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COLLEGE OF CHEMISTRY • UNIVERSITY OF CALIFORNIA, BERKELEY

Paul Alivisatos Living the engaged life

- T.Z. Chu
- Faculty profiles
- Panos on Brewer



Catalyst

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UNIVERSITY OF CALIFORNIA, BERKELEY

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ON THE COVER

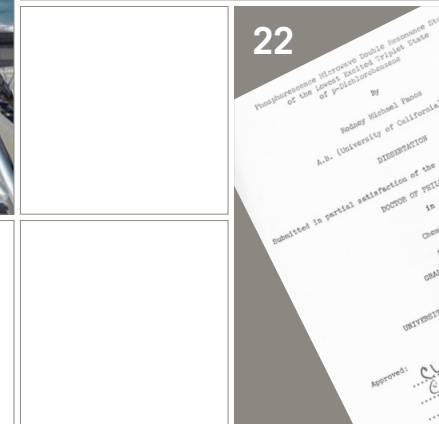
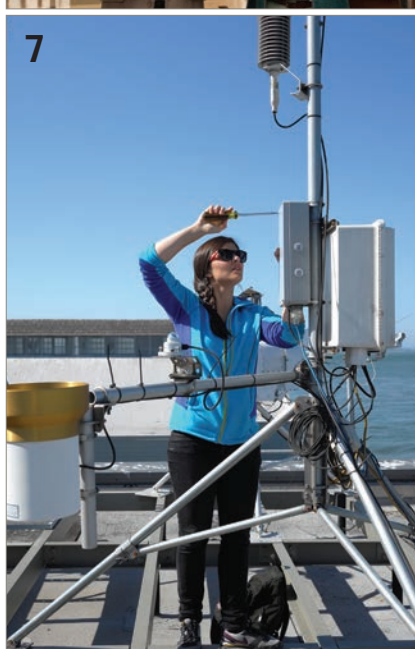
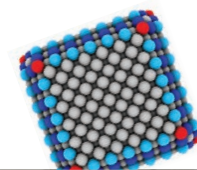
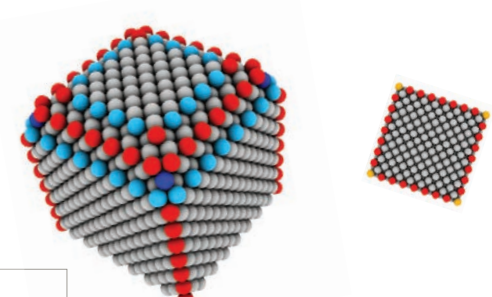
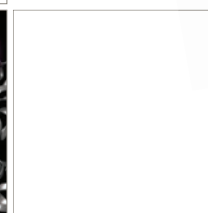
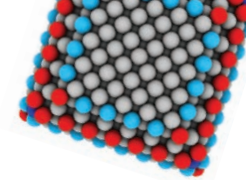
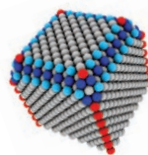
In addition to being a renowned scientist and inventor, Renaissance man Paul Alivisatos is also a skilled photographer. This is his photo of Villa Monastero in Varenna, on Italy's Lake Como.

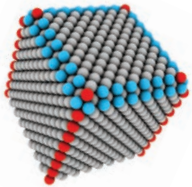
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FALL 2016

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Adapting to Budgetary Challenges while Creating New Opportunities



DOUGLAS S. CLARK
Dean, College of Chemistry
Gilbert N. Lewis Professor

While the College continues to maintain its excellent standing in a changing budgetary climate, we have implemented several initiatives focused on increasing revenue generation. One of our goals was to establish additional professional education programs to offer greater opportunities for students and provide additional funding to the College. The success of the Product Development Program—which evolved into a highly successful professional degree program with increasing enrollments each year—has paved the way for other degree programs. Our newest is the Master's Degree in Chemical Engineering with a concentration in Bioprocess Engineering; this program was officially approved by the Graduate Council this summer. CBE is now recruiting the program director and preparing the marketing and application materials for the first cohort of students. We have more new professional degree programs in the planning phase, so stay tuned for further details.

The College has also continued to build national and international partnerships with industry and academia to promote collaborative research and graduate training programs, and to support outreach to students abroad. One newly developed venture is the Summer Youth Intensive Program, a one-week summer intensive for high school students designed to offer opportunities for scientific research in chemistry, biochemical engineering, material science and related fields to prepare them for future success in college. In addition to preparing students for studying chemical sciences, this program generates revenue,

and we expect increasing enrollments as word of this exciting opportunity spreads among future scientists around the world.

We are also extremely proud to have arrived at a working model for the Berkeley Catalyst Fund, an outside venture fund that will allow us to strengthen the entrepreneurial ecosystem that is developing in the College and turn emerging technologies into commercial successes that will benefit the College, the campus, and society at large. Related to this effort is the formation of the *Berkeley Catalyst Philanthropic Fund (BCPF)*, a fund created to allow donors to invest in the Berkeley Catalyst Fund while supporting the campus and receiving donor recognition at the same time. A vital component of this effort has been the degree to which the BCF/BCPF has become a driver for outreach and cultivation of our entrepreneurially minded alums.

It is with future alums in mind, and all they will contribute to improving our world, that we continue to create new opportunities for expanding education and furthering research within the College of Chemistry. Together, we will overcome the budgetary challenges we now face in ways that will strengthen and enrich the offerings of our College.

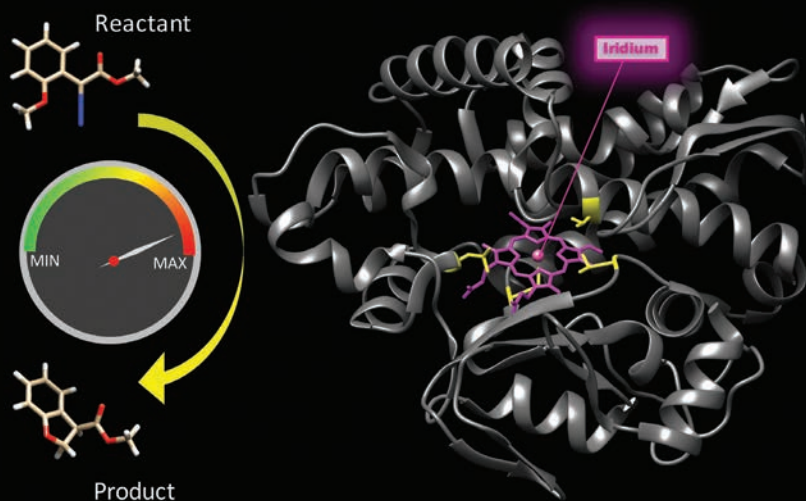
NEW & NOTABLE

RESEARCH • VIEWS
DISCOVERIES • AWARDS

Hartwig lab creates bionic enzymes

Bionic enzymes got a needed boost in speed thanks to new research by the Hartwig lab. By pairing a noble metal with a natural enzyme, researchers created a hybrid capable of churning out 2,550 product molecules per hour, a frequency comparable to biological counterparts.

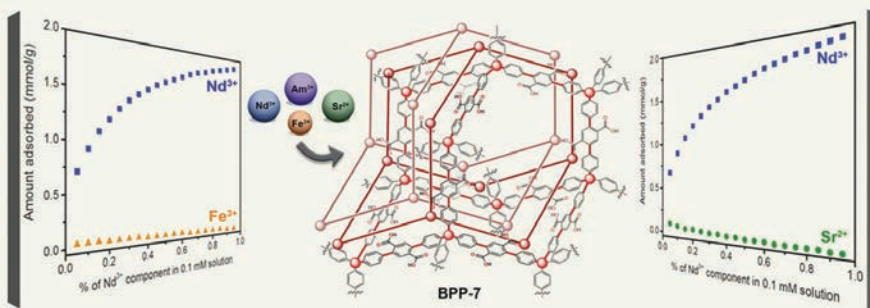
The development, reported in *Science*, represents a major advance for artificial metalloenzymes, which promises to open up a world of beneficial molecular products not currently possible with natural enzymes.



CHEMISTRY

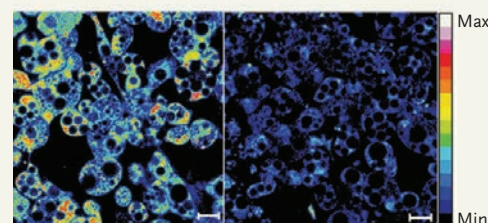
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CHEMISTRY/LBNL



Long uses PAFs to soak up fission products

Jeff Long and CoC and LBNL colleagues have demonstrated that a porous aromatic framework (PAF) can selectively uptake neodymium ions, a promising development towards separation in the treatment of fission products.



Normal Copper Levels Deficient Copper Levels

Chang lab discovers role of copper in fat burning

A new study from the research group of Chris Chang is further burnishing copper's reputation as an essential nutrient for human physiology. The research team, with help from LBNL, has found that copper plays a key role in metabolizing fat.

CHEMISTRY/LBNL

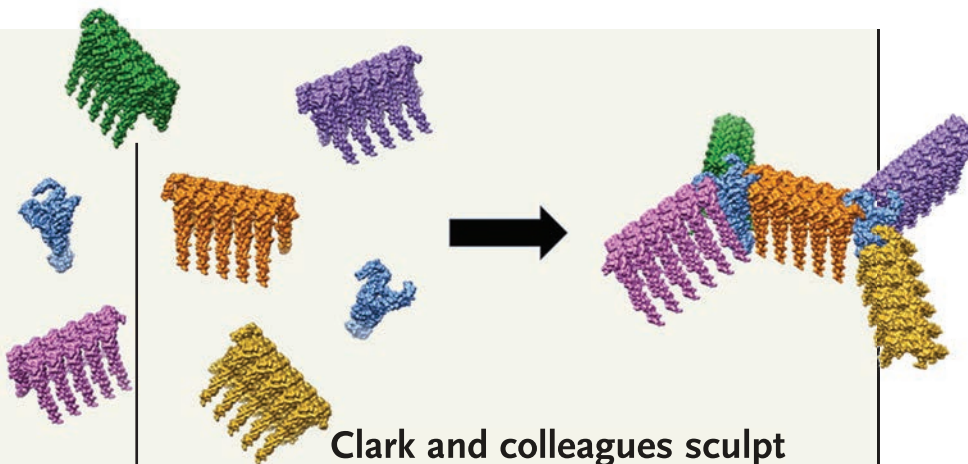
CBE STUDENT

BEAM wins Zipcar award



Berkeley Engineers and Mentors (BEAM), a group of Berkeley students who teach and mentor local K-8 students with science and engineering activities and demonstrations, has been selected as the Zipcar 2016 "Students with Drive" Grand Prize Winner.

CBE undergrad and BEAM co-president Bernardo Gouveia says that the program provides student organizations at eligible colleges and universities with free Zipcar memberships and driving credits to support their activities on campus and in their local communities.



Clark and colleagues sculpt nanostructures from proteins

CBE professor Doug Clark, along with colleagues, is learning to control self-assembly of proteins.

This ability is being exploited in the emerging field of protein nanotechnology to create nanoscale structures. Simple protein subunits assembled into complex designs give rise to functional materials and devices.

CBE

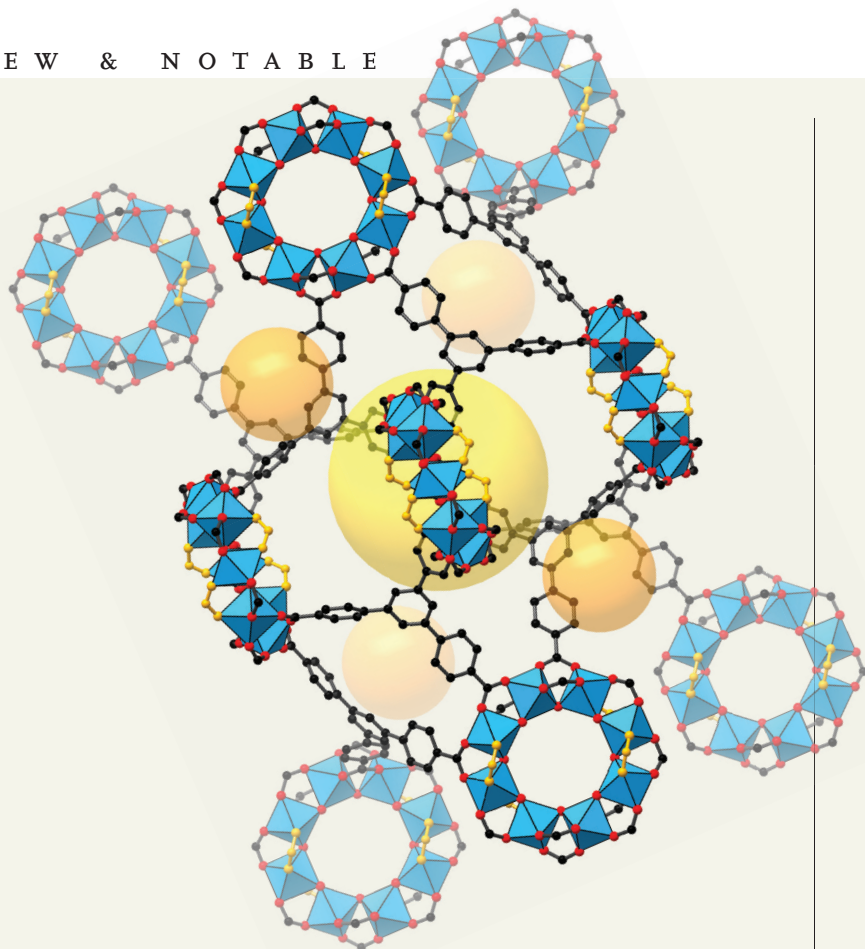
COLLEGE

College celebrates opening of expanded Pitzer Center

On Saturday, Nov. 5, the College of Chemistry celebrated the opening of the newly expanded Pitzer Center for Theoretical Chemistry. This beautiful renovation, as well as the improvements to the original Pitzer Center on the lower level, was made possible by a generous gift from the Pitzer Family Foundation.

The Pitzer Family Foundation has been an outstanding source of support for the College of Chemistry. It has endowed both the Kenneth S. Pitzer Center for Theoretical Chemistry and the Kenneth S. Pitzer Distinguished Professorship in Chemistry, a chair currently held by Martin Head-Gordon. Thanks in part to the Pitzer family's ongoing philanthropy, the college houses what is arguably the finest theoretical chemistry group in the nation.





Yaghi measures molecules with MOFs

Chemistry professor Omar Yaghi and colleagues have created a new sort of nanoscale display case that enables new atomic-scale views of hard-to-study chemical and biological samples.

Their work, published in *Science* magazine, could help to reveal new structural details for a range of challenging molecules by stabilizing them inside sturdy structures known as metal-organic frameworks (MOFs).

CHEMISTRY

INNOVATION



Iglesia and Alivisatos named fellows of the National Academy of Inventors

CBE professor Enrique Iglesia and chemistry's nanotechnology pioneer Paul Alivisatos were among 175 distinguished academic inventors named fellows in an announcement today by the academy. Both are also faculty scientists at Lawrence Berkeley National Laboratory, and Alivisatos is a former director of the lab.

Election as an NAI fellow is "a high professional distinction accorded to academic inventors who have demonstrated a prolific spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on quality of life, economic development and the welfare of society," according to the academy's announcement.

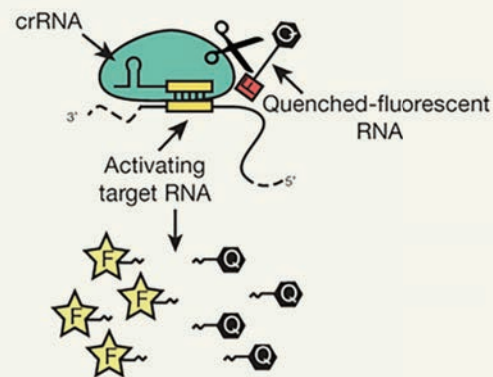


Ignacio "Nacho" Tinoco has died

As this magazine went to press, we learned that emeritus chemistry professor Ignacio "Nacho" Tinoco died on Nov. 15 at the age of 85. More details will be forthcoming on the college website and in the next issue of *Catalyst*.

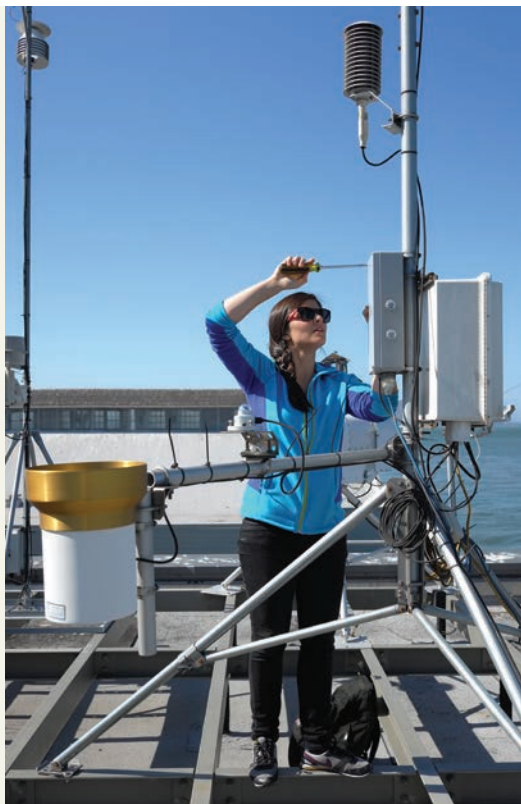
IN MEMORIAM

CHEMISTRY/MCB



Doudna, Cate, Tjian extend CRISPR to RNA

Chemistry professors Jennifer Doudna and Jamie Cate, molecular biologist Robert Tjian and Doudna Lab researchers have expanded the role of the newly discovered CRISPR protein C2c2, deciphering two distinct RNase activities that enable guide-RNA processing and RNA detection.



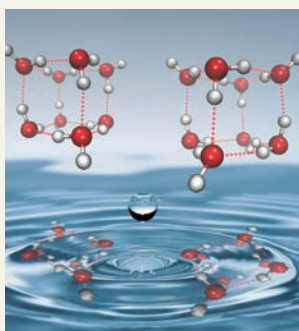
Cohen group measures and models atmosphere at local and global scales

Chemistry professor Ron Cohen and group are using sensor technology to measure the concentrations of atmospheric gases at both local and global scales. From that data they develop computational models that describe the emission processes that cause those observations.

Saykally explores the water octamer

For a simple compound that is central to almost every aspect of our existence, water remains fiendishly difficult to understand.

Chemistry professor Rich Saykally and co-workers have taken a step forward by characterizing the water octamer, a cluster of eight water molecules in a roughly cubic form.



The octamer is important because it represents a transition to structures formed by stacking quasi-planar rings, a dominant pattern in larger systems.

CHEMISTRY

Frances Arnold wins 2016 Millennium Technology Prize

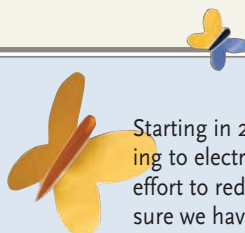
CBE alum and Caltech professor Frances Arnold (*Ph.D. '85, with Harvey Blanch*) has received the 2016 Millennium Technology Prize in recognition of her discoveries that launched the field of 'directed evolution,' which mimics natural evolution to create new and better proteins in the laboratory. This technology uses the power of biology and evolution to solve important problems, often replacing less efficient and sometimes harmful technologies.



The Millennium Technology Prize is one of the world's most prestigious science and technology prizes. Arnold is the first woman to win the award, underscoring her status as a strong role model for women working in technology.

CBE

CHEMISTRY



Starting in 2017, the College of Chemistry will be moving to electronic invitations to our many events, in an effort to reduce costs and save resources. Please make sure we have your correct email address, so you don't miss out on events and news from the College!

Please submit your email address here:
chemistry.berkeley.edu/email

Thank you for your support and understanding.

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Catalyst magazine goes digital

Due to budget cuts, the next issue of *Catalyst* will be digital only. Please check chemistry.berkeley.edu for information on the new Spring 2017 issue.

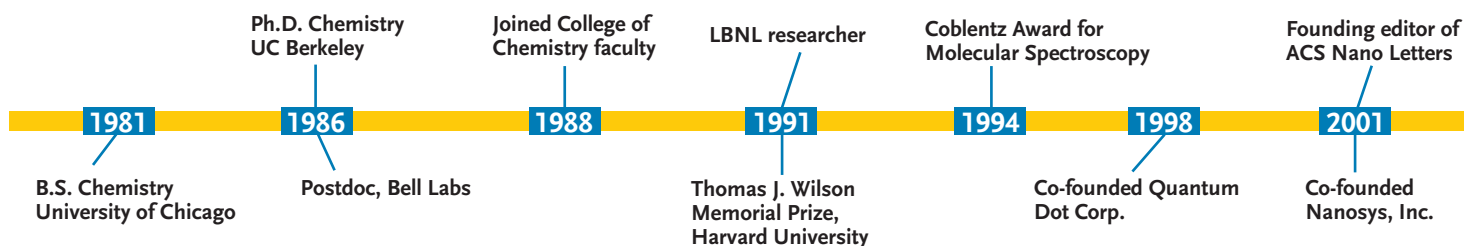


Living the engaged life

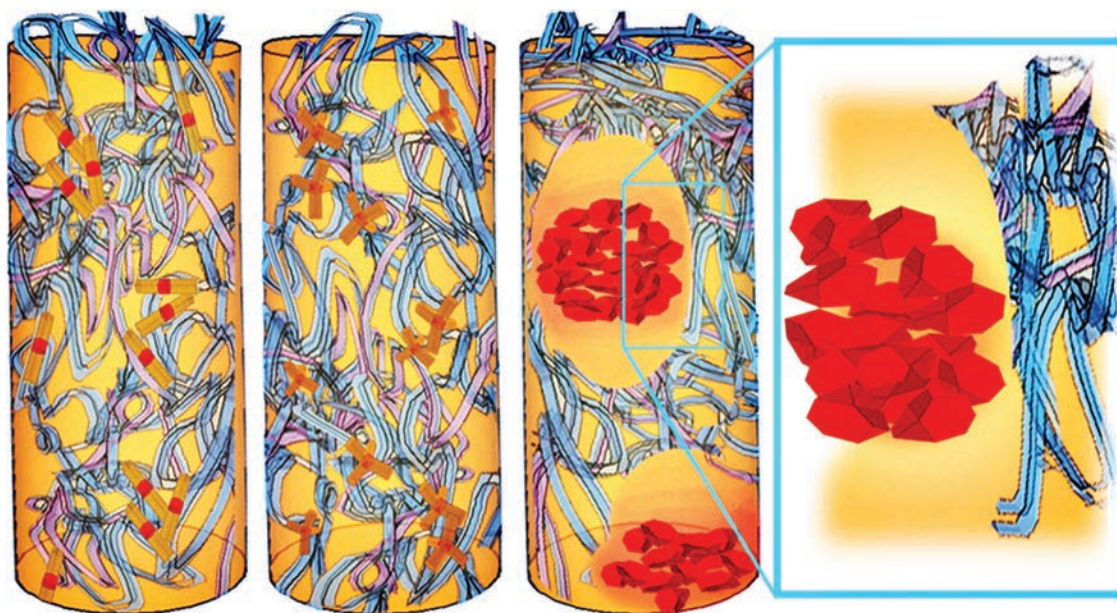
PAUL ALIVISATOS, WINNER OF THE NATIONAL MEDAL OF SCIENCE



ALIVISATOS MILESTONES



College of Chemistry, UC Berkeley



These images depict structures of polymer nanocomposites. The different structures have very different degrees of stiffness. Alivisatos lab members conducted many experiments and then constructed lattice spring model simulations that provided useful tools for engineering the properties of polymer-matrix nanocomposites. This approach can help to shed light on how to fine-tune the elastic properties of structural polymeric nanocomposite fibers.

Paul Alivisatos is a Berkeley chemistry alumnus and professor, the current Vice Chancellor for Research, a former director of the Lawrence Berkeley National Laboratory, and now the college's most recent winner of the National Medal of Science

Yet for all the accolades and accomplishments, what really brought home the value of his research for him was a recent trip to Costco. There, at the front of the store, were all the latest and biggest wide-screen televisions. Among the most highly rated are the Samsung models, which use a quantum dot technology pioneered in the Alivisatos lab and developed at Nanosys, a company he co-founded in 2001.

From steam engines to computers, it's hard to pin an exact date for when a new technology "starts." But for nanotechnology, formally defined as the manipulation of matter with at least one dimension sized from 1 to 100 nanometers, the seminal date is usually given as December 29, 1959. On that day the Caltech physicist Richard Feynman gave a talk called, "There's Plenty of Room at the Bottom."

In the talk, Feynman noted, "Atoms on a small scale behave like nothing on a large scale, for they satisfy the laws of quantum mechanics. So, as we go down and fiddle around with the atoms down there, we are working with different laws, and we can expect to do different things."

"The periodic table of the elements is two-dimensional," explains Alivisatos. "Nanotechnology adds a third dimension. As we drill down and make bits of matter smaller and smaller, their properties change, just as properties change as we move across the periodic table."

As a chemist, Alivisatos came of age in the 1980s, when the foundations for nanotechnology were laid by inventions like the atomic force microscope and the discovery of buckminsterfullerenes, or "buckyballs," previously unknown forms of carbon. Both these discoveries would later win Nobel Prizes.

Alivisatos wrote his 1986 Ph.D. thesis, "The photophysical properties of molecules near metal and semiconductor surfaces," in the research group of Charles B. Harris here in the College of Chemistry. For postdoctoral research he moved to AT&T's Bell Labs, where he worked with Louis Brus, the discoverer of the colloidal semiconductor nanocrystals known as quantum dots.

Alivisatos returned to the College of Chemistry to join the faculty in 1988, where he has since made several discoveries in the fabrication and use of quantum dots and other nanocrystals. His second startup, Quantum Dot Corporation, develops quantum dots for use in fluorescent sensors in biomedical imaging. The company was acquired by Life Technologies and is now a part of Thermo Fisher Scientific. As a Senior Faculty Scientist at LBNL, Alivisatos developed

Elected to the National Academy of Sciences

ACS Award in Colloid and Surface Chemistry

Eni Award for Energy and Environment

Ernest Orlando Lawrence Award, DOE

Computation and Engineering's Nanoscience Prize

2004

2005

2006

2007

2009

Elected to the American Academy of Arts and Sciences

Founding Director, DOE Molecular Foundry

Rank Prize for Optoelectronics

Director of Lawrence Berkeley National Laboratory

nanoparticles for energy applications, including photovoltaic solar panels and catalysts for the production of hydrogen and other fuels.

It has been a decade since *Catalyst* magazine profiled Alivisatos in our first issue. We recently caught up with him in his new office in California Hall. There he demonstrated the latest quantum dot wide-screen television from Samsung and graciously answered our questions.

Q When you were 10 years old, in 1969, you and your sister left Chicago to live with relatives in Athens, Greece, and attend school there. You left the United States during the fervor of the sixties and moved to a country that was under the control of a military junta. You returned to the U.S. in 1974 to attend the University of Chicago, after civil society had been restored in Greece. How did that experience affect you?

“The distinction between basic and applied research is not helpful. They are not in opposition, they are woven together.”

A It was a big life event, a difficult period. I didn't speak any Greek when I arrived. In some areas the classes were more advanced than in the U.S., so I had to struggle to catch up while I was learning a new language at the same time. But people were very kind.

The great thing for me was that I had to find my own path and make things work. I came through it OK. The Greek government was oppressive, the teachers didn't want any fuss and the students felt the constant tension. But for me, more than that was the effect of living in a different culture. Living in two different cultures makes you aware of things you didn't perceive before. It makes you open to possibilities.

Q Why does Berkeley produce scientist/statesmen more than any other university? There was Glenn Seaborg, who famously advised 10 presidents, there is you and your role as director of LBNL, and most recently, there is Jennifer Doudna, who has taken a step back to ask

the hard questions about how society should deal with CRISPR and the genetic engineering revolution it will enable.

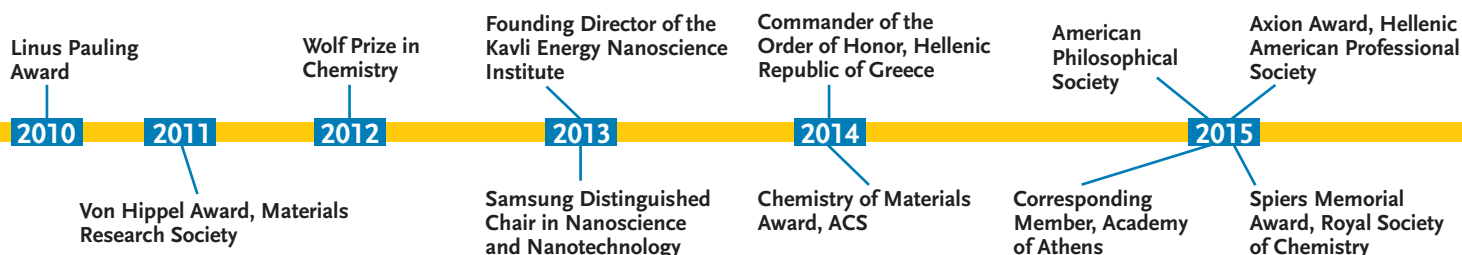
A Berkeley is the university that questions how to make society better. We engage with society. We have to. Having studied classical Greek thought and the Socratic method, I was attracted to this ethos and to Berkeley's broader perspective. As for CRISPR and asking hard questions about its potential, it is a tribute to Berkeley and to Jennifer as a human being. It's wonderful to see—that's what we should be doing.

Q As Vice Chancellor for Research, you deal with the ongoing consequences of the Bayh-Dole Act of 1980 and that law's emphasis on working with industry. There have been controversies—the Novartis agreement and the Energy Biosciences Institute come to mind. How does this growing emphasis on entrepreneurship affect Berkeley's research mission?

A What is special about Berkeley is that we challenge the *status quo*. Becoming more interactive with the rest of the world is a really good thing. How do we most effectively accomplish this interaction? Entrepreneurship is one of the best ways of producing positive social change. It's not the only dimension, but it's one dimension we should be proud of.

The distinction between basic and applied research is not helpful. They are not in opposition, they are woven together. How can we allow these two different perspectives on research to work together organically to make discoveries that quickly become useful for society? That's the question. Sometimes out of left field comes a discovery that produces practical outcomes really fast. I think CRISPR is an astonishing example. That's Berkeley in action.

Q From 2009 to 2016, you were the director of LBNL. You were in the thick of the explosion of energy and climate change research at the lab. Are you optimistic or pessimistic now about how we will adapt?



A There have been many wonderful developments in the energy sector. Renewables are in a much different place than 10 years ago. One thing that no one anticipated then was the production of low-cost natural gas thanks to fracking, and how it would displace coal. Burning natural gas creates about half the carbon dioxide emissions, and it is much less polluting than coal. As a consequence, our CO₂ emissions are dropping. But the problem is still very big. How do societies remain resilient when facing the need to adapt? That is the question we will have to confront.

I am convinced that healthy societies with more and more people will be able to protect the environment. We have enormous human potential. There are now 20 to 25 countries with vibrant science cultures. In 20 years, there may be more than 50. We will all need to do everything we can to contribute to finding solutions. There is plenty to do. It makes me optimistic, not pessimistic.

Q After all these years of being a researcher and scientist administrator, what comes next? What sort of guideposts do you use to navigate such a varied career?

A Every day I'm involved with my research group. I'm enjoying what I do now. Someday this will be just another period in my history. I'll move on.

In 1974 I returned from Greece to attend the University of Chicago. The classics were part of the humanities core curriculum there. Greek philosophy emphasized the search for truth and living an engaged life. I loved it. The lessons have stayed with me.

When I was a young assistant professor at Berkeley, I shared an office with Ken Pitzer. He had retired by then but was still conducting research. He was a brilliant theoretical chemist who had also been the president of Rice University and of Stanford. He had led a full life in a practical way and I admired that.

Q How does it feel to win the National Medal of Science?

A It was the honor of a lifetime. It was very special for me to meet President Obama, someone I admire. Only a few experiences like that happen in a person's life.



The National Medal of Science

was established by the 86th Congress in 1959 as a presidential award to be given to individuals "deserving of special recognition by reason of their outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences." Listed below, from oldest to newest, are the college's 11 medalists.

1974 KENNETH S. PITZER
National Medal of Science in Physical Sciences
Presented by President Gerald R. Ford

1983 GEORGE C. PIMENTEL
National Medal of Science in Chemistry
Presented by President Ronald Reagan

1986 YUAN TSEH LEE
National Medal of Science in Chemistry
Presented by President Ronald Reagan

1989 MELVIN CALVIN
National Medal of Science in Chemistry
Presented by President George H. W. Bush

1991 GLENN T. SEABORG
National Medal of Science in Chemistry
Presented by President George H. W. Bush

1997 DARLEANE HOFFMAN
National Medal of Science in Chemistry
Presented by President William Jefferson Clinton

1997 HAROLD S. JOHNSTON
National Medal of Science in Chemistry
Presented by President William Jefferson Clinton

2001 GABOR A. SOMORJAI
National Medal of Science in Chemistry
Presented by President George W. Bush

2003 JOHN M. PRAUSNITZ
National Medal of Science in Engineering
Presented by President George W. Bush

2012 JUDITH P. KLINMAN
National Medal of Science in Chemistry
Presented by President Barack Obama

2014 PAUL ALIVISATOS
National Medal of Science in Chemistry
Presented by President Barack Obama



Berkeley Vice Chancellor
for Research

Dan David Prize

2016

Awarded the National
Medal of Science

Named fellow of the
National Academy of
Inventors



T. Z. Chu: A man for his time

Tao-Zeun (T.Z.) Chu, one of the college's most loyal and beloved alums, lived a life that could have been taken from the pages of an epic 20th-century novel—a story of love, war, exotic locales and international scientific achievement. But for T.Z. what remained the most important were family, good work, a place to call home, and generosity, especially to the two schools that shaped his life. We interviewed T.Z. at his home in Los Altos Hills in mid-August, about four weeks before he died at age 82.



CHINA

Shanghai



T.Z. Chu's life story starts before his birth, when a mysterious young woman arrived in Shanghai from Japan in the late 1920s. Although she lived under an assumed name, the local Japanese authorities in Shanghai had been notified by Tokyo of her presence, for she was a member of the family that ruled Japan as the Ashikaga shogunate from 1338 to 1573.

Tseneko Ashikaga, born in 1904, had fled the rigid life of an aristocratic woman in Japan. She began working in Shanghai as a tutor and translator. There a young businessman named Vico Chu began studying with her.

Vico, born in 1901, was from a family of silk merchants in Hangzhou, a city of gardens and canals south of Shanghai. The family business had exported millions of dollars worth of silk to France and other countries in the early 1900s.

Vico had been educated at the University of Lyon in France and had traveled throughout Europe. In the late 1920s he returned to China and settled in Shanghai to set up a textile weaving and dyeing business.

He could already understand several languages and could read and write in French, English and Chinese. Learning Japanese with his tutor Tseneko was next. The teacher and student fell in love, and they married in 1930. Tseneko eventually renounced her Japanese citizenship to live as a Chinese national.

In 1932 fighting broke out briefly in Shanghai between the Japanese and the Chinese forces under Nationalist leader Chiang Kai-Shek. An uneasy truce remained in place until outright war erupted in 1937. T.Z. Chu was born during the stable period of Japanese occupation before the war, in 1934. He was the middle child, with a sister, Li-Chun, born two years before, and another sister, Li-Chiang, born six years later.

Says T.Z., "My mother and father baked a cake when the war started and kept it in the freezer all those years until the war ended. By then it was a little dried out." Although the end of WWII in 1945 brought another period of relative calm, it would not last long. With the Japanese no longer in control, civil war roared to life between the communists and the nationalists.

The company started by T.Z.'s father survived until the communist takeover in 1948, when the family fled Shanghai for Mumbai (Bombay), India. Says T.Z., "It was December 29, 1948. We left on the last Air France flight and spent one night in Hong Kong and New Year's Eve in Saigon."

Once in India, plans to start a new company disintegrated when Vico and his business partner were not able to secure the necessary permits during the turmoil that followed the post-colonial partition of India in 1947.

The Chu parents moved to Bangkok to start an export business after enrolling their three children in a unique boarding school in India. The Woodstock School was founded in 1854 as a Protestant girl's school in a British colonial hill station. It became an American missionary school in 1872. Although T.Z. arrived at the school speaking no English, at his graduation he was honored as the "Best All-Around Student."

The school is still located in Mussoorie, 150 miles NNE of New Delhi in the foothills of the Himalayan Mountains. At an altitude of 6,500 feet, the coolness attracted the families of foreign diplomats (and later many tourists). Says T.Z. about his time there, "In my 1952 graduation class of 31 students, we had nine different nationalities. I was never conscious of being a minority at the school and later in life. Our parents visited us in India periodically from Bangkok, and my mother spent several summers in Mussoorie to be with us."





芒島樣子女
及他子與籠中



同 上



京柳 極屋內



憶子外祖母及前古松
已數百年被雷災感痛發全良



同 上



憶子外祖母及前古松
已數百年被雷災感痛發全良
憶子外祖母及前古松
已數百年被雷災感痛發全良
憶子外祖母及前古松
已數百年被雷災感痛發全良



島岡小姐



待魚上釣
睡者為籠中



島岡小姐



宰割



歸航



歸航

航夫共四人計信魚一尾有取合
憶子外祖母及前古松
已數百年被雷災感痛發全良

T.Z.'s father Vico was a talented amateur photographer. He took these images of T.Z.'s mother (upper right) and his infant first child, T.Z.'s older sister (lower left) on a trip to Japan, probably in 1933.

Tangier

MOROCCO

By the time T.Z. graduated from the Woodstock School, his parents had moved to Tangier to establish a carbon dioxide plant to supply the growing beverage industry in North Africa. An ancient trading city located where the Strait of Gibraltar meets the Atlantic Ocean, Tangier was an international protectorate that later became part of Morocco.

Eighteen-year-old T.Z. stayed a month with his parents in Tangier, then a destination for eccentric artists, spies and obscure millionaires. He walked the same streets as expatriate American novelist and composer Paul Bowles, best known for his novel, *The Sheltering Sky*. Other American visitors included author William Burroughs and playwright Tennessee Williams.

In January 1953, T.Z. crossed the Atlantic in rough weather on a WWII-era freighter. He arrived in New York and traveled across the United States by train. He was met in Berkeley by his older sister, who had arrived two years earlier.

An East Coast college would have been much closer to Tangier than Berkeley but, explains T.Z., "At that time, it was not easy for relatively poor Chinese to be accepted by Ivy League schools. My parents were quite poor then, having to borrow money to build the carbon dioxide plant, and Berkeley was one of the top universities that welcomed foreign students of modest means.

"My older sister went straight to Berkeley from the Woodstock School in India. My younger sister left Woodstock School in fourth

grade when my parents moved to Tangier. She graduated from a French school there and was also accepted by Berkeley.

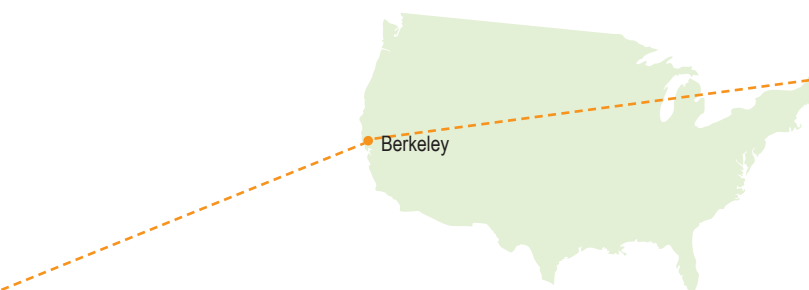
"My sisters and I were able to attend Berkeley because tuition was low and because of the Berkeley Students Cooperative (BSC), which significantly reduced food and living costs. We are all supporters of BSC in gratitude."

BSC was started in 1933 by 14 students, with the encouragement of Harry Kingman (1892–1982), a beloved figure who played one season with the New York Yankees, then helped lead the international office of the YMCA from his Berkeley office, coached various Cal baseball teams and, in retirement, became a self-funded civil rights lobbyist in Washington, DC.

During the Great Depression, BSC was one of many student cooperatives formed to help students afford housing and food. These cooperatives also took in students who were facing racial and religious discrimination.

Although he led a humble student life, T.Z. has fond memories of those years. "There was a corner drugstore owned by a very kind Japanese-American couple," he recalls. "They took special interest in me because of my mother and occasionally offered me a much-appreciated free ice cream cone.

"There was, and still is, a pizzeria and beer garden near where I lived where a huge amount of beer was consumed on weekends. I was not aware until after I graduated that beer came in bottles smaller than a quart, because I had never seen one."



T.Z. assumed more and more leadership roles in the co-op and was eventually elected president. He recalls one special honor, when he shared the podium in 1958 with Eleanor Roosevelt during the 25th anniversary celebration of the BSC. Says T.Z., “We drove a car to San Francisco to pick her up. She was very gracious, but once we began driving, she immediately fell asleep. It was the only way she could maintain her busy schedule.”

T.Z. had been accepted as a chemical engineering student, but he switched to physical chemistry when he learned that chemical engineering required a prerequisite of mechanical drawing, which he would have to take at Berkeley High.

“Berkeley was a lot of work for me, being a chemistry major in a highly competitive environment,” he recalls. “Many of my fellow students were older, serious veterans of the Korean War returning to school on the GI Bill. Fortunately, many grad students ate in the BSC dining halls and were often willing to help me.

“I attended three-hour lab classes most afternoons and worked evenings and weekends to pay my way through college. I graded papers for the math department and tutored psychology grad students in statistics.

“In the summers I worked a union cannery job in San Leandro, where we canned a variety of fruits. I was the only Asian in the plant. At first I was given one of the toughest jobs, scooping hot apricot jam into #10 cans by hand. After five days, when the plant managers realized I was a chemistry major, my job got much easier—measuring temps, recording data and using a pH meter. I also learned to understand and appreciate the sentiments of the blue-collar workers, mostly Portuguese immigrants, which served me well in business.”

T.Z.’s first job out of college set him on a path that he would follow for the rest of his career. He was hired by Keene Dimick, an agricultural chemist who worked at the USDA Western Regional Research Center, in Albany, CA. For several years the research center had been investigating the chemistry of flavor, and Dimick hired T.Z. to help develop a gas chromatography (GC) instrument that could be used for his work, and for many other purposes.

T.Z. worked in his boss’s garage in Walnut Creek. Dimick kept a low profile in his startup since by day he worked in a government lab. He named his company Wilkens Instruments and Research, Inc., after his brother-in-law in Napa County who assembled the devices in his garage there, with help from his fellow teachers at Napa High School.



BERKELEY STUDENT COOPERATIVE

The company was better known as Wilkens Aerograph, after the name of their product. Notes T.Z., “The company grew quickly and before I realized it, I was put in charge of marketing and sales and later assumed responsibilities over R&D and manufacturing as well.” A succession of increasingly sophisticated aerographs became the standard gas chromatography instruments in analytic chemistry labs for many years.

In 1956, Tangier’s status as an international protectorate ended and the city became part of Morocco. T.Z.’s parents sold their carbon dioxide plant to a French monopoly, Air Liquide, and moved to Versailles, France.

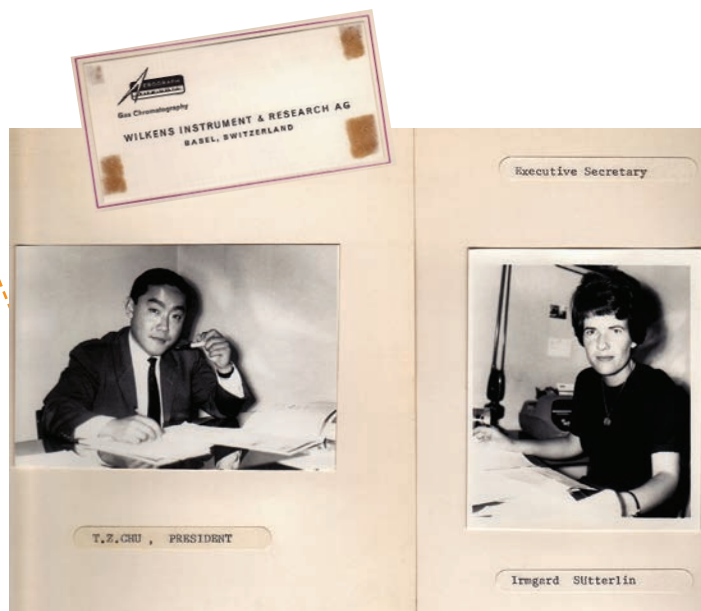
As business grew for Wilkens Aerograph the company began receiving several letters of interest from European chemical companies and government labs. T.Z. decided to travel to France, stay with his parents in Versailles and visit the companies that had inquired about the Wilkens instruments.

“When I showed the letters to my father,” says T.Z., “he let me know that they were from some of the most important companies in Europe. I had several successful visits, and when I returned home, I persuaded my boss to open a European branch of the company. He was not particularly convinced but eventually agreed on the condition that I would move there to open and run the European office.”

In 1963 T.Z. arrived in Basel, Switzerland. He had taken the advice from an Ernst and Young consultant who steered T.Z. away from the better-known cities of Geneva and Zurich by pointing out that Basel was the home of many Swiss chemical and pharmaceutical businesses.

Says T.Z., “I was one of only two Asians working in the city. As a representative of a new foreign firm, I lacked the clout to hire older professional salesmen. Instead, I hired technically trained young chemists about my own age. We were treated as helpful colleagues

Basel
SWITZERLAND



by our customers, which helped establish our credibility. I had made the right decision, although for the wrong reason. I count several life-long friends among my staff from those years.”

The most important co-worker he met in Basel was his wife-to-be, Irmgard Suetterlin. The couple married in 1963. They have one daughter and two grandchildren. Although Irmgard has maintained her Swiss citizenship (T.Z. is a U.S. citizen), the couple agreed their daughter should be born in the United States. “Over the years,” he says, “our house has been a home-away-from-home for many Swiss visitors.”

Two years after T.Z. arrived in Basel, European sales of Wilkens Aerograph instruments outnumbered those in the United States, and the company became the world leader in sales of gas chromatographs. Large instrument firms began to take an interest, and the company was sold to Varian Associates, an early Silicon Valley firm that pioneered the development of nuclear magnetic resonance (NMR).

Recalls T.Z., “My boss at Wilkens became the largest shareholder in Varian and retired a wealthy man, and a generous one—he gave me ten percent of the company. Varian kept me on to manage their new division and made me, at 33, the youngest vice president in the company.”

T.Z. added another continent to his business itinerary when he took on the responsibility for a new Varian acquisition in Australia. “I commuted between my house in Berkeley and Melbourne every month for about two years, until an interesting young company asked for my help and I resigned from Varian in 1969.”

Bob Finnigan was seven years older than T.Z. With a Ph.D. in electrical engineering, he had worked for Lawrence Livermore National Laboratory and Stanford Research Institute (SRI), where he became fascinated with the potential of combining the analytical power of gas chromatography (GC) with mass spectroscopy (MS), through the use of emerging computer-based data systems (DS).

He founded Finnigan Instrument Company in 1967 to develop GC/MS/DS instruments. Although the company was a technical

innovator, it struggled financially. T.Z. agreed to become an investor and serve as CEO in 1969.

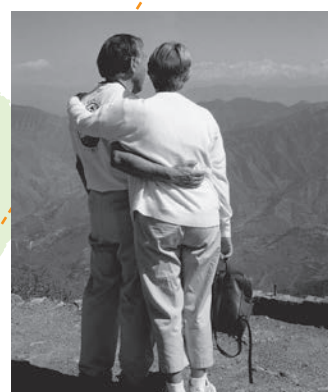
“Finnigan quickly became a successful company,” says T.Z. “I like to say we owe our success to Rachel Carson and her book *Silent Spring*. With growing concerns about DDT, PCBs and other environmental pollutants, demand for Finnigan instruments really took off. Pharmacology, and the testing for the presence of drugs, both legal and illegal, was another expanding market. I took the company public and became the first Asian CEO of a public technology company.”

T.Z. stayed with Finnigan for 23 years, until it was sold to Thermo Instrument Systems, now Thermo Fischer Scientific, in 1990. He stayed on with the new company as the subsidiary’s president for two more years.

About the final years of his career T.Z. says, “I was recruited to serve as a limited partner of a venture fund but returned to serve as CEO of several instrument companies that needed turn-around leadership. I retired for good in 2012 at age 78.”

It was in 1970, during his early years at Finnigan, that T.Z. and Irmgard moved to a comfortable house in Los Altos Hills. Over the years, his family gravitated to the Bay Area. Both his parents are buried here, and his sisters live nearby. “We can count about 40 members among our extended families who now live within an hour’s drive from our home,” he notes.

Despite his busy career, T.Z. has always found time for public service. In 1972 he was a founding board member of the Women’s



Los Altos Hills



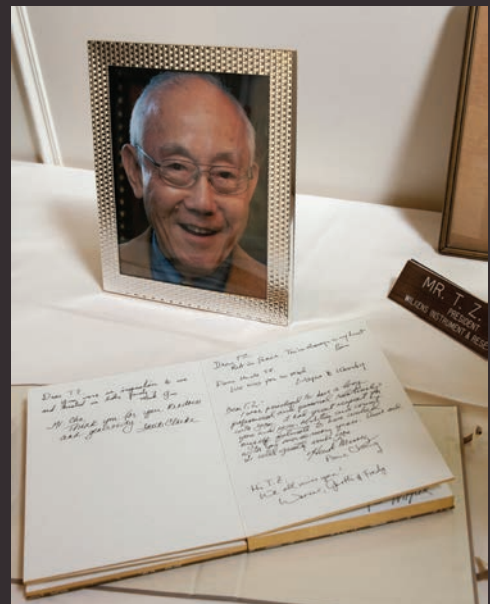
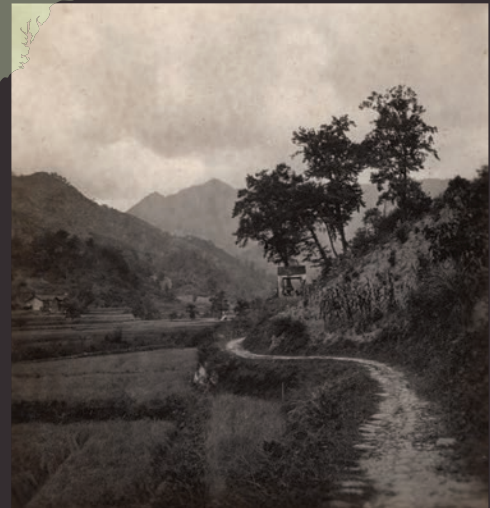
Resource Center, the first non-profit organization with the mission of advancing women's careers in technology companies. He was elected Chairman of the American Electronics Association in 1980 and served on the board of Friends of Woodstock School from 1996 to 2006.

T.Z. has always been a steadfast supporter of UC Berkeley and the College of Chemistry. He has served both as a UC Berkeley Foundation Trustee and a member of the CoC Advisory Board. T.Z. and Irmgard Chu became Builders of Berkeley in 2003 and funded the T.Z. and Irmgard Chu Distinguished Professorship in Chemistry (currently held by Matt Francis) in 2005.

At 82, Chu can look back on a life well lived. His advice for young people?

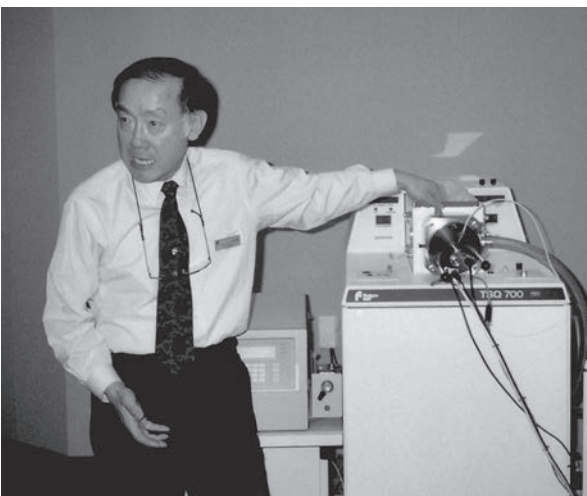
"I would advise future generations to always keep the best interests of their succeeding generations in mind. By that I mean don't focus on realizing immediate personal gain, but try to figure out how to leave behind a better social environment for succeeding generations. I sincerely believe providing the opportunities for good education is the key, and we all can do something about that."

PHOTOS COURTESY OF THE CHU FAMILY



MICHAEL BARNES

Four weeks after we interviewed T.Z. for this story, he passed away peacefully at his home in Los Altos Hills on September 15, 2016, following a valiant three-year battle with esophageal and throat cancer.



MARKITA LANDRY

The art of mentoring

I inch my chair forward toward the table and earnestly peer over the paper my older sister Markita is writing on.

“To start you look at the first number, and then work your way down,” she explains. My brow furrows in concentration as she explains how to tackle the advanced math problems I have had trouble with in my fifth-grade class.

“Now, pretend this is how many cookies you have. If you had seven friends, how many whole cookies would they each get?” she asks. I consider the question thoughtfully.

“Two!” I say, beginning to now grasp not only the rote steps but also the concepts behind them.

“Good. And how many would be left over for you to eat?”

After working through a few more problems and developing a serious need for sugar, we rush upstairs to find our father, the designated Sunday afternoon ice cream scooper.

Today, as one of the newest assistant professors in the Department of Chemical and Biomolecular Engineering, my older sister, Markita Landry, is a teacher and mentor for all the undergraduates, graduate students, postdocs and visiting scholars that pass through her lab and her classroom. From experience I know that she takes her role as a mentor seriously, having served as my role model throughout my life.

I watched in elementary school as Markita devoured book after book in our living room, uninterested in helping me bargain with my mom for more TV time. In the winter months I held her hand firmly as she shuffled me across the ice-skating rink in the courtyard of our school in Canada, where we grew up.

When we visited family in Bolivia, she held my hand as we weaved in and out of the

street markets in La Paz, pausing only to buy *salteñas* or to catch our breath when the high altitude left us winded. In high school, after our family moved to North Carolina, she left me awestruck when she joined the wrestling team, demonstrating in one fell swoop her drive, originality and, well, girl power.

College was where the first formal signs of the professor-to-be emerged. As a biochemistry major at the University of North Carolina at Chapel Hill, her intention was to go to medical school. Instead, she was charmed by one of her electives, modern physics.

“I had a great professor who showed us how abstract physics is relevant to real life,” Markita later told me. “I realized then that I wanted to use physics to understand the biological processes I was learning in my other classes.”

After tacking on a physics degree and disappointing our parents—who had warmed up to the idea of a medical doctor in the family—she joined the lab of Professor Brian Kuhlman, where she performed experiments to confirm the lab’s computational modeling of protein-protein binding interactions.

As a high schooler at the time, I spent weekends with her in the dorms, always welcome to spend the night and never made aware that I was perhaps spoiling a night or two out. I watched my sister navigate through college and learned not only about her classes, but also how to make the dining-hall lunch pass stretch into dinner and how to use this cool new website called Facebook.

Later, I saw her off to graduate school at the University of Illinois at Urbana-Champaign, where she earned her Ph.D. in chemical physics. I continued to visit, for weeks at a time, and often accompanied her into the

lab of Yann Chemla—a former postdoc from the lab of Carlos Bustamante at UC Berkeley—to learn about their work studying protein-DNA interactions using optical tweezers to hold and manipulate biopolymers.

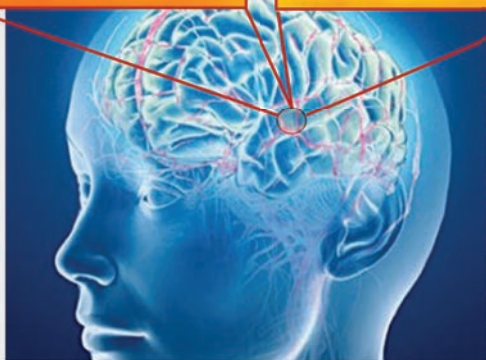
As one of the first graduate students in the Chemla group, Markita spent much of the early years setting up the lab. “There were a lot of boxes,” she recalls, laughing. The optical tweezers had to be adjusted to prevent them from damaging DNA, while other instruments had to be calibrated to understand their temperature sensitivity. Eventually she was able to get the equipment to cooperate.

“Once the Chemla lab was up and running, I tracked proteins as they translated DNA and found that they were monomers, not dimers,” she said. “This confirmed a proposed mechanism of protein movement along DNA. Being one of the first to join the Chemla lab gave me a good appreciation of the process of starting and running a lab. I enjoyed all aspects of it—grant writing, presenting and working with the other students—in addition to the experiments.”

Not satisfied with restricting her graduate-school experience to one technique, one research group or even one country, she found ways to expand and complement her work through collaborations. I heard how, as part of the NSF East Asia and Pacific Summer Institute, in the lab of Toshio Yanagida at Osaka University in Japan, she imaged proteins interacting with single DNA strands by using total internal reflection fluorescence (TIRF) microscopy.

“I made bridges out of DNA on micropedestals,” she explains. “This way I could watch proteins move along the DNA bridges.”

I later heard stories of how the German graduate students in the lab of Hermann Gaub at the Technical University in Munich



Sisters Alexandra (l.) and Markita Landry. (above) CBE professor Markita Landry is developing neurotransmitter nanosensors that can image dopamine release in the brain.



taught her how to functionalize nanomaterials with polymers. After a stay of only one month, she could tune her fluorescence signals by changing the functionalization herself.

Markita would return to Germany to attend the 2010 Lindau Nobel Laureate Meeting, sharing the opportunity with hundreds of other young researchers to mix and mingle with 59 Nobelists. Her successes in graduate school motivated her to pursue a career in academia. Her graduate school experiences also motivated me to pursue a Ph.D., leading me to enroll in the Department of Chemical and Biomolecular Engineering at UC Berkeley. Neither of us would have guessed that the department would one day include both Landry sisters.

Markita next focused on her new postdoc appointment in the Department of Chemical Engineering at MIT. There, in the lab of Michael Strano, she used the tools she had learned from studying single-molecule biophysics in Illinois and Japan to build a near-infrared fluorescence microscope that could image the polymer-functionalized nanomaterials she had learned to synthesize in Germany. In doing so, she created

sensors capable of detecting biologically relevant molecules at the short timescales and small length scales that are relevant for biological function.

Now at UC Berkeley, my sister and her research group are hoping to take her sensors one step further, to image at the single-molecule scale *in vivo*. One of Markita's greatest interests is in detecting and studying elusive biomolecules such as dopamine, a neurotransmitter.

"It's difficult to detect, let alone image, neurotransmitters in the brain," she explains. "We specifically focus on molecules that don't have molecular recognition elements and where optical detection is challenging, such as in the deep tissues of the brain."

Working in collaboration with Linda Wilbrecht, who studies behavior and learning in mice in Berkeley's Department of Psychology, Markita aims to directly image when and where key neurotransmitters are released in the brain, and how that process may be affected either by a subject's environment or behavioral disorders.

Our parents and I are not the only ones who believe my sister's research holds promise. Her preliminary results and tenacious hard work have so far earned her a 2015 Burroughs Wellcome Fund Career Award, as well as a 2016 Beckman Young Investigators Award.

And yet, even with the busy schedule of a new assistant professor, Markita still has found the time to go out tango dancing with me and to travel across Malaysia during winter break (even if it meant toting along her laptop to finish up some grant applications).

However, the most memorable moment for me came in May 2016, when as a member of the CBE faculty, my big sister hooded me as I was presented with my Ph.D. in chemical engineering—a fitting task for someone who has mentored me for over two decades. I can speak first-hand to the value of her guidance, and I can't wait to see what remarkable ideas, projects and students emerge from her lab.

BY ALEXANDRA DEL CARPIO LANDRY

KE XU

Navigating between worlds

Ke Xu is comfortable navigating between different worlds—geographic, cultural and scientific.

He was born in 1982 in the city of Ya'An, where the Tibetan Plateau meets the Chengdu Plain in the center of Sichuan Province, about two hours' drive from the booming city of Chengdu.

Xu left Ya'An when he was six years old and moved to one of China's largest cities, Chongqing. His father had been a graduate student there while the family lived in Ya'An, and both his parents had been appointed English professors at Chongqing University.

When he was 11, his parents temporarily moved to Nanjing to teach, while Xu went to Beijing to live with his grandmother. When he was 14, his parents came to Beijing to teach at Tsinghua University. Xu lived in campus housing with them and remained at Tsinghua for his undergraduate studies.

Tsinghua University is located in the university sector of NW Beijing, near the Summer Palace. Founded in 1911 on the grounds of an old royal garden, the university survived the tumult of WWII and the Cultural Revolution. Known as one of best universities in China, it educates 31,000 students on its 980-acre campus. Xu studied chemistry and graduated with a B.S., with highest honors, in 2004.

For graduate school, Xu flew across the Pacific Ocean to attend Caltech in Pasadena. It was the first time he had been outside of China. At Caltech he joined the lab of Jim Heath, a former Miller Fellow in chemistry at Berkeley who had worked with Rich Saykally. In Heath's lab Xu planned to do research in chemical physics.

"It was an interesting time to be in Heath's lab," says Xu. "He did his Ph.D. at Rice University with Smalley and Curl, where his

work helped them win the Nobel Prize for the discovery of C_{60} and other new forms of carbon called fullerenes. Yet as a mid-career scientist Heath switched gears and began to work on biology. That encouraged me to think I could make the switch as well."

Xu wrote his award-winning Ph.D. thesis on the nonlinear electrical properties of one-dimensional nanostructures. Then for his postdoc he decided it was his turn to jump into the realm of biology. In 2009 he joined the lab of Xiaowei Zhuang, a Howard Hughes Medical Institute (HHMI) investigator and professor at Harvard University. Zhuang had developed an imaging technique, stochastic optical reconstruction microscopy (STORM), that explored the inner workings of cells at the nanoscale and single-molecule levels. STORM is just one of many techniques that have become available since researchers developed super-resolution fluorescence microscopy in the 1990s.

Visible light spans the electromagnetic spectrum between red at 700 nanometers to violet at 400 nanometers. "Because of the diffraction effect," says Xu, "it's very difficult to use even the best optical microscopes to see objects smaller than the wavelengths of light. But by using advanced STORM techniques, we are able to resolve objects below 10 nanometers in size, about the size of many proteins and other biomolecules."

To visualize how this works, imagine a large public Christmas tree like the one at the White House in Washington, DC, or in Union Square in San Francisco. The tree is covered with an interesting pattern of strings of closely spaced LED lights. Each string has its own unique color. All of the LED lights are blinking at random.

You want to document how the strings of lights were strung on the tree, but you only have an older low-resolution black-and-white

digital camera. If you snap a single photo, all you can see is the outline of the tree and a random pattern of blurry pixels of white.

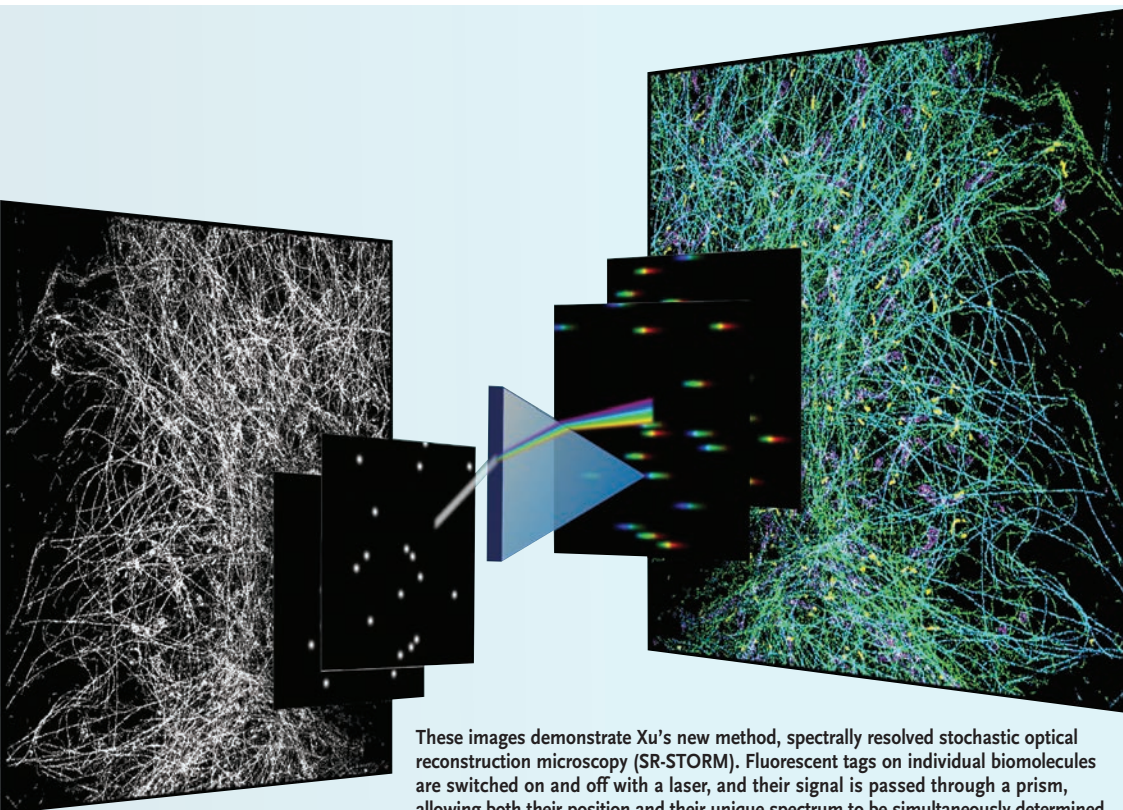
However, if you were extremely patient, you could stand there and snap hundreds of photos of the tree. Then, for each image, you could carefully plot the center point of the blurry dot. Finally, you could superimpose all the images together digitally to reconstruct the original pattern of lights and reveal their structure.

At a nanoscopic scale, STORM operates in a similar fashion. Individual biomolecules are labeled with fluorescent dyes, which are switched on and off with a laser. By recording the location of the fluorescence signals as they are turned on and off, the positions of hundreds of thousands of molecules can eventually be determined.

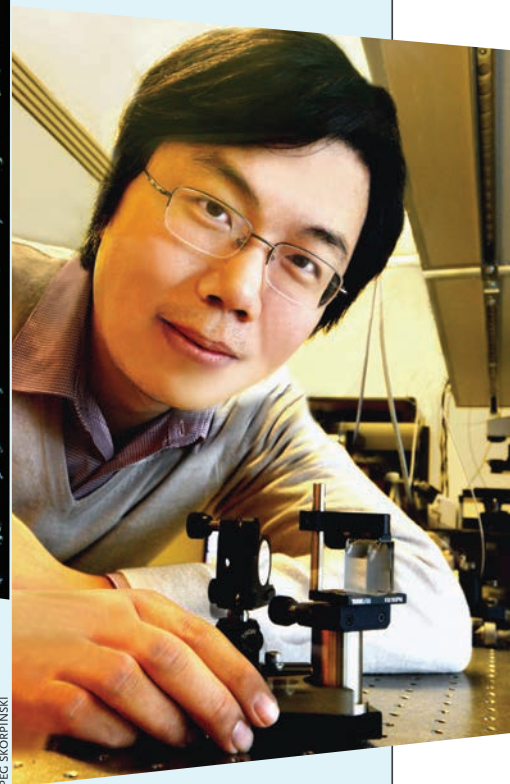
Using these techniques during his postdoc, Xu revealed with exquisite detail the structure and molecular composition of axons, the tube-shaped structures that transfer signals from one nerve cell to the next, and to muscle and other cells.

"Like many cells," says Xu, "human nerve cells have very distinct structures and depend on these structures to function properly. Understanding how nerve cells work, and the diseases that result when they fail to work, requires the ability to image their nanoscale structures."

Xu joined the Berkeley chemistry faculty in 2013 and has been extending STORM by integrating it with the cornerstone of physical chemistry—spectroscopy. Many images of the nanoscale realm use false colors created after the fact to distinguish features. To return to our analogy of the Christmas tree, the black-and-white images could be artificially colored—one string colored red, another green—to help us tell them apart.



These images demonstrate Xu's new method, spectrally resolved stochastic optical reconstruction microscopy (SR-STORM). Fluorescent tags on individual biomolecules are switched on and off with a laser, and their signal is passed through a prism, allowing both their position and their unique spectrum to be simultaneously determined.



PEG SKORPINSKI

Xu developed a new technique to directly resolve the subtle nuances of color in STORM images, this time by directly recording the full fluorescence spectrum of every single molecule. He tagged different molecules with separate fluorescent dyes, each dye emitting a slightly different color when illuminated by a laser. By recording and resolving the wavelengths of each single molecule as the molecules individually light up one after another, he was able to reveal the different structures inside the cells in true color. In our Christmas tree analogy, this would be similar to replacing the black-and-white camera with a more modern color version.

To demonstrate the power of this new technique, he simultaneously imaged four subcellular features tagged by four red dyes that are highly similar in color—and was able to clearly discriminate them from each other with excellent spectral and spatial resolution. His lab is now combining this new technique with dyes that change color in different environments to report, with ultrahigh resolution and sensitivity, changes in local pH, viscosity and other aspects of living cells.

Xu has dubbed his new true-color technique SR-STORM (spectrally resolved STORM). And if that breakthrough is not enough, the Xu group has also developed a technique for using electron microscopy to help confirm their results on wet and untreated whole cells.

Explains Xu, “Electron microscopes use beams of electrons, not light, to create images. This means they can resolve details at the nanoscale with ease. However, the samples have to be dehydrated because the imaging takes place in a high vacuum. This drying process destroys some of the structural details that we were hoping to see.”

The Xu group's solution was to cover the sample with a single-atom-thick film of graphene, a flat layer of carbon atoms arranged in hexagons. Since the graphene is impermeable, it allows cells and other biological structures to remain in their native hydrated state.

Adds Xu, “Using this approach, we can perform both STORM and electron microscopy on the same wet samples, which allows us to correlate the results and confirm the details of the structures we are imaging.”

2016 has been a good year for Xu. *Chemical and Engineering News* took note of Xu's accomplishments and included him in their Class of 2016 “Talented 12.” According to the magazine's editors, their feature story “blows the covers of a group of top-notch chemistry ‘operatives’ whose mission it is to solve some of the world's most diabolical scientific problems.”

In addition, along with College of Chemistry colleague Markita Landry, Xu was one of eight researchers nationally to receive the 2016 Beckman Young Investigators Award. Earlier in the year he won an NSF CAREER Award and was elected a 2016 Sloan Research Fellow. Most recently, Xu was also one of 18 researchers nationally to win a 2016 Packard Fellowship.

For a young man who never set foot outside of China until he left for grad school, Xu has shown himself to be a true pioneer and has quickly made a new home here in the College of Chemistry.

UNDERGRAD
B.A. '68, Chem

GRADUATE
Ph.D. '73, Chem

Married Jeanne Marie Volstorff (B.A. '70, Soc. Sci.) in 1972. After graduation, drove across country to Dayton, OH, to gain some experience in a foreign land. Worked there for the Air Force Materials Laboratory in the field of materials science and non-destructive evaluation.

Two children and five years later, began research work in the development of structural composite materials at the Rockwell International Science Center in Thousand Oaks, CA, where Jeanne began teaching school. With children off to college, Jeanne and Rod moved back to the Bay Area where he directed efforts in product development for ALZA Corporation in Palo Alto. Now retired and living in Redwood City.

RON PANOS ON LEO BREWER

A critical moment

Several big events colored the year 1969. Richard Nixon enjoyed his first year in office. An unusually large rock concert garnered nationwide headlines from a small New York town called Woodstock. Governor Ronald Reagan called up the California National Guard to quell riots in Berkeley... and in April of that year, the Department of Chemistry at the University of California scheduled an oral Qualifying Exam to consider my suitability for the Ph.D. program in chemistry.

I remember that last incident quite well. I wore for the occasion the only suit I owned. Neil Bartlett, chemistry department chairman, invited Leo Brewer, George Jura and Clayton Heathcock of chemistry, and an M. Pomerantz from the Department of Physics, to attend the exercise and decide my fate as a potential Ph.D. candidate.

Just before 2 p.m. on the afternoon of April 27, I left my desk occupying one corner of the laboratory overseen by Charles Harris on the fifth floor of Latimer Hall, walked down the hallway, descended a flight of stairs and waited in the small seminar room I found at 444 Latimer. At precisely 2 p.m., Brewer and Heathcock met me there. I stood, they sat. Professor Pomerantz joined the group within a few minutes and we all awaited the arrival of Jura.

After some time, Leo Brewer glanced at his watch and, wearing a somewhat annoyed expression, asked the others if they thought it appropriate to begin without George Jura. Meeting assent, he began the proceedings by introducing himself and his fellow committee members.

I found myself in awe of Leo Brewer. The eye patch he wore gave him an air of mystery and, among those present, his was the only name familiar to me. Pomerantz came from physics and Clayton Heathcock had only

recently joined the chemistry faculty, but the text over which I labored to learn thermodynamics had Leo Brewer's name on it.

Knowing that committee members should have all seen the brief explanation contained in the invitation memorandum, Leo Brewer asked if I would begin by explaining to the committee the basis by which I had chosen to conduct the C_{13} NMR study about which I intended to speak.

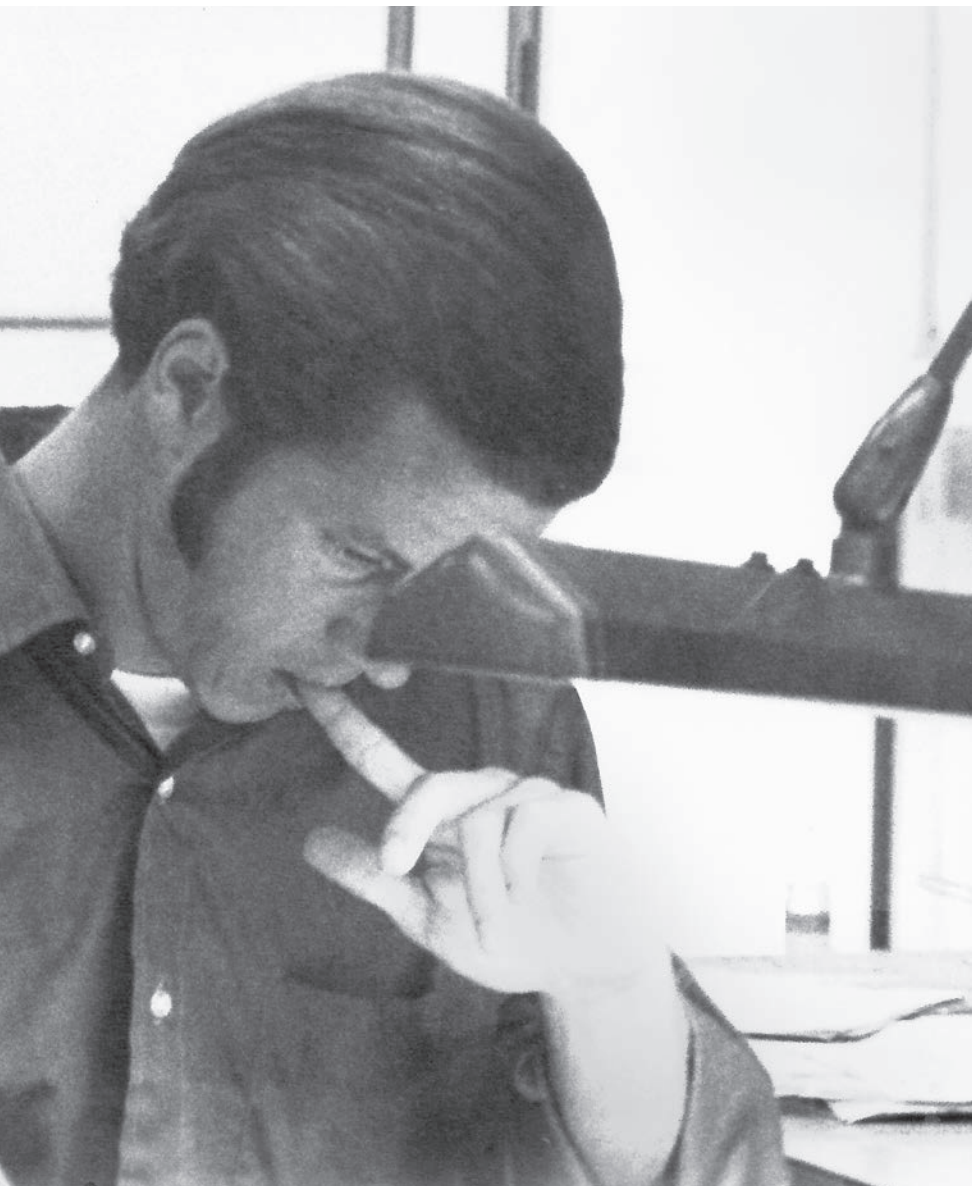
I remember being slightly tempted to admit that I had not chosen it at all. Charles Harris had given me the assignment because a brand new Varian HA-100 NMR spectrometer sat down on the D-level of Hildebrand Hall, and he wanted to use it. Chuck Harris had himself joined the department only a year or so earlier and, although he later came to prefer the more formal name of Charles, he then encouraged his students to call him Chuck.

Discarding that line of explanation, I began to describe the anomalously low magnetic susceptibility of copper acetate below room temperature, explaining how a measurement of the chemical shift of the C_{13} NMR resonance frequency for bridging acid carbons might throw some light onto reasons for the compound's odd magnetic behavior.

I had only just started elaborating the theoretical basis for believing we could accomplish such a measurement in solution when the door burst open and George Jura entered the room to stop my explanation in mid-sentence. Seizing a chair that rested against the table between the committee and me, he turned it around, sat straddling the chair, grabbed a loose copy of my summary document and scanned it quickly to remind himself of the discussion topic. Without missing a beat, he then pulled the cigarette dangling from his lips, held it between the two finger stubs of his one

hand, pointed it at me and asked, "What would you expect to see happen if those two metal atoms were zinc instead of copper?"

The question came at me like a cannon shot. I froze. For a very long moment, my head refused to function. A millennium or two passed before I began to ask myself what this man could possibly mean by throwing a completely new atom into my carefully prepared thinking. I had not studied the properties of zinc acetate. I had studied copper acetate. What kind of question was he asking? What can I possibly say about zinc? Perspiration began to soak through my undershirt.



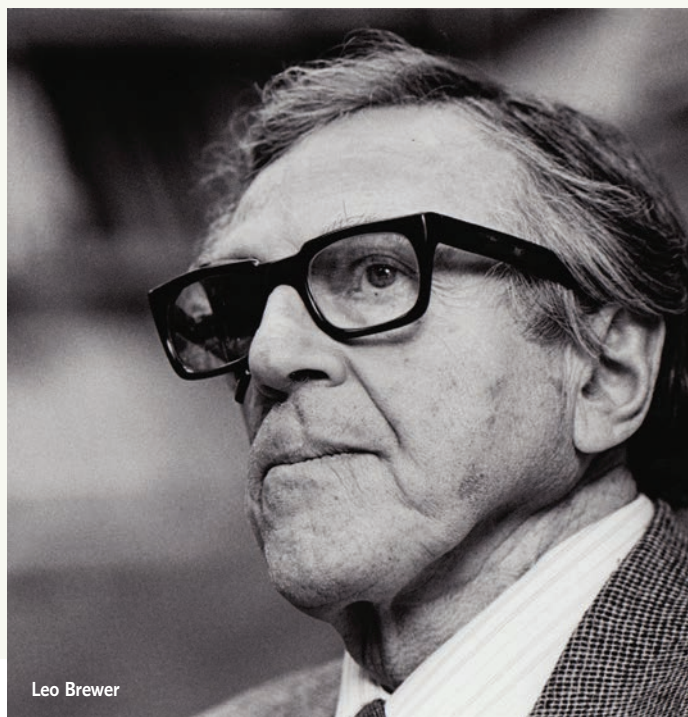
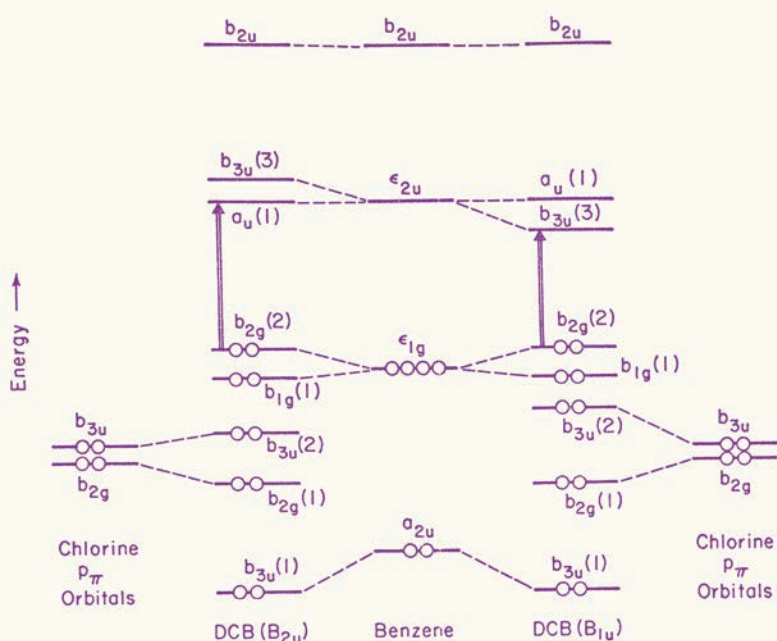
Although I cannot say what emotion showed, I'm sure the word 'fear' might have entered the minds of those who could see my face. That's when Leo Brewer looked steadily at me through his one good eye and, speaking slowly and calmly, said, "or nickel."

I stared at him for a moment. Not being as intimately familiar with the Periodic Table as either he or George Jura, I required that moment before I realized, *Of course, each one sits on either side of copper. Now ... what does that mean?* I asked myself before launching into a bit of thinking-out-loud. "Well," I began, "If one less electron were present, then..."

I remember thinking as I left the qualifying committee alone in Room 444 to decide my fate that I was very lucky to have had Leo Brewer on that committee. His little hint made all the difference. Without it, I'm not at all sure I would have seen the direction of George Jura's thinking. With it, I managed to salvage my candidacy and go on to further study at Cal.

Today I lament the fact that I never sought out Leo Brewer to thank him for the boost he gave me at a critical moment. I should have done so. The opportunity to connect with people like him is one of the reasons the College of Chemistry at UC Berkeley maintains a reputation as one of the world's premier institutions for the study of chemistry.

Qualitative Effects of Parachlorine Substitution in the Benzene π -Orbitals.



Leo Brewer

CLASS OF 2016

Where have all the students gone?

In the spring, some of the students who planned to walk in the May 2016 commencement ceremony shared their plans with us:

"I'm looking forward to a rewarding career at Sandia National Laboratories' Material Science and Biological Sciences Divisions."
—Isaac Avina (M.S. ChemE)

"I will be starting a full-time job at Anheuser-Busch in New York City upon graduation. I also plan on continuing to pursue my passion for video production by starting a media company."
—Rahul Batra (B.S. ChemE)

"Hire me. Please."
—Jorjit S. Bhullar (M.S. ChemE)

"I will be continuing on for a Ph.D. in organic chemistry at either UC Irvine or UCLA. I'm looking forward to continuing research in organic chemistry as well as new adventures down in SoCal!"
—Kersti J. Caddell Haatveit (B.S. Chem)

"I'm returning to Thailand to work in a research position for the Thai government."
—Thawatchai Chaijarasphong (Fall 2016, Ph.D. Chem)

"I'm planning to apply for medical schools and join Doctors without Borders in the future."
—Ka H. Chan (B.A. Chem)

"I will be pursuing my Ph.D. degree in Materials at University of California, Santa Barbara."
—Yu H. Chang (B.S. ChemE and Mat Sci & Engr)

"I am excited to begin attending graduate school as a Ph.D. student starting in 2016."
—Tiffany Q. Chen (B.S. Chem)

"Data Analyst."
—Da Bin Choi (B.S. Chem)

"I'll be heading to the UK to study MPhil in Advanced Chemical Engineering at Cambridge as a Churchill scholar."
—Chun Man Chow (B.S. ChemE)

"After graduation, I am planning to go travel to Japan, Taiwan, Iceland, and the UK with the most important people in my life. In August, I will be starting the next portion of my life as a production engineer for

Dow in Louisiana. I hope to work there for three years before moving to where my significant other is located."
—Wen H. Chu (B.S. ChemE)

"Keep doing chemistry research!"
—Yuyang Dong (B.S. Chem)

"I will be continuing my education next year as a medical student working toward an M.D. at Washington University School of Medicine."
—Casey W. Drubin (B.S. Chem)

"Molly will continue their quest in life of studying the phytochemistry of medicinal plants and fungi, being extremely queer and colorful, and destroying the patriarchy."
—Molly A. Endries (B.S. ChemBio)

"I intend to spend some time traveling through Asia and Africa, then finally starting a career as a banker."
—Oladotun Fatade (Fall 2016, ChemE and Mat Sci & Engr)

"Ph.D. Chemistry."
—Dillon T. Flood (B.S. ChemBio)

"Hoping to attend medical school."
—Ryan E. Flores (Fall 2016, B.S. ChemE)

"Currently interning in a Chem lab at WET Design for brominated water testing. Looking forward to being a Dental student in the future."
—Charlene N. Gibbert (Fall 2015, B.A. Chem)

"Taking two years to apply to medical school but will be pursuing either an M.B.A. or M.S. in computer science in the meantime!"
—Brittany S. Gomez (Fall 2016, B.S. ChemBio)

"Thanks to my education in the College of Chemistry, I'm pursuing a Pharm.D. to become a pharmacist!"
—Kristina M. Hoh (B.S. ChemBio)

"I will graduate in August with a Chemistry Ph.D. degree. I will travel to France for half a year and will become a postdoc after I come back to the U.S."
—Yu Fang Hsieh (Summer 2016, Ph.D. Chem)



“I’ll go to grad school, chasing a Ph.D. degree.” —**Bowen Hu** (B.S. Chem)

“New job at exciting VC-funded biotech startup!” —**Pei-Yi Hu** (B.S. ChemE)

“Job hopefully in Chicago!”
—**Tammy H. Huang** (B.S. Chem)

“Starting a brewery in Spain.”
—**Luna Izpisua-Rodriguez** (B.A. Chem)

“As a chemical engineer and materials scientist, expect to work in a chemical engineering field associated with energy.”
—**Hyojin Kim** (Fall 2016, B.S. ChemE and Mat Sci & Engr)

“After graduation, I am moving to the UK to begin my postdoctoral studies at the University of Cambridge.”
—**Nikolay I. Kornienko** (Ph.D. Chem)

“In the fall, I will be starting a Ph.D. program in Chemical Engineering.”
—**Makoto A. Lalwani** (B.S. ChemE)

“I plan to find a career in software development in the Bay Area or in SoCal. I am seeking to employ my chemistry background in my future career to develop more chemistry-related applications, and bring Chemistry to the computing era.”
—**Jason D. Lee** (Fall 2016, B.S. Chem and Computer Sci)

“My plan is to go to a graduate school and further my studies to become an FNP so I can have a promising career to support my only son.”
—**Soo Y. Lee** (Fall 2016, B.S. ChemBio)

“I will be staying at Berkeley but switching tracks to theoretical chemistry in the group of Martin Head-Gordon.”
—**Daniel S. Levine** (Ph.D. Chem)

“Graduate school in Biosciences/Biomedical Sciences in SoCal!”
—**Christine S. Liu** (B.S. ChemBio)

“Not sure yet. I will continue my graduate school somewhere else.”
—**Hanwei Liu** (B.S. ChemBio)

“I’m planning on becoming a ranger at Yosemite National Park!”
—**Narbe Mardirossian** (B.S. '11, ChemE; Ph.D. Chem)

“Graduate school in inorganic chemistry.”
—**Jonathan F. Melville** (B.S. Chem)

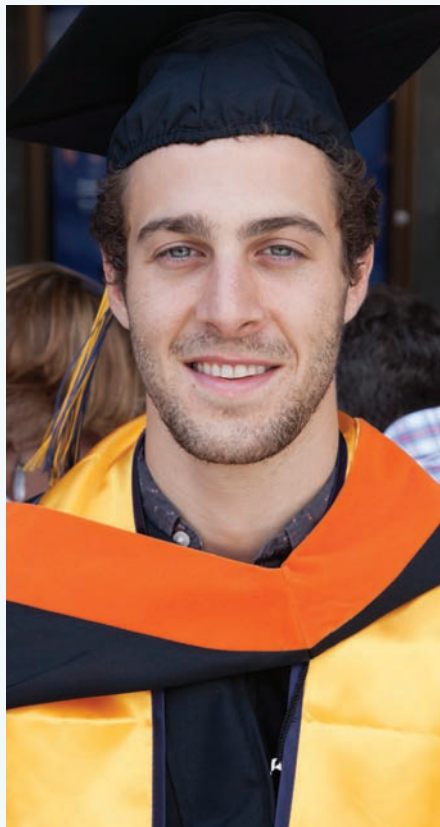
“Apply to medical school!”
—**Gregory M. Ow** (B.S. ChemBio)

“I’m going to begin a graduate program in materials science and engineering to apply all the things I have learned to developing new and exciting polymer materials.”
—**Vincent Pang** (B.S. ChemE and Mat Sci & Engr)

“I will have a gap year for research experience on campus and will apply for Ph.D. program.” —**Jong D. Park** (B.S. ChemBio)

“I will be continuing my studies at UC Berkeley by completing my M.S. in Chemical Engineering and Product Development through Berkeley’s innovative Product Development Program. It will be a great opportunity to pursue my interests in business and management while continuing to grow my technical skills.”
—**Apurva A. Pradhan** (B.S. ChemE and Mat Sci & Engr)

“I’m planning to go to graduate school for a Ph.D. in Materials Science and Engineering.”
—**Sonal V. Rangnekar** (B.S. ChemE and Mat Sci & Engr)



“After finishing my final semester at Utrecht Medical Center, Holland, I immediately began working as a systems engineer for Roche Diagnostics, located near my hometown of Livermore, CA. I am continuing to learn about the forefront of molecular medicine and will most likely apply my knowledge and growing professional network towards a master’s or Ph.D. in translational medicine.”
—**Austin J. Rayford** (B.S. ChemBio)

“I plan to pursue a career in computational chemistry. The College of Chemistry has prepared me for such an endeavor and in the future I plan to continue my studies in theoretical chemistry.”
—**Edson D. Romero** (B.S. ChemE)

“I want to enter medical school, and ultimately become a cardio surgeon.”
—**Maryam Safarian** (B.S. ChemBio)

“Starting as an Operations Manager for Anheuser-Busch in June.”
—**Dustin A. Schell** (B.S. ChemE)

“This summer I will begin graduate work at UCLA. I am thrilled to continue my pursuit of biophysics research under the esteemed faculty, Shimon Weiss and William Gelbart, where I will begin work on a joint single-particle viral genome delivery.”
—**Maya A. Segal** (B.S. ChemBio)



"I am planning to go to a pharmacy school to become a pharmacist."

—Hae J. Shin (B.S. ChemBio)

"My plans are to find a biotechnology job in the Bay Area and do college ministry at my church."

—Morgan S. Shishido (B.S. ChemE)

"Will be attending graduate school to pursue my Ph.D. in chemistry."

—Renee J. Sifri (B.S. Chem)

"A new job perhaps as a short-term plan."

—Preet K. Singh (M.S. ChemE)

"Looking for job opportunities."

—Shalini Suresh Kumar (Fall 2015, M.S. ChemE)

"Going to graduate school in Nuclear Engineering."

—Felicia Sutanto (B.S. Chem)

"Medical School. Graduate school for Neuroscience/Genetics."

—Stefan R. Sweha (B.S. Chem)

"Traveling to Europe right after graduation! Barcelona, London, Monaco, here we come. Real life can wait just a bit."

—Jared E. Tan (B.S. ChemBio)

"Gonna derp for a bit and then look for a job."

—Anthony T. Tong (M.S. ChemE)

"After graduation I'm going back to Chile for an R&D job and will get married in 2017."

—Camila Valiente (M.S. ChemE)

"Ph.D. student at Princeton University."

—Shuo Wang (B.S. ChemE)

"I plan to pursue a master's degree in engineering management."

—Yiran Wang (B.S. ChemE)

"Hoping to get a new job after graduation (ideally in a lab). Graduate school will soon follow."

—Yung-Hua Wang (B.S. Chem)

"Pay back my loans as a productive member of society, then become an over-educated beach bum."

—Ross K. Ward (B.S. Chem)

"I will be pursuing a Ph.D. at Yale in organic synthesis. I hope to work on synthetic methodology and mechanistic studies."

—Conner V. Wilson (B.S. Chem)

"Still finding a job! But will work to stay in the Bay Area in the semiconductor industry."

—Jingting Wu (B.S. ChemE)

"Job."

—Zijue Wu (M.S. ChemE)

"I will be attending graduate school for my Ph.D. degree."

—Jiansong Xu (B.S. Chem)

"Ph.D. Study."

—Qin Yang (B.S. Chem)

"I am incredibly blessed to accept my new position as a Procurement Business Analyst at Apple starting in Summer 2016! My future primary career goals focus on product and brand management, where I can combine my technical expertise as an engineer with strong industry and business experience. My drive is to champion the development of technology to enable as many people as possible to aspire for their dreams. My second priority lies in personal development in the realms of entertainment and performance arts. I have a deep passion for sharing my experiences through my vlogs and blogs, and aspire to touch as many lives as possible with positive media and genuinely good content revolving around singing, dancing, acting, fitness, and anything else that I enjoy doing. My long-term life goals also include reconstructing the education system to better adapt to the individual learning needs of everyone. When I feel the time is right, I'd like to focus my efforts on a disruptive education strategy, deeply influenced by my background as an engineer and athlete through which I've gained invaluable perspective studying technical subjects in both home-school and traditional school environments."

—Jay A. Yostanto (B.S. ChemE)

"I'm definitely going to travel as much as I can before work, and hopefully not fall asleep from jet lag at work. Will be in a rotation program at MilliporeSigma."

—Lucy M. Yu (B.S. ChemE)

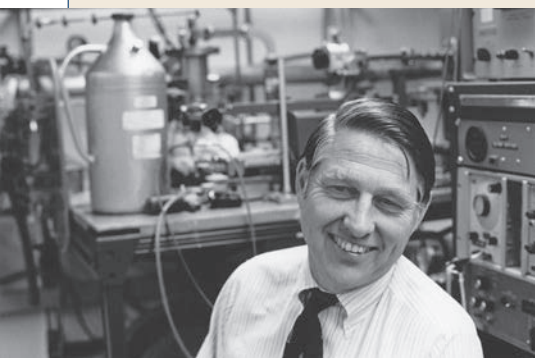
"My start-up today will make "Gen Zhang College of Chemistry" come true."

—Gen Zhang (B.S. ChemE)



In Memoriam

Faculty



ROLLIE J. MYERS JR. (*Ph.D. '51, Chem with William Gwinn*) passed away on September 12, 2016, in Berkeley, CA. He had been dealing with a chronic heart condition for some time and died peacefully in his home.

Born in Hastings, NE, in 1924, Rollie moved with his family to South Pasadena where, as a star chemistry student in high school, he held various summer jobs at Caltech. He obtained a B.S. ('47) and an M.S. ('48) from Caltech as a student of Linus Pauling and Ernest H. Swift. He joined our chemistry faculty in 1951 after earning his Ph.D. with William Gwinn.

Although he mentored many graduate students, Rollie was best known for teaching a wide variety of undergraduate courses and serving as an example of excellence in teaching, research and service for more than 40 years. He was an expert in radio and microwave spectroscopy and is widely recognized for having established the college's NMR facility.

Rollie was predeceased by his wife, Sylvia Harcstark Myers (*Ph.D. '55, English*). His laughter and wonderful soul are greatly missed. Remembrances can be made in his name to the College of Chemistry at chemistry.berkeley.edu/giving or to the American Chemical Society.

Friends of the college

MARTHA ANN SEARES PITZER passed away on June 22, 2016, in Columbus, OH. She and her husband, Russ, a trustee of the Pitzer Family Foundation, have

been outstanding friends of the College of Chemistry for many years, central to making theoretical chemistry at Berkeley world-renowned. Thanks to the generosity of the foundation—named after the late chemistry professor/dean Kenneth S. Pitzer and founded by his three children, Russ, John and the late Ann Pitzer—the college recently celebrated the opening of an expansion of the Pitzer Center onto the third floor of Gilman Hall.



Martha first earned an R.N. degree in Los Angeles, CA, and then obtained not only a B.S. and M.S. in nursing from The Ohio State

University, but also a Ph.D. in family relations and human development. A dedicated caregiver, she served on the nursing faculty of Ohio State and Otterbein College for many years and worked as a hospital nursing specialist and lactation consultant. She was a charter member of the Medical Center Service Board at Ohio State and a member of the nursing honor society, Sigma Theta Tau. Her volunteer work included Riverside Methodist Hospital; Nationwide Children's Hospital; Lamaze; and the Association of Women's Health, Obstetric and Neonatal Nurses. She is remembered by her family for her sweet demeanor, her intelligence and her loving nature.

ELLA J. SKINNER, widow of retired Shell Oil chemical engineer John R. Skinner (*B.S. '41, Chem*) and a generous friend of the College of Chemistry for many years, died last December 13, 2015. She was a talented pianist. She and John lived in Oakland and greatly enjoyed attending alumni events at the college and the university. It was a pleasure to see them at our alumni events and football games. Their enthusiasm for the college was inspiring. In a letter to the dean a few years ago, they named the college in their will, furthering their giving on behalf of undergraduate education here.

Alumni

'42 Myron Tribus (*B.S. Chem*) died on August 31, 2016, in Pensacola, FL.

He was an organizational theorist and, from 1974 to 1986, the director of the Center for Advanced Engineering Study at MIT. With a Ph.D. in engineering from UCLA, he joined the UCLA faculty before becoming dean of Dartmouth College's school of engineering in 1961, where he led the development of a curriculum emphasizing hands-on engineering design and entrepreneurship.

'49 Arthur I. "Art" Morgan Jr. (*B.S. '43, Chem; M.S. ChemE with Charles*

Wilke) passed away on July 1, 2015, in Berkeley, CA. Retired director of the Western Regional Research Center of the U.S. Department of Agriculture and former adjunct professor of food science at Berkeley, he was a generous supporter of the college who regularly attended the G.N. Lewis alumni era events. He is survived by his wife, Lillian Morgan, a Berkeley alum (*B.A. '43, Psychology; Cred/Cert '43, Social Welfare; M.S.W. '48*).

'51 Milton H. "Milt" Ritchie (*B.S. Chem*),

a loyal friend of the college, passed away on February 4, 2016, in Chula Vista, CA. He was a volunteer for the Cupola Era Endowed Chair committee and a regular attendee of our Cupola Era alumni events. Between 1946 and 1968, as one of few African-Americans among his classmates and co-workers, he earned a B.S. at Berkeley, obtained a master's degree in public administration from the University of Southern California and worked for the Naval Air Weapons Station in China Lake, CA, in addition to serving in the Army. In the mid-70s, he obtained a master's degree from Stanford in materials science and engineering and joined Hughes Aircraft Company, doing research on semiconductors in infrared devices. Milt and his late wife, Ethel, have bequeathed a significant gift to the College of Chemistry through a charitable gift annuity.

'53 John W. Cahn (*Ph.D. Chem with Richard Powell*), a foremost thinker in materials science, passed away on March 14, 2016, in Seattle, WA. His career at NIST in Gaithersburg, MD, focused on metallurgy. His wide-ranging discoveries, for which he received the 1998 National Medal of Science and the 2011 Kyoto Prize for advanced technology, related to the ways molecules interact—and how those interactions help create the properties, such as strength or slickness, that make some substances more useful than others.

'54 Erwin W. Hornung (*Ph.D. Chem with William Giauque*) died on May 2, 2016, in Berkeley, CA. A generous friend of the college who regularly attended college events, he had retired from his position at UC Berkeley as a research chemist in the Giauque lab.

'58 After a valiant three-year battle with esophageal and throat cancer, **Tao-Zeun "T.Z." Chu** (*B.S. Chem*) passed away peacefully at his home in Los Altos Hills on September 15, 2016. Please see our alumnus profile of T.Z. on p. 12.

'59 George A. Boswell (*B.S. '56, Chem; Ph.D. Chem with William Dauben*) died on December 11, 2015, in Reno, NV. A good friend of the college who volunteered on the committee to establish the Dauben Lectureship, he worked as a research chemist for DuPont in Wilmington, DE, for more than 30 years.

'62 Edward E. Genser (*Ph.D. Chem with Robert Connick*) died on June 23, 2015, in Oakland, CA. He joined California State University at Hayward (Cal State East Bay) as a chemistry professor in 1970, where he developed a curriculum, still in use, to effectively engage non-science majors while also conveying core principles.

B. Neal Harman (*M.S. ChemE with David Lyon*), who with his wife, Gloria, has been a generous supporter of the college, passed

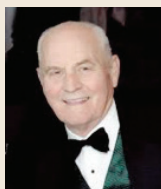
away on April 16, 2016, in North Ridgeville, OH. He spent most of his career with Rohm and Haas Chemical Company in sales.

'63 Andrew S. Grove (*Ph.D. ChemE with Andreas Acrivos and Eugene Petersen*), co-founder and longtime leader of Intel Corporation, died March 22, 2016, in his home in Los Altos, CA. He was best known for his technical contributions to early semiconductor design, as well as for his fast-moving and assertive management style. He is considered one of the creators of the technology business ethos that defines Silicon Valley. As a refugee from Communist Hungary, he studied chemical engineering in New York before earning his Ph.D. in chemical engineering here.

'65 John B. Nash (*Ph.D. Chem with Samuel Markowitz*) who, with his wife, Mary, has been a generous supporter of the College of Chemistry, passed away on August 20, 2016, in Kinston, NC. After earning his Ph.D. in nuclear chemistry, he was employed for nearly 30 years as a research chemist at the E.I. Du Pont Company in Kinston.

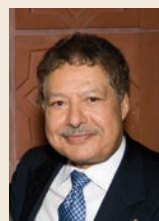
'66 Robert H. "Bob" Hauge (*Ph.D. Chem with Leo Brewer*), professor in chemistry and materials science & nanoengineering at Rice University, died on March 17, 2016, in Houston, TX. A highly cited chemist, he contributed to groundbreaking work in spectroscopy, fluorine chemistry and high-temperature inorganic chemistry.

'67 M. Ross Johnson (*B.S. Chem*), a staunch friend and supporter of the college and a member of our Advisory Board, passed away at his home in Chapel Hill, NC, on October 17, 2016. He was an internationally renowned medicinal chemist and expert in drug design and drug discovery who had a long and productive career as an inventor, discoverer, executive and entrepreneur in the pharmaceuti-



cal and biotech industries, most recently as co-chairman and co-founder of Parion Sciences. He earned his Ph.D. in organic chemistry from UC Santa Barbara in 1970. In 1989, he was named the inaugural Distinguished Research Fellow in the Laboratory of Medicinal Chemistry, NIH, in recognition of his contributions and influence and, in 2011, he was inducted into the Medicinal Chemistry Hall of Fame.

'75 Nobel Laureate **Ahmed H. Zewail** (*Pdoc Chem with Charles B. Harris*),



the college's 2010 G.N. Lewis Lecturer, died on August 2, 2016, in San Marino, CA. He was the Linus Pauling Professor of Chemistry and Physics at Caltech. A native Egyptian, he earned his Ph.D. at the University of Pennsylvania before coming to Berkeley as a postdoc. He was the sole recipient of the 1999 Nobel Prize for his pioneering developments in femtoscience, making possible observations of ephemeral molecular phenomena on the femtosecond (10^{-15} second) time scale of atomic motion. He and his group developed the field of 4D electron microscopy. He promoted science education and world peace and served on many national and international boards.

'76 Tao-Shih "Tao" Hsieh (*Ph.D. Chem with James Wang*) passed away on August 4, 2016. Born in China, he fled as a child with his family to Taiwan, where he earned his B.S. in chemistry. He immigrated to the U.S. for grad school at Berkeley, followed by a postdoc position at Stanford. In 1980 he joined the biochemistry department at Duke University. In 2009, he became director of the Institute of Cellular and Organismic Biology of Academia Sinica.

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Since March 2016, we have learned of the deaths of 75 alumni.

For a complete list, please visit:
berkeley.box.com/v/chem-memorial-fall2016

COMPILED BY KAREN ELLIOTT



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On LinkedIn

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Join us at College of Chemistry - UC Berkeley.



On @cal alumni network

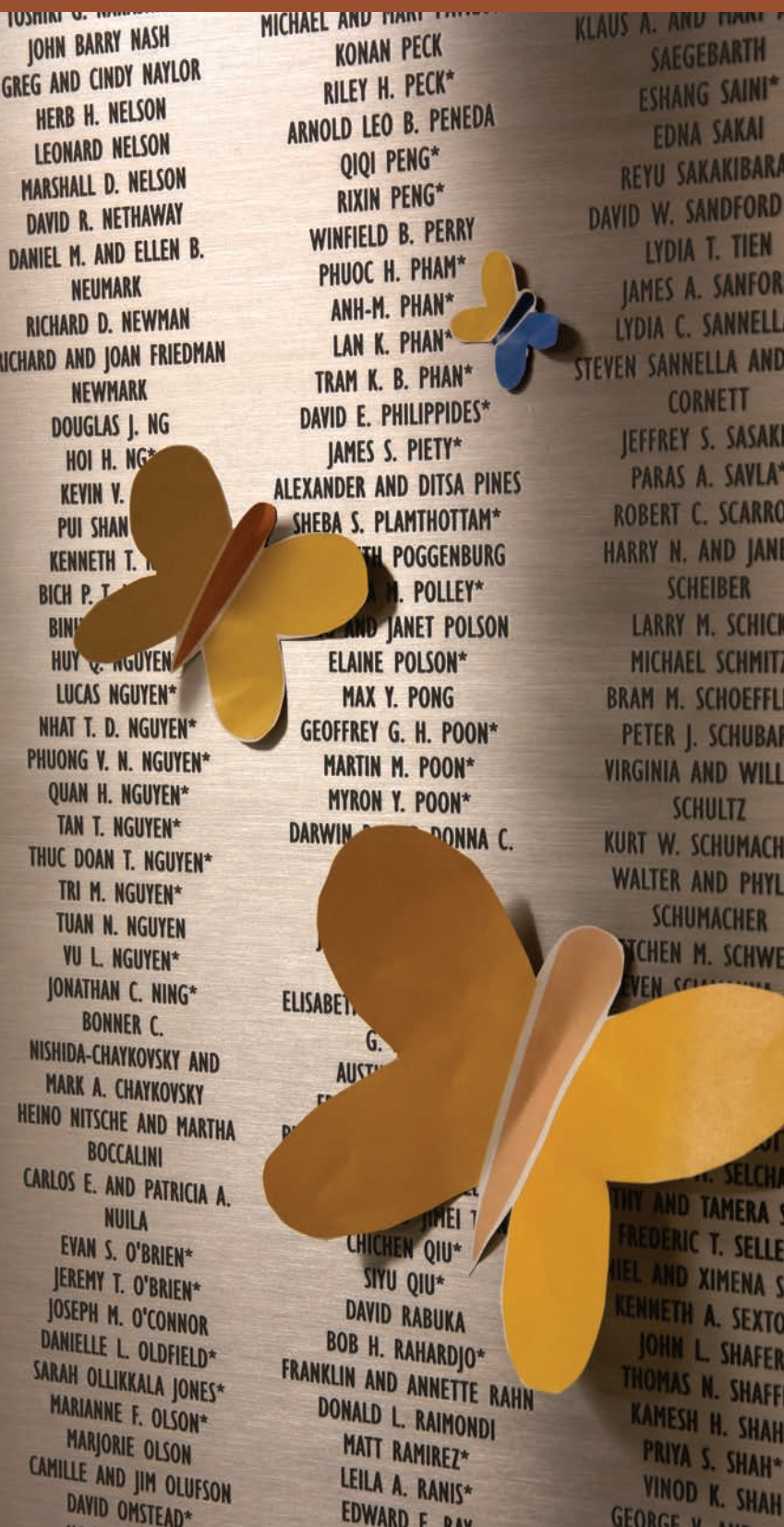
Keep in touch with your classmates. cal.berkeley.edu



Give to the college

givetocal.berkeley.edu/chem

Fall 2016 **Catalyst**



Upcoming Spring 2017 Events

All-Era Alumni Brunch

March 11 11 a.m.–1 p.m.
Krutch Theater, Clark Kerr Campus
Join Dean Doug Clark, Professor Evan Miller, and your fellow alumni from all alumni eras for brunch, a presentation, and the latest news from the College.

Cal Day

April 22 11 a.m.–2 p.m.
Pimentel Hall
This campus-wide open house will feature activities and presentations in the College of Chemistry.

As the date approaches, visit calday.berkeley.edu for details.

Commencement

May 15 7 p.m.–9 p.m.
Zellerbach Auditorium

+ For more information on events, visit chemistry.berkeley.edu/events, or email coc_events@berkeley.edu

+ To make sure you hear about upcoming events and news, please submit your email address to: chemistry.berkeley.edu/email



DON'T MISS OUT!

The College of Chemistry will be moving to electronic invitations starting in 2017.

