Chemistry and Chemical Biology

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The Chairman's Notebook

An Important New Collaboration Caps a Very Good Year

The 2000 calendar year brought great news to the department on many fronts. Perhaps the most important is the announcement (see page 5) of a tri-institutional collaboration between Sloan-Kettering Institute, Rockefeller University, and both the Weill Medical College and the Ithaca campus of Cornell University. The venture is supported by $160 million, funded in part by a donation from an anonymous patron. The support will be split equally among the three principal institutions, with Cornell's share being divided between the Weill Medical College and the Ithaca campus. Chemical biology, computational biology, and nanobiotechnology will be the major beneficiaries in Ithaca. Among the important opportunities the program will provide to the department are positions for two assistant professors, who will have joint appointments at the three major institutions; increased support for graduate students wishing to work on collaborative research programs at the three institutions; and a protein expression and purification facility, to be housed in Baker/Olin. Because the area of collaboration coincides strongly with our increased effort in chemical biology, the tri-institutional research program provides welcome and timely resources. Spearheading the effort at Cornell will be Professor Bruce Ganem.

Another welcome addition to the department is Assistant Professor Brian Crane (see page 2). Brian joins us after graduate work at the Scripps Research Institute and after a Helen Hay Whitney Postdoctoral Fellowship at the California Institute of Technology. He has set up laboratories on the ground level of Olin and will use x-ray techniques to study how metalloproteins change their configuration following changes in the redox state of their metal centers.

Several other personnel changes have occurred in the department. We are delighted that Frank DiSalvo has agreed to become director of the Cornell Center for Materials Research and that Jon Clardy has agreed to serve as senior associate dean in the College of Arts and Sciences. We look forward to their leadership in these important positions, but we will miss having their outstanding teaching on a full-time basis. My own term as chair ended on January 1, 2001. The department, especially this member, is very grateful to former chair Bruce Ganem for volunteering to serve as acting chair while I am on leave during the spring semester. I am also pleased to announce that as of July 1, 2001, Barry Carpenter will become the new chair and that Roger Loring will become associate chair. The department joins me in supporting their efforts and wishing them well.

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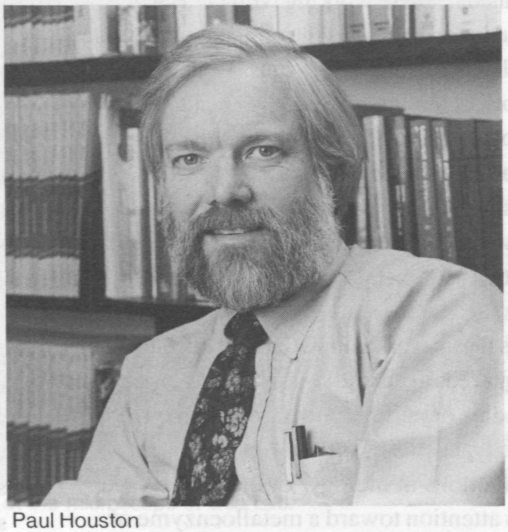


Jon Reis Photography

Paul Houston

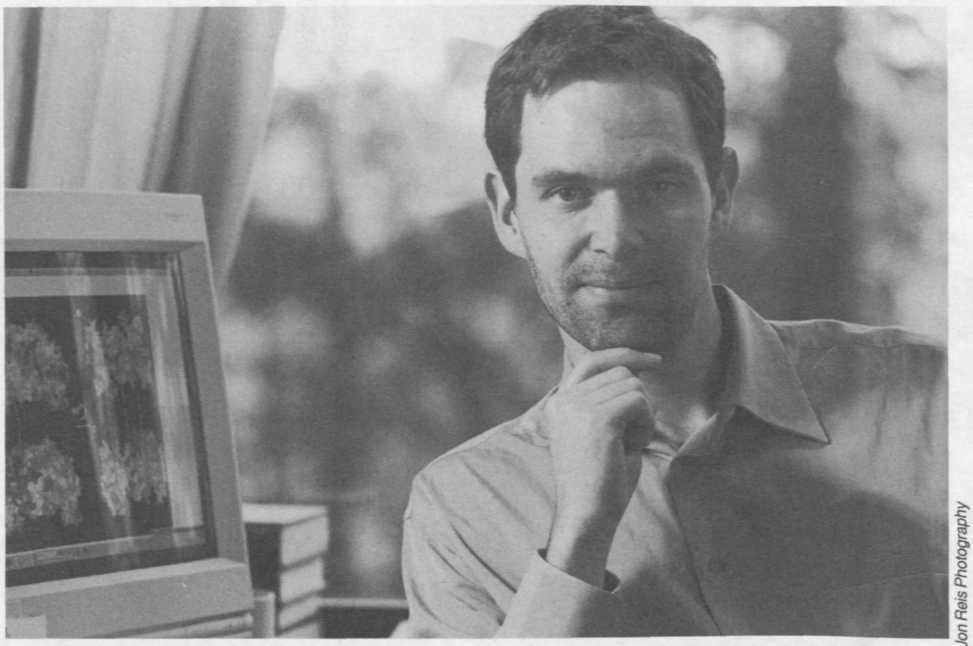
Cornell Events at the 221st ACS Meeting, San Diego

Cornell and Stanford University Reception
7:00–8:00 pm, *before the Monday, April 2, performance of* Oxygen
(see pg 14)
At the Lyceum, 79 Horton Plaza

Cornell University Continental Breakfast for Alumni and Friends
7:45 am, Tuesday, April 3,
Carlsbad Room, Marriott

Brian R. Crane Joins the Department as an Assistant Professor

Brian Crane comes to the chemistry faculty from a postdoctoral fellow position with Harry B. Gray at the California Institute of Technology. Crane aims to understand the physical properties of metalloenzymes and the structural principles of photo- and redox chemistry in biology. He is interested in how metalloproteins catalyze chemistry and how redox processes transduce energy and information within cells.



Jon Reis Photography

Brian R. Crane

Crane's interest in biological chemistry began as an undergraduate at the University of Manitoba, in his hometown of Winnipeg, Canada, where working with Dr. Harry Duckworth, he was introduced to the remarkable chemistry of enzymes. With a desire to work at the interface between chemistry and biology Crane then became one of the first graduate students at the Scripps Research Institute in San Diego. There he became fascinated with the structures and reactivity patterns of metal-containing enzymes.

His thesis work with Dr. Elizabeth Getzoff centered on crystallographic and biochemical studies of sulfite reductase, an enzyme that catalyzes two of the three six-electron reductions in biology. Crane then turned his attention toward a metalloenzyme of fundamental chemical interest that was also highly relevant to human biology: mammalian nitric oxide synthase (NOS), the enzyme responsible for production of the cellular signal and cytotoxin nitric oxide (NO). Working with Dr. John Tainer at Scripps and Dr. Dennis Stuehr at the Cleveland Clinic, he determined the first structures of NOS in complex with substrates, intermediates, and inhibitors. These studies suggested strategies for designing new, more effective NOS inhibitors. In collaboration with pharmaceutical companies, Crane and colleagues have worked toward the design of potent, isozyme specific NOS inhibitors to treat inflammation, septic shock, and pain.

However, to fully comprehend the chemical reactions occurring at protein metal centers, Crane believes that new methods that combine chemistry, spectroscopy, and structure determination are needed. To this end, he joined the bio-inorganic chemistry group of Harry Gray at Caltech as a Helen Hay Whitney Fellow. There, Crane developed new photochemical systems, methods, and instrumentation for triggering and characterizing transient intermediates in single-protein crystals, where atomic structure can be precisely defined. At Cornell he intends to extend this work to the study of metalloenzyme intermediates by transient spectroscopy and X-ray diffraction.

"The general goal of our work will be to understand how protein structure controls the reactivity of cofactors and in particular mediates the interaction of these cofactors with photons and electrons," Crane says. He emphasizes that in biology, such mechanisms are important not only to metabolic processes but also to the transfer of information in cells. In this regard, the Crane group will also study proteins that allow organisms to sense and respond to their environment via interactions with light or high potential electrons. Prime examples include components of biological clocks of eukaryotic organsims. Proteins that allow cells to keep track of time and entrain to cycles of the day must couple the activation of "sensing cofactors" to protein conformational change. At a molecular level, it is not well understood how this happens. The Crane group plans to investigate these intermediates using a combination of structure and spectroscopy in the same manner that intermediates in metalloenzyme catalysis will be pursued.

Crane aims to develop a multidisciplinary research program that involves the integration and augmentation of materials and methods from the fields of bioinorganic chemistry, optics, visible spectroscopy, and protein crystallography. He finds the Cornell chemistry department an ideal environment in which to pursue such research.

This past fall Crane presented a new graduate course, Physical Chemistry of Proteins (686), a subject last taught by Professor Harold Scheraga some years ago. The course offers a quantitative perspective on the physical properties of proteins, beginning with colloidal properties; moving through structural, conformational, and dynamic properties; and ending with the nature of long-range electron transfer and activated states in proteins.

It's "All Too Wonderful" for the Computing Chemist, Sarunya Bangsaruntip

Roger Segelken, Cornell News Service

Professors were amazed—and Sarunya Bangsaruntip admits surprise, too—that in four years at Cornell, she managed to squeeze in one more research project, yet another tough class, extra volunteer work, and a second undergraduate major.

"It was all too wonderful to pass up," said Bangsaruntip, who graduated with a dual degree from two colleges (Arts and Sciences and Engineering) in two of the most rigorous fields (chemistry and computer science), with solid research accomplishments to her credit and with the gratitude of people she helped along the way.

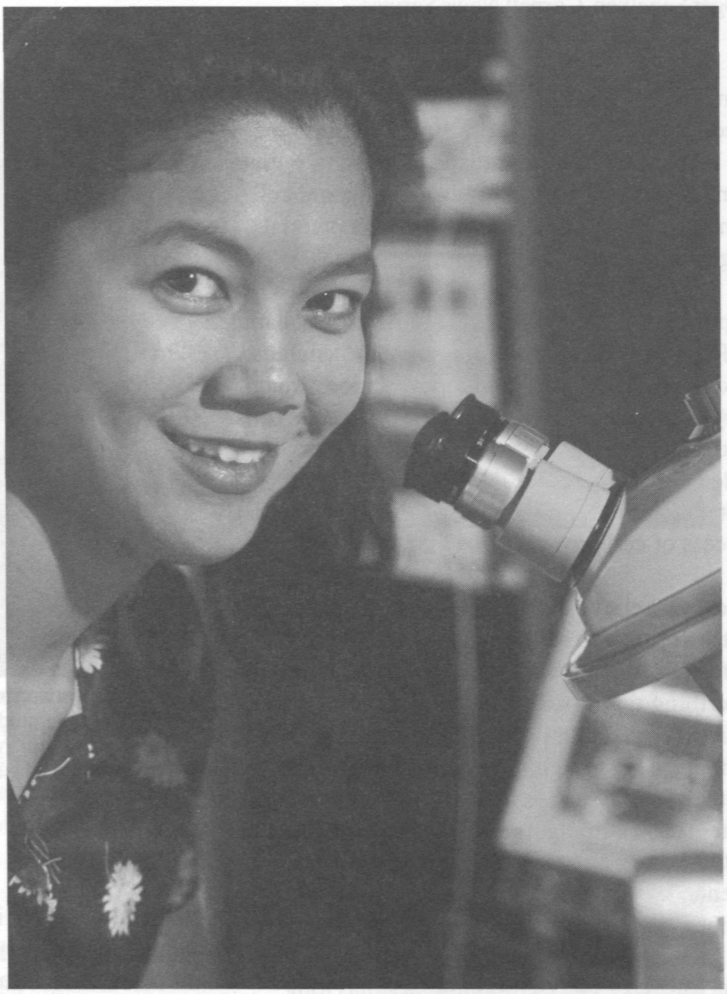
"Sarunya is the absolute brightest, most motivated, most mature, and overall most promising undergraduate scientist I have had the joy to work with in my 15 years as a research scientist," said John A. Marohn, assistant professor of chemistry. Noting Bangsaruntip's undergraduate research—first in synthetic inorganic chemistry, then in applied chemistry at the IBM Almaden Research Center, where she worked on the kinetics of photoresists, and most recently in Marohn's physical chemistry lab, to improve the sensitivity of MRFM (magnetic resonance force microscopy) instruments—Marohn said: "It is truly rare to see a student who can excel in such different areas." Known to her friends as Tang, the native of Thailand attended Cornell on a national scholarship and said the intercollege degree began with the yearning to learn a little computer programming. "It seemed like good knowledge to have," she said, "and pretty soon it was another major." She knew her plan would require a 20-plus credit-hour load each semester, but professors at Cornell encouraged her to be all that she could be. And so she did. And did it again, bringing her computing skills to the chemistry lab to implement a digital control system for the MRFM and joining advanced graduate students in super-tough courses like Statistical Thermodynamics (Chem 678), where she ranked among the top of the class.

"Sarunya is, quite simply, the most outstanding and enthusiastic undergraduate I have ever had the pleasure of teaching," said Melissa A. Hines, associate professor of chemistry, who said she wanted to make sure Bangsaruntip is credited for her extracurricular good works, as well.

Those good works include activities like the co-presidency of WISER (Women in Science and Engineering Resource), in which she organized chemistry peer tutors and taught numerous students herself. In Alpha Chi Sigma, the professional chemistry fraternity, she was the alumni secretary. Besides seeking alumni support, Bangsaruntip led chemistry education outreach programs in local schools and reached out to the general public with events such as Chemistry Day at Pyramid Mall. "I've had such a good experience at Cornell," Bangsaruntip said, "and I wanted to help others to do as well."

After growing up in Bangkok, Ithaca is the littlest place Bangsaruntip ever lived, but it's also the loveliest, she says. "Someone told me this could be my only opportunity to live in this kind of area, and every time I cross the North Campus bridge, I remember how beautiful it is."

For a view like that, Bangsaruntip would slow down her bicycle a notch or two, but mostly she sped around campus to save precious time. Intramural volleyball was her other form of exercise. About the only time she sat still, it seemed, was to watch the stars through Cornell's Mt. Pleasant and Fuertes Observatory telescopes. Or she would set up her portable telescope on clear nights and invite friends to contemplate the chemistry that's occurring in distant galaxies.



Robert Barker/University Photography

Sarunya Bangsaruntip at the microscope in Olin Lab.

The next stop for Bangsaruntip is Stanford (although Berkeley, MIT, CalTech, Chicago, and Harvard also wanted her) where she is persuing a Ph.D. in physical chemistry. Then it's back to Thailand to be a research professor at a university or a scientist in a government institute.

But first, a little summer "vacation" with those fascinating polymers: There's more research to be done at the IBM lab, and scientists there are looking forward to her help.

"It hasn't been easy, but it's stuff I like to do so I don't mind," the computing chemist said. "I've been quite lucky that what I like to do coincides with what I get to do."

Malignant Cell Growth Caused by Hyperactive "Switch," Research Finds

Roger Segelken, Cornell News Service

Cancer researchers in Cornell's College of Veterinary Medicine have learned how some proteins receive the marching orders that dispatch them to initiate signaling pathways and produce malignant cell transformation. The discovery offers potential targets for drugs to block tumor growth.

Reporting in the June 15 issue of *Nature*, a team led by Richard A. Cerione, professor of molecular medicine and chemical biology, describes what happens when normal protein traffic in cells runs wild: A hyperactive form of the molecular switch called Cdc42 increases the shuttling of other proteins throughout the cell, disrupting the orderly process of cell growth.

"We now believe that Cdc42 has to traffic proteins that are critical to cell growth toward the cell surface," Cerione said in a prepublication interview, describing the process by which protein-coated vesicles containing protein cargo are moved to the right place at the right time. "Cdc42 has to be switched on—perhaps for only a minute—to traffic proteins and stimulate cell growth. But if Cdc42 is mutated and remains switched on for an extended period of time, cellular activities are overstimulated," he said.

"The role of Cdc42 in protein traffic has long been suspected but never directly demonstrated," Cerione added. "But now that we know about its trafficking target, we can try to design drugs to moderately inhibit the normal activity of Cdc42—in effect to make it a little bit sick—and tone down the cell-growth activities for therapeutic value."

The Cdc42 protein acts as a molecular "switch" with a key role in regulation of the cell cycle, the "program" that guides cell growth and cell division. It is believed to play a dual role, alternating as an essential protein for normal cell growth and as a switch that allows protein signals from a mutated Ras oncogene to cause cancer. (The Ras oncogene is implicated in 30 to 50 percent of all cancers.) Cdc42 was discovered and cloned in 1990 both from *S. cerevisiae* (budding yeast) by a group at the University of Michigan and from a human cDNA library at Cornell by researchers in Cerione's laboratory.

Robert Barker/University Photography

The cancer-research team responsible for the cell-signaling discovery includes, from left, graduate student Wen Jin Wu, research associate Jon W. Erickson and Professor Richard A. Cerione, in Baker Laboratory. Not shown is team member Rui Lin, a graduate student at the time of the study.

In the February 2000 issue of the journal *Cell*, a research team led by Cerione announced the three-dimensional molecular structure of the protein complex of Cdc42 and GDI (for guanine nucleotide-dissociation inhibitor). The latest discovery of Cdc42's role in intracellular protein shuttling has prompted commentary articles by other cancer researchers in the same issue of *Nature* and in the next issue of *Cell*.

In addition to Cerione, who is a professor both in Cornell's College of Arts and Sciences and College of Veterinary Medicine, the finding was primarily the work of Wen Jin Wu, a Cornell graduate student in the field of pharmacology; other contributors to the study were Jon W. Erickson, a research associate in the Cerione laboratory; and Rui Lin, a Cornell graduate student at the time of the study and now a postdoctoral researcher at University of California-San Francisco. The study was supported by the National Institutes of Health.

While structural mapping of cellular switches, such as the Cdc42/GDI complex, is conducted by X-ray crystallography in Cornell's MacCHESS facility (macromolecular high-energy synchrotron source), the protein-traffic study was something of a fishing expedition, Cerione said.

"Wen Jin Wu baited the hook with Cdc42 that was switched on or activated and trolled through cell lysates to see what proteins he could catch and sequence," Cerione said, describing a commonly used technique by his laboratory to search for important Cdc42-targets. Wu fished in lysates prepared from mouse fibroblasts, a type of cell in connective tissue found in all mammals that is a standard cellular model for cancer studies.

Like a lure that attracts some fish but not others, the activated Cdc42 "caught" molecular binding sites on a specific protein that normally coats trafficking vesicles, the researchers reported.

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CU/Weill Announces $160 Million Collaboration in Bio Research

Roger Segelken, Cornell News Service

Cornell and its Weill Medical College have joined two of New York's other leading research institutions in announcing the creation of a $160 million collaborative program in basic biological research sparked by a private donor who will contribute half the total investment. The program will involve several of the Ithaca campus's leading researchers in chemistry and chemical biology and in computational biology.

The collaboration among Cornell and Weill, Sloan-Kettering Institute and the Rockefeller University will include the joint recruitment of a dozen new faculty members, reflecting the level of investment demanded by the technological demands of science today.

The joint venture was announced at a news conference at Rockefeller by President Hunter Rawlings; Arnold J. Levine, president of Rockefeller; and Harold Varmus, president of Memorial Sloan-Kettering. Also speaking was Lisa Staiano-Coico, senior associate dean for research at Weill Cornell, representing Antonio M. Gotto, dean of the medical college, who was out of the country.

"This new and unique institutional collaboration of these outstanding research centers will allow us to take on the most exciting intellectual challenges of the twenty-first century: how to utilize the full knowledge of the human genome and how to apply new technologies in structural biology and nanotechnology to advance human health," Rawlings said. "Each of our institutions brings unique talents and resources to our partnership so we are a good fit. For example, the Cornell Theory Center, which houses our supercomputer, will play a significant role in this venture."

The three areas targeted for development are: *Chemical biology:* Spearheading this research will be professors of chemistry and chemical biology Tadhg P. Begley, Richard A. Cerione, Jon C. Clardy, Brian Crane, Steven E. Ealick, and Bruce Ganem. A new generation of drugs will be precisely targeted to block or reverse disease processes at the molecular level. Development of these new therapies will depend on collaborations among chemists, cell biologists and biophysicists who study protein structure.

The Department of Chemistry and Chemical Biology, which will play a major role, is creating an interface between chemistry and chemical biology that is promoting both basic and translational research in modern biomedical science.

Computational biology: Leading this research will be Ron Elber, professor of computer science. High-throughput methods such as those employed by the Human Genome Project are producing massive quantities of data that remain in a disorganized state. Collaboration among computer scientists, mathematicians, physicists, engineers, and biologists is needed to identify functional connections among genes and to work toward eventual applications in the diagnosis, treatment, and prevention of human disease.

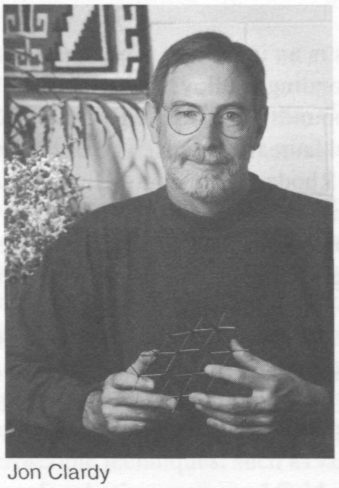
Elber's work in computational molecular biology (CMB) is bringing together researchers from physics, chemistry, biology, and computational and mathematical sciences. The goal of the CMB team is to unravel biological complexity at the molecular level using the Theory Center's 128-processor cluster of high-performance servers.

Cancer biology: Under the cooperative venture, cell and developmental biologists will invent and apply new technologies to understand how healthy cells grow and differentiate and how the disruption of normal processes can lead to tumor formation. The participating institutions will expand their programs in cell and developmental biology, with an emphasis on developing and applying techniques for chemical intervention in cellular processes and real-time imaging of living cells.

Also involved in the collaboration will be

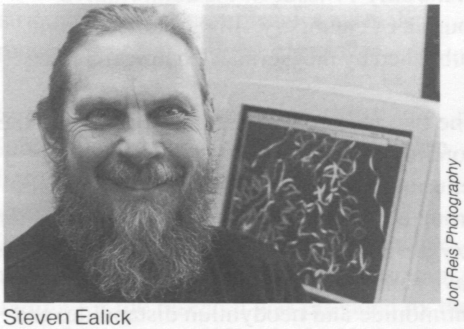
Jon Reis Photography

Tadhg Begley



Jon Reis Photography

Jon Clardy



Jon Reis Photography

Steven Ealick

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Research on Structures of Future Technology Yields Secrets of Bonding

David Brand, Cornell News Service

In the nineteenth century, fundamental discoveries were made by unlocking the chemistry of carbon, but wide exploitation of these major discoveries came slowly. It took some years, for example, before this knowledge led to the development of new drugs and synthetic fibers.

Now, two researchers at Cornell have made important theoretical discoveries that, similarly, have long eluded chemists: They have established the principles of crystal bonding of a group of thousands of compounds. But history repeats itself in that, thus far, nearly all of these unusual compounds have no industrial uses, although many have interesting electronic and magnetic properties.

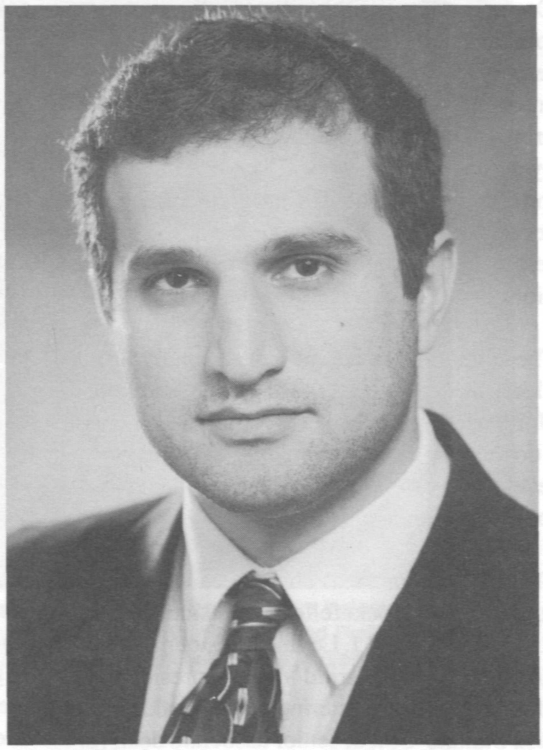
"This is an important step in understanding the bonding in alloys and intermetallic compounds," said Roald Hoffmann, Cornell's Nobel laureate chemist who also is the Frank H. T. Rhodes Professor of Humane Letters. Hoffmann, despite his seniority, was led in this pioneering work by his graduate student, Garegin Papoian, who came from Armenia to study under Hoffmann and now is a postdoctoral researcher at the University of Pennsylvania. The two chemists have laid out a theory that extends the understanding of bonding in an important class of alloys.

Hoffmann's and Papoian's "novel bonding scheme" was described in more than 40 pages in the July 17 issue of the authoritative journal of chemistry, *Angewandte Chemie,* published by the German Chemical Society.

The two researchers began by looking at the bonding of compounds of antimony, tellurium, tin, and selenium, all called "main group elements," below carbon, nitrogen, and oxygen in the periodic table. The compounds have names like europium and lithium antimonide and neodymiun distannide, and although they have been known for many decades, "experimentalists have said nothing about what holds these compounds together," said Hoffmann.

It was known that these compounds have in them curious structural motifs, quite uncommon in organic or other inorganic molecules. The compounds, in fact, blur the line between the different types of bonds that hold atoms together in a molecule or a crystal. In this case, the bonds are a melange of metallic bonds, covalent bonds—created by the sharing of electrons—and ionic bonds—formed by the transfer of electrons.

These "isolated puzzles" are now explained by the two researchers in a formula that is based on "magic numbers." In physics and chemistry, magic numbers designate the sum of electrons in a molecule that leads to special stability. In the Papoian-Hoffmann bonding formula, magic numbers refer to the electron counts that indicate whether a stable compound is linear or square: seven electrons per atom for a linear chain; six electrons per atom for a two-dimensional square lattice; and five electrons per atom for a simple cube lattice.



University Photography

Garegin Papoian

The crystal structures themselves can be seen in a series of computer-generated drawings—not based on theory but on direct experimental work—that have an interlocking, architectural perfection. The molecular structures, ranging from simple geometries to complex lattices, reveal their bonding networks in a series of multidimensional building blocks. "Some look terribly complicated," said Hoffmann, "but take them apart and you can see square lattices with atoms above and below, and squares forming octahedrons—fantastic structures with a certain 'Star Wars' quality."

But how can such structures reveal themselves sometimes as compounds of antimony and other times as tellurium or tin? "Because it's the number of electrons that determines the chemistry, less so the identity of the nucleus underneath," Hoffmann explained.

"What we have here is theory at its best—qualitative theory, building connections between different parts of the chemical universe, even though to outsiders these units appear not to be close to each other," Hoffmann said. "I pride myself on seeing connections, which is what I also try to build between science and humanities. Anything I can do to connect diverse things feels worth doing."

Papoian's and Hoffmann's paper in *Angewandte Chemie* is titled "Hypervalent Bonding in One, Two and Three Dimensions: Extending the Zintl-Klemm Concept to Nonclassical Electron-Rich Networks."

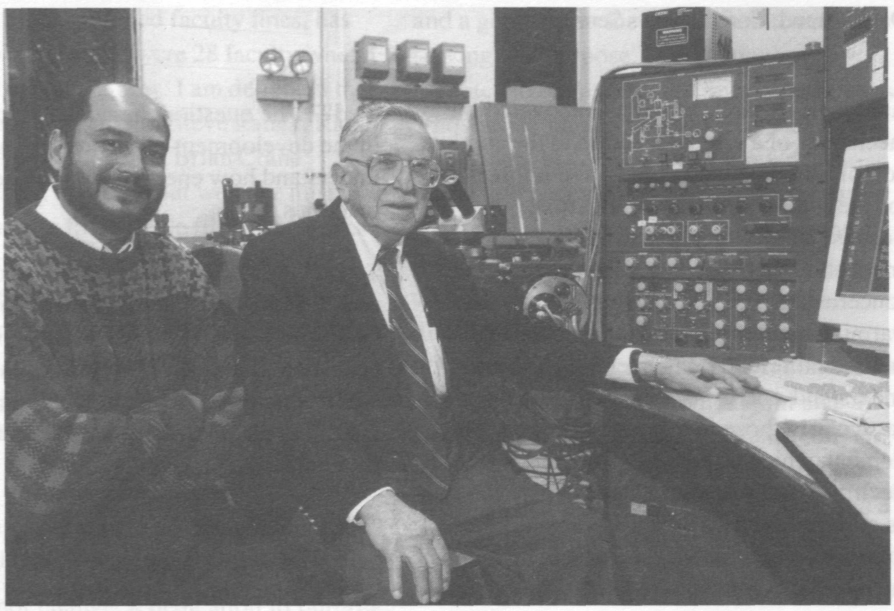
Researchers' Technique Images Therapeutic Drugs at Work in Cancer Cells

Jeff Evans '01, Cornell News Service

Chemical biologists in the department have pioneered an imaging technique that offers researchers a new way to observe the working of therapeutic drugs within single cancer cells.

The technique, called ion microscopy, promises to open new avenues of cancer research because it offers a high sensitivity for detecting isotopes of elements — atoms of the same element with different numbers of neutrons.

"Ion microscopy's high sensitivity makes it an ideal tool for localizing anticancer drugs inside tumor cells," said Subhash Chandra, a senior research associate in the Department of Chemistry and Chemical Biology. He explained that many therapeutic compounds used in cancer treatments contain chemical markers, known as elemental tags, that allow ion microscopes to judge their efficacy.



Frank DiMeo/University Photography

Senior Research Associate Subhash Chandra, left, and Professor Emeritus George H. Morrison with the ion microscope in their lab in Olin.

Chandra was the lead author of a report on the development of the biological and biomedical application of ion microscopy in the journal *Analytical Chemistry*. The subcellular location of transported ions inside normal and cancer cells can be studied with ion microscopy by placing a stable, or nonradioactive, isotope into a laboratory rat's bloodstream, thereby allowing the imaging of cells of the target organ with the transported isotope. The studies described in the journal were performed in cell cultures and on tissues from rats, although, said Chandra, human cell cultures and tissues have been used in studies.

The technique is novel because molecules that have been labeled with either stable or radioactive isotopes can be located within the cell. A researcher using ion microscopy instead of the more common autoradiography (a method that locates radioactively labeled molecules) can use stable isotopes to run studies that would not be possible with radioactively labeled molecules. This shortens imaging time, assuring that the subcellular location of labeled molecules is native to the cell.

The form of ion microscopy described in the journal report is called SIMS, for dynamic secondary ion mass spectrometry. This method uses cryogenically prepared frozen freeze-dried cells in the ion microscope's high vacuum. The advantage of SIMS imaging, Chandra writes in the paper, is that it provides three-dimensional imaging capability for studying the subcellular distribution of elements (or isotopes) and simultaneous analysis of a wide region containing many cells within the same field of view. This is a major advance for biological researchers, providing reproducible observations among a number of cells and ample imaging data.

Further, said Chandra, "The preparation of cells with cryogenic methods preserves the native chemical and structural makeup of the cells for ion microscopy analysis."

The ion microscopy group developed a way of growing cells on silicon chips and cryogenically preparing them with a method called "sandwich fracture." This method overcomes compositional and conductive problems and allows cells to be studied for their intracellular chemical composition.

The ion microscope was invented in 1962 and originally was exploited in the semiconductor and electronics industry by such companies as IBM Corp. and Intel Corp. The microscope uses a beam of ions to bombard the sample surface, a process that produces secondary ions by etching off the sample's top layer of atoms. These secondary ions are then filtered. Other microscopic techniques, such as laser scanning confocal microscopy and field emission scanning electron microscopy, are used to help to recognize the location and distribution of ions or molecules in smaller structures, such as cellular organelles.

The other authors of the report, titled "Subcellular Imaging by Dynamic SIMS Ion Microscopy," are also members of the Department of Chemistry and Chemical Biology: Duane R. Smith, research associate, and Professor Emeritus George H. Morrison. Funding for the research was provided by the National Institutes of Health, the National Science Foundation, and the U.S. Department of Energy

CU Research Team Makes Fundamental Discovery about Hydrogen Combustion

David Brand, Cornell News Service

A Cornell research team has uncovered the mechanics of a critical reaction in the combustion of hydrogen that could have implications for the future of energy production.
Because of growing concerns about future energy sources based on fossil fuels—concerns that range from supply to global warming—considerable experimental and theoretical research is under way to better understand energy conversion processes, particularly those involving hydrogen. The element, which is readily formed through the electrolysis of water and leaves only water as its combustion byproduct, is viewed as an attractive future material for use in heating and the internal combustion engine.

"The process we are studying is one of the most fundamental steps in combustion," said principal investigator Floyd Davis, associate professor of chemistry and chemical biology. "Of course, ultimately the goal is to develop more efficient ways to convert energy from one form to another, but what we are doing is more fundamental: to study how energy is released in this reaction."

The researchers' report appeared in the Nov. 3 issue of the journal *Science.* Other authors are Davis's graduate students, Brian R. Strazisar and Cheng Lin. Their experimental report and a separate theoretical research paper by another group are discussed in an accompanying article by George C. Schatz, a Northwestern University chemist. The importance of the two papers, Schatz said, is that they "present important new results concerning a topic of longstanding interest to chemists, namely the relationship between reagent and product vibrational motions and the dynamics of chemical reactions."

Davis explained that during the combustion of hydrogen in air, energy is released in the form of heat, which to the observer appears as a hot flame. But at a submicroscopic level, the energy is released when the newly formed water molecules are produced in excited vibrational and rotational levels. The question, Davis said, is "how is this energy distributed?" The question, he noted, is important in the development of theoretical models to understand how energy flows in chemical reactions.

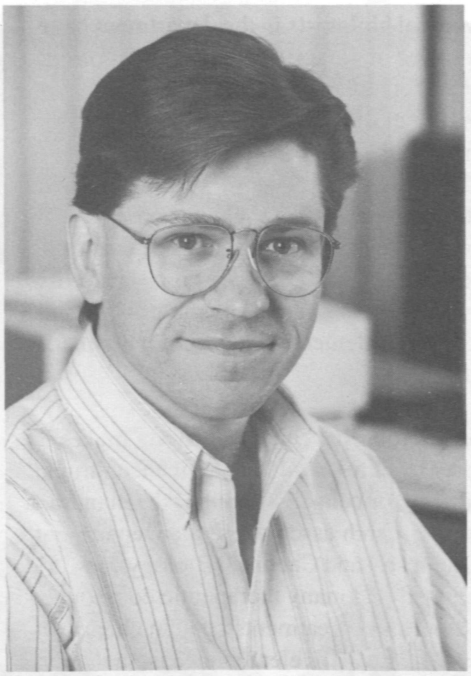
To find the answer, Davis and his coworkers used a technique called crossed molecular beams in which two separate molecular beams cross at right angles. Four lasers were used to measure the angular and velocity distributions of newly formed chemical products.

"A chemical reaction results from successful collisions between molecules," said Davis. "If the orientation of the reactants [the colliding molecules] is correct, they can pass through a critical configuration known as the transition state, allowing products to be formed."

In the reaction studied by Davis and his colleagues, the oxygen atom in a hydroxyl radical (OH) grabs an atom from deuterium (D_2), forming water called monodeuterated water (HOD) and a deuterium atom. A hydroxyl radical is an oxygen atom connected by a single bond to a hydrogen atom. Deuterium, or heavy hydrogen, is an isotope of hydrogen, or a hydrogen atom with a neutron added. In all, the reaction involved four atoms and six dimensions.

"By observing where the products are scattered, and by measuring their velocities, we can learn about the details of the reactive encounter," said Davis.

He likens the effect to a game of baseball. When a batter hits a line drive, it is because the bat has struck the ball head-on. A pop fly results when the bat hits the ball slightly below its center. By watching where the "baseball" goes, researchers can learn about its collision with the "bat." In nature, molecules bump into each other constantly, but in most cases collisions don't lead to a reaction. Thus researchers are interested in how the probability of a reaction depends on the details of the collision.



John Reis Photography

H. Floyd Davis

A closely related issue is how energy is distributed into newly formed molecules following chemical reactions. In the reaction involving the formation of HOD+D, the Cornell group found that the HOD is primarily formed with two quanta of vibrational energy in the oxygen-deuterium (OD) bond. A quantum is the smallest "package" of energy that can be observed.

"The significance of this measurement is that since the 1980s, theory predicted that the energy would be deposited nearly statistically into all of the vibrational modes of HOD," said Davis.

Recently, though, new calculations predicted that energy would instead appear only in certain HOD vibrational modes. The Cornell experimental measurements are in nearly total agreement with these theoretical results.

"This is a breakthrough in our understanding of the way a reaction occurs," said Davis.

The *Science* article is titled "Mode-Specific Energy disposal in the Four-Atom Reaction $OH + D_2 — HOD + D$."

Chairman's Notebook *(continued from page 1)*

Since this is my last newsletter column, perhaps I may be excused if I take the opportunity to provide a biased review of my term. In retrospect, much was started during my watch, and much of what was started needs still to be completed. We have changed our name, signifying a new emphasis on chemical biology. We are well on the way toward renovation of Baker and construction of new laboratory facilities, but we have a long, hard road to follow. While the administration has been very supportive, a site must still be selected and substantial funds must still be raised. Without these improvements, however, we will not be able to carry out either our teaching mission or our program of scientific expansion, both in more traditional areas and in chemical biology. That expansion, really a decision to fill unoccupied faculty lines, has made real progress. We were 28 faculty when I started, and we are 32 now. I am delighted that the addition to our ranks of Steve Ealick, Rick Cerione, John Marohn, and Brian Crane occurred during my term, but we have many more positions to fill if, while filling vacancies opened by retirements, we are to reach a steady-state size of near 37. It always helps in faculty searches to have attractive positions to offer. The department is extremely grateful to Robert Laughlin, who established in 1999 the Frank and Robert Laughlin Chair of Physical Chemistry.

Although much has changed during my term, our department is strong primarily because of what does not change, a dedication to purpose and a goodwill in the department toward serving that purpose. I am particularly indebted to our executive director Earl Peters, whose wisdom and long-term service to the department have helped guide my decisions during the past years. I am also appreciative for strong assistance from Barry Carpenter, the head of our curriculum and teaching committee, and from Barbara Baird, our director of graduate studies. In the end however, we play a small role as individuals. It is the robust support from alumni and friends as well as the hard work and collegiality of faculty and staff that have made our department a welcoming place to work and a premier center for research and teaching.

Malignant Cell *(continued from page 4)*

"Cdc42 has to traffic specific proteins—among the thousands of different proteins that are essential for cell growth—and it now appears this all has to happen in synchrony with a number of other signaling events activated by Cdc42," Cerione explained. "This requires that Cdc42 talks to multiple targets, sending signals that influence cell shape as well as genetic activity in the nucleus. In effect, Cdc42 is like the conductor of an elaborate symphony, making certain that diverse cellular activities all occur with a precise timing and coordination.

"The problem is that when Cdc42 becomes hyperactive and gives the full-speed-ahead signal, you no longer have carefully regulated shape changes and there is a loss of cell growth control, thus yielding the hallmarks of cancer cells."

Cerione noted, "We're not saying that Cdc42 is the only or even primary perpetrator—the problem often starts with mutated Ras genes—but given the essential role of Cdc42 in Ras-induced malignant transformation, the identification of the critical cellular targets for Cdc42 will give us new possibilities for intervention."

CU/Weill *(continued from page 5)*

Harold Craighead, director of the Nanobiotechnology Center (NBTC), a national science and technology center at Cornell. The professor of applied and engineering physics is involved in collaborative projects on new molecular species for microfabrication and cell growth and in developing the use of microfabrication in biology.

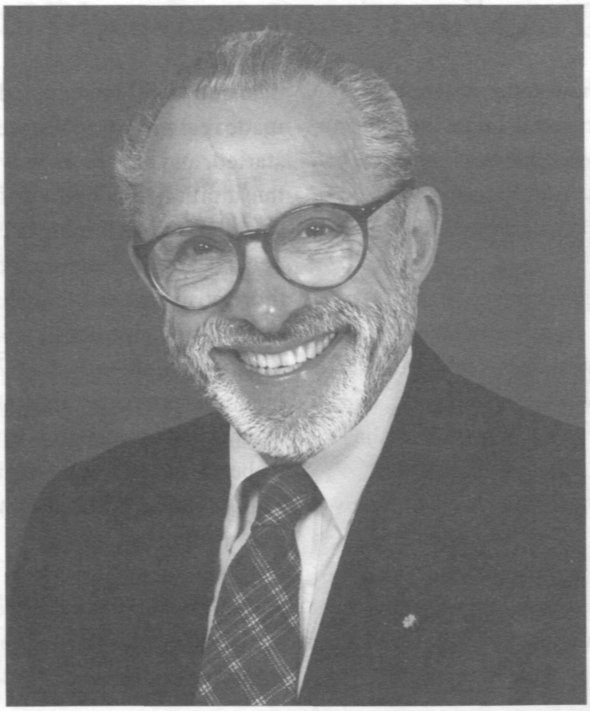
More than 20 faculty members from each of the institutions played a role in developing the program. Some initial steps have already been taken, including a multi-institutional scientific seminar on chemical biology hosted by Rockefeller. A second seminar on computational biology was held July 22 at Cornell's Ithaca campus. Joint recruitment is also under way for specialists in bioinformatics.

The joint faculty recruitments will occur over the next 5 to 10 years. These joint appointees will have full faculty privileges at each of the partner institutions. Visiting investigator programs and enhanced telecommunications links will facilitate collaborations among investigators based in Ithaca and Manhattan. In addition, plans are being developed for a shared graduate program.

The partner institutions will create core facilities for fundamental technologies such as high-performance computing, physical analysis of molecular structure, light and electron microscopy, DNA sequencing and other tools for genetic analysis, and the broad range of chemical techniques that are applied to biology. One aspect of the partnership will be its group governance by the leaders of each institution. Laboratory space also will be shared.

The partner institutions have undertaken previous successful collaborations. In 1991, for example, they created a tri-institutional M.D.-Ph.D. program funded through the National Institutes of Health that is one of the most highly rated training programs in the country.

Earl Peters Retires



Almost. After 24 or so years in his current position as executive director in the Department of Chemistry and Chemical Biology and its predecessor Department of Chemistry, and a total of 28 years at Cornell University, Earl will retire on June 30, 2001. His connection with the department will not totally cease at that time; for a few years we will have his services available as needed to work on special projects, particularly in the area of alumni relations. His main "postparting" activity, after playing with the grandchildren and their trains, and unless something more interesting comes along, will involve deacquisitioning stuff to make space in the garage for cars.

Don Brown Retires after 34 Years

On March 31, 2000, the Department of Chemistry and Chemical Biology held a retirement party for Don Brown. Don came to the Chemistry Department in 1966 and has seen many evolutions of the department—in its people, structure of its buildings, and its name.

After serving time in the navy, Don was hired to work as a stockkeeper in the stockroom, which was then housed in the basement of Baker Laboratory (where Laboratory Services is currently located). A year later, the Spencer T. Olin Laboratory addition was built and the Stockroom was moved to room G-75 where it remains. Don began working under the guidance of John Piscopo, who, Don jokes, "taught me everything I know. . . so you see, it's not my fault!"

Don has befriended many students, postdoctoral associates, staff, and faculty throughout his 34 years here. When asked what his fondest memory of the department is, he answers without hesitation, "the people." While these people are sad that he will no longer be a daily appearance with package deliveries and smiles, they are also happy to know that his retirement will bring him much joy.

Don's future plans are centered on a new grandson, Noah Lyn Brown. When Don can coax Noah away from shopping with his grandmother, Minta, he plans to do a lot of fishing with him.

Don Brown with his wife, Minta (center), and daughter Melinda (left).

Don leaves the department with kind thoughts for all: "I want to say thank you for letting me be a part of your lives. . . . I have been truly blessed in my life because of the wonderful people that I have met in the chemistry community." We feel the same, Don!

Spring 2001 Frank and Robert Laughlin Visiting Professor of Physical Chemistry Lectures

The Frank and Robert Laughlin Visiting Professorship is now in its second year. The 2001 lecturer will be **Henk Lekkerkerker.** Lekkerkerker, von 't Hoff professor of physical chemistry University of Utrecht, the Netherlands, received his Ph.D. from the University of Calgary in 1971. From 1974 to 1985, Dr. Lekkerkerker held professorial positions at the Free University of Brussels. In 1985 he moved to the University of Utrecht, where in 1999 he became the vice dean of faculty in chemistry and from 1998-2000 he served as the scientific director of the Debye Institute.
Dr. Lekkerkerker's current research includes the study of the liquid crystal phase behavior of suspensions of rod-like and plate-like colloids, the study of the phase behavior of mixed colloidal systems, and the study of interfaces in phase-separated colloid polymer suspensions.

Dr. Lekkerkerker's many honors and awards include the Izaak Walton Killam Memorial Fellowship at the University of Calgary, 1969–71; the Bourke Medal, Faraday Division of the Royal Society of Chemistry, 1993; president of the European Colloid and Interface Society, 1995–96; election to the Royal Netherlands Academy of Arts and Sciences in 1996; the Onsager Medal of the University of Trondheim in 1999; the Eli Burnstein Lecturer of the University of Pennsylvania, 2001; and the Laughlin Visiting Professorship.

The overall title for this lecture series is *The Phase Science of Simple Fluids, Colloids, and Proteins* with individual lectures on March 6: *When is a Liquid?;* March 8: *Hard Problems with Hard Spheres;* March 13: *Gentle Force of Entropy Connects Disciplines;* March 15: *Shape Matters.*

Spring 2001 Franz and Elisabeth Roessler Lectures

In April 2001, Klaus Möbius, from the Free University of Berlin, will visit the department to deliver the 2001 series of Roessler Lectures entitled *Millimeter and Submillimeter High-Field EPR on Bioorganic Systems—The FU Berlin Approach; Structure and Dynamics of Cofactors in Primary Photosynthesis—What Do We Learn from High-Field/High-Frequency EPR and ENDOR?; and Light-Induced Proton Transfer Characteristics of Bacteriorhodopsin—A Site-Specific Spin-Label/High-Field EPR Study.*

The lectures are named in honor of an endowment by the family of Franz Roessler, a German chemist who emigrated to the United States in 1882 to found the Roessler and Hasslacher Chemical Company. The company became part of DuPont in 1930. Roessler's son, Hans, was a student in Cornell's Department of Chemistry in the early years of the century. Roessler family endowments support a named professorship in the Department of Chemistry and Chemical Biology as well as lecture visits by prominent German chemists.

Dr. Möbius received his Ph.D. in physics from the Free University of Berlin in 1965, was a research assistant and associate, then professor from 1971 until the present. He has served the Free University of Berlin as vice dean from 1991 to 92 and dean from 1992 to 93.

He has received several awards and honors, including the Max-Planck Research Award, 1992; the International Zavoisky Award, 1994; the Philip-Morris Research Award, 1996; the AMPERE Award of the European Groupement AMPERE 1998; the Roessler Lectures; and has been an invited scholar at the Tohoku University in Sendai, Japan, in 2001.

Spring 2001 Aggarwal Lectures

This series of lectures, inaugurated in 1995, is funded by the late Sundar L. Aggarwal, Ph.D. '49. Aggarwal, who retired as vice president and director of GenCorp research division in 1988, was an industry consultant who received industry awards and published articles on and received patents for synthetic rubbers, block polymers, and composites. He was a fellow of the Institute of Materials Science and a member of the American Chemical Society, the Directors of Industrial Research, and the Industrial Research Institute.

Professor Mitsuo Sawamoto from Kyoto University will deliver the Spring 2001 Aggarwal Lecture Series. Sawamoto's research centers on novel polymerization reactions, in particular, living and precision polymerizations, that provide polymers of well-defined architectures, molecular weights, and functionalities; new polymerization catalysts and initiating systems; the chemistry of polymerization intermidates (carbocations and radicals); and the precision synthesis of new macromolecules, such as block, end-functionalized, star, and amphiphilic polymers.

Lectures are scheduled for May 21, 22, and 23, titled "Metal-Catalyzed Living Radical Polymerizations towards Precision Polymer Synthesis," "Lewis Acid-Catalyzed Living Cationic Polymerizations Towards Precision Polymer Synthesis," and "Precision Polymer Synthesis via Living Polymerizations," respectively. The first two lectures will take place as part of the Cornell Center for Materials Research Polymer Outreach Program (POP) Symposium. POP is collaborative research programs between Cornell faculty groups and scientists in industry. For more information see the POP web site at www.ccmr.cornell.edu/pop/.

Geoffrey Coates Awarded Packard Fellowship for Young Researchers

David Brand, Cornell News Service

Geoffrey Coates, an assistant professor of chemistry and chemical biology, has been awarded a David and Lucile Packard Foundation Fellowship for Science and Engineering, designed to support young researchers.

The fellowship will support research in Coates' laboratory directed toward the discovery of catalysts for the synthesis of biodegradable polymers from biorenewable resources, such as carbon dioxide.

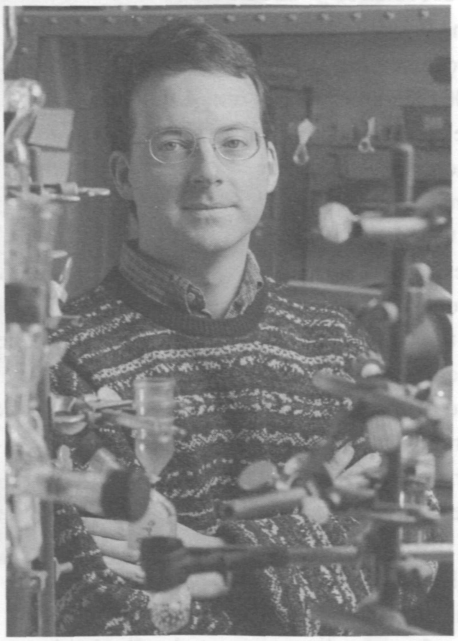
Each year the Packard Foundation invites 50 universities to submit two nominations each, and from this list the foundation awards 24 fellowships.

Coates earned a doctoral degree in organic chemistry from Stanford University in 1994. He joined the Cornell faculty in 1997, after postdoctoral studies at the California Institute of Technology.

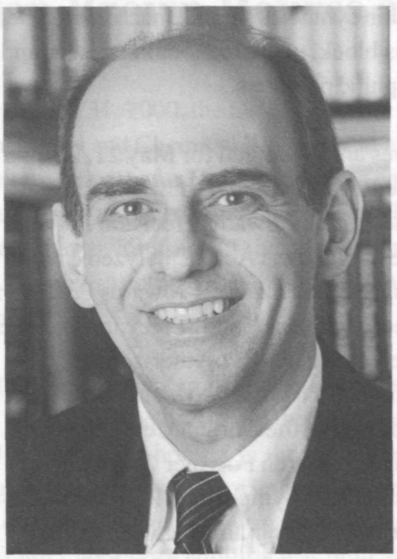
In 1999 he was selected by *Technology Review* magazine as one of 100 young innovators under the age of 35 "who exemplify the spirit of innovation in science, technology, business, and the arts."

Coates also received a four-year, $328,000 Faculty Early Career Development Program grant last year from the National Science Foundation.

The David and Lucile Packard Foundation was created in 1964 by David Packard and Lucile Salter Packard. In 1988 the foundation established the Packard Fellowships for Science and Engineering to allow the nation's most promising young professors to pursue their science and engineering research with few funding restrictions. The fellowships are aimed at researchers working in areas that are not generously funded by government and other agencies.



John Reis Photography



John Reis Photography

Bruce Ganem Named Clark Professor of Entrepreneurship and Personal Enterprise

Cornell News Service

The J. Thomas Clark Professorships of Entrepreneurship and Personal Enterprise, three-year appointments for 2000–2003, foster participation in Cornell's universitywide Entrepreneurship and Personal Enterprise Program (EPE) by providing funding for faculty members throughout the university to develop new courses or engage in research in the areas of new business creation, innovation and development. J. Thomas Clark '63, MBA '64, and Nancy Williams Clark '62, M.Ed. '64, created the Clark Endowment in 1993, and since that time 10 professors from across the curriculum have held Clark professorships.

Bruce Ganem was elected to a second term as a Clark professor. He will continue developing courses and projects involving entrepreneurship in the sciences. Courses will include Entrepreneurship in Chemical Enterprise and Scientific Issues in Corporate Entrepreneurship. In addition, Ganem hopes to offer one or more symposia on entrepreneurship in the sciences that are of broad interest to EPE, Cornell, and the local community.

Ganem's research at Cornell has focused on the use of organic synthesis, structure-based drug design, and protein engineering to study biological pathways. Recent studies in his lab on the biosythesis of phenylalanine have revealed key features about the production and regulation of this important amino acid, which is a global commodity used in the manufacture of Nutrasweet. Ganem's lab also is involved in the synthesis of chemically functionalized silicon surfaces for diagnostic and therapeutic technologies.

Ganem has been an A. P. Sloan Foundation fellow and a J. S. Guggenheim fellow. His awards include the Dreyfus Teacher-Scholar Award, the Clark Teaching award, and the 1999 Chemical Manufacturers' *Catalyst* Award. He consults for major pharmaceutical companies and serves on the scientific advisory boards of several biotechnology companies. Ganem obtained his Ph.D. degree at Columbia University and has taught at Cornell since 1974.

Frank DiSalvo Named Director of Materials Research Center

David Brand, Cornell News Service

Francis (Frank) DiSalvo has been named director of the Cornell Center for Materials Research (CCMR), one of 29 such national centers supported by the National Science Foundation (NSF). DiSalvo has agreed to serve for five years.

DiSalvo, the John A. Newman Professor of Physical Sciences at Cornell since 1996, succeeds Neil Ashcroft, the Horace White Professor of Physics, who has held the post for the past three years. Ashcroft, who is returning to research and teaching, said of DiSalvo: "He is a very distinguished physical chemist with broad and far-sighted interests in materials research and with a strong background in industry."

The CCMR is an interdisciplinary research center funded by the NSF's Materials Research Science and Engineering Centers Program. The center reports directly to the office of the Cornell vice provost for research, and its membership spans the College of Arts and Sciences and the College of Engineering. "We can foresee several developments in the years ahead for CCMR," said DiSalvo. "First, we want to expand our support base. We hope that CCMR will become an umbrella organization for different collaborative materials research programs. Presently our major sources of support are the NSF and the university." But, he said, the NSF is limited in the support it can provide for all of CCMR's interdisciplinary research or new research that is envisioned for the near future. "Second, we are expanding our very successful educational outreach program and initiating a much expanded industrial outreach program with the help of generous state support. Third, we continue to aim to be the best nationally and internationally at what we do: materials research."

DiSalvo received his B.S. in physics from the Massachusetts Institute of Technology in 1966 and his Ph.D. in applied physics from Stanford University in 1971, after which he joined the research staff at AT&T Bell Laboratories (now Lucent Technologies), where he later headed several research departments. In 1986 he moved to Cornell's chemistry department (now the Department of Chemistry and Chemical Biology), teaching freshman chemistry for engineers (a course in scientific literacy for nonscientists), senior-level inorganic chemistry, and a graduate course in solid state chemistry. He currently is teaching a junior-level laboratory course in instrumental analysis.

In 1991 DiSalvo was awarded the American Physical Society International Prize for New Materials and was elected to the National Academy of Sciences. He is a fellow of the American Academy of Arts and Sciences. He has published more than 300 scientific articles and holds eight patents.

The main goal of the new director's research has been the discovery and understanding of new chemical and physical phenomena in solids. Particular research emphasis is on the synthesis of novel compounds and the subsequent characterization of their structural, thermal, electrical, and magnetic properties. Compound types extensively examined include chalcogenides, oxides and more recently nitrides, structurally low-dimensional phases, metal cluster phases, and intermetallic compounds. Phenomena of interest have included thermoelectric cooling, intercalation reactions, reversible reactions for battery cathodes, and structural phase transitions.

John Reis Photography

Recently the NSF renewed the CCMR's funding, awarding the center $19.9 million over five years.

Nobelist Hoffmann gets Hirschfelder Prize

David Brand, Cornell News Service

Roald Hoffmann has been named the 2000–2001 winner of the Joseph O. Hirschfelder Prize in UW-Madison Theoretical Chemistry.

The Hirschfelder Prize is the largest in the field of theoretical chemistry and is awarded annually by the Theoretical Chemistry Institute. It carries a stipend of $10,000.

Hoffmann is the Frank H. T. Rhodes Professor of Humane Letters and Professor of Chemistry at Cornell University. Hoffmann has made enormous contributions to theoretical chemistry, especially with regard to the geometry and reactivity of organic and inorganic molecules and of infinitely extended structures. He is the author or co-author of more than 450 scientific articles and two books.

Hoffmann is also a writer of scholarly and popular articles on science and other subjects.

The Hirschfelder Prize is named after the late Joseph O. Hirschfelder, the founder of the UW-Madison Theoretical Chemistry Institute and an influential force in modern theoretical chemistry.

Hoffmann and a Stanford Colleague Find *Oxygen* Has a Life of Its Own

Franklin Crawford, Cornell News Service

Edited slightly to update performance information

Combine the literary talents of two renowned chemists with a passion for theater and the result is *Oxygen*, a two-act play by Carl Djerassi and Roald Hoffmann that is set for six performances at the San Diego Repertory Theatre April 2–7. Directed by Bryan Bevell, *Oxygen* is a fully staged professional production.

Hoffmann, a Nobel laureate in chemistry and the Frank H. T. Rhodes Professor of Humane Letters at Cornell, and Djerassi, professor of chemistry at Stanford University, best known as developer of the oral contraceptive pill, describe *Oxygen* as "a play about priority and competition in science and the moral consequences of these...about the discovery of oxygen and revolutions, chemical and political...and it is about the Nobel Prize."

Oxygen alternates between 1777 and the year 2001 when the Nobel Foundation decides to begin awarding a "retro-Nobel" for those great discoveries that preceded the establishment of the Nobel prizes 100 years before. Foundation members think the task will be a simple matter of reaching back to a period when science was done for science's sake, when discovery was pure and unalloyed by controversy and hype. But the plot thickens when the French chemist Antoine Laurent Lavoisier is forwarded as a candidate. Lavoisier seems a shoo-in: the father of modern chemistry, he is credited with the discovery of oxygen. But did he really discover oxygen? Or was it Joseph Priestley, the English Unitarian minister? Or was it the Swedish apothecary Carl Wilhelm Scheele? And what do their wives have to say about it all?

Beyond their impressive scientific credentials, both men are noted for their literary endeavors. Hoffmann is the author of three books of poetry and three books of nonfiction; Djerassi has published five novels and a short story collection in a genre he calls "science-in-fiction." He also has written an autobiography and more recently embarked on writing a trilogy of plays, the first of which (*An Immaculate Misconception*) was broadcast in May 2000 as "Play of the Week" by BBC World Service.

Oxygen evolved from discussions between Hoffmann and Djerassi about a fascinating historical coincidence: In 1774, Priestley was a guest in Lavoisier's home, and the English minister described how he had made oxygen. At approximately the same time, Lavoisier received news of a similar discovery from Scheele. But Priestley and Scheele did not know what they had discovered and Lavoisier seized the day.

San Diego Repertory Theatre
At the Lyceum, 79 Horton Plaza

Box Office 619-544-1000

Performances

Monday, April 2	8:00 pm
Tuesday, April 3	5:00 and 8:30 pm
Wednesday, April 4	5:00 and 8:30 pm
Thursday, April 5	8:00 pm
Friday, April 6	8:00 pm (Sold out)
Saturday, April 7	8:00 pm

Hoffmann and Djerassi take the facts and run with them, bringing all three men and their wives together, at the invitation of King Gustav III, to Stockholm in 1777. The rest is pure theater as the play shifts between the eighteenth-century characters, their science, politics and ambitions, and the Nobel committee's twenty-first-century arguments.

The playwrights collaborated on *Oxygen* for nine days in August 1999 at Djerassi's London summer flat and for a week at Cornell. Subsequent drafts and revisions have been a long-distance affair.

The San Diego production follows a May 2000 production at the Eureka Theatre Company in San Francisco, and staged, rehearsed readings given December 1999 and February 2000 respectively in San Francisco (ODC Theatre) and London (Tricycle Theatre). The play also received an earlier reading by faculty at Ithaca College. These events served as workshops and provided vital feedback, said Hoffmann.

"Science is inherently dramatic ..." write the authors in a paper about their collaboration, "... because it deals with the new and unexpected...but can "science-in-theatre" also fulfill an effective pedagogic function on the stage or are pedagogy and drama antithetical?"

Aye, there's the rub. Plays of ideas, particularly scientific ideas, are a rare though not entirely ignored genre, the authors explain. Successful productions of Tom Stoppard's *Arcadia* and currently on Broadway, Michael Frayn's *Copenhagen*, are proof that science and scientific plays can indeed hold their own in the footlights—as long as the human element shares center stage.

Djerassi and Hoffmann have labored to ensure that audiences who attend *Oxygen* are entertained as well as edified. Aside from the San Diego production, there will be stagings of *Oxygen* in London, France, and Germany in 2001. Wiley/VCH will also publish the script in book form in April of this year.

Commencement 2000

Forty-six new bachelor's degree recipients convened in Baker 200 with members of the faculty, friends, and family for the Department of Chemistry and Chemical Biology's diploma presentation on Sunday, May 28. The departmental ceremony and reception followed the 132nd all-university commencement at Schoellkopf Stadium.

The new graduates were presented their diplomas by Professor and Chair Paul Houston who spoke on "Satisfaction."

January Graduates

Michael Edward Niver, Lauren Gabrielle Lamb

May Graduates

Sarunya Bangsaruntip, Aimee Marguerite Baumann, Mara Kate Brandsdorfer, Hyun Bok Cho, Susan Emily Crown, Jai Ruhi Damle, Nicholas Andrew Darling, Allan Antonio Dias, Adis J. Diaz, William Phillip Fletcher, Evaldas Giedrimas, Jason Gregorio, Byron Kig Hon, Melanie Ann Iwamoto, David Matthew Jenkins, Noah Charles Kanter, David Brian Kastrinsky, Christina Tara Khan, Jeffrey Hall Kozlow, Naveen Kumar, Sonja Lamberson, Cappi C. Lay, Thomas Michael Lento, Jesse Mischa McFarland, Keyur Jagdish Mehta, Daniel Mirman, Tim Mitin, Nansen Ng, Chuck Dinh Nguyen, Patrick Francis Noonan, Robert Stephen Saley, Sung Bin Sin, Barbara Joy Sit, Catherine Abigail Skibo, Scott James Stanat, Amar Jitendra Thosani, Greg Sukit Vanichkachorn, Aguru Watanabe, Renee Pui San Wong, Sam Wei-Lung Wu, Shih-Hao Yeh, Hong Yin, Juan Zurita

August Graduate

Robin Michael Chan

Class of 2001

Graduating with Honors

Summa Cum Laude

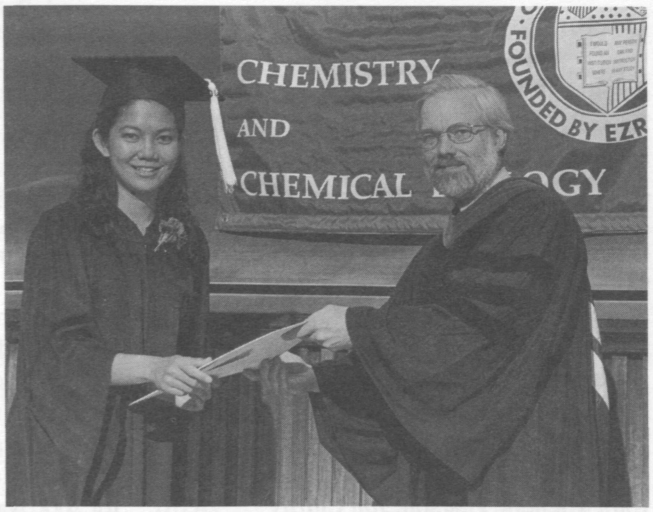
Sarunya Bangsaruntip and David Matthew Jenkins

Magna Cum Laude

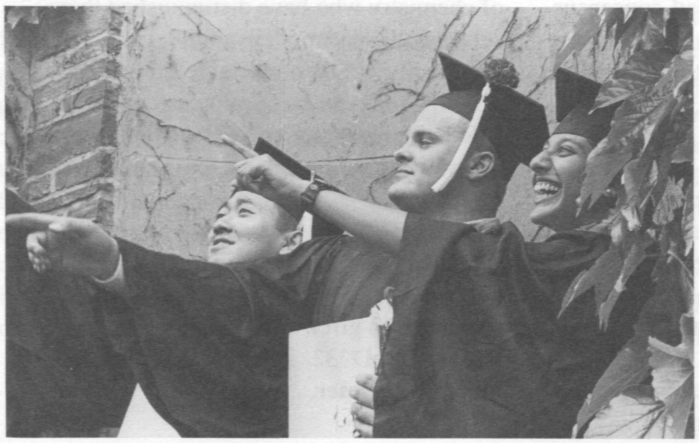
David Brian Kastrinsky

Cum Laude

Aimee Marguerite Baumann, Hyun Bok Cho, Nicholas Andrew Darling, William Phillip Fletcher, Tim Mitin, and Barbara Joy Sit



Summa cum laude graduate Sarunya Bangsaruntip receives her diploma from Paul Houston.



Onward and upward!

Photos by John Reis Photography

Undergraduate Awards

The Leo and Berdie Mandelkern Prize was established in 1991 with a gift from Leo Mandelkern, AB '42, PhD '49, and his wife, Berdie, and is awarded annually to an outstanding student of the senior class majoring in chemistry who will go on to graduate study in chemistry or biochemistry. The 2000 recipient, **Sarunya Bangsaruntip,** is planning to attend Stanford University.

The George C. Caldwell Prize was established in 1913 with a gift from Mrs. Grace Caldwell Chamberlain and Professor Frank Caldwell and is awarded annually to two senior chemistry majors shown general excellence. The 2000 recipients were **Susan Emily Crown** and **David Matthew Jenkins.**

The Hypercube Scholar Award for Scholastic Excellence in Chemistry, consisting of a certificate and copy of HyperChem software, was established in 1998 by Hypercube Inc. It is given to a graduating senior who has shown excellence in courses and research and who has shown an interest in chemical molecular modeling. The 2000 recipient was **David Brian Kastrinsky.**

The American Institute of Chemists Medal is presented to an outstanding graduating senior who has a demonstrated record of leadership, ability, character, and scholastic achievement. The 2000 recipient was **Aimee Marguerite Baumann.**

The Merck Index Award, which consists of a Merck Index with the name of the recipient imprinted in gold, is given by Merck & Co., Inc., and presented to two outstanding chemistry majors in the senior class. The 2000 recipients were **Nicholas Andrew Darling** and **Tim Mitin.**

The Harold Adlard Lovenberg Prize was established in 1939 with a gift from Mr. Oscar R. Lovenberg and is awarded annually to a member of the junior class with a major in chemistry who has shown general excellence. The 2000 recipient was **Pakorn Kanchanawong.**

The ACS Analytical Prize is awarded to a student in the College of Arts and Sciences who has completed the third year of undergraduate study and who displays interest in and aptitude for a career in analytical chemistry. The recipient, **Brian English,** receives an 8-month (16 issues) subscription to *Analytical Chemistry.*

The CRC Press Chemistry Achievement Award is presented to two sophomore chemistry majors who do outstanding work in organic chemistry courses 357–358 or 359–360. The 2000 recipients were **Yelena Koldobskaya** and **Joshua Ladau.**

The A. W. Laubengayer Prize was established in 1966 with a gift from former students and colleagues of Professor Laubengayer and is awarded annually to an outstanding student in each of the introductory chemistry courses 103, 207, and 215. The 2000 recipients, all in their freshman year, were **Allison Friedman, Nieraj Jain,** and **Gavin Slitt.**

Graduate Diplomas and Awards

Doctorates in the Field of Chemistry

August 1999
Einar K. Fridriksson, *Barbara Baird* (Adviser)
Maggie A. Hupcey, *Chris Ober*
Erika F. Merschrod, *Roald Hoffmann*
Jay Clark Molstad, *Frank DiSalvo*
Garegin A. Papoian, *Roald Hoffmann*
Colleen K. Van Pelt, *J. Thomas Brenna*
Shu Yang, *Chris Ober*

January 2000
Laurie Irene Hill, *Frank DiSalvo*
Thomas S. Hughes, *Barry Carpenter*
Yingbo Li, *Bruce Ganem*
Kara Michelle Pearson, *Jon Clardy*
Sotiris Pentidis, *Roger Loring*
Paul Stephan Pyenta, *Barbara Baird*
LeGrande M. Slaughter, *Pete Wolczanski*
Min Wu, *Tadhg Begley*

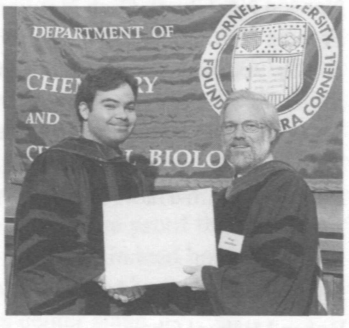
May 2000
John J. Bellizzi III, *Jon Clardy*
Yuan-Hon Kiang, *Stephen Lee*
Cynthia L. Kinsland, *Tadhg Begley*
Hans Ulrich Stauffer, *H. Floyd Davis*

The DuPont Teaching Prizes are awarded annually to teaching assistants who have demonstrated excellence in teaching a desire to upgrade the quality of undergraduate education. Graduate students who received the prize for 2000 were **Sean Breslin, Matt Cremeens, Boaz Ilan, Jon Schroden, Erick Strauss,** and **David Moore.**

The Richard Evans Prize is awarded when faculty and students from introductory chemistry courses reach a broad consensus that there is a teaching associate who meets the high standards of service to the students set by the late Richard Evans. The honoree for 2000 was **Jane Walcott.**

The Howard Neal Wachter Prize is awarded annually to a promising graduate student in physical chemistry who has demonstrated a potential to contribute to the profession. The 2000 recipient was **Ryan Williams.**

The Tunis Wentink Prize is awarded annually to outstanding graduate students in any area of chemistry who have distinguished themselves both academically and in the quality and quantity of their research. Prize winners present their research findings at a symposium held in the spring. The 2000 recipients were **Sean Brady, Ming Cheng,** and **Hans Stauffer.**



PhD graduate John J. Bellizzi, III, receives his diploma from Paul Houston.

The Robert W. Work Award is presented annually to a graduate student in the field of polymer or fiber chemistry and is made possible by a gift from Cornell alumnus Robert W. Work, PhD '32. The 2000 recipient was **Marc W. Weimer.**

News From Alumni and Friends

Thanks to all of you who returned the survey in Newsletter 72. As you can see, we received quite a bit of alumni news! Read on to see what your classmates are doing. (More to follow in the next newsletter).

1930s

Joseph H. Brant, PhD '35, has been retired since 1970. He holds a Callaway Chair in the Textile Engineering School at Georgia Tech, following retirement. He has resided at Tryon Estates retirement facilities in Columbia, N.C., since June 1992. He says he's "old, but in good health!"

Paul T. Clark, BChem '34, celebrated his sixtieth wedding anniversary on June 23, 2000. He took his family to Bermuda for the occasion and is staying active.

John R. Macdonald, BChem '39: "In 1939 went into Steel Mill Control Chem. Labs, then on to Production Planning and Control for total 43 years Steel Mills; Jones & Laughlin Steel Corp, Aliquippa, Pa. two years, 1939–41; A. M. Byers Co., Ambridge, Pa., 1941–60; Phoenix Steel Corp., Phoenixville, Pa., 1960–83 (retired). Night school—Carnegie Tech and University of Pittsburgh noncredit metallurgy. Business management courses at Geneva College, Beaver Falls, Pa. (credit); statistics and introductory computers, Ursinus College, Collegeville, Pa. (credit). On retirement in 1983 went into seasonal income tax preparation business—still at it half-time, seasonal."

Francis B. Rosevear, BA '33, MA '35, PhD '37: "Retired for a quarter century. Still: Scoutmaster, saxophone in concert band, oboe/English horn in orchestra. Attended sixty-fifth reunion of Class of '33. (Wife, Ruth [Fisher], '36 in chemistry, an active nutrition consultant.)"

Robert B. Secor, BChem '36: "Filtrol Corp. produced the first zeolitic silica/alumina petroleum cracking catalyst used commercially in a 'fluid' cracking unit. Use of this type of catalyst, instead of the mineral and gel type silica/aluminas used previously, led to extensive patent litigation. Other Cornell chemists and chemical engineers were involved with me on both sides of these legal disputes in the 1960s."

Elizabeth F. Washburn, AB '36: "No chemical news. Moved from Vestal, N.Y., to Charlotte about 10 years ago to be near my sister and her family. Keep busy with stamp collecting, genealogy, and reading (mostly nonfiction-nature, conservation, biking, mountain climbers, 'whodunits,' etc.—and of course C&E News!)."

1940s

Frances P. Coffin, MS '48, PhD '51: "Worked for Lewis Lab (now Glenn), NASA, Cleveland, 1951–73. In retirement have been involved in financial services, most heavily in taxes—recently (since '83) on a volunteer basis."

Rudolph D. Deanin, AB '41: "The Plastics Academy has just elected me to the Hall of Fame."

Robert L. Horton, BA '47, PhD '50, is publishing a historical novel titled *As We Look Back*. "It is based on the personal experiences of myself and my family."

Marie P. Kautsky, BA '46, is retired from the University of Colorado Medical School as senior instructor in ob-gyn. She did research in steroid hormones.

Leo Mandelkern, BA '42, PhD '49, has been selected to receive a Herman F. Mark Polymer Chemistry Award given by the Division of Polymer Chemistry of the American Chemical Society. The award is given in recognition of his outstanding achievements in research and leadership in polymer science. Dr. Mandelkern is R. O. Lawton Distinguished Professor of Chemistry, Emeritus, at Florida State University, Tallahassee, Fla.

1950s

Phillip Adams, PhD '50: "As my consulting business has dried up, I am contemplating retirement. I hate to give up 50 years of knowledge of synthetic organic chemistry and process development, but that's life. My wife and I visit our grandchildren in the Boston area and watch them grow up. I still maintain contact with Ed Whiting (Weinstein) PhD '50 and Irv Berstein PhD '51. During the past years, I have seen Ted Taylor PhD '50, Jim Bohrer '50, Bob Horton '51, Lew Feistandig '49. I had spent most of my career with Millmaster Onyx, a custom organic manufacturer, mainly as R/D director and member of corporate operating committee."

Peter B. Bloom, BA '58, MD: "Since leaving Cornell upon graduation I received my MD from the University of Pennsylvania School of Medicine in 1962. I am now clinical professor of psychiatry at the University of Pennsylvania School of Medicine where I teach on a voluntary basis while conducting my private practice of psychiatry for almost 30 years. I am continually grateful for my foundation in chemistry received at Cornell, which has benefited me throughout my entire career."

Ellis R. Glazier, BA '51: "I am now teaching an intensive course about writing scientific papers in English for *Scientists* here in Mexico. I travel to the requesting institution and give a week's course. Thoroughly enjoyable experience."

Richard A. Haggard, AB '58, PhD '65: "I help record chemistry books for the blind and dyslexic—a side benefit being that I can keep up with current texts on the undergraduate level, and they are impressive in breadth and depth these years. A little tutoring in chemistry and physics helps keep in touch with high school students, with also an eye toward 'recruiting' for Cornell, along with usual secondary school contacts in general with talented seniors."

Donald N. Robinson, AB '55, PhD Minnesota '59: "During my career as research chemist, I authored 10 patents in the areas of curable ethylene/propylene elastomers, poly vinylidene fluoride membranes, vinylidene fluoride copolymers and adhesives. I retired in 1996 after a 37-year career as a research chemist and chemistry professor. I volunteer as an organist and pianist at our church and at nursing homes. At Cornell, I did an honors research project on the preparation of perfluoroallene under the direction of Prof. William Miller in 1954–55. Prof. Miller was an excellent adviser."

1960s

David N. Armentrout, PhD '65: "I am still happily making ion exchange resins at the Dow Chemical Co. in Midland, Mich."

Robert E. Filner, BA '63, PhD 72, was recently renominated for his fifth term as the Democratic candidate for congress from California's 50th District in San Diego. He has served in congress since 1992.

Kathleen A. Gaffney, BA '65, MD Cornell '69, MPH Harvard '71: "My public health career has included Ithaca 1973–79 as Tompkins County health commissioner where I learned Cornell was a major polluter and behind in water treatment and waste disposal technology in spite of the knowledge on campus. I was pleased to live next door to Prof. Charles Wilcox and keep in touch at Reunion now. But he was the first person at Cornell who took a personal interest in me as a student and later an NSF student researcher. I know how hard he worked to modernize the labs for students and address hazardous materials exposure and disposal. My career has taken me to Oregon and now to Nassau County, but my years at Baker are fond memories."

David S. Kliger, PhD '69: "After a brief job to the East from Ithaca to Boston, I left the East Coast to move to Santa Cruz, California, in 1971 and have been here ever since. Since that time I have been a faculty member in the Department of Chemistry and Biochemistry at the University of California, Santa Cruz and for the last 10 years have also served as dean of the Natural Sciences Division here. Santa Cruz is like Ithaca in that we have a university at the top of a hill overlooking the town and a big body of water—only our "lake," the Pacific Ocean, is a lot bigger than Cayuga. Our winters are also slightly milder and we don't have to rely on the college newspaper to see the Sun each day. Santa Cruz is a great place to live and the university is a great place to work. I've moved my research over the years from chemical physics to biophysics but still use techniques of time-resolved spectroscopy, with polarized as well as unpolarized light, that Andy Albrecht sparked my interest in at Cornell."

Neil Lark, PhD '60, "retired in 1999 as professor and chair of the Physics Department at University of the Pacific. During his 37 years at UOP his interests evolved from nuclear chemistry to nuclear physics to astronomy to astronomy education. He held visiting research positions in Amsterdam, Copenhagen, Canberra, Hawaii, Brookhaven, Los Alamos, Livermore, and Berkeley."

Simon J. Leach, visiting scientist 1965–65, 1976–77, 1981, with Prof. Harold Scheraga: "Awarded Medal of the Order of Australia for "Services to Science," in particular in protein chemistry June 2000."

Gordon B. Robinson, PhD '64: "Bernhard Baruch School—MBA courses in law, marketing, and finance; Mobil Oil/Chemical Corp.—research, venture management (up to 1967), merchant banking in New York City, Houston, and Toronto—1967 to present. Mainly involved in creation of new businesses, performing corporate audits to determine communication efficiencies and defects with all publics."

John C. Shelton, PhD '64: "Retired as professor of chemistry from California State University, Hayward, in 1997. I am now enjoying my other profession as an AKC dog judge."

1970s

Rafael G. Aviles, postdoc with Prof. Paul Houston 1979–80: "I am celebrating my twentieth anniversary with Rohm and Haas. Recently named manager of the Computational Technologies Section of the Analytical and Computational Technology Center. I lead a group of scientists and research fellows in areas such as molecular modeling, computational chemistry, computer simulations, statistics, design of experiments, and laboratory instrument automation and robotics. Got married last July. My wife, Blanca Martinez, has a PhD (organic chemistry) from Spain. She works in the Agricultural Products Discovery department at Rohm and Haas."

Mina K. Dulcan BA '70, MD: "Osterman Professor of Child Psychiatry, Northwestern University Medical School Children's Memorial Hospital; editor-in-chief *Journal of the American Academy of Child and Adolescent Psychiatry*."

Norman G. ("Gary") Howell, MS, PhD '76: "After 17 years in R&D Procter & Gamble and six years as business development and marketing executive with Great American Financial Resources (formerly American Annuity Group), Gary has begun a business development consulting practice named Kinetic Mind Rescues. Current clients include a small analytical instrument manufacturer and a mid-sized, high-technology engineered coating firm that specializes in aerospace applications. Gary and his wife, Melanie (who is president of the nonprofit organization Abstinence Educators' Network), have three sons: Adam, an Internet graphic designer; Alex, a ninth grader; and Steven, a seventh grader."

Allen W. Nicholson, BA '75: "I am presently a full professor in the Department of Biological Sciences at Wayne State University. My research program is focused on ribonuclease mechanisms and ribonuclease involvement in post-transcriptional gene regulation. I am editing a *Methods in Enzymology* volume on ribonucleases. I am pleased to say that Harold Scheraga has graciously agreed to write a chapter for the volume. I had the pleasure of taking his Biopolymers course, spring 1975."

Scott A. Reines, M.D., PhD '73, appeared in a full-page photo in March Annual Report 1999 (Merck Research Laboratories) "for anyone who wants to see what I look like now!"

Susan D. Roberts, BA '70: "After graduation, I worked for 10 years doing environmental analytical work for Pacific Environmental Laboratory in San Francisco. After the birth of our first daughter, my husband, Dick, and I moved to north central Washington and built our lodge, which we have been operating since December 1991. I continued to work as a chemist part-time, consulting for N. A. Degerstrom Inc. in Spokane, doing heavy metals analyses and process development until the mid-1990s. These days my only chemistry is in the kitchen of the lodge."

Dennis P. Strommen, PhD '71: "I continue to be chairman of the Chemistry Department at ISU but plan on stepping down in two years. Ten years as chairman is enough for anyone. I also ran into Bill Morrison, PhD '71, in San Francisco where we drank a lot of wine. On a sad note, my wife, Carol, passed away on March 23, 1998."

Simon "Skip" Ulmer, PhD '72: "In 1998 'retired' from 26 years in corporate America—Dupont and Johns Manville—to form my own consulting group specializing in strategic planning, marketing, new product development, and leadership."

1980s

Robert Hamers, PhD '86, and **Jeanne Hamers**, PhD '88: "Bob Hamers received a John Simon Guggenheim Fellowship for research in Molecular Electronics. Bob will be on sabbatical from the University of Wisconsin, Madison during the 2000–2001 academic year. Bob, Jeanne, and their children, Laurel (eight) and Kaitlyn (three), will spend a few

months at Oxford University and also plan to visit China. Bob also received a Kellett Mid-Career Award from the University of Wisconsin, Madison."

Stephen R. Hammes, BChem '85: "I completed my MD and PhD at Duke University in 1992. I met my wonderful wife (Shawn) six months before leaving North Carolina for San Francisco. She came with me and we were married shortly afterward. I completed my internship and residency at UCSF where I met Bruce Ganem's brother Don, and went on to complete my fellowship training in endocrinology in 1999. My wife, myself, and our two children, Noah and Emma, now live in Dallas, Texas. I am an assistant professor of medicine at the University of Texas Southwestern Medical School where I do mainly basic science research. My wife, Shawn, works in the Clinical Trials office at UTSW."

Jamin Huang, PhD '80: "After 18 years in the agrichemical discovery area (as active chemist, then project leader/group leader) with three different companies (Union Carbide, Rhône-Poulenc, and now Aventis, all through merger or acquisition), I have moved to the opposite end of the R&D process as registration manager in the Regulatory Affairs Department. Training in Prof. Meinwald's group prepared me to be flexible and versatile."

Ronald D. Icenogle, PhD '81, has been accepted as a full member of the international writers' organization P.E.N. (short for "Poets, Essayists, Novelists") based on his having "demonstrated work of substantial literary value." P.E.N. was founded in 1921 by D. H. Lawrence, Joseph Conrad, John Galsworthy, Clara Dawson Scott, and George Bernard Shaw to promote friendship and intellectual cooperation among writers worldwide, regardless of their political, religious, or philosophical views. It also fights to protect freedom of expression and to defend writers suffering from oppressive regimes, including working for the release of writers around the world who are prisoners of conscience. Ron's literary work includes his 1996 nonfiction work *Science and Moral Choice: An Examination of the Foundations of Moral Philosophy* (St. Louis: Green). This book presents a compelling argument for how small yet profound changes in traditional ethical thought can resolve the apparent conflicts between science and ethics. (A description of the book is available at http://members.aol.com/ricenogle/smc.html.)

David T. Kim, BA '84: "MD from University of Pennsylvania 1988, board certified in emergency medicine. Wife's name is Susan; children Zachary (six) and Ethan (two)."

Michael P. Nancollas, AB '81, has now been in full-time practice (orthopaedic/hand surgery) for nine years.

Robert Toreki, AB '87: "In May I left my faculty position in the Department of Chemistry at the University of Kentucky to pursue my Internet company, Interactive Learning Paradigms, Inc. (ILPI). ILPI specializes in custom web-based training solutions in all areas, with an emphasis on environmental health and safety. Come check us out at www.ilpi.com."

1990s

Dana C. Buske, AB '95, received her PhD in organic chemistry from MIT in May 2000.

Louis G. Hom, BA '93, PhD '99, Department of Molecular and Cell Biology, University of California, Berkeley (adviser: Loy Volkman). Currently a postdoc with Kim Janda in the Chemistry Department at the Scripps Research Institute."

Kathy Liu, AB '92: "I am finishing up my fifth year of teaching high school chemistry at the Walnut Hill School (seventh year overall in teaching!). The school is an independent school that offers students intense training in the arts (music, theater, dance, creative writing, and visual arts). It is always a challenge to make connections between my students' lives, arts, and chemistry, but I love working at this school! At this point, I cannot imagine doing anything other than teaching. Cornell remains a big part of my life: I live with two Cornell friends. I am active in the Cornell Club of Boston and have many Cornell friends in the Boston area."

Jonathan Zisk, PhD '94: "Teaching high school has been at once glorious, thankless, enriching, and exhausting. I cannot imagine greater challenge and satisfaction—except possibly trying to be a good father."

In Memoriam

Jeanne Polak-Recht: "It is with regret that I must inform you of the death of my husband, **Dr. Howard Leonard Recht**, on the twenty-eighth of February 2000. He was born in Pittsburgh on July 16, 1927, the oldest of two children of Nathan Ralph Recht and Rose Cohen Recht. He was formerly married to the late Louise Kaufman. In addition to [me] he is survived by four children: Marcia Schneider, R.N.N.P. of Northridge, California; Sarah Glaser of Chicago, Illinois; Natalie Recht of Sunnyvale, California; and Dr. Michael Recht of San Diego, California, as well as eight grandchildren—Gerald, Robert, Yehuda, Mendl, Schneur, Litsa, Yosef, and Schmuel. He is also survived by his sister, Dr. Audrey Recht, of New York. My husband received his bachelor of science degree from Carnegie Tech in 1948 and his doctorate in physical chemistry from Cornell University in 1951. He was awarded several patents while working as a scientist for North American Rockwell for 30 years in California in his specialties of water purification and fuel cell technology. He was a member of Sigma XI Honorary, the American Physical Society, the American Chemical Society, the Electrochemical Society, the New York Academy of Sciences, and Phi Sigma Phi. In addition, he was a fellow of the American Association for the Advancement of Science. He devoted his professional life to the study of water purification as well as fuel cell technology. Besides his many scientific achievements, he was active in civic affairs, serving as president of the San Fernando Valley Symphony Orchestra. He was respected for his vast knowledge and collection of music. He had also served on the board of directors of the America United for Separation of Church and State. All who knew him will miss him greatly."

Marsha Scherago: "My husband, **Earl J. Scherago** '49, passed away May 8, 2000."

On Friday, June 9, the Department of Chemistry and Chemical Biology hosted an open house for returning alumni and friends in the faculty lounge of Baker Laboratory.

The tables in the lounge were filled with memorabilia to reminisce over and refreshments to replenish energy for walking around campus.

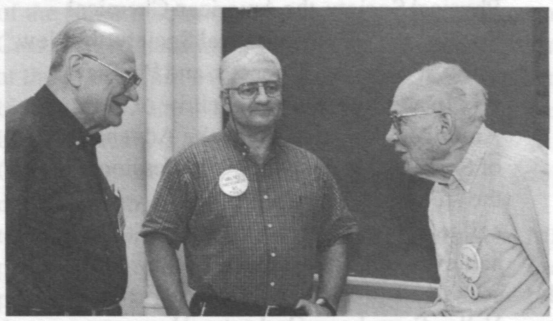
Ronald Wharton, AB '85, his fiancee, and Professor McLafferty

Gloria Welt Sage, AB '57, Martin Sage, AB '55, and Professor Scheraga

Sue Degerstrom Roberts, AB '70

Ralph, PhD '62, and Margaret, MS '61, Miano discover memorabilia they contributed to the department.

Al Blomquist, AB '55 and Leonard Ladin, AB '55



Professor Scheraga, Walter Gadkowski, AB '65, and Ellison Taylor, BChem '35

Photos by John Reis Photography

2001 Reunion
Open House
Friday, June 8, 1:30–3:00 pm
125A Baker Laboratory

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