamics leads the way in this innovative field.

**NO means not oxygen**

Michael Marletta’s group is trying to reconcile how a toxic and chemically reactive gas like nitric oxide (NO) can function as a signaling molecule in humans. Their research is currently focused on how NO can be specifically trapped by its receptor in the presence of high concentration of O₂, a competitor. The receptor contains a heme molecule, which is, generally speaking, an oxygen attractor, and yet the receptor does not bind O₂. A collaborative effort with the Kuriyan lab on an O₂-binding bacterial protein that is evolutionarily related to the receptor has now provided the molecular insight to understand how nature has solved this difficult problem in coordination chemistry to control
important physiological processes such as blood pressure regulation.

A cork screw guide for DNA

The Kuriyan lab has also put forth a new model of the DNA clamp loader, a donut-shaped ring complex that encircles DNA during replication. Using X-ray crystallography, John Kuriyan and his colleagues found that the replication complex spirals around the DNA like a cork screw, snugly wrapping the DNA. This new structure also provides insight into how the ATPase activity of the clamp loader is triggered, leading to the loading of the clamp and the dissociation of the loader. The DNA itself, fitting cleanly inside the clamp loader, may trigger the activity directly.

The better to see inside you

Kenneth Raymond and his colleagues are synthesizing new contrast agents for use in MRI. Since MRI images the protons in water, and molecules with unpaired electrons can alter the proton resonance, most commercial image contrast agents exploit special electronic properties of gadolinium (Gd). The optimal contrast agent has the maximum number of coordinated water molecules and optimal water exchange rates and rotational correlation times. Additionally, the agent must be stable and not cause toxic side effects. These requirements present a tantalizing challenge to fundamental coordination chemistry.

Scientists in the Raymond lab have prepared a series of Gd(III) complexes that are stable and have substantially higher relaxivity than most clinically-used agents due to their near optimal water exchange rates. Patents based on this research have been licensed by Schering AG.

Faculty awards continue to accumulate

Congratulations to our faculty members, who were well represented among the winners of national ACS awards: Paul Alivisatos won the ACS Award in Colloid & Surface Chemistry; Stephen Leone received the Peter Debye Award in Physical Chemistry; Jeffrey Long received the National Fresenius Award; Luciano Moretto was honored with the Glenn T. Seaborg Award for Nuclear Chemistry; and Peidong Yang won the ACS Award in Pure Chemistry.

In addition, Kristie Boering received the 2004 Chemistry Department Teaching Award. David Chandler was awarded the Bruce Mahan Chair in Chemistry and has just been awarded the 2005 Irving Langmuir Prize by the American Physical Society. Jean Fréchet received an honorary doctorate from the University of Ottawa. Jay Groves won a Beckman Young Investigator Award. Darleane Hoffman attended a Reunion of the Priestley Medalists, held by the Chemical Heritage Foundation in August as part of the 200th anniversary of the death of Joseph Priestley, the discoverer of oxygen. Richard Saykally won the Joannes Markus Marci Medal from the Academy of Sciences of the Czech Republic for his outstanding contributions to laser spectroscopy. Saykally also received the E. O. Lawrence Award in Chemistry from the Department of Energy. Don Tilley is a Miller Professor for 2004-2005. Dean Toste won both a Dupont Young Investigator Award and an Eli Lilly Grantee Award. Dirk Trauner received an Amgen Young Investigator Award and the Astra-Zeneca Excellence in Chemistry Award. And Birgitta Whaley received the Humboldt Research Collaboration Award.

Michael Marletta’s group is trying to reconcile how a toxic and chemically reactive gas like nitric oxide can function as a signaling molecule in humans.

Using X-ray crystallography in collaboration with John Kuriyan’s group, Marletta and his colleagues have yielded insights into how receptors distinguish between oxygen and nitric oxide.
Elton Cairns has worked on battery and fuel cell technology for almost 40 years, so it’s only natural that he drives a hybrid car (a Toyota Prius, to be exact). He is thrilled to be motoring around Northern California in a “green” car based on chemical principles he helped discover.

“The focus of my research is to understand at the atomic level what features are important for high performance and long life of both batteries and fuel cells,” he said.

Chemical engineering or chemistry?

Although he is a member of the chemical engineering department, Cairns has straddled the thin line between chemistry and chemical engineering throughout much of his career. He received a B.S. in each field at Michigan Tech— as if just one degree wasn’t challenging enough. He applied to graduate school at Berkeley based on the chemistry department’s outstanding reputation, was accepted into the College of Chemistry and, as a nice bonus, won the Dow Chemical Company Fellowship.

“I arrived in the college office to register and to get my paycheck,” he noted. “That’s when I discovered that my fellowship was intended to be for a chemical engineering student.”

The administration at first wanted him either to enroll as a chemical engineering student or to give up the fellowship, two alternatives that did not appeal to Cairns. “I ended up keeping the fellowship and majoring in chemical engineering but did half of my thesis work in chemistry, graduating in 1959. And I had the honor of being John Prausnitz’s first graduate student,” he continued.

“After graduation I was invited to work on the proton exchange membrane fuel cell at General Electric, eventually helping to develop the first fuel cell system to be launched into space, through the Gemini program,” related Cairns. “In outer space, you need a lightweight and extremely efficient power plant, a requirement uniquely met by fuel cells, especially since price is not a prevailing issue.” He then moved to Argonne National Lab, where he started the battery and fuel cell program there.

Leading LBNL

In 1978 Berkeley called with an offer for Cairns to become Associate Director at LBNL and Professor of Chemical Engineering. “It was supposed to be a five-year appointment at LBNL, but kept being extended, eventually ending in 1996, after 18 years, when I came to the chemical engineering department full-time.” Now a professor of the graduate school in chemical engineering, Cairns is devoted around the clock to research.

“The demand for batteries and fuel cells is continuing to grow. People want cell phones and laptops that don’t discharge in the middle of an important call or presentation,” he explained.

Electrodefundamentals

“We study the fundamentals of the materials for electrodes using techniques from electrochemistry and analytical tools that are sensitive at the atomic level.

“Most high-performance rechargeable batteries use lithium, which moves between the positive and negative electrodes as the battery powers a machine and is then
recharged. The materials in the electrode must be able to accommodate the lithium ions with a minimum of structural rearrangement. Right now, the positive electrode tends to be comprised of cobalt oxide, which is toxic, hazardous to the environment, expensive and in short supply.

“One of the most promising alternatives to cobalt oxide is manganese oxide (Mn$_x$O$_y$), which is cheap and environmentally benign. One drawback, though, is that Mn$_x$O$_y$ batteries do not last long because the material breaks down too quickly; Mn$^{+3}$ can disproportionate to Mn$^{+2}$ and Mn$^{+4}$,” he explained.

However, Cairns and his colleagues found that by replacing a small amount of the manganese with another metal, such as chromium or aluminum, the electrode is more stable and the lifetime of the battery can be greatly extended.

“My group is investigating how the stability of Mn$_x$O$_y$ is affected by small amounts of different metals. We are studying these materials at the atomic level using spectroscopic techniques, including X-ray absorption spectroscopy in collaboration with professor Stephen Cramer of UC Davis, and NMR in collaboration with fellow chemical engineering professor Jeffrey Reimer. We have also pioneered the use of photothermal deflection spectroscopy for in situ characterization of electrochemical systems.

“Through these methods, we have demonstrated that the greater the covalency of the chemical bonds in the metal oxide, the more stable it is as an electrode material,” he explained.

At the other end of the battery, Cairns’s group is synthesizing and testing new materials for the negative electrode, which is usually made of flammable carbon materials. In a battery, flammable equals danger. Additionally, the carbon electrode material is too slow in taking up the lithium ion, which can lead to the extremely unsafe situation of lithium metal being deposited on the electrode.

Then there are fuel cells

Fuel cells are a close relative of the battery—both convert chemical energy to electrical energy. A lot of research directors and politicians are currently betting that fuel cells will be an environmentally-safe replacement for internal combustion engines in cars. “However, there are some serious challenges that must be solved by chemical engineers before fuel cells are ready for prime time,” said Cairns. “Fuel cells typically operate on hydrogen, so it needs to be carried on the vehicle in a storage tank or produced on board by a complex fuel reformer. Hydrogen is difficult to store. Right now the storage system weighs 30-50 times the weight of the hydrogen it stores. And storing a flammable gas at high pressure on a vehicle doesn’t seem like a good idea.”

“Once we get around these problems by developing an electrocatalyst that will act directly on the methanol and use very little energy in the conversion of CH$_3$OH to CO$_2$ and H$_2$ and electricity, it would also operate under mild conditions,” he explained. So far, platinum alloys are the most promising.

Although he is technically retired from teaching, Cairns still loves to interact with students in the lab. “I have graduated approximately 30 students so far. With all of them I have enjoyed the intellectual adventure of designing the experiments and interpreting the results. Not two days are alike; this keeps me interested and involved.”

**“There are some serious challenges that must be solved by chemical engineers before fuel cells are ready for prime time.”**
Faculty Profile: Graham Fleming

HOW DOES your garden grow? . . .

Plants. Solar energy. The connection is obvious. What is not obvious is how to translate the plants’ ability to meet their energy needs from sunlight to the human scale. Luckily, Graham Fleming is working on that translation.

Fleming spends much of his time using lasers to observe super-fast events, such as the main energy transfer steps in photosynthesis, the process of using the energy from sunlight to convert carbon dioxide and water into oxygen and carbohydrates. “Understanding how plants convert sunlight into usable energy is a fascinating challenge with very practical applications,” he said.

The primary chemical step in photosynthesis takes place inside what is called a reaction center. Here an electronically excited chlorophyll molecule transfers an electron to a donor, setting in motion a series of steps culminating in the electron being transferred to carbon dioxide. The entire cycle of events can run at 200-300 times per second, yet even on a bright day, the reaction center electron donor only absorbs a photon of sunlight per second. So the reaction center in plants is surrounded by 200-300 absorber molecules that make up the light harvesting system. If this works with perfect efficiency—and it does—then the photosynthetic system can run optimally.

“Although scientists know the steps of the pathway, actually following a single excitation in photosynthesis is a daunting task. “With 300 identical chlorophyll molecules absorbing the photon within each photosystem (light harvesting unit), how do you follow the energy? It is like staring at a maze in which every side is identical,” said Fleming.

“It turns out, however, that the chlorophyll molecules are not exactly alike, differing slightly in the electronic energy,” he explained. As the excitation jumps from molecule to molecule, it samples these different energies. Thus the excitation progressively forgets what the initial energy was. This memory loss can be observed by sophisticated laser experiments called photon echo measurements.

Humankind’s energy consumption is expected to double by 2050. It is not clear where this extra energy will come from, but what is clear is that a better understanding of photosynthesis is likely to be of crucial importance in meeting our energy needs.

So, how to apply the study of photosynthesis to solar energy? It turns out that knowing the principles that plants use to convert sunlight to energy may change the materials of solar cells. In collaboration with chemistry professor Martin Head-Gordon, Fleming and his colleagues have studied the design of nature vs. manmade materials. “To our surprise, we found that nature often breaks the rules developed by chemists. In a chloroplast,
chlorophyll and carotenoid molecules are packed so closely together that transitions and energy levels that would be ineffective, or even inoperative, in widely-spaced chromophores (which can occur in the lab setting), play a crucial role in transferring the excitation energy toward the reaction centers.

“We also know that leaves are responsive, constantly regulating photosynthesis by reacting to changes in light, even to a slight cloud passing over the sun. We would like to understand how light harvesting is regulated in plants,” he added.

For example, no matter how efficient the process, an electron in chlorophyll will eventually become unpaired and transfer its energy to the oxygen, which slowly destroys the photosystem, which is the protein-pigment complex present within higher plant and cyanobacterial thylakoid membranes. “Nature has never found a way to fix this over billions of years of evolution, although when Photosystem 2 is destroyed, it lowers the efficiency of photosynthesis. Plants regulate the efficiency of light harvesting in Photosystem 2 to minimize the damage caused by oxygen. This process is very poorly understood, yet is important in determining worldwide crop yields. We have an active collaboration with Kris Niyogi [in the plant and microbial biology department] to determine the molecular actors in this regulation process.”

Fleming started his career as a pure physical chemist. But he always had a biological bent and looked for crossover projects. “If you want to use spectroscopy to study biology, photosynthesis is a great process to focus on; it’s all about excited states,” he said.

“Thirty years ago, we didn’t have the ability to measure in a useful manner something as complex as the photosynthetic systems—measuring the absorption spectrum didn’t yield much information. It was clear that the things we really wanted to see were too fast, even the pico-second [10^-12— a thousand times slower than the femtosecond] timescale was too slow to work with,” Fleming noted. “This spurred me and others to develop more sophisticated instruments.”

British by birth, Fleming obtained his Ph.D. in physical chemistry in 1974 at the University of London, followed by postdoctoral stints at Caltech and the University of Melbourne before landing at the University of Chicago. In his 18 years on the faculty there, Fleming established himself as an expert on the application of femtosecond spectroscopy to chemical and biological processes. He has been here in the chemistry department since 1997.

And if research and teaching aren’t enough, Fleming is also currently directing three entities—QB3 (the California Institute for Quantitative Biomedical Research), the Physical Biosciences Division at LBNL, and the new Stanley Building project. “I enjoy working with the educational issues of QB3; the research challenges at LBNL; and keeping everything on schedule and dealing with occupancy issues with the Stanley Building,” he said.

Fleming’s research—breaking down the events that occur after sunlight strikes a leaf—does put a different spin on contemplating a flower-filled field, as he well knows. He sees plants for their color and their beauty—as well as their trillions of super-efficient energy converters. But don’t look for him in the garden. He gets hay fever.

“If you want to use spectroscopy to study biology, photosynthesis is a great process to focus on; it’s all about excited states.”
There's never been a better time than now to be a Berkeley student interested in solving problems at the boundaries of traditional disciplines. New degree programs have been established in the college, and new institutes devoted to interdisciplinary education and research have sprouted up, including QB3 (the California Institute of Quantitative Biomedical Research) and the BBNI (Berkeley Nanosciences and Nanoengineering Institute). New courses have been added on such topics as quantum computing and chemical nanotechnology, and degree requirements have been tweaked to address changes in both the professional world as well as in the laboratory.

“Education is following what happens both in research fields and in the job market. In both cases there has been an increase in activities in areas that fall between traditional disciplines. When it is no longer obvious how to prepare students for changes in the workplace using the more traditional majors, then the education needs to change, evolving new majors and minors,” said Herbert Strauss, Associate Dean for Undergraduate Affairs. Supporting Strauss’s observation, chemistry professor Michael Marletta noted, “The traditional departments—chemistry, biology, physics—were set up in British universities back in the middle-ages, but they forgot to tell nature.”

Chemical Biology at the Undergraduate Level

One of the major changes in the Department of Chemistry is the new prominence of chemical biology at both the undergraduate and graduate level. “We want to give students a strong background in traditional chemistry combined with a new sensibility on how to apply it to biological problems,” said chemistry professor Carolyn Bertozzi.

Undergraduates in the college can pursue the new B.S. degree in chemical biology, which teaches biology in the manner in which it is being used in research. “Biology has changed enormously in the past decade, but the curricula had not. The field is much more quantitative and molecular now, and there is a large demand for chemists and biologists well-versed in the molecular, structural, and computational areas,” explained chemistry professor emeritus Ken Sauer, who had a lead role designing the new major.

“We have formalized and organized what was a natural evolution, providing an administrative umbrella and a set curriculum to guide the students,” said Marletta. “Solving problems doesn’t have to occur at the interface of disciplines, but unless a scientist has specific training, diving into the unknown can bescary.”

This major is aimed at students who want to work in the rapidly growing areas of research in molecular and quantitative biology. And, as both Dean Heathcock and Chair Harris mention in their columns (on pages 2 and 4), students are lining up for this program, which has a current enrollment of 138 undergraduates.

Two new courses—Chem 103 and Chem 135—are aimed at chemical biology students and are proving quite popular. Noted Marletta, who teaches Chem 135, an introduction to biochemistry for chemistry majors, “I think the department was surprised at how popular this degree is turning out to be, Chem 135 being a prime example. The first time this class was taught two years ago there were 20 students. This year there are 130 students, mainly chemistry and chemical biology students or joint majors.”
Chem 103 focuses on inorganic chemistry in living systems and replaces both Chem 104A and 104B for chemical biology majors. Said chemistry professor Chris Chang, who is teaching the newly-offered course, “We have about 80 students enrolled, which is the same class size as Chem 104A. [Since it’s a new class, we’re] still hashing out the order and presentation of some topics, but I think we’re hitting a good pace now for everyone.”

**Chemical Biology at the Graduate level**

In only its fourth year, the Chemical Biology Graduate Program (CBGP) is already looking to expand. “We have a National Institutes of Health training grant that supports six students per year, but our actual target is ten students a year,” said Bertozzi, who co-directs the program with Michael Marletta, a professor of chemistry and of biochemistry and molecular biology. “But the funding is coming together: Chiron has recently donated one fellowship, and we are actively looking for more sponsors.”

The CBGP spans several departments, including chemistry, chemical engineering, molecular and cell biology, and bioengineering. Students apply to a home department first, and then later to the CBGP once they decide to matriculate at Berkeley. Once in the program, they have access to a wide pool of faculty members, as 36 professors from the four departments participate in the program. The CBGP also requires that graduate students complete three lab rotations in their first year so they can experience a multidisciplinary educational approach. “I think that I really benefited from the rotation system,” said Kevin McCusker, a CBGP student working with chemistry professor Judith Klinman. “I found that it encourages collaboration and promotes networking, because we are interacting with more scientists and getting more exposure to different fields.”

There is also a social component to the CBGP. “Departments provide a sense of community, loyalty and belonging, which is going to be a challenge for interdisciplinary programs and institutes, which are by definition bigger and more fluid,” observed Susan Marqusee, a professor of molecular and cell biology. “The CBGP aims to provide that community feel, hosting bi-monthly poster sessions where the students get out of their labs and mingle with one another and with faculty members.”

Currently the CBGP is looking to establish a summer research program for undergraduates from groups that are historically under-represented in chemistry, allowing students in their junior year at California colleges and universities to complete a ten-week summer project here on the Berkeley campus. “This will both expose them to research and encourage them to apply...”

“The CBGP aims to provide a community feel, hosting bi-monthly poster sessions where the students get out of their labs and mingle with one another and with faculty members.”
here for graduate school as well,” said Karen Wong, CBGP administrator. “We are applying for funding from federal agencies to support this endeavor; however, we are asking pharmaceutical/biotech companies and private foundations to help launch this wonderful opportunity by providing seed funds.”

Beyond the degree programs, major institutes have been set up to enhance education and research collaborations at the interface of traditional disciplines. The California Institute for Quantitative Biomedical Research (happily shortened to QB3) was developed as a cooperative effort among three UC campuses—San Francisco, Berkeley and Santa Cruz—to advance the coming biomedical revolution, in which our understanding of biological systems at all levels of complexity will increase dramatically because of the application of the quantitative sciences—mathematics, physics, chemistry and engineering—to biomedical research.

To train a new generation of students able to integrate fully the quantitative sciences with biology and medical research, QB3 has helped to create a computational and genomic biology program for graduate students and additional new programs aimed especially at undergraduates. “For example, we are starting a new internship program for undergraduates,” said Susan Marqusee, the UC Berkeley QB3 Associate Director. “Students can apply through the institute for a six-to-nine month full-time internship after their junior year. It’s a good way for chemistry and physics students to get training in biotech. Students receive an educational opportunity, some cash, and more in-depth training.

“For graduate students, the new building—Stanley Hall—will be key, providing clusters of expertise. There will be a lot of sharing of equipment and techniques, allowing experts in different fields to interact in a meaningful way,” continued Marqusee. Scheduled for completion in 2006, the new building will house researchers from six different colleges, and will be the largest research building on campus according to Graham Fleming, a professor of chemistry and the UC Berkeley QB3 Director.

“We hope to radically change interdisciplinary education, and I am convinced that we are on the right path. Many of these multidisciplinary institutions are being set up to meet the demands of the students. We have an active group of faculty, and our students are very organized,” emphasized Fleming. “Students can take advantage of state-of-the-art science in various disciplines to study big problems.”

QB3 serves as a central information center for all three campuses, streamlining the distribution of information about biomedical education and research to students and researchers.

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Nanotechnology & nanoscience

Another institute fostering interdisciplinary education and research is the Berkeley Nanosciences and Nanoengineering Institute (BNNI). Nanoscale science, simply put, is the science of doing things on a really small scale, and it is one of the hottest tickets in town. It seems you can hardly open a newspaper today
Education at the Boundaries of Disciplines

without reading something about how nanoscience and technology will soon change our day-to-day lives. Noted Geoffrey Owens, Dean of Biological Sciences, “Advances in nanoscale science and engineering will catalyze changes of enormous social and economic significance.”

Such large-scale changes in society and in science will require a new type of education. As the National Academy of Sciences recently concluded in its report, Small Wonders, Endless Frontiers: “The new breed of student must have disciplinary depth but also be unafraid to cross disciplinary boundaries, must be energized by talking with colleagues in other fields, enjoy collaboration. He or she must learn the languages and methods used by more than one field.”

“Berkeley will play a key role in educating the next generations of leaders in science and industry,” said chemistry professor Paul Alivisatos. “When nanotechnology begins to have a greater commercial impact, the shortage of trained workers with the necessary skills is likely to emerge as a growth constraint on the industry,” said Alivisatos. “We have top-ranked programs in the relevant disciplines, which is critical for creating a world-class program in nanoscale science and engineering.”

As disciplines evolve and expand, there is a demand from students for these courses to be taught. BNNI is the umbrella organization for expanding and coordinating Berkeley’s research and educational activities in nanoscale science and engineering and is co-chaired by Alivisatos and Tom Kalil, Special Assistant to the Chancellor for Science and Technology. The institute has over eighty participating faculty members from diverse fields in seven departments and will bring in an additional eight faculty members, expanding the research and educational opportunities for both undergraduate and graduate students.

Noted Alivisatos, “Many faculty members involved in nanoscience and nanotechnology report that they are unable to accommodate all of the undergraduate interest in participating in their research groups. They also report that many of their students are getting jobs directly related to their experience as ‘nano-scientists’ as opposed to physicists, chemists or engineers.”

In recognition of the growing importance of all things nano, the campus recently established the Designated Emphasis (DE) in Nanoscale Science to provide specialized multi-disciplinary training and research opportunities to doctoral students in 11 departments and programs. At Berkeley, acquiring a DE is like earning a “minor” with a Ph.D. degree and appears on the transcript. Participating graduate students have access to courses, research opportunities, seminars and internationally renowned faculty across disciplines.

**Nano courses**

An interdisciplinary curriculum is being established that focuses on nanoscale science and engineering, with faculty members developing new courses at the undergraduate and graduate level.

In the college, chemistry and chemical engineering professor Jean Fréchet has offered a freshman seminar called “Chemistry and the Interface of Nanoscience and Nanotechnology.” In addition, chemistry professor Birgitta Whaley has team-taught a course on “Quantum Information Science and Technology,” tar-
The new biochemical engineering laboratory in Latimer Hall will give students a chance to experience ‘hands-on’ instruction in some of the latest techniques in research.

Education at the Boundaries of Disciplines

geted to seniors and first-year graduate students. “The course was very well received, had an interdisciplinary group of students from the Colleges of Chemistry, L&S and Engineering, and was very rewarding to teach,” said Whaley. “I think that all three professors, two teaching assistants and the students who took it last year would agree that they all learned a great deal.” This is a resounding theme among the faculty: they learn as much from the students as the students do from them.

The Berkeley Nanotechnology Club

A large demand for nanotech information has been tapped by the Berkeley Nanotechnology Club, which began when a Haas M.B.A. student, doing an independent study on nanotech, sent out a mass e-mail soliciting interest in a nanotech club. Six months later, in May 2004, more than 340 people attended the club’s inaugural event, which brought in speakers from different fields in industry, banking, government and academia. The events was cosponsored by the Colleges of Engineering, Chemistry, and Letters & Science, along with the law and business schools.

The nanoclub and its website improve communication on campus and with the outside world by allowing interested students and friends to quickly and easily access the wealth of research in nanoscience and nanoengineering on campus.

The club is also a way to break out of a narrow field and get exposure to other departments, according to Ryan Layton, co-president of the club and a graduate student in mechanical engineering.

Focused options in chemical engineering

For chemical engineers, educational choices are quite plentiful. In the chemical engineering department, the focused options have long offered a way for undergraduate students to get intimately familiar with a specialized area of research. The current focused options are biotechnology, chemical processing, environmental technology, materials science and technology, and applied physical science.

A few years back, the options were revamped— with the option of “no option” being added to provide more flexibility in scheduling. “I believe that the undergraduate years are ideally suited for a more general education,” said David Graves, chemical engineering professor and the vice chair of undergraduate affairs. “Students may not know what they want to do straight-away, changing their field and subfields multiple times. The ‘no option’ option allows students to take their technical electives in various disciplines so they can learn a bit about lots of fields, such as environmental, biological and materials sciences.”

“Adding required coursework based on evolving interdisciplinary fields is always tricky because we either have to add on to the existing requirements— which is done, as chemical engineering students now need 128 units to get their degree— or we have to
take away hours from another discipline, such as physical chemistry, in such a way that the students still receive a comprehensive core of more-traditional chemistry and chemical engineering,” said Strauss.

One course requirement that has been added is MCB 102. “Biology has become relevant to chemical engineers, since many of them go on to be employed in the biotech industry,” explained Strauss.

**Still a few walls to knock down**

The interdisciplinary degrees and institutes are meeting the demand from students and bringing together scientists from distinct disciplines to work toward similar goals, but challenges to interdisciplinary education and research still lie ahead. Hiring faculty members who work at the interface is traditionally not easy to arrange. Joint appointments require more paperwork and administration.

“It is a relatively new phenomenon to have people involved with other appointments,” observed Dean Clayton Heathcock. “For a long time, Judith Klinman and Jack Kirsch [who have joint appointments with MCB] were unique. Now more than 20 percent of the college faculty members have appointments in another department, including Arup Chakraborty and Jean Fréchet, who have dual appointments in both of our departments.”

Another snag to offering multi-department courses is that, historically, workloads are department-based and resources, such as staff and TA positions, are allocated on this basis. “When courses are taught by a team, it’s unclear which department gets credit,” explained Heathcock. “We need new ways to track and credit this. There currently are not enough multi-department classes for this to be a big problem, but as interdisciplinary centers and majors gain in popularity, it is an issue that needs to be addressed.” In addition, new and often cross-listed courses can be tricky to coordinate in order to avoid duplication.

“We also need to guard against people having less loyalty to their home departments. When professors start teaching in different departments, it makes it harder to focus on administrative work or to take a major administrative job in either department since their loyalty is spread more thinly,” Heathcock continued. “This is not insurmountable, just a new problem.”

Fortunately, Berkeley has the talented and ambitious people ready to work out any kinks that arise through these collaborative efforts.

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**EXPLORE ONLINE**

**Chemical biology B.S.:**
http://chemistry.berkeley.edu/ugrad_info/policies/degree_reqs.html

**Chemical Biology Graduate Program:**
http://cbgp.chem.berkeley.edu/

**QB3:** http://www.qb3.org/

**Stanley Hall:** http://healthsciences.berkeley.edu/facilities/stanley.cfm; watch its construction at http://www.berkeley.edu/webcams/

**Nanoscience Initiative:** http://nano.berkeley.edu/nanosite/

**Berkeley Nanotechnology Club:** http://Nano club.berkeley.edu
Irmgard and T.Z. Chu

T.Z. and Irmgard Chu have always been modest about their giving—but never modest in the amounts they gave—even since they first started supporting the college in 1983. Their giving has been unrestricted, and it was the college’s idea to name a chair in chemistry in their honor, as both recognition for their generosity and inspiration for others.

Born in Shanghai, T.Z. and his family fled communism in the late 1940s. He found sanctuary at the Woodstock School in Mussoorie, India, graduating in 1952. T.Z. came to Berkeley because he had a cousin at Caltech and his parents, unfamiliar with California geography, thought that it was nearby. It was the college’s good fortune.

His affection for his alma mater, however, was not immediate. Competing with Korean War vets who were eager to make up for lost years, T.Z. worked hard; for him, Berkeley was not a place of fraternity parties and good times. But he learned chemistry from his professors and much about life and other cultures from his fellow students, and in time he came to appreciate that his Berkeley experience had prepared him well for the technological world that was on the horizon.

Graduating in 1958 with a B.S. in chemistry, he worked for Varian and a predecessor company making gas and liquid chromatographs before becoming co-founder of Finnigan Corporation, a leading manufacturer of mass spectrometer systems, in 1968. T.Z. retired from Finnigan two years after they were bought out by Thermo Electronics in 1990. He became a venture capitalist, and then in 1993 he became CEO of Hoefer Scientific, which in turn was bought out by the instrument subsidiary of Upjohn/Pharmacia, from which he retired (again) in 1997.

He met his wife, Irmgard, while he was establishing European operations for his company in her native Switzerland. They were married and in the mid-1960s she came to California.

T.Z. and Irmgard responded to the College of Chemistry’s first fundraising appeal in 1983, and they have been dedicated supporters of, and volunteers for, the college and University ever since. T.Z. was involved in the campus’ first capital campaign, and he was active in the New Century Campaign. He gave a sizable gift to help the college meet a Kresge Challenge grant for Tan Hall, and in 1995 he notified the college that he had included it in his estate plans. Two years later, he accepted an appointment as a Trustee of the University of California, Berkeley Foundation, serving until this year, while also serving on the College Advisory Board. In 1999 the Chus established a Charitable Remainder Unitrust with some property that they owned, naming the college as beneficiary. Wanting to help the campaign but hoping to wait out the downturn in the market, they pledged an additional $500,000 in unrestricted funding for the college in September 2000—a pledge more than fulfilled in 2003 with a gift of stock.

And then came an extraordinary gesture in response to the poor budgetary news this past year, they terminated their own life interest in their unitrust, resulting in more than a half-million dollars of discretionary funding for the dean this past year. To date, they have donated more than $1.15 million, most of it designated for unrestricted use in the College of Chemistry. The Dean has used some of this funding for the chemical biology program and some to help with the establishment of another endowed chair. In 2001 the UC Berkeley Foundation awarded T.Z. the Trustees’ Citation for his philanthropic leadership, and this year the College is pleased to recognize the Chus with the establishment of an endowed chair.

**The T.Z. and Irmgard Chu Endowed Chair in Chemistry**

An extraordinary gesture

by Jane Scheber

“Our contributions to the College of Chemistry did not require any recognition nor did we expect any. We were simply trying to return in a small way to the institution that had made my rewarding career in analytical instrumentation possible. To have a chair named after us was...overwhelming”

T.Z. Chu
He was an excellent scientist, a good man,” said Nobel laureate Yuan T. Lee of his Ph.D. advisor and former colleague, Bruce Mahan. Born in 1930, Mahan received his A.B., A.M., and Ph.D. from Harvard University. His thesis advisor was George Kistiakowsky, who started the young Mahan in research in gas phase reaction kinetics, which he would pursue throughout his career.

Mahan joined the Berkeley faculty in 1956. Among his courses was a new freshman chemistry course described in the catalog as “Lecture and laboratory for students of superior facility and preparation”—today’s Chemistry 4. The textbook he wrote for the course, University Chemistry, was internationally acclaimed and was translated into eight other languages, including Japanese, Turkish, and Greek. The book sold more than half a million copies and went through four editions.

Although innately shy, Bruce was one of the early winners of the campus teaching award in 1961; the students admired his deep understanding of chemistry and respected his demanding, but fair, standards. At the graduate level, he fostered independence in his students, encouraging them to take the initiative and plan the next step in their work. Lee, his best known student, attributed his own success to the way that Bruce trained his students.

From 1968-71, Mahan chaired the Department of Chemistry and successfully recruited many of the faculty members who are responsible for the department’s continued outstanding reputation. He carried his rigorous but fair standards into his dealings with the faculty as well as his students.

Bruce’s research focused on molecular collisional processes, especially collisional energy transfers and ion-molecule reactions, a field that he pioneered. He was the first to recognize that efficient energy transfer from excited polyatomic molecules was attributable to frequent events with a small amount of average energy transfer rather than to rare events with large amounts of average energy transfer. His work was recognized with election to the National Academy of Sciences in 1976.

The previous year, Bruce was diagnosed with amyotrophic lateral sclerosis (ALS), or “Lou Gehrig’s disease,” an incurable illness that slowly causes paralysis, starting with the extremities and working its way to the central organs. In the course of the next four years, he went from crutches to a wheelchair to bed, and finally to a respirator. Despite his condition, he remained cheerful, actively directing his graduate students, revising his textbook, and continuing his research. Always a man of few words, at the end he could communicate only by his eyes. His illness forced him to resign in 1980, and he died two years later.

As his faculty colleagues said at the time of his death, “Once Bruce made a commitment he never wavered. He had the honesty, integrity and above all the ability to do whatever he said he would do. He would never quit and he would never give an excuse. He faced ALS as he would any other challenge. He just kept fighting.”

Bruce Mahan left one-third of his estate to the chemistry department, where the funds were used in part to establish the Bruce H. Mahan Departmental Teaching Assistant Awards. Now his former colleagues, students and friends have contributed additional funds and have chosen to recognize him by creating the Bruce H. Mahan Endowed Chair in Chemistry. The chair holder is Professor David Chandler—like Bruce, an internationally acclaimed physical chemist.

1 From “Bruce Herbert Mahan” by Yuan T. Lee, Rollie J. Myers, Kenneth Sauer, and Ignacio Tinoco Jr., In Memoriam 1988, University of California. This publication provided much of the information for the above column.
He first came to the University of California in 1939, and for the next 62 years, until his death in May 2001, John R. Thomas was closely affiliated with the College of Chemistry. Now, through the loving generosity of his wife, “Mitzie,” his contributions to the College will continue in perpetuity through the John R. Thomas Endowed Chair in Physical Chemistry.

Born in 1921 in Kentucky, John moved to California with his family in the 1930s. After graduating from Oakland High School, he enrolled in the College of Chemistry and earned a B.S. in 1943 and a Ph.D. in 1947, working with Professor William Gwinn. During World War II, John was employed in research on chemical warfare and later, with several other graduate students at the time, he worked on the Manhattan Project.

He took a position with Chevron Research in 1948, but the following year Professor Kenneth Pitzer, on leave to direct research at the Atomic Energy Commission, persuaded John to join him in Washington, D.C., as Assistant Chief of the Chemistry Branch of the AEC. In 1951, John returned to Chevron, where he remained the rest of his career.

At Chevron, he did pioneering research on the combustion of hydrocarbons and, with colleagues, he contributed important studies on the chemistry of antioxidants, lubricants and detergents. Between 1968 and 1970, John moved rapidly from research scientist to president of Chevron Research Company. In 1983, he was also named vice-president of Chevron Corporation. He held both posts until his retirement from Chevron in 1986. In 1990, the college successfully nominated him for the American Chemical Society’s Earl B. Barnes Award for “leadership in chemical research management.”

During his years at Chevron, John maintained a strong interest in the activities of the college. He was instrumental in securing Chevron’s financial support, and in retirement, he co-chaired the college’s fund-raising efforts for building Tan Hall. During his lifetime, he and Mitzie personally donated nearly $120,000 to Berkeley, primarily to the College of Chemistry. From 1984 to 1990, he was also a trustee of the U.C. Berkeley Foundation, from which he received the Trustees Citation. He was a regular attendee at the Berkeley Fellows annual dinner, and he and Mitzie never missed a college event.

Following John’s death, his wife of 57 years, Beatrice “Mitzie” (nee Davidson), struggled to go on without him. The two had met in a carpool while they were students at Berkeley, and her ties to the university had been strengthened when she earned her teaching credential through UC’s Internship Program after raising her family. A junior high school teacher in Lafayette, she shared John’s interests in skiing, hiking, the outdoors, and travel, and following their retirements they had particularly enjoyed Bear Treks.

Mitzie wanted to do something to memorialize John, focusing on how she could best use her IRA to accomplish this purpose. With the endorsement of her children, Richard Thomas and Jonnie Jacobs, she decided on an endowed chair that would reflect John’s interest in research. She signed the paperwork in May 2003, and a few months later she, too, was gone. Their legacy, however, will live on indefinitely.
Charles Wilke was an internationally recognized chemical engineer, one of the founders of the Department of Chemical Engineering at Berkeley, and a mentor to some 100 graduate students and many hundreds of undergraduates. It was therefore quite fitting that some of his former colleagues and students decided to pay tribute to him in his last years. Remarkably, what started with a generous gift from Juana (Jennie) and Andreas (Andy) Acrivos, a former colleague in the department of chemical engineering, grew within a year into an endowed chair in Charlie’s memory.

Charlie chaired the Division of Chemical Engineering from 1953 to 1956, succeeding Theodore Vermeulen, and when the Department of Chemical Engineering was established in 1957, he became its first chair. He was responsible for guiding the growth of the department from five faculty members to sixteen, and he played a key role in making the chemical engineering department at UC Berkeley preeminent at a time when the discipline was evolving toward the social and economic importance it enjoys today.

Having established an international reputation in the 1950s as a leading scholar in the field of diffusion and mass transfer, he shifted directions in his research in the early 1960s to help establish the budding field of biochemical engineering—a field that today enrolls about one-third of all the students in the chemical engineering department.

Andy Acrivos was one of the young faculty members whom Charlie had recruited to Berkeley in 1954. They were colleagues until 1962, when Andy was recruited by Stanford to help shape that department; in 1988 Andy retired from Stanford and became the Albert Einstein Professor of Science and Engineering at the City College of the City University of New York. But both he and Jennie, who was a postdoctoral fellow with Kenneth Pitzer at Berkeley before becoming a professor of chemistry at San José State, maintained their ties to UC Berkeley and never forgot their deep affection for Charlie. Visiting in the spring of 2003, Andy rallied some of his friends on the Berkeley faculty—Eugene Petersen, Jud King, and Harvey Blanch—and former student Darsh Wasan; together they became lead donors and solicited funds in Charlie’s honor from his former students and colleagues. Charlie—suffering from cancer and exhausted from caring for his wife, Bernice, who was suffering from Alzheimer’s—was deeply moved by their efforts and promised that he would contribute to the fund.

Bernice, a teacher and school principal before her illness, passed away in March 2003, and Charlie turned to setting his own affairs in order. Shortly before his death in October 2003, he designated the Department of Chemical Engineering as the beneficiary of his IRA. The $452,000 that the department received put the chair goal over the top.

Charlie’s work had been recognized with the highest awards of his profession, including election to the National Academy of Engineering and the Colburn and Walker Awards of the AIChE. But none of these meant more to him than the efforts of his friends to endow a chair in his name. The Charles R. Wilke Endowed Chair in Chemical Engineering is now a reality. It will be used to support junior faculty on a rotating basis, meeting the needs of the department for start-up funds and reflecting Charlie’s own support during his lifetime of junior colleagues.
Alumnus Profile: R. Stanley Williams

ELECTRONICS on a Small Scale . . . . . . . . . . . .

Stan Williams is an HP Senior Fellow at Hewlett-Packard Laboratories and founding Director (since 1995) of the HP Quantum Science Research (QSR) group. After receiving his chemistry Ph.D. from Berkeley in 1978, Williams spent fifteen years as a faculty member at UCLA, where he maintains adjunct professor status. His primary scientific research during the past twenty-five years has been in the areas of solid-state chemistry and physics, and their applications to technology. His work has evolved into the areas of nanostructures and chemically-assembled materials, with an emphasis on the thermodynamics of size and shape. Most recently, he has examined the fundamental limits of information and computing, which has led to his current research in molecular electronics. He has won numerous awards for his scientific achievement, including the Dreyfus Teacher-Scholar Award, the Sloan Foundation Fellowship, the Julius Springer Award for Applied Physics and the Feynman Prize in Nanotechnology.

When did you know you wanted to be a scientist?
I knew I wanted to be a scientist the day that the Sputnik satellite was launched. The only thing is, I had no idea what a scientist was— I thought I was going to be Buck Rogers.

What event led you into research?
My research career began when I met Robert Curl at Rice University (where Williams received his B.S. degree). He hired me as a freshman and immediately put me in front of a microwave spectrometer to collect data and perform experiments. He also started to teach me quantum mechanics using the Heisenberg approach before I knew what a partial differential equation was.

Why did you decide to come to Berkeley for graduate school?
Bob Curl and several other Rice professors were Berkeley alums. They told me I had to go to Berkeley, which pushed me out here. I interviewed at [several universities], and I chose Berkeley because the professors seemed to have the most fun toys to play with. I wound up working for Dave Shirley doing photoemission, which at the time was one of the most equipment-intensive experiments.

What were some of your favorite memories from Cal?
Frankly, it was primarily my research work. I found learning about the physical world amazing—I would work until I was about to drop, get some rest, and start up again.

How often do you get to visit Berkeley and interact with the department?
I only get over to Berkeley a couple of times per year, unfortunately. I am on the advisory board for the College of Chemistry, and there are always local workshops or symposia in which I participate.

What do you consider to be your greatest achievement?
My most significant scientific achievement is building a team at Hewlett-Packard Labs to perform strategic research in the physical sciences. This team comprises experts in areas such as computer architecture, electrical engineering, materials science, experimental physics of electron transport, theoretical physics, physical chemistry, polymer chemistry, electro-chemistry, and optical physics. As a team, we have
“I chose Berkeley because the professors seemed to have the most fun toys to play with.”

introduced many new concepts into the scientific community that no individual or team from one discipline could have conceived.

What has been your best experiment?
My best experiment was the analysis of germanium growth on silicon surfaces using Scanning Tunneling Microscopy, performed shortly after I joined HP Labs. I do get into the labs, but no longer to perform experiments myself. I am a great believer in the HP tradition of “management by walking around,” so I wander through the labs several times a week so that I can see what everyone is doing, and perhaps help out with suggestions or by providing a sympathetic ear when people are having problems getting their experiments to work.

How about your best theory?
I have done low levels of theory during my entire career, ranging from quantum mechanics, thermodynamics, and even classical kinematics. My most complete and original theoretical contribution (done while I was on sabbatical leave in 1987 in Japan, and thus had a lot of time to devote to it) was a new approach to calculate ion scattering distributions from multiple atoms on or near a solid surface. This approach has been adopted by a fairly substantial community, and is the basis for all of the surface structure analysis done by ion scattering in Japan and other places as well.

How has the teaching of science changed since you were a graduate student?
There is a greater emphasis on slick presentations using Powerpoint, etc., rather than the struggle of using blackboards and chalk, and one-on-one mentoring. I think this means less participation in the learning process by the students.

Where do you hope to see science education go?
I would like to see a significant level of science taught to every high school student in the U.S. The world is becoming increasingly technical, and it is more important to have educated consumers and voters.

A lot of press has been given to the molecular electronics research at HP.
Molecular electronics is really a code term for what is now being called post-CMOS nano-electronics. The area has enormous potential from scientific, technical and economic perspectives. We hope that our work will be the beginning of a new electronics revolution, in the same way that the invention of the transistor created the electronics revolution that has been going on for the past forty years. The applications will be to make everything that is currently electronic more capable while consuming less electrical power. I am not smart enough to predict what new applications will come of it, but in the end they will be more important than those that we can predict. The major challenges ahead are primarily scientific—really understanding the physical and chemical nature of nanometer-scale materials, their interfaces, and how electrons and photons interact with them.

Anything else you would like to volunteer about your work and research?
To borrow a line from a song: “What a long strange trip it’s been!” I’ve had a lot of ups and downs, but in the end all that matters is that I have one more up than down. I think that I have surprised almost everyone, especially myself, with how far I have gone in my chosen profession. There are so many new ideas to learn, new phenomena to discover, new tools to invent, and new experiences to live.

I chose Berkeley because the professors seemed to have the most fun toys to play with.
Dear Fellow Alumni,

Busy, busy, busy. Believe me, I know how you feel. Too busy to help out with the alumni association— or are you? One vital way to remain connected with the college and the students is to serve as a career networker via the @cal online community program. This is a fine way to assist current students in their quest for career fields and specializations. Later this fall a new feature will be available that will allow alumni to upload photos for their Directory profile and Career Network profile, if they so choose.

Speaking of the @cal program, we currently have just over 10 percent of our eligible alums registered, of whom 26 percent have made themselves available to be contacted via the Career Network program. To those who are registered and networkers already, a big thank you. And to those who aren’t yet— well, come on aboard! I encourage you to take the time to register for Cal’s online community program to stay connected with your fellow Bears. The program has many benefits besides the online directory and career network. New this fall is “Web Conferencing,” which includes a “Live Event” series that uses real-time web conferencing to feature notable alumni and faculty members for an ongoing discussion with @cal members.

Again, I strongly urge you to consider joining this exciting online community, not only to stay in touch with classmates but also to assist the college’s students. To register, go to https://chemalum.berkeley.edu. You will be asked for a PIN, which you may obtain by requesting it from the customer service department at the time of registration. I hope to see more of you online!

As we go to press, there are several events coming up this fall:

**Continuing Nanotech Forums**

We are continuing to cosponsor the MIT-Stanford-UC Berkeley nanotechnology monthly forums, which have been incredibly successful not only in highlighting the leaders of nanotechnology, but also in reaching out to the three alumni communities and bringing them together to network and discuss this growing field.

**Homecoming & Parents’ Weekend**

This year during Homecoming & Parents’ Weekend, two of our alumni era groups, the “Free Radicals” (1964-79) and the “CHEMillenniums” (1980-99), will host a brunch in the McCollum Room, following Assistant Professor Dirk Trauner’s lecture on October 16. The chairs from both departments will MC this event and will discuss the latest happenings in the college. Prior to the lecture we will have a continental breakfast for all alumni, parents, students, and friends in the Tan Hall lobby.

**AIChE event**

The AIChE Alumni and Friends reception will be held on Tuesday, November 9, at the Hilton Austin in Austin, Texas during the 2004 Annual AIChE Conference. All alumni and friends are invited to attend.

**Alumni Era Events**

The “Alumni of the G. N. Lewis Era” will host their annual luncheon on Thursday, November 18 in the Heyns Room at The Faculty Club. Professor Clayton J. Radke of the chemical engineering department will be the speaker.

In late winter/early spring we will have the “Cupola Era” alumni luncheon— please look for more details on the college’s homepage.
1940

Edward A. Everts (B.S., Chem) is an independent television producer working for a community access station in Charlotte, VT, where he has helped make such programs as the Peace and Justice Review and Veterans For Peace—Live. He is an active traveler, having recently explored bird habitats in Brazil and ancient cave paintings in southern France. He looks forward to an upcoming trip to New Zealand, where he will visit the North and South Islands and go birding.

1951

Thomas M. McCarthy (B.S., ChE) lives in Limal, Belgium with his wife, Monica. Since retiring as director of product development at Procter & Gamble, he has served as a consultant on environmental affairs, working particularly in the area of waste management and specializing in biogas utilization. He writes, "I have recently acquired two beautiful grandchildren. In whatever spare time is available, I am an avid herb gardener."

David R. Nethaway (Ph.D., Chem), though retired since 1991, stays very busy; he still works one or two days a week as a nuclear chemist at Lawrence Livermore National Lab, makes his own wine (Cabernet Sauvignon, Gewürztraminer, and plum wine this year), and runs several miles a day. He and his wife, Sally, enjoy traveling, and have plans to visit Alaska, Southern California, and Kansas this year. They live in Alamo, CA.

1952

Harold C. Freeman, Jr. (B.S., Chem) worked for four years as a chemist before entering seminary school in 1959. After serving two churches in northern Minnesota, he was pastor of the Presbyterian Church in Hastings, MN for 25 years. Though retired since 1988, he is still active in the ministry. He writes, "I authored the book, He Turned My Wine into Water, an account of my years as an alcoholic and how Jesus set me free." He and his wife of 54 years, Joella, have four sons and four grandchildren, and are expecting their first great-grandchild in November. The couple recently moved to Farmington, MN.

1955

Ernest R. Birnbaum (B.A., Chem), a retired professor of chemistry at St. John's University, shared with us this anecdote about Prof. William Giauque, who was Birnbaum's senior-year advisor: "One day I asked Dr. Giauque if he were free to speak with me. He replied in the affirmative, but that he could only spare me a few minutes because he was preparing for teaching his next class. That class was thermodynamics, the very subject in which he had won his Nobel Prize!" Birnbaum notes that he "continues to marvel at, and to grow in respect for, Dr. Giauque's diligence."

1959

Richard E. Bozak (Ph.D., Chem), emeritus professor of chemistry at California State University, Hayward, attended the 15th International Plant Protection Congress in Beijing, P.R.C., in May. While in China, he presented an invited lecture at the Center for Research and Development of Fine Chemicals at Guizhou University, addressing the organic molecular structures in medicinal herbs.

1961

Mary R. S. (Weir) Creese (Ph.D., Chem), who is retired from the Department of Medicinal Chemistry at the University of Kansas, published the second volume of her survey of nineteenth-century women scientists, Ladies in the Laboratory II, which came out this summer from Scarecrow Press, covers women in continental western European countries and Ireland.

1965

Darsh T. Wasan (Ph.D., ChE) received a Langmuir Lecture Award this year from the ACS Division of Colloid and Surface Chemistry. He is the Motorola Chair Professor of Chemical Engineering and vice president for international affairs at Illinois Institute of Technology, where he works on dispersion science and engineering. He has held a variety of major academic and administrative posts in his career at IIT, and has served as editor-in-chief of the Journal of Colloid & Interface Science since 1993. Here at Berkeley, he gave one of the eulogies at the memorial service for Charles Wilke.

1969

Christopher A. Lapinski (Ph.D., Chem) has been named the winner of the ACS's 2005 E. B. Hershberg Award for Important Discoveries in Medicinally Active Substances. He is retired from Pfizer Global Research & Development.

1976

M. Douglas LeVan (Ph.D., ChE) was named J. Lawrence Wilson Professor of Engineering at Vanderbilt University, having previously been Centennial Professor of Chemical Engineering. He serves as chair of the
chemical engineering department, and is one of the world’s leading scholars in adsorption processes. He is currently developing equipment to make oxygen from the atmosphere on Mars.

1977
B.S. Marc Machbitz (ChE) retired from ChevronTexaco this June and moved with his family to Dallas.

1978
B.S. Scott M. Rocklage (Chem), who received his Ph.D. in chemistry from MIT, recently retired as CEO of Cubist Pharmaceuticals in Lexington, MA. He now works as a venture capital investor with 5AM Ventures, a firm that specializes in seed and early-stage life science startup companies.

1980
Ph.D. Michael Pirrung (Chem) received a 2004 Chemical Pioneer Award from the American Institute of Chemists. The award recognizes chemists who have made outstanding contributions that have had a major impact on chemical science and industry, and has been awarded to 13 Nobel laureates. Pirrung was honored for his invention of DNA microarrays.

Ph.D. Geraldine L. Richmond (Chem), Philip H. Knight Professor of Liberal Arts and Sciences and professor of chemistry at the University of Oregon, has been named the winner of the ACS’s 2005 Francis P. Garvan-John M. Olin Medal, which recognizes distinguished service to chemistry by women chemists. She writes that she and her family—husband Andrew Lange (Ph.D. physics), a professor of physics at Caltech, and their three sons, ages 7, 8, and 14—“spent the last year on sabbatical in various wonderful parts of the world: Australia, Wales, Egypt, Namibia, Madagascar, and South Africa.”

1988
Ph.D. Kelly Moran (Chem) received an Environmental Award from the EPA in recognition of her contributions to advance pollution protection. She was one of 36 individuals and organizations in the western states selected to receive the annual award in recognition of their efforts to preserve and protect the environment. As manager of the pollution prevention program at the Palo Alto Regional Water Quality Control Plant, she has implemented many efforts to control water pollution, including one that reduced levels of five key metals in the Palo Alto plant’s wastewater by 40-90 percent. As a Sierra Club representative, she led a coalition to help pass legislation that provided significant funding to the Department of Toxic Substances and Control’s pollution prevention program, and launched a project that prevented two million gallons of contaminated wash water from entering storm drains or wastewater treatment plants.

1989
M.S. Stuart B. Adler (ChE) See 1993 Ph.D. ChemE.

1992
B.S. Laura S. (Magde) McWilliams (Chem and B.A. Geophysics) received her Ph.D. in oceanography from MIT/Woods Hole Oceanographic Institution. She is a senior project scientist who does environmental consulting for Blasland, Bouck and Lee in Portland, OR.

Ph.D. Tom F. Fuller (ChE) has accepted the position of director of the Center for Innovative Fuel-Cell and Battery Technologies at the Georgia Tech Research Institute at Georgia Institute of Technology, where he will also be appointed professor in the School of Chemical and Biomolecular Engineering. For the past 10 years he was with United Technologies Corp., where he served as director of engineering at UTC Fuel Cells.

1993
Ph.D. Stuart B. Adler (ChE), assistant professor of chemical engineering at the University of Washington, was the first recipient of the Electrochemical Society’s Charles W. Tobias Young Investigator Award. The award, which honors our long-time faculty member, was established in 2003 “to recognize outstanding scientific and/or engineering work in fundamental or applied electrochemistry or solid-state science and technology by a young scientist or engineer.”

David S. Brown (Chem) is a process chemist in quality control at Shell Chemical in Martinez, CA.
Classnotes

Postdoc Elizabeth Z. Bida (Chem) has been promoted to full professor of organic chemistry at Louisiana State University in Shreveport.

Manolis Stratakis (Chem) is an associate professor of chemistry at the University of Crete, Greece.

1994
B.S. Michael A. Branch (ChE and Nuclear Engineering) works for PWI Technologies in Kirkland, WA, where he is a Sun certified Core Solaris systems engineer.

1995
B.S. Chris Sinz (Chem) earned a doctorate at UC Irvine before spending two years as a postdoc at Caltech. In 2003, he became a senior research chemist at Merck in Rahway, N.J.

Postdoc Ram B. Gupta (ChE) was promoted to full professor of chemical engineering at Auburn University, where he holds the Alumni Professor chair.

1996
B.S. Jeremy Baryza (ChE and Chemistry) was one of six graduate students chosen this year by the ACS Division of Medicinal Chemistry to receive its postdoctoral fellowship. Now a graduate student at Stanford, Baryza is studying new molecules for the treatment and understanding of human disease, focusing on functional analogs of bryostatin for the treatment of cancer.

1998
Ph.D. Cofounder and principal staff scientist at Quantum Dot, Marcel Bruchez (Chem) has been honored by the Technology Review by being named to the TR100, a list of innovators under the age of 35. As a graduate student, he helped to develop applications for quantum dots—tiny semiconductor crystals that emit light brightly in a range of sharp colors and are used in biomedical research. This work represents “one of the first commercial applications of nanotechnology,” Bruchez told the magazine.

Scott M. Husson (ChE), assistant professor of chemical engineering at Clemson University, received the New Faculty Research Award from the American Society for Engineering Education SE Section.

1999
B.S. Stephanie Grancharov (Chem) received her M.Phil. in materials science engineering from Columbia University in May 2003. She will spend this year on a Fulbright Fellowship at the Max Planck Institute of Colloids and Surfaces in Potsdam, Germany, before returning to Columbia to finish her Ph.D. While in graduate school, she also worked on nanoscale materials and devices at IBM’s T. J. Watson Research Center.

2001
B.S. Janet D. Chuang (Chem) writes, “I spent the year after graduation teaching English in China, and now am at MIT, enjoying the Boston seasons and finishing a master’s in environmental engineering. Hello to fellow alums, and Go Bears!”

B.S. Amy S. Ng (ChE) is a process engineer at Novellus Systems in San Jose, CA.

Alexander T. Hawk (Chem) is working in the college as a research assistant in Steve Leone’s lab.
Classnotes

M.S. Gavin M. Hoch (ChE) is an associate engineer at Environ International Corp. in Emeryville, CA.

Ph.D. Erik M. Freer (ChE) is a postdoctoral researcher and nanobiotechnologist at IBM in San Jose, CA.

Di Gao (ChE) started as an assistant professor of chemical and petroleum engineering at the University of Pittsburgh this fall.

David T. Kim (ChE) will begin work as a senior associate in environmental consulting for Environ Corporation in Emeryville, CA.

Gary K. L. Lee (ChE) is a research scientist at Cell Genesys in South San Francisco, CA.

Alumni Association News, continued from page 24

RWE, Cal Day and Berkeley Nano in the Spring

Real World Engineering, Cal Day, and the Berkeley Nanotechnology Forum 2005 will be coming up in the spring. RWE ’05, hosted by the College of Engineering, is a great event for current students to learn from alums about various career specializations, options and suggested steps to take to obtain their goals. If you live in the greater Bay Area, please consider participating on an alumni panel.

Cal Day is always fun for alumni, students, prospective students and their parents, and the surrounding community to tour college labs, hear a lecture from one of the college’s faculty and participate in various programs throughout campus.

And, the Berkeley Nanotechnology Forum 2005 promises to be a dynamic event sponsored by the Colleges of Chemistry, Engineering, and Letters & Science; Boalt Law School; and the Haas Business School. Key leaders in the nanotechnology field will be featured at this forum, which is scheduled for Saturday, April 30.

Last May we hosted a kickoff event for our newest alumni era group, which has not yet been officially named but is fondly referred to as the “Young Alumni—2000 and Beyond.” The association planned a celebratory reception for this new alumni era group and also included the graduating students of the college. It was such a hit that everyone involved agreed it should be an annual event.

As another way of congratulating the graduating students, the association gave out travel mugs and included a certificate for a cup of coffee from the Coffee Lab in Giauque Hall to give the students an extra jolt to make it through finals and dissertations!

I do hope to see you at some of the college’s events, and I welcome your comments about suggested programs, etc. Please feel free to contact me at rzuckerman@plexikon.com or Camille Olufson at colufson@berkeley.edu.

I hope that 2004 was a fine year for you and your family, and that 2005 will even be better!

Best Regards,

Rebecca Zuckerman, Ph.D. ’00, Chem
George W. Brown, Jr. (B.S. Chemistry, M.A. Physiology, Ph.D. Computational Biochemistry) passed away on January 9, 2004. He was a professor of fisheries at the University of Washington, where he taught courses on the biochemical and physiological effects of pollution, and conducted research on nitrogen metabolism, especially in primitive fishes. He also worked as a consultant in the area of pollution and served on the editorial board of Aquatic Toxicology.

Before joining the University of Washington faculty, he was a postdoc at the National Institutes of Health (1956), an assistant professor at the University of Wisconsin Medical School (1957-61), and an associate professor at the University of Texas Medical Branch at Galveston (1961-67). He had two sons, Jonathan and Eric, and a daughter, Becky. He lived in Edmonds, WA.

Murray Goodman (Ph.D. Chem), a pioneer in peptide chemistry, died June 1, 2004, of pneumonia at the age of 75. His research focused on the chemical synthesis of natural peptide mimics and the way in which their structure contributes to their function. He was a professor of chemistry and biochemistry at the University of California, San Diego, and was editor-in-chief of the journal Biopolymers from 1963 until his death.

A native New Yorker, he received his B.S. from Brooklyn College and, following his graduate studies at Cal, did postdoctoral work at MIT and Cambridge University. In 1956 he rejoined the faculty at Polytechnic Institute of Brooklyn, eventually assuming directorship of the school’s Polymer Research Institute. He left in 1970 to join the faculty of UCSD, where he served for six years as chair of the chemistry department.

He was the recipient of many awards, including the ACS’s Ralph Hirschmann Award in Peptide Chemistry (1997), the Herman F. Mark Polymer Chemistry Award (2000), and an Arthur C. Cope Scholar Award (2001). He also contributed to San Diego’s Jewish community, serving as president of the Congregation Beth El synagogue in La Jolla and on the boards of the Hillel Foundation and the La Jolla County Day School. He is survived by his wife, Zelda, three sons, and six grandchildren.

Andrew C. Braisted (Ph.D. Chem), a scientist who worked at the interface of chemistry and biology, passed away on October 4, 2003, after suffering a heart attack. He was 39 years old.

He earned his B.S. in chemistry at Bates College and did his doctoral work at Berkeley under the direction of Peter Schultz, in whose laboratory he developed the first antibodies that catalyzed oxy-Cope rearrangements. These antibodies later became important for understanding structural changes that accompany the maturation of antibody catalysis.

As a postdoctoral researcher with James A. Wells at Genentech, he did a series of studies showing it was possible to make “minimalized” versions of protein A through a combination of phage display, rational design, and peptide chemistry. He demonstrated that selection methods evolve function both by optimizing binding determinants and by folding.

In 1998, he became the first scientist to join Sunesis Pharmaceuticals, founded by Wells, in South San Francisco. He was an instrumental figure in the company, helping to build its scientific and technological capabilities, as well as its staff, facility, and even its name. He was co-inventor of an important fragment-based drug discovery technology called “tethering™,” a highly sensitive technique that screens fragments rather than full molecules of drug leads, and he was a central member of a team that developed high-affinity small-molecule inhibitors to the cytokine interleukin-2. Braisted is survived by his wife, Joelle Morrow, M.D., and his son, Miles Andrew Braisted.
UC Regents approve GPA eligibility changes

The Board of Regents recently approved a plan to raise the minimum grade-point average for students to become eligible for admission, deflecting criticism that the change may disproportionately affect minority students. The September 23 decision, which goes into effect for students entering the university in 2007, increases the minimum required GPA from 2.8 to 3.0 on a 4.0-point scale.

This action was the second time the Regents had raised eligibility requirements this year. In July, the Regents toughened the kinds of courses that will be used to calculate grade-point average, and they made other technical changes to shrink the pool of eligible students from 14.4 to 13 percent of the high school graduating class.

The higher GPA threshold is intended to shrink the pool of eligible students still more, from 13 percent to 12.8 percent of students graduating from the state's public high schools—a figure closer to the 12.5 percent initially set by the state's Master Plan for Higher Education in 1960.

The hot gets hotter and drier

In an intriguing study, California researchers predict that the state will experience significantly hotter summers by 2100, impacting human health and causing water shortages. Using the most sensitive climate models to date, the findings are dramatic and "illustrate more than ever the urgent need to control greenhouse-gas emissions now," said study co-author W. Michael Hanemann, a professor of agricultural and resource emissions at Berkeley. According to the study's lower-emissions scenario, in which alternative energy and fuel-efficient technology play a key role, the summer temperatures here would increase 4 to 5 degrees Fahrenheit by the end of the century. If no changes are made in our consumption of coal and fossil fuels, the summer temperature would rise an astonishing 7 to 15 degrees Fahrenheit. The hotter summers could cause significant reductions in the Sierra Nevada snowpack, which supplies the state's reservoirs and rivers.

Heavy medal

The Berkeley contingent made a big splash at the 2004 Summer Olympics in Athens. Led by All-American swimmer Natalie Coughlin, who won five medals in swimming, Berkeley-affiliated athletes took home 17 medals in various sports, including water polo, beach volleyball, soccer and rowing. A total of 42 Cal athletes competed in the Athens Olympics—10 current students and 32 alums represented either the U.S. or their ancestral or native countries. The men's swimming team had the most Blue and Gold at the games, with 12 Bears.

Back in black

UC will sustain significant budget cuts for the 2004-2005 year as the government comes to terms with its shortfall. Over the last few years, the UC system has had to absorb both a 16 percent reduction in funding through program reductions, fee increases for students and less-competitive salaries for faculty and staff, as well as a 16 percent increase in student enrollment. However there are no new cuts, and the state funding increases are scheduled to resume over the next few years, with a three percent increase projected for 2005-2006.

Under an agreement between UC President Dynes and Gov. Schwarzenegger, UC will receive funding to preserve its internationally acclaimed academic programs, to provide broad accessibility for promising California students, and to sustain its deep impact on the economy, health, and quality of life of California. The compact lays the foundation for the University to recover from the latest budget cuts and, ultimately, to begin building again. Further information can be found at www.universityofcalifornia.edu/news/compact/welcome.html.