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The Center for the Study of Complex Structures

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The five initiators of the Center for the Study of Complex Structures (from left): Professors Walter Klemperer, Jeffrey Moore, Stephen Sligar, James Lisy, and John Gerlt.

Professor Stan Smith Appointed to Murchison-Mallory Chair

The inaugural holder of the Murchison-Mallory Chair in General Chemistry is Stanley Smith, Professor of Chemistry and Chemical Education. Professor Smith is a world renowned creator of chemistry software used in thousands of schools for teaching general and organic chemistry courses. At the U. of I. the chemistry software is available on about 100 PCs in the Chemistry Learning Center and networked throughout the campus. It replaces 1/3 to 1/2 the laboratory instruction in beginning chemistry courses, serves as a tutorial for remedial courses and furnishes electronic homework for introductory organic chemistry courses.

Professor Stan Smith

Smith has led the evolution from analog videodisc to digital CD-ROM, reducing instructional costs by allowing laboratory simulations to use full motion video with complete student interaction directly in the classroom with only a computer.

Professor Smith's work has received wide recognition. He received the Learning Periodical Group Award for the Best Microcomputer Software of the year in 1983, the EDUCOM/ENCRIPTAL Best Tutorial Software award in 1987 and the award for the Best Integrated and Best Chemistry Software in 1989. He also received the Chemical Manufacturing

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The Center for the Study of Complex Structures

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In an unprecedented move that will lead chemical sciences in to the twenty-first century, the School of Chemical Sciences at the University of Illinois has established a Center for Complex Structures to meet critical challenges in the quest for molecular understanding of complex biological and chemical processes. Elucidating highly complex structures for the ultimate understanding of molecular and cellular function has required a realignment of disciplinary boundaries to enhance access to more modern NMR and X-ray capabilities. At the same time, the unique opportunities in materials chemistry provided by breakthroughs on a number of fronts demand that we advance available instrumentation for determination of the structure and dynamics of innovative chemical compounds.

Regardless of their disciplinary affiliation, scientists studying complex structures recognize that they share many problems and use similar tools and techniques requiring the most advanced NMR spectrometers and X-ray diffractometers. The range of complex structures is very wide, including, for instance, macromolecules, both biopolymers and well-defined syntheticoligomers, mesoscale assemblies, new molecular architectures, covering a broad range of size scales, ordered and partially ordered states of condensed matter, including extended solids where connectivity extends from one end to the other of a macroscopic object. An example of a mesoscale assembly is shown in Figure 1.

The Center for Complex Structures will provide an umbrella for two interdisciplinary programs already in place, the Biomolecular Chemistry and Materials Chemistry Programs. The new Center will be the physical focus of the movement towards interdisciplinary research and education and has already fostered the creation of new courses such as a practical course in X-ray crystallography. It is expected that the Center will play a key role in graduate education since personnel are extensively involved in training students to operate instrumentation as well as teaching the fundamentals necessary for interpretation of research results. As such, the Center will be a hands-on facility designed to familiarize students with the most advanced instrumentation available.

The new Chemical and Life Sciences Laboratory has a 1600 sq. ft. space designated for part of the Center for Complex Structures which will accommodate the high-field 750 MHz NMR spectrometer, a generous gift to the school provided by the Keck Foundation (see sidebar) with support from the Provost (Vice Chancellor for Academic Affairs). Further funding has been made available through the 3M Foundation to renovate the X-ray laboratory and create a new Materials Chemistry Laboratory. Renovations will improve lab safety, add new instrumentation, facilitate sample handling, provide a controlled laboratory environment, enhance data transfer capabilities and modernize computational and conference space.

We are very fortunate to have received funds from the National Science Foundation to help support the purchase of a state-of-the-art X-ray diffractometer which will increase the rate of data collection so that collection times even on structures with large unit cell dimensions can be recorded in only 6-12 hours. Funds from NIH and vendors, including Varian and Oxford, have amplified university resources in NMR and will help us to obtain additional funds by demonstrating our past accomplishments and future plans.

To provide specific examples of the types of problems to be addressed by the new NMR and X-ray crystallography instrumentation, we have included a few descriptions of ongoing research projects that have reached the limits of current instrumental capabilities. Professor Klemperer is interested in developing low temperature chemical routes to advanced ceramic materials for integration into semiconductor devices. This involves monitoring the evolution of extremely complex oxide structures as the materials are processed. Barium dititanate, for example, can be identified in the solid state by its characteristic seven-line ^{17}O NMR spectrum but only when high magnetic fields are employed (see Figure 2). The new 500 MHz wide-bore solid state NMR spectrometer will be an essential tool for investigating the processing of this and other dielectric and ferroelectric oxide materials.

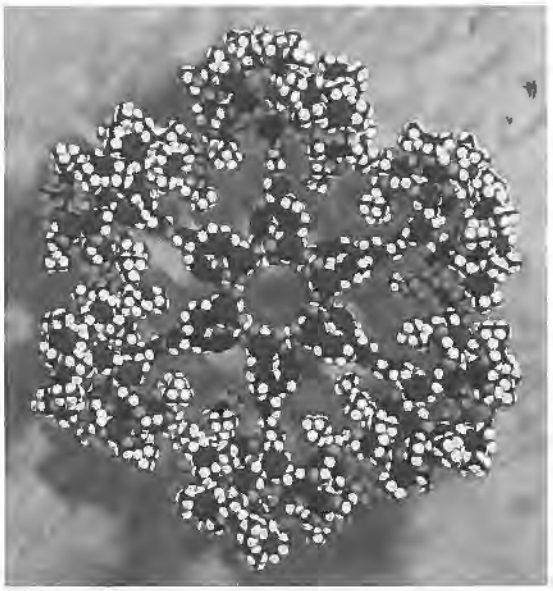


Figure 1. Self-Assembling Dendrimers • Shows that hydrogen bond-mediated self organization can be used to form mesomolecular dendritic assemblies with high stabilities and discrete structures. A molecular modeling study of one of the largest aggregates showed roughly a disk shape with a 2-nm thickness and a 9-nm diameter.

Professor Zimmerman's studies of the solution of aggregates of dendritic macromolecules, shown in Figure 1, will benefit from small angle X-ray scattering (SAXS) measurements for structure verification and investigation of the kinetics of aggregation. Today, size exclusion chromatography suggests the presence of discrete aggregates of dendritic macomolecules of about 100 diameters. The new X-ray instrumentation will make it possible to characterize aggregate size and shape. Kinetics of aggregation processes are completely unknown but current evidence suggests that time scales are amenable to analysis by proposed SAXS instrumentation.

Professor Zukoski of Chemical Engineering is interested in the effects of flow on the microstructure of particles in the 1-20 nm size region. Previous studies have linked changes in packing to large changes in the suspension's mechanical properties. In dilute suspensions, the SAXS instrumentation will provide information about the size and shape of the particles of interest. While in dense suspensions, information will be gained about how particles pack. Understanding how particles rearrange during flow is one of the key goals of the research to be undertaken with the new SAX capabilities. Professor Sligar will utilize the SAXS instrumentation to answer fundamental questions in macromolecule molecular recognition and the synthesis

and assembly of mesoscale biological systems.

At this time, the Center for Complex Structures is a research infrastructure. Critical to advancement of the investigative mission of the School is the recruitment of outstanding faculty, post-doctoral fellows and graduate assistants. We are fortunate that a portion of the 3M contribution will be available for graduate fellowships for students who are interested in the Materials Chemistry Program. In order to make interdisciplinary studies available for interested students and postdoctoral fellows, we are seeking additional external support. A named fellowship for either graduate or postgraduate studies would give additional substance to the program.

The School of Chemical Sciences at the University of Illinois has had a long-standing tradition of excellence in the establishment of centralized facilities. The creation of the new Center, building upon this past, provides the needed infrastructure to lead chemical sciences into the 21st century. The Center for Complex Structures will foster the instruction and research mission of this campus at the highest level, helping to keep the University of Illinois at the forefront of education and scientific achievements.

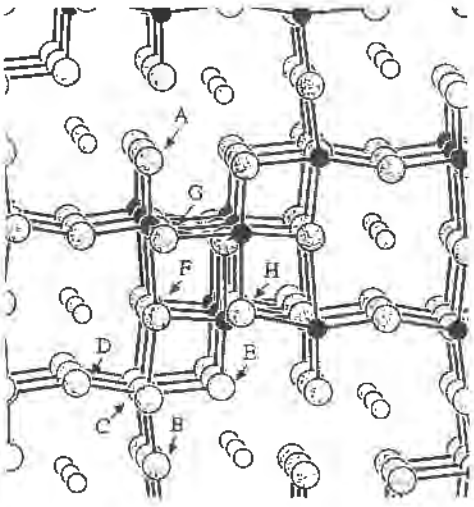


Figure 2. Resolution of ^{17}O NMR Resonances of Barium Dititanate • Shows that barium dititanate contains eight types of structurally distinct oxygens labeled A-H above. At high magnetic fields, seven of the eight $TaTi_2O_5$ solid state ^{17}O NMR resonances can be resolved.

The Keck Grant

The University of Illinois has received a $725,000 grant from the W.M. Keck Foundation of Los Angeles to help purchase state-of-the-art instrumentation for the School of Chemical Sciences' new chemical and biological research center.

The grant will go toward the purchase of a $1.8 million, 750 megahertz nuclear magnetic resonance (NMR) spectrometer, an instrument used to study the dynamics of complex structures such as proteins and nucleic acids.

The spectrometer will be housed in the U. of I.'s Chemical and Life Sciences Building. The instrument will be the focal point of the Center for Complex Structures that will apply advanced NMR and X-ray technology to the study of molecular and cellular functions.

"The Keck grant was clearly the enabling piece that allowed us to reach state-of-the-art instrumentation for the center," said Stephen G. Sligar, Director of the School of Chemical Sciences. "It was an absolutely critical component."

According to Sligar, the center's technology will encourage the removal of traditional barriers between the disciplines of chemistry, biochemistry, chemical engineering, and molecular and cell biology.

Examples of the types of research that the center will pursue include:

- The study of solid state and solution structures of critical biological and synthetic macromolecules;
- Investigation of the structure and intermolecular interactions in multicomponent biological systems, such as those involved in gene expression, energy transduction, intercellular signaling and cell division;
- Examination of protein structures by solid-state NMR and X-ray methods.

The spectrometer will be installed in July, with the dedication of the Center for Complex Structures planned for September. More than 300 graduate students and postdoctoral fellows at the School of Chemical Sciences use NMR instrumentation for their research.

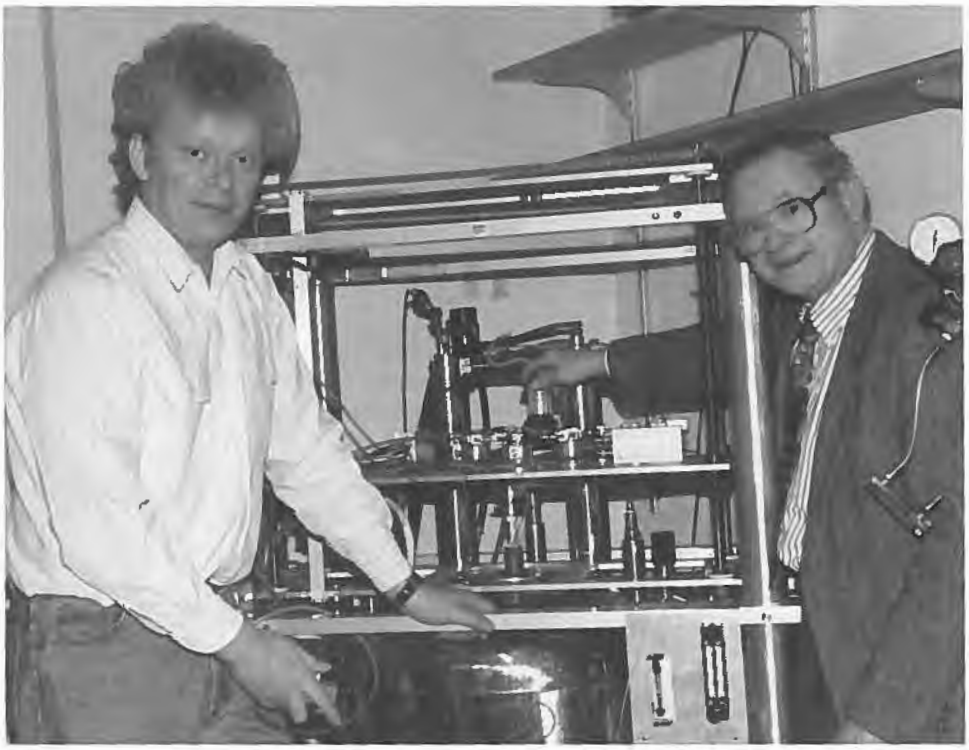
Sligar praised the work of his colleague James M. Lisy in preparing much of the detailed information that went into the grant proposal. "He was indispensable," Sligar said. Lisy is a professor of chemistry and chair of the School's Service Facilities Committee.

The School of Chemical Sciences, which comprises the departments of biochemistry, chemistry and chemical engineering, recently created two new research programs, biomolecular chemistry and materials chemistry, to allow students to work with faculty throughout the School regardless of departmental boundaries.

The W.M. Keck Foundation, one of the largest charitable foundations in the United States, was established in 1954 by the late William Myron Keck, founder of the Superior Oil Co. The foundation's grants focus on research in science, engineering and medicine.

Electron Paramagnetic Resonance Lab Advances Research Activities World Wide

At the entrance of this interdisciplinary laboratory hangs a world map with pins indicating locations of current collaborators. They range over almost all the continents, with the highest concentration throughout the United States. The Illinois EPR Research Center at Urbana is supported in large part by the National Institutes of Health, which has designated it as a national Biomedical Technologies Research Resource. It was established in 1985 as part of the Biomedical Technologies Area, a national program in the NIH National Center for Research Resources. The laboratory was established in 1985 to support research, especially that of biomedical significance, throughout the country, to develop new techniques and new instrumentation for that mission, and to document and disseminate information on new electron paramagnetic resonance (EPR or ESR) research results and techniques to researchers world wide.



Drs. Smirnov on Left and Belford on Right Demonstrate the 100 GHz EPR Spectrometer.

Under the directorship of Linn Belford, Professor of Chemistry and Medicine, the laboratory offers a variety of instruments at different frequencies, utilizing the magnetic properties of unpaired electrons to examine the characteristics of their environments. With EPR techniques the electron becomes "a chemical spy" that can report on structural and dynamic properties of its environment and distances between sites where the electrons are located. The sites can be organic or inorganic radicals, metal ions, or unpaired electrons in solids. The laboratory's many studies of free radicals have been important to the biomedical community for several reasons. Free radicals can be dangerous to human health because of their ease in attacking chemical bonds. Many of us take "anti-oxidant" vitamins in an effort to limit the resulting damage. Paradoxically, some radical species can themselves be antioxidants that protect against harmful radicals. EPR spectroscopy is extremely sensitive; it can detect minute concentrations of radicals and also microscopic amounts of oxygen or nitric oxide, which are paramagnetic "essential molecules of life."

As Prof. Belford and the Center's associate director, Prof. Peter Debrunner, explain, the laboratory collaborates in several projects aimed at discovering relationships between structure and function in proteins (e.g., metalloenzymes). The laboratory s high-frequency EPR spectrometers, NMR-EPR double-resonance spectrometers, and pulsed EPR capabilities help researchers examine the local structures at active sites of enzymes utilizing the unpaired electrons in metal ions as the chemical spies.

With the growing use of magnetic resonance imaging (MRI) as a medical diagnostic technique, the laboratory has conducted studies of different contrast agents (paramagnetic MRI "dyes") to evaluate their effectiveness in enhancing the medically interesting aspects of the images. Other studies evaluate the dangers posed by the possible toxicity of contrast agents. As laboratory codirector Robert Clarkson, Professor of medicine, bioengineering, and veterinary clinical medicine points out, these studies have led to a

Smith

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Association Catalyst Award in 1987 and the IBM EDUCOM Louis Robinson award in 1992.

In accepting the appointment, Professor Smith said, "I simply represent the many people who have contributed to the current high level of success of the teaching program in chemistry....I hope that this Chair benefits everyone in the (Chemistry) Department with special emphasis on those who teach in general chemistry."

In announcing the appointment, Professor Paul Bohn, Head of the Chemistry Department, reminded his colleagues of "Stan's long-time dedication to the instructional enterprise here, his many innovations in computer-aided instruction, and the degree of professionalism he brings to all of his activities in Chemistry. He is a richly deserving and appropriate honoree."

clearer understanding of the mechanisms by which contrast agents work and already have helped to guide the synthesis of superior products. The laboratory manager, Dr. Alex Smirnov, describes some other health-connected studies of the Center. For example, studies for pharmaceutical companies have provided insight into how drug delivery systems work and how ethanol affects biological membranes.

Core Research

In addition to collaborative research and service, the laboratory also conducts core research of particular interest to its own faculty and staff. For instance, Prof. Clarkson has been conducting studies stemming from his long-standing interest in coal, which is a family of very complex carbonaceous structures. Clarkson has identified a special component of an Illinois coal as having the potential for important medical applications. The component, an organic carbonaceous material known as fusinite, can be used to measure oxygen or nitric oxide levels in microorganisms or animal (including human) tissue. Fusinite, and tailored synthetic substitutes that are being developed in the laboratory, can enhance EPR imaging and can make it possible to map out the distribution of oxygen or nitric oxide in subjects, including living tissue. Scientists can place fusinite or its synthetic counterparts in living cells and use it to monitor oxygen and nitric oxide metabolism. Using this technique, they can monitor physiological changes in a single living cell. In the future, cardiologists may be able to use fusinite-like materials to check for the effect of oxygen deprivation on the heart and surrounding tissues as a way to help decide whether coronary bypass surgery will work.

Some of these studies are possible at the ... sary to work with very small samples or at very low concentrations and where multiple chemical species or molecular environments coexist. In the Illinois laboratory, spectroscopy can be done on ... scrutiny and projects are under increasing pressure to prove their value to the nation, the laboratory staff take great pride in the fact that not only is the Center in its eleventh year of operation under continu-

Campanelli Joins the Biochemistry Department

James Campanelli

Looking out the window at the whirling snow and ice, it was difficult to understand how Jim Campanelli could have chosen to leave Stanford, where he has lived since 1980, and take a position at the University of Illinois. However, the invitation of the Markey Foundation Initiative plus the strengths of the U. of I. in the neurosciences overcame our weather related deficiencies. Campanelli spent the last 16 years in California, moving there as an undergraduate, and later receiving his Ph.D. and postdoctoral training at Stanford University.

Campanelli is a neurobiologist, interested in the molecular aspects of the nervous system. Specifically, his area of interest is the molecular aspects of synapse formation, which bridges the fields of biochemistry, developmental biology, and neuroscience. He has been studying the synapse between motor neurons and the spinal cord in rats or rat tissue cultures. The question he is investigating is how the protein expressed by the cell causes the receptors to cluster on muscle cells and how that cluster is maintained.

His organism of choice is the rat because the organs are larger than in mice and therefore more convenient for investigation. The rat is a vertebrate and findings from his studies may be applicable to other vertebrates. Also, the protein expressed by the cell has similarities to dystrophin, the protein that causes Duchaine and Becker muscular dystrophy in humans and may provide important insights into these devastating diseases.

Campanelli is very grateful for the generous start-up package he received from the Markey Foundation Initiative. The start up grant has assumed increasing importance as the search for research grants has become ever more difficult and a young researcher needs resources in order to establish his research program.

In addition, he was lured by the strong tradition of interdepartmental research he noted at the U. of I. especially in the neurosciences, in the departments of Physiology, Cell and Structural Biology and Biochemistry. He enjoys his colleagues and the one graduate student who has already joined his laboratory. He is very impressed with the facilities of the Beckman Institute and is looking forward to extensive interactions with the wide range of scientists who are associated with the U. of I.

Faculty Research

Pressure Tuning Spectroscopy

Harry G. Drickamer, Professor Emeritus of Chemical Engineering, Chemistry and Physics is a world renowned pioneer in the use of high pressure to study molecular and electronic phenomena, a field of research he has pursued since the early '50s. The basic concept of his work is "pressure tuning spectroscopy".

The optical, electrical, magnetic, and chemical properties of materials, collectively their electronic properties, depend on the interactions of the outer electrons on the atoms, ions, or molecules which make up the material. These electrons can be described as existing in atomic or molecular orbitals of different size and shape. Therefore, their energies are perturbed to different degrees by compression. From these perturbations, Drickamer has been able to extract information about electronic and vibrational properties and molecular interactions.

He has characterized electronic states, excitations and interactions. He has shown that one can vary bulk properties continuously over large ranges at constant temperature and discontinuously at phase transitions. He has been able to establish, often unequivocally, the relationship between bulk and molecular properties if one measures a molecular property in the same medium over the same range. He has also demonstrated that one can measure the effect of pressure on the optical properties (absorption and emission) of ions or molecules in glasses, polymers, or intercalates, and to compare the effects with pressure studies of the same molecules in crystals to characterize the amorphous environments.

Drickamer has used pressure tuning spectroscopy to test theories concerning chemical and physical phenomena, such as ligand field theory. Another major function of pressure tuning has been the transformation of materials to new ground states, such as insulator to metal transitions, in a series of elements and compounds. In this article we will demonstrate the range of Drickamer's research with two examples, the first of which is a transformation of heavy alkali metals into transition metals through the use of high pressure.

Ligand Field Theory and Heavy Alkali Metals

The electronic orbitals of angular momentum two (the d orbitals) consist of two orbitals with electron density concentrated along the x,y,z axes, and three with the electron density concentrated between the axes, as shown in Figure 1. In the transition metals (e.g. Fe, Co, Ni, etc.) these orbitals are only partially filled with electrons. In a free atom or ion, all the d electrons have the same energy, but, as pointed out by Bethe long ago, in a crystal lattice there is a relative increase in the energy of the electrons in orbitals pointing toward the atom or ions of the lattice. This idea is the basis of ligand field theory and the active field of coordinate chemistry.

Pressure studies provided an early test of Bethe's prediction that, if the ions are treated as point charges, the splitting of ds and dp orbitals should increase as R^{-5} (R = ligand-transition ion distance), while for point dipoles, the splitting should increase as R^{-6}. From optical and x-ray studies under pressure for NiO, a cubic lattice, it was shown that the effect is ~ R^{-6}. Since this early research, there have been extensive studies of changes in spin state, oxidation state, coordination and geometry of complexes under pressure.

In an isolated atom or molecule, the electrons exist in a series of discrete energy levels. In a crystal, because of interactions between electrons, a better description involves bands of closely spaced allowed levels separated by energy gaps. Here we

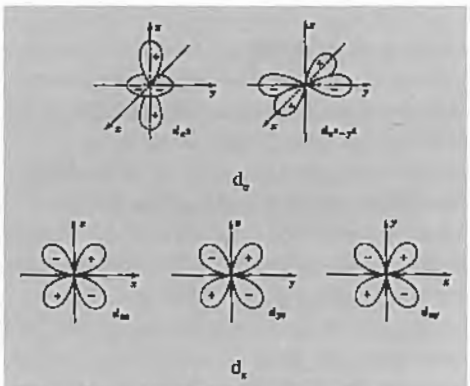


Figure 1. The Atomic d Orbitals (Orbitals of Angular Momentum Two) • The line of ds orbitals have their electron density concentrated along the x, y,and z axes. The electron density associated with the dp orbitals is concentrated between the axes.

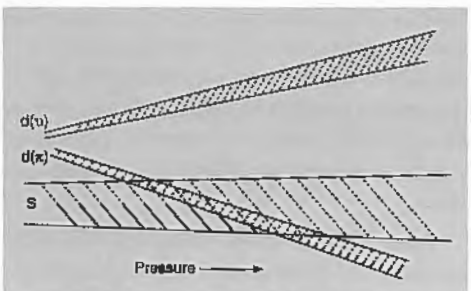


Figure 2. Relative Energies of Energy Bands Arising from Atomic Level s, ds and dp Orbitals as a Function of Pressure • Within each band, the solid diagonal lines represent the filled levels while the dashed lines indicate empty levels available for electrical conduction.

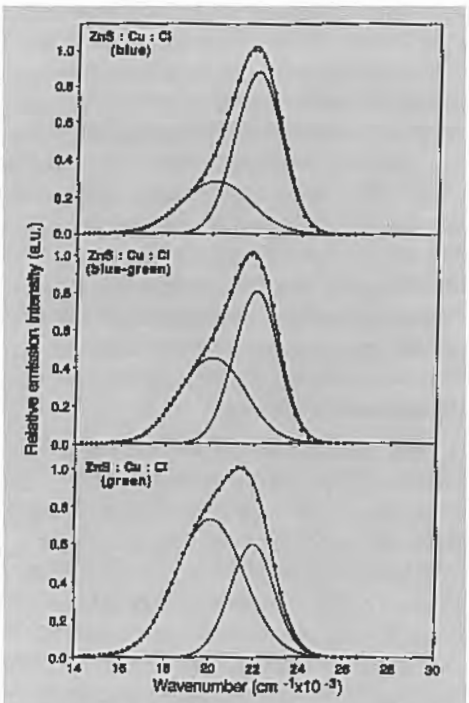


Figure 3. Emission Spectra from Three Samples • The blue emission from the Cl^- donor to the Zn(a) acceptor is at ~ 22,500 cm^{-1}. The green emission (from Cl^- to the Cu^+ acceptor is at ~ 20,000 cm^{-1}.

discuss an interesting case involving the heavy alkali metals, Cs, Rb, and K. These all have a single valence electron in an orbital of spherical symmetry. The conduction band is made up of these s electrons. For almost all metals, the resistivity decreases with pressure (~30%-40% in 100 kbar) because the vibrational amplitude of the electrons decreases. Experiments by Bridgman showed that the resistivity of Cs increased rapidly with pressure, exhibited a cusp near 40 kbars and then decreased somewhat. Much later Drickamer found similar cusps at considerably higher pressures for Rb and K.

There is an empty d band a little above the conduction band in Cs, considerably higher in Rb and higher yet in K. The centers of energy of the s and d bands increase with pressure approximately in parallel. At one atmosphere, the splitting between the ds and dp orbitals is small but the compressibilities are such that for Cs the ligand field increases by a factor of ~ 7 in 100 kbars. The corresponding increases for Rb and K are about 5.5 and 4.5.

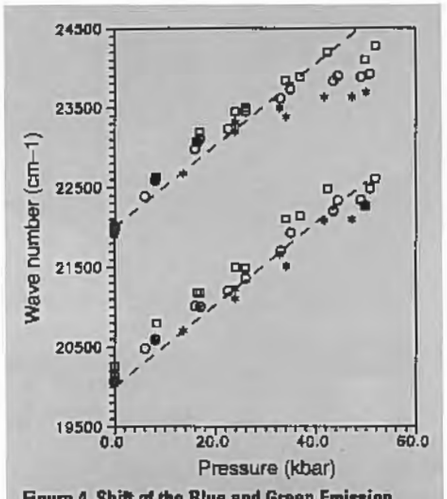


Figure 4. Shift of the Blue and Green Emission Peaks with Pressure • The shift of the blue and green emission peaks with pressure is essentially identical for all these materials with different degrees of doping. The dashed line shows the change of the energy difference between the highest filled band and the lowest empty band in ZnS. The emission energies increase in direct proportion to the change in the ZnS host material.

As shown in Figure 2, within each band, the solid diagonal lines represent the filled levels while the dashed lines indicate empty levels available for electrical conduction. As a consequence of the compression, the s band and dπ band mix and cross at some level of pressure. The scattering between the bands accounts for the cusp, and, at higher pressures, the alkali metals become transition metals—an example of high pressure alchemy.

The Colors on TV Screens and Monitors

The second example is from recent studies by Drickamer showing how materials give different colors, as seen on TV screens and computer monitors. The colors are due to luminescence of inorganic crystals with appropriate dopants. In this experiment the materials give blue, blue-green and green colors. The base crystal is ZnS, a colorless material with a structure similar to Si, Ge, GaAs, diamond, etc. The dopants are Cu^+ and Cl^-. In all cases, the ratio Cl^-/Cu^+ is about seven. To balance the charge, extra Zn(o) vacancies appear in the lattice.

The initial energy gap between the top of the valence band and bottom of the conduction band is 29,000 cm^{-1} (in the UV). Drickamer excited electrons across this gap with a UV laser. In a TV screen it is done via an electrical potential. The electrons travel through the lattice until they reach a Cl^- whose wave function overlaps a zinc vacancy Zn(o) or a Cu^+, or until they are trapped and lose their energy thermally. The $Cl^-\rightarrow Zn(o)$ emission is blue, while the $Cl^-\rightarrow Cu^+$ emission is green.

Figure 3 shows emission spectra from three samples. The blue emission from the Cl^- donor to the Zn(o) acceptor is at ~ 22,500 cm^{-1}. The green emission from Cl^- to the Cu^+ acceptor is at 20,000 cm^{-1}. The top part of the Figure shows the case where blue predominates and the bottom part of the Figure shows the situation where green predominates. Because of the "natural" presence of Zn vacancies, at low dopant concentration the blue emission dominates while at higher dopant levels one sees predominantly green light. Because the human eye is more sensitive to green than to blue, a person would see the bottom spectrum as green even with a substantial amount of blue present.

Harry G. Drickamer

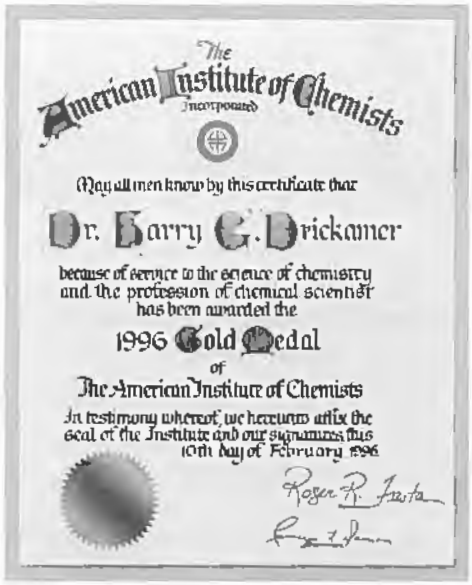
With increasing pressure, the energy difference between the top of the valence band (the highest filled band) and the bottom of the conduction band (the lowest empty band) increases by 52 cm^{-1} per kbar. As Figure 4 shows, both the $Cl^-\rightarrow Zn(o)$ and Cl^- to Cu^+ emissions shift to higher energies at exactly the same rate. The squares, circles and stars in the figure represent samples with different degrees of doping. The dashed line shows the change in the energy difference between the highest filled band and the lowest empty band in ZnS. The emission energies clearly increase in direct proportion to this change in the ZnS host material. In semiconductor parlance, the donors are "pinned" to the conduction band and the acceptors are "pinned" to the valence band. By 40 kbar the $Cl^-\rightarrow Zn(o)$ emission has moved into the violet region of the spectrum, nearly in the UV, while the $Cl^-\rightarrow Cu^+$ emission is blue at this pressure.

From these results Drickamer predicted that, in a lattice with the ZnS structure but a wider gap at one atmosphere (for example, a mixed ZnS_xO_{1-x} crystal) these dopants would give blue and violet light, while in a crystal like ZnS_xSe_{1-x}, with a smaller gap, one would get yellow and green emission with the same dopants at one atmosphere.

Awards and Honors

The wide variety of disciplines which Drickamer's work has affected is attested by the fact that he has received more than 22 awards from 14 different national and international organizations. He has been elected to the National Academy of Sciences (1965) the American Academy of Arts and Sciences (1971), the National Academy of Engineering (1979) and the American Philosophical Society (1983).

Among his numerous prizes are the P.W. Bridgman medal (1979) (Drickamer was the first awardee), the Langmuir Award in Chemical Physics (1974), the Debye Award in Physical Chemistry (1987), The Buckley Solid State Physics Prize (1967), the Michelson-Morley Prize from Case-Western Reserve (1978), the Colburn Award (1977) and the Walker Award from the AIChE in 1972. He won the John Scott Medal from the City of Philadelphia (1984) the Welch Prize from the Welch Foundation (1987),


The American Institute of Chemists
Incorporated

May all men know by this certificate that

Dr. Harry G. Drickamer

because of service to the science of chemistry and the profession of chemical scientist has been awarded the

1996 Gold Medal

of

The American Institute of Chemists

In testimony whereof, we hereunto affix the seal of the Institute and our signatures this 10th day of February 1996

Roger R. Fusta

the Elliott Cresson Medal from the Franklin Institute (1988) and the National Medal of Science in 1989. Just recently, this year, he received the Gold Medal from the American Institute of Chemists (see above).

Drickamer describes his contributions as falling into the following three categories: "(1) We were the first to show that pressure could be used to study atomic, molecular and electronic phenomena—the stuff of modern chemistry and physics. (2) We have been fortunate to pick the right techniques and the right systems to study so that one could demonstrate the wide applicability of high pressure, and pressure tuning spectroscopy in particular, to solve many problems of modern condensed phase chemistry and physics. (3) We have been diligent enough to study a wide variety of materials by a variety of techniques so that the power and versatility of pressure tuning spectroscopy has become apparent."

By first developing this concept and then by demonstrating extensively how broadly it applies in chemistry and physics, Drickamer has established pressure tuning spectroscopy as a central tool of modern science.

Merit Program Encourages Students with High Potential

The Chemistry Merit Program is designed to encourage and retain students in scientific and engineering careers through active learning. The program serves about 150 students per semester, in general chemistry and organic chemistry courses. It is modeled after a similar program in mathematics which targets women and minority students.

Studies have shown that students with high potential often become discouraged with the pursuit of a scientific career in the first two years of undergraduate study. The Merit program addresses this issue by placing these high potential students into active learning workshops in order to encourage them to stay in science and engineering careers. Students are invited into the program based on their ACT scores and high school records. After an interview with the Merit program during orientation (before the beginning of their freshman year) they self-select into the program.

As Professor Paul Bohn, Head of Chemistry, points out, "We had observed that the number of minority students starting in the sciences and engineering was small and gets smaller as students proceed through the stages of education.

The Merit program is one mechanism to address the minority manpower pipeline problem that concerns our corporate friends as well as ourselves".

The Program Model

The model for the program originated at Berkeley in mathematics and is based on three closely linked ideas. In "active learning" students work in groups and take responsibility for teaching each other as well as for learning. The instructors become facilitators for the student groups but do not present material, as in a traditional recitation setting. A second focus of the program is on challenging the students by presenting them with material that pushes the upper limits of their capabilities. The chemistry questions and problems are designed to elicit discussion and require students to work together. The material is

deliberately made more difficult than the material presented in traditional classes.

The third focus is on helping the students to build networks which integrate social and academic interests. Many students enter the university with highly developed social or academic networks. The most successful students integrate these two networks to form relationships with others. Students in the workshops learn to think of science as a human endeavor as well as a technical enterprise, one in which interacting with others facilitates learning. Susan Arena-Zumdahl, the program director, and her staff, anticipate that encouraging students to work in groups will facilitate their retention in these technical fields, but only longitudinal research will indicate whether this hypothesis is correct.

The students in the Merit program spend two hours in each workshop, instead of one hour in the traditional recitation setting. Although the students spend a majority of the time talking with each other about chemistry and working on worksheets, they also talk about extracurricular life and career interests and develop a true support network of friends with shared academic interests. These networks begin to function independently of the workshops as students learn the benefits of forming networks and of working with others in a team setting, both assets in the corporate world.

Although the workshops are offered in chemistry and mathematics at the U. of I., a wide array of students benefit because the program is open to anyone who takes these courses regardless of their major, which may be in agriculture, biology, engineering, home economics or a chemical science. With additional funds, the workshops could be expanded to include more subjects, more students and more outcome research to indicate the validity of the model.

A Former Workshop Participant

What do workshop students think of the program? To find out, we interviewed Latasha Napper, now a junior in Chemical Engineering, who has taken 6 merit workshops, 3 in chemistry and 3 in mathematics. Latasha enjoyed the experience enough to encourage her to become a Chemistry tutor for minority students at the Office of Minority Student Affairs.

Latasha heard about the math workshop from a teacher at her high school. Many of our current students have heard about the program from workshop alumni. Latasha's teacher encouraged her to accept the invitation to join our program. From the math workshop she learned of the chemistry workshop and decided to apply to that program as well. Latasha states it this way, "I thought that it would be helpful because of the way that the class is taught; we were encouraged to come up with the answers ourselves instead of the teachers teaching you all the time".

"The workshops taught me to reason through the problems because the worksheets were hard. They also taught me analytical thinking skills which have been very helpful in other classes. I learned to figure out what I was given in the worksheet and what I needed to find out and how to figure it out. Without the workshops I would not have gained as deep an understanding of what is going on".

Latasha Napper

Latasha still works together with some of the students from her freshman workshops because many of the others are also Chemical Engineering majors and still take classes together. She liked the workgroups because they were not only helpful but also fun. She tends to get frustrated when she doesn't know how to proceed and still works with others when efforts to solve a problem by herself have proven unsuccessful. She finds it beneficial to have the perspective of other people working on the same problem.

Merit Workshops — The Future

Clearly, the chemists at Illinois are onto something here. A stiff challenge, the opportunity to work hard with others, and the novel active learning approach, mixed together, are providing something exciting, something that Bohn, Arena-Zumdahl, and their colleagues hope will go at least a small way to changing the face of science and engineering in America.

Dedication of Our New Building Set for September, 1996

For those of you who have not seen our new building, we hope that an occasion will arise which will bring you to campus and to see our new home. The new Chemistry and Life Science Laboratory is one of the largest structures on campus, well designed to match the general U. of I. rchitecture.

We will cut the ceremonial ribbon on Friday morning, September 27. The official event will be followed by punch and cookies and tours of the building. Other events to mark the opening of the new building will be occurring throughout the year.

Congratulations to . . .

Dennis G. Brown

Clarkson University in Potsdam, NY, has announced the appointment of Dennis G. Brown as president. Dr. Brown received a Ph.D. in '69 in the U. of I. Chemistry Department under the supervision of Professor Drago..

Since 1990, Dr. Brown has served as Provost and Senior Vice President for Academic Affairs at Drexel University. Before that, he was Senior Vice President for Academic Affairs at the University of Nevada-Reno, Dean of the College of Letters and Science at Montana State University, and Assistant Vice President for Academic Affairs and Research at the University of Idaho.

As an administrator, Dr. Brown has been a facilitator of fundamental change, especially in the curricular arena. At the University of Idaho, for instance, Dr. Brown undertook a major restructuring of the delivery of statistics instruction and consulting services across campus, reorganizing the School of Home Economics, and developing a humanities core curriculum. He also helped conceive, implement and fund a program to assist faculty with mid-career changes, and led a successful effort to implement an honors program.

Dr. Brown received his B.S. degree from Whitman College and was elected to Phi Beta Kappa and Phi Kappa Phi. He has been a Fellow for the W.K. Kellogg Foundation and Fellow of the Alexander von Humboldt Stiftung. He currently serves on the boards of the Ben Franklin Technology Partnership, and the National Commission for Cooperative Education.

Brown

Vince Magnuson

Dr. Magnuson Ph.D. '68 (Chemistry with Stucky), has been named Vice Chancellor for Research for Academic Administration at the University of Minnesota in Duluth. Since 1973 Magnuson has been a Chemistry Professor at UMD and was appointed interim Vice Chancellor last July.

In his new position, Magnuson hopes to provide students "with an affordable education in a comprehensive university that focuses on an exemplary undergraduate learning experience." In addition, he hopes to increase opportunities for students to be involved in active learning experiences, to promote and support faculty creativity and research, and to strengthen academic ties with the community colleges of northern Minnesota.

Dr. Magnuson is past Chair of the UMD Chemistry Department, past American Chemical Society National Councilor, and past Chair of the UMD Campus Assembly. He also pursues an active research program involving both graduate and undergraduate students in molecular structure determination by X-ray diffraction.

Magnuson

Zerwekh

Morrison

Joseph E. Zerwekh

Dr. Joseph E. Zerwekh, B.S. '70, (Chemistry), has been appointed the inaugural holder of the Frederick C. Bartter Professorship in Vitamin D. Research at the University of Texas Southwestern Medical Center at Dallas. Dr. Zerwekh is currently the associate director of the UT Southwestern's Robert T. Hayes Center for Mineral Metabolism Research.

In describing Dr. Bartter, for whom the Professorship is named, and his world famous NIH colleague, Dr. Albright, Dr. Zerwerkh said "what made them so special is that they were able to form hypotheses about disease processes and genetic defects based solely on clinical observation. As the laboratory tools have become available, we have been able to prove what they could only hypothesize. It is remarkable that they could form such accurate hypotheses just from clinical observation. That indeed represents the pinnacle of good clinical research."

A professor of internal medicine, Zerwekh has been on the faculty at UT Southwestern Medical Center since 1977. He received a Ph.D. in Biochemistry at the University of Arizona. His research focuses on Vitamin D metabolism. He plans to continue investigations into possible defects in the Vitamin D receptor and their roles in kidney stone disease and certain types of osteroperosis. Dr. Zerwekh also hopes to clone the enzyme that makes the biologically active form of Vitamin D, a research effort that he describes as a formidable task.

Hall

Congratulations to

CONGRATULATIONS TO . . .

Bruce A. Morrison

On June 1, 1995, Mr. Morrison M.S. '70 (Chemistry with Leonard) was sworn in as a Director of the Federal Housing Finance Board. President Clinton designated him to serve as Chairman.

Bruce Morrison has traveled a long way from Organic Chemistry. In '73 he graduated from Yale Law School and since then has built an outstanding career in politics and in private law practice.

Morrison served in the House of Representatives from '83 to '91 and also ran for governor of Connecticut in '90. In Congress he earned a reputation as a strong advocate for affordable housing and community development and for strong capital standards for financial institutions. As a member of the House Banking Committee, Mr. Morrison helped craft legislation to improve the regulation and supervision of insured financial institutions and authored legislation on the use of federal funds for the development of owner-occupied housing in urban areas.

In private practice Mr. Morrison specialized in immigration issues and international trade and investment. During the 101st Congresss, he was Chairman of the Judiciary Committee Subcommittee on Immigration, Refugees and International Law and authored the Immigration Act of 1990. Mr. Morrison founded the Third World Debt Caucus, which advocated the restructuring of the debts of Lesser Developed Countries to expand investment and trade.

Gammon

Henry K. Hall, Jr.

For his many significant contributions to polymer chemistry, Professor Hall, Ph.D. '49 (Chemistry with Frank) has received the 1996 ACS Award in Polymer Chemistry. According to a colleague, "Hall is an innovator in the field of polymer chemistry and is recognized around the world for his accomplishments." His work has placed strong emphasis both on organic synthesis for the development of novel monomers that lead to useful, new, high polymers, and on physical-chemical principles that provide insights into the equilibria and mechanisms of polymerization reactions.

Hall has made significant contributions in a number of different scientific areas. His germinal research on ring-opening polymerization has led to an understanding of the relationship between ring strain in small molecules and their ability to form polymers. Hall was also the first to apply the new discipline of conformational analysis to the polymerization of cyclic monomers. He was the first to establish the polymerizability of trisubstituted ethylenes.

Observations of spontaneous polymerizations between highly electrophilic ethylenes and nucleophilic comonomers led Hall to develop the bond forming initiation theory, which states that a 1,4-tetramethylene-zwitterion diradical is the true initiator of these spontaneous polymerizations. The concept is currently being extended to photochemical polymerizations and to many reactions of small molecules.

Recently, Hall has turned his attention to the design and synthesis of "smart" polymers for high-technology applications. For example, he has developed highly photorefractive polymer composites based on polyvinyl carbazole and azo dyes that display near 100% diffraction efficiency. These materials are useful for holographic storage and image processing.

Before joining the faculty at the University of Arizona, Professor Hall worked for 17 years at DuPont, first as senior research chemist in the textile fibers department, and then as group leader in central research.

Steve Gammon

Steve Gammon, Ph.D. '89, (Chemistry with Rauchfuss and Smith), has been named Idaho Professor of the Year by the Carnegie Foundation for the Advancement of Teaching through the Council for Advancement and Support of Education. According to the interim President of the University of Idaho, "Gammon's work in the classroom and in the laboratory represents the best of what the University of Idaho is. He is able to make chemistry, and science in general, interesting and understandable to elementary school children as well as graduate students through his thorough knowledge of the subject, creative use of technology and enthusiasm."

At Idaho Gammon is the coordinator of general chemistry, managing the instruction of approximately 1,500-2,000 students annually. By working with Professor Stan Smith at the U. of I., Gammon became interested in computer based instruction. Gammon is a member of the Computers in Chemistry Laboratory Instruction Initiative, sponsored by the NSF to bring technology into the introductory chemistry teaching laboratory.

Professor Gammon credits all three U. of I. advisors for his subsequent success. He worked under the supervision of Professor Tom Rauchfuss for the first 3½ years, studying inorganic chemistry, then 1½ years under Professor Stan Smith in chemical education, all of which was coordinated by Professor Larry Faulkner, now Provost of the University. Gammon describes Smith as a strong supporter, far beyond "the call of duty." He especially appreciates Professor Smith's efforts to keep in touch and to introduce him to the tools he needed for his current work.

Gammon's software is widely used in high schools and in undergraduate chemistry classrooms throughout the United States. In nominating Gammon for the award, one of his university srudents wrote, "I must attribute a large part of my current interest in sciences to Dr. Gammon and his enthusiasm in making introductory chemistry walk and talk and breathe."

More Congratulations on page 19

Alumni News

'30s

Leonore Hollander, Ph.D. '32 (Chemistry with Rose) has completed her autobiography *A Life as Lived*. It is available through Raspberry Productions in Sebastopol, CA.

'40s

Sidney Loeb, B.S. '41 (Chemical Engineering) was honored by the North American Membrane Society last May. At UCLA in '60 Loeb and a colleague completed development of the first practical membrane for what is now the most widely applied desalination process, reverse osmosis. This work sparked a subsequent exponential growth rate in both synthetic membrane research and membrane processes generally. Dr. Loeb is retired Professor of Chemical Engineering at Ben Gurion University in Beersheva, Israel.

R.J. Thorn, Ph.D. '42 (Chemistry with Phipps) has written a book: *Chemical Equilibria Bases for Oxide and Organic Superconductors*, which will be published by John Wiley & Sons. Prior to retiring in '84, Dr. Thorn was a Senior Chemist and Group Leader of the High Temperature Materials Chemistry Group at Argonne National Laboratory.

'50s

John P. Dismukes, Ph.D. '59 (Chemistry with Bailar) has been elected a Fellow of the Electrochemical Society. Since '79 he has been with the Corporate Research Laboratory of Exxon Research and Engineering Company in Annandale, NJ. He has coordinated a major research program in solar grade silicon development and now holds the position of Senior Research Associate in advanced materials research related to diamond, structural materials, and inorganic composites.

'60s

Christopher Allen, Ph.D. '67 (Chemistry with Moeller) has been appointed Director of the Vermont EPSCoR program. He will also continue his research in hybrid organic-inorganic polymers and inorganic ring system chemistry.

Alumni News continues on the next page

Gumprecht Gift an All-Around Winner

Dr. William Gumprecht BS '53 (Chemistry) has made a most welcome gift to the Chemistry Department called a Charitable Remainder Unit Trust (CRUT). This deferred giving vehicle, which provides current tax benefits and a lifetime income for himself and his wife, is one aspect of a sophisticated financial plan. One of his important goals as the donor is to reduce his heirs' estate taxes, which can seriously diminish the value of their inheritance. The CRUT will make this possible.

William Gumprecht

For his annual income, Dr. Gumprecht chose a relatively low rate of return from the CRUT because he wishes to see the capital grow. However, the annual income is ample to pay the premiums on a Wealth Replacement Trust insurance policy of approximately the same value as the CRUT. His heirs are the beneficiaries of the policy. Therefore the total value of his estate has not decreased and the heirs will have diminished inheritance taxes because that part of the estate will come to them in the form of a non-taxable life insurance payout.

With the help of his financial advisors, Dr. Gumprecht devised this well-planned route to maintaining the value of his assets while also benefiting the U. of I. Chemistry Department, one of his favorite charities. Although he received his Ph.D. at the U. of Minnesota, Dr. Gumprecht sees his undergraduate training at the U. of I. as the foundation of his distinguished career. As an undergraduate, he only saw the department in its entirety but benefited greatly from his contact with faculty and graduate students and from his membership in AXE house. Evidently, the faculty noted his potential because he was accepted for graduate work at Minnesota as a result of an arrangement, resulting in a "swap" of promising students, set up by Professors Adams and Marvel.

An outstanding faculty at Quincy, (IL) Senior High and relatives who are Illinois alumni led Dr. Gumprecht to the Urbana campus. After completing his studies there and at Minnesota, he took a position with DuPont, where he has remained throughout his professional career at The Chambers Works' Jackson Lab. His initial projects there involved research on synthetic dyes. Neoprene and "Teflon" are two important products emanating from the Jackson Lab. Dr. Gumprecht has been with the "Freon" (now Fluoroproducts) division of DuPont for the last 20 years, experimenting with environmentally compatible materials and processes to make them. In recent years, he has also consulted extensively for DuPont in developing business opportunities in Russia and mainland China and has made many trips to distant parts of the world. His current position is that of Senior Research Associate.

Because of his loyalty to Chemistry at Illinois and to Professors Marvel and Fuson in particular, Dr. Gumprecht feels the idea of an unrestricted gift to chemistry is an "irresistible" opportunity, especially since he can benefit the department without sacrifice to either himself or his heirs. He correctly foresees that it is difficult to predict the most pressing needs of the department at a future date when the money will become available. Since he was not aligned with any one professor during his undergraduate studies, he believes that an unrestricted gift to the department will "count the most".

He is looking forw to accepting the department's invitation to present a colloquium next year, and to meeting the young professors and graduate students whose reputations for excellence have reached him. Of his gift, he says, "I lose a little earning power right now when I don't need it and at the same time I can help to keep the U. of I. Chemistry Department right at the top, where it belongs".

Grad Students Win Notable Fellowships

Hertz fellowships are highly selective, financially rewarding and carry enormous prestige. They are awarded to students who demonstrate an interest in applied science and meet rigorous standards. The competition is national and only about one in 20 applicants is successful. **Troy Tanzer** won the coveted award as a first-year graduate student in our analytical program.

Troy was impressed with the screening procedures which required not only an excellent academic record, but also a series of technical interviews with former Hertz Fellows. After completing the interviews, Troy said, "I was very honored to get a Hertz Fellowship".

Troy had developed an interest in chemistry while in high school where he took a heavy load of technical courses. At that time, he had not been eager to go to college and had seriously considered joining the military to save money and start a business. However, he applied to and was accepted by Harvey Mudd College, where he enjoyed football and rugby. But he found that the "best part" of college was the professors, all of whom consulted with industrial concerns and gave their students opportunities to engage in "real world" projects.

During his undergraduate studies he was awarded a Dow Fellowship with a generous stipend. It included a plant trip where officials described the employment opportunities offered by Dow but urged them to attend graduate school first. One possibility that Troy is considering is working for a large company, like Dow, to develop contacts and to look for an opportunity to create a business by exploiting a patent that does not have sufficient commercial potential to interest the parent company.

Troy chose the U. of I for graduate work because during his visit, "I met several professors with whom I clicked on a personal level and who were also doing research that seemed very interesting. At other schools, I would be fortunate to meet one". He is satisfied that he made the right decision.

Troy Tanzer

Aliston Thomas

Aliston Thomas has won an **Illinois Minority Graduate Incentive Program (IMGIP) fellowship**, established by the Illinois Board of Higher Education in 1985 to increase the number of underrepresented minorities among the faculty of Illinois colleges and universities. The program is for students who meet high academic standards and are working for a Ph.D. in the life sciences, physical sciences, engineering, or mathematics. The applicant has to be accepted for graduate study by an Illinois institution of higher education and be nominated by that institution for the state-wide competion. The IMGIP Board makes the final selection for the state.

A member of Professor Andrzej Wieckowski's research group, Aliston has received previous awards during his graduate studies. He was a recipient of a graduate student award from the ACS Division of Analytical Chemistry, one of only five awarded annually. He has also won second place in a poster competition sponsored by the National Association of Corrosion Engineers International.

Eleven graduate students in the School of Chemical Sciences are current holders of **NSF fellowships**. These are highly selective, national awards for students in science and engineering. About one in 10 applicants is successful. We are fortunate to have 6 winners among the chemistry students, 3 in chemical engineering, and 2 in biochemistry.

Alumni News

Donald Barton, Postdoc '60-'62 (Chemistry with Yankwich) has taught physical chemistry at Memorial University in Newfoundland, CANADA from '62 until his retirement in '92.

Earl W. Henry, B.S. '68 (Chemistry) was appointed Vice President of Clinical Research at Guilford Pharmaceuticals in Baltimore, MD. Prior to joining Guilford, Dr. Henry was Executive Director of Clinical Research and Global Head of the Central Nervous System Therapeutic Area at Sandoz Research Institute. Prior to joining Sandoz, Dr. Henry held various positions at Pfizer. He received his M.D. degree from the University of Chicago.

Cynthia Jameson, Ph.D. '68 (Chemistry with Gutowsky) has been named a University Scholar at UIC. She joined the Chemistry Department at UIC in '68 and is the only woman on the research faculty. She is a Fellow of the AAAS and editor of *Magnetic Resonance Review*.

Marvin Poutsma, Ph.D. '62 (Chemistry with Curtin) has been elected a Fellow of the AAAS. He is with the Department of Energy's Oak Ridge National Laboratory. His previous position was at Union Carbide's former Corporate Research Laboratory in NY where he served as program leader of the fossil fuels chemistry group, head of the organic chemistry and chemical physics section, director of the former Chemistry Division, and, most recently, as director of the Chemical and Analytical Sciences Division.

Michael R. Rosenthal, Ph.D. '65 (Chemistry with Drago) has been appointed Deputy Secretary of the Maryland Higher Education Commission in Annapolis, MD. The Commission coordinates the activities of all higher education in Maryland.

Thomas R. Sharpe, Ph.D. '67 (Chemistry with Martin) retired from DuPont Merck Pharmaceutical Company in February, 1994 after 27 years with DuPont and DuPont Merck. He joined OsteoArthritis Sciences in Cambridge, MA as Vice President of R&D in March '94 and was promoted to President and CEO in August, 1994.

Alumni News continues on the next page

Alumni News

Leslie J. Story, B.S. '61 (Chemistry), has been appointed Executive Vice President—Specialty Business at Occidental Chemical Corporation. Story joined OxyChem after 19 years with BASF Corporation where his most recent position was Group Vice President, chemical intermediates. Prior to joining BASF, Story was with DuPont where he worked in the research, technical, product, and business development areas.

'70s

John S. Brabson, Ph.D. '75 (Biochemistry with Switzer) has been named Dean of the Division of Natural Sciences and Education for '95-'98 at Mills College in Oakland, California. He is Professor of Chemistry at Mills College.

David L. Monts, B.S. '73 (Chemistry) has been promoted to associate professor with tenure in the Department of Physics and Astronomy of Mississippi State University. He holds a joint appointment in MSU's Diagnostic Instrumentation and Analysis Laboratory.

Janet Ollinger, Ph.D. '74 (Chemistry with Coates), belatedly sent word that in 1992 she had been awarded the Rohm & Haas highest form of recognition, the Chairman's Award, which had been given only twice before in the history of the company. Ollinger, who is product registration manager for Dithane fungicide, successfully led a group of scientists and business people to conduct a Special Review, also known as a food safety study. Dithane is the company's largest selling product and the backbone of the Agricultural Chemical Business of Rohm & Haas. The massive study led the EPA to approve the use of Dithane for 45 food crops and, essentially, saved the product for the company.

Craig Tyner, Ph.D. '77 (Chemical Engineering with Drickamer) is a chemical engineer with Sandia National Labs. He is a member of the team that is working on Solar Two, called the most advanced solar power plant in the world. The project is sponsored by the US Department of Energy, Southern California Edison and other utilities.

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Gutowsky Receives Tribute at NMR Celebrations

Although Gutowsky did not attend the symposium marking the Golden Jubilee of NMR, held at Harvard last December, his friend and former student, David McCall Ph.D. '53 participated as his "proxy." McCall has recently retired as Director of the Chemical Research Laboratory at AT&T Bell Laboratories and as Director of Environmental Chemistry Research. McCall made a presentation on Gutowsky's early contributions called "Chemical Applications in the Early Days", excerpted below. Of the twelve talks on NMR, this was the only one on chemistry. It recognizes that Gutowsky was the first chemist to work in the field.

Herbert Gutowsky

David McCall

Herb arrived at Illinois in September of 1948. Roger Adams was Head of Chemistry and, the Department was famous for classical organic chemistry. At that time, organic chemists were totally reliant upon infrared spectroscopy to identify intermediates. Most of the 250 graduate students at Illinois beat a path to the door of the IR lab daily. I was intimately familiar with the lab owing to the fact that it was across the hall from my office and inhabited by one of the two female graduate chemists in the department. Herb Gutowsky was hired to oversee the IR lab and it was a big job. Before long, he had provided them with an even better method. Roger Adams, knowing nothing of NMR, quickly became appreciative of Herb's talents and saw to it that he was promoted and otherwise encouraged.

By the time I arrived at Illinois in September of 1950, Herb had assembled a spectrometer and had managed to get a steel company to construct the magnet. He also took on his first graduate student, Charles Hoffman Ph.D. '51, who synthesized all the known binary fluorides and some that were not known. Some of these materials are hideously corrosive and Hoffman made them all in a lab without hood facilities.

Herb also hired an undergraduate EE major, Bob McClure, who understood electronics and made the lab work. McClure used to take us down the street to get liquid nitrogen. He drove his Harley-Davidson and Leon Meyer, Ph.D. '53, or I would balance the large dewar on the back fender. The process could be exciting in icy weather.

McClure got the lab's first convincing data on proton shifts in June, 1950. For a chemist with Gutowsky's imagination, this was a very exciting development. When Leon Meyer joined Herb's group later in the year, he had the ideal collaborator for the development of the new chemical method. Meyer compiled and assigned shift data for several hundred compounds. The result was a working table with which the chemists could identify the characteristic spectra of compounds. Herb took this chart to the Chicago ACS meeting in 1953 and it was an instant hit, as it was at home. NMR is still the standard method, more than 40 years later. IR has not disappeared but it is secondary to NMR in importance.

Another phenomenon of importance to chemical NMR is exchange coupling, which was the subject of my MS thesis. It was discovered that nuclear resonances were often groups of lines in characteristic patterns which resulted from interactions between neighboring nuclei. By studying the patterns in many molecules, we came to know what to expect and realized that the patterns could tell us what the nuclei were attached to. This added greatly to the usefulness of NMR as a chemical tool. In this work, including the theoretical understanding of the unexpected effect, we collaborated with Professor Charley Slichter in the physics department. The era passed quickly but the durability of the findings and analyses is gratifying.

In retrospect, the chemical shifts, exchange couplings and chemical exchange phenomena seem rather straightforward. I can assure you that we did not regard them as such in the early 1950s. I have neglected the experimental methods that had to be developed as we went along, e.g. sweeping through the resonances slowly enough to avoid the "wiggles" was a non-trivial but necessary advance.

When I arrived at Illinois, I was told that 'We do not minor in physics'. After some tense discussions, it was allowed and the interactions were great. We profited enormously from the enthusiasm and approachability of Charley Slichter and his students. Another of Herb's early collaborators was George Pake in the physics laboratories at Harvard, with whom he undertook his first NMR experiments. Even those of us who had never been east of Ohio identified with Harvard. Getting my second order degree with Herb Gutowsky was a high point in my life.

Faculty and Staff Honors

Stanley Smith, Professor of Chemistry, has been named the first holder of the Murchison-Mallory Chair in General Chemistry (See page 1 for further information.)

Harry G. Drickamer, Professor of Chemical Engineering, Chemistry and Physics, has received the 1996 Gold Medal Award of the American Institute of Chemists. This is the highest award of the Institute and is given annually to an individual who has stimulated activities of service to the science of chemistry or to the profession of chemistry or chemical engineering in the US.

Ed Seebauer, Professor of Chemical Engineering, has received the 1995 Semiconductor Research Corporation Inventor Recognition Award. The award names Ed's patent "Selective Low Temperature Chemical Vapor Deposition of Titanium disilicide onto Silicon Regions."

Jeffrey Moore, Professor of Chemistry, has received a Cope Award.

Richard Alkire, Professor of Chemical Engineering, Vice Chancellor for Research and Dean of the Graduate College, has been inducted as a fellow of the AAAS.

Paul Lauterbur, Professor of Chemistry and Director of the Biomedical Magnetic Research Laboratory has been elected a Senior Member of the Institute of Electrical and Electronics Engineers, Inc.

Gregory Girolami, Professor of Chemistry, has been named an associate in the Center for Advanced Study for the Academic Year, 1996-97. In addition, he has also been named a Beckman associate.

Rebecca Simon, Director of the Placement and Undergraduate Student Advising Office, received the Outstanding Academic Professional Award of the School of Chemical Sciences. She is the first recipient.

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David Wiemer, Ph.D. '76 (Chemistry with Leonard) won a '93-'94 Collegiate Teaching award at the University of Iowa. He has been at the University of Iowa since '78.

Richard P. Zerger, Ph.D. '73 (Chemistry with Stucky) is Professor of Chemistry at Bethel College in North Newton, KS.

'80s

Douglas Antelman, Ph.D. '89 (Biochemistry with Clark) was recently promoted to Senior Research Scientist at Canji, Inc. in San Diego, CA. Dr. Antelman's work focuses on gene therapy for cancer.

William Burton, Ph.D. '89 (Biochemistry with Gumport) has been elected President of the Lincolnwood based Leukemia Research Foundation. Dr. Burton is a science writer and media relations manager at the University of Chicago Medical Center.

John Cavanaugh, M.S. '85 (Biochemistry) has joined the Ashtabula Medical Center. Dr. Cavanaugh is a pathologist who earned his M.D. degree at UIC in '89. He is a member of the US and Canadian Academy of Pathology, the American Society of Clinical Pathologists, and the College of American Pathologists.

Mark H. Fishbein, B.S. '81 (Chemistry) was elected to Fellowship in the American Academy of Pediatrics. Dr. Fishbein received his MD degree in '85 from UIC.

Mitchell J. Hait, M.S. '86 (Chemical Engineering) has taken a position as senior engineer with Radian International in Tucker, GA.

Kenneth W. Harlow, Ph.D. '89 (Biochemistry with Switzer) has been promoted to Lektor, a position equivalent to associate professor with tenure in the Department of Protein Chemistry at the University of Copenhagen in Denmark.

Shiv Kumar, Postdoc '85-'88 (Chemistry with Leonard) is Director of Nucleic Acid Chemistry of Amersham Life Science in Cleveland, OH.

Thomas Larson, B.S. '82 (Biochemistry), and B.A. '82 (History and Philosophy of Science) has taken a position as patent examiner in the biotechnology group of the Patent & Trademark Office in Arlington, VA. He has also completed a postdoctoral fellowship in

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Alumni News

molecular biology at the Roche Institute of Molecular Biology.

Yu Zhou Li, Ph.D. '88 (Chemistry with Scheeline) has been promoted to associate professor with tenure at Clarkson University in Potsdam, NY. Dr. Li received Clarkson's Outstanding New Teacher Award in '93. He serves as chair of the Northern NY section of the ACS.

Chad Peterson, B.S. '89 (Chemistry) received his Ph.D. in chemistry from the U. of California at Berkeley. He is currently conducting postdoctoral studies at Trinity University, San Antonio.

Brian Rotsch, B.S. '81 (Biochemistry) received the prestigious fellowship award from the Academy of General Dentistry in '95. Dr. Rotsch maintains a private practice in Pontiac and Fairbury. He also serves on the staff of Saint James Hospital. He completed his DDS degree at UIC.

D. Sangeeta, Ph.D. '89 (Chemistry with Klemperer) has taken a position as materials scientist in G.E. Corporate R&D in Schenectady, NY.

Tim Stephan, B.S. '82 (Chemistry) was recently promoted to area manager in the maintenance department at the Anheuser-Busch Brewery in Williamsburg, VA.

Ray Wheatley, B.S. '81 (Biochemistry) has been promoted to Director of Technology Transfer at the University of Texas Southwestern Medical School in Dallas, TX.

'90s

David Allen, Ph.D. '90 (Chemistry with Beak) won the '93 Malcom Baldrige National Quality Award. Allen is a chemist in Tennessee Eastman Acid Division's Product and Process Development Laboratory. He is responsible for new product development and laboratory support of existing products. He has been with Eastman since '90.

Ray Dieter, Jr., B.S. '94 (Chemistry) is with the Glen Ellyn Clinic and President of the Center for Surgery. He has published a textbook, *Thoracoscopy for Surgeons: Diagnostics and Therapeutics*. He spoke at the Bolivian Medical Society in October, '95

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In Memoriam

W.E. (Butch) Hanford, Ph.D. '35 (Chemistry with Adams) passed away in January, 1996. Dr. Hanford was an industrial chemist whose wide-ranging interests led to both the development of polyurethanes and the first liquid household detergent. Polyurethanes are now found in an infinite array of products including skateboard wheels, varnishes, heart valves and building insulation. Dr. Hanford developed the polyurethane project in 1936 when he was working at DuPont.

Dr. Hanford also helped to make teflon a commercially viable product for the DuPont Company. In 1942 he joined General Aniline and Film Corporation, directing the work that led to the first liquid household detergent, marketed as Glim. Then, in 1946, Dr. Hanford moved to the M.W. Kellogg Company where he became director of petroleum and chemical research. Dr. Hanford later joined the Olin Corporation, where he became Research Director in 1953.

A report has reached us that **Veto Banaitis** '40 (Chemistry) is deceased.

Bernard R. Bluestein, Ph.D. '49 (Chemistry with Marvel), died in September, '95. He had been employed by Witco Corporation for the past 40 years. After receiving his Ph.D. at Illinois he did postgraduate work at Rutgers and Purdue Universities. He taught chemistry at Coe College in Cedar Rapids, IA. His career turned to industrial R&D when he went to work at a refinery in Petrolia, PA, which later became part of Witco Corp. Within Witco he served as Corporate Director of Research, as Vice President of Witco's Allied Kelite Division, and as corporate supervisor of patents and environmental regulation.

Howard C. Burns, B.S. '40 (Chemical Engineering) died in November, '95. He worked for the Prest-O-Life Battery Co. and Electric Storage Battery Inc. in several states.

Sister Mary Josetta Butler, Ph.D. '39 (Chemistry with Audrieth) died in March, '95. At the time of her retirement in '63, she was President of St. Xavier University and had served the university for almost 25 years. She joined the faculty in '39, served as Academic Dean from '40-'46 and as Executive Vice President from '56-'60. For her 86th birthday, the Board of Trustees of the University recognized her achievements by establishing a scholarship and lecture fund in her name.

News has reached us that **John Campbell** B.S. '27 (Chemistry) is deceased.

Dean W. Christman, B.S. '40 (Chemistry) died in June, '93. He had been employed by A.E. Staley in Decatur, IL.

We have received word that **Howard Cogan** A.M. '32 (Chemistry) died in April, 1994.

Edgar H. Grahn, Ph.D. '55 (Chemistry with Moeller) died in June, '95. He had served as professor of chemistry and Dean of the Graduate School at the University of Idaho from 1946 until his retirement in '77.

We have been informed of the death of **Deane W. Hullinger** B.S. '43 (Chemistry) in San Jose, IL.

Word has reached us that **Paul W. Leppla**, Ph.D '43 (Chemistry with Clark) has passed away.

We have heard that **Charles Malone** B.S. '75 (Chemistry) died in January, '95

We have been informed that **Florence W. Shaw**, A.B. '26 (Chemistry) died in '94.

Harlan E. Tiefenthal, M.S. '48 (Chemistry) died in November '91. He had been Vice President of MDM Chemicals.

We have been informed that **Herbert F. Tilton** B.S. '22 (Chemical Engineering) died in January, 1955.

Correction

In the last issue of the newsletter, Bill Gurolnick, B.S. '52 (Chemical Engineering) unfortunately made it into the In Memoriam column. He has assured me that, to the contrary, he is not only living but more active than ever. After 26 years with Gold Eagle Co. in Chicago, IL he is now Director of Purchasing. In his spare time he has built a new house, plays tennis weekly and attends aerobic classes three times a week. Your editor apologizes for the error but is happy to know that the newsletter has enough readers that Bill had a great many phone calls inquiring about his health.

Zorich Gave Keynote Address

Nora Zorich M.D. '84 (UI College of Medicine at UC) and Ph.D. '87 (Biochemistry with Jonas) is a graduate of our Medical Scholars Program. In February she was invited to give the keynote address to the UI Medical Scholars Program Research Symposium.

Dr. Zorich served as a U. of I. McKinley Health Center staff physician and joined Procter & Gamble in 1989. Her research at Procter & Gamble has helped the company's fat-substitute, called olestra, gain federal approval when used in chips and crackers. Although products manufactured with olestra, under the brand name Olean, probably will not be available to the general public for about a year, Zorich has high expectations for the future of the product. So far, there is no evidence of serious side effects despite rigorous testing. Taken in moderation, the product may become the answer to weight watchers' never ending struggles with excess poundage.

LAS Honors Nowak

Dr. Robert Nowak, Ph.D. '56 (Chemistry with Marvel) received an Alumni Achievement Award from the College of Liberal Arts and Sciences in 1995. Dr. Nowak is President and CEO of Michigan Molecular Institute. He also serves as Interim President and CEO of MMI's Dendritech subsidiary. Before joining MMI, Nowak had spent 37 years in research with The Dow Chemical Co. In 1983 he was named Director of Central Research at Dow and assumed additional responsibility as chief scientist in 1990.

To reach your editor...

Thanks to modern technology, you can now reach our office by e-mail at scsnews@uiuc.edu and by FAX at 217-333-3120, Attn: Editor SCS News. Please continue to send your news and also include comments on the newsletter, alumni and development programs and any questions you may have on any of the above. We enjoy hearing from you.

Carter Campaign Makes Rapid Progress

The personal solicitation phase of the campaign is nearing completion thanks to the hard work of the Campaign Committee and our able chairman, Chuck Sweeley. In addition to individual gifts, we have received a corporate gift from Abbott Laboratories and a special matching program from Upjohn, companies which have benefited from the "Carter presence." Negotiations are currently under way with several other companies.

Herbert Carter

The good news is that we have a total in gifts, anticipated corporate matches, pledges, and deferred gifts of about $166,000. This brings us close to the $200,000 goal set at the beginning of the campaign. However, as many of our readers are well aware, a current fellowship endowment actually needs $300,000 in order to furnish an annual income of $15,000. It is our hope that our final tally will be close to the full amount needed to award an annual Herbert E. Carter Fellowship in Biochemistry.

One of the pleasures of this campaign have been the moving tributes that many donors have sent along with their contributions. For instance, one donor wrote, "I am pleased to know that you are organizing the Carter Fellowship Fund. I cannot tell you enough how proud I am to be a student of his and able to contribute to this event in his honor." This sentiment is shared by many of the 56 donors who have already helped with the campaign. With the excellent beginning shown in this early report, we are confident that the campaign will be successful.

Alumni News

and at the International College of Surgeons in San Juan, PR in December, '95.

Natalie Hawryluk, B.S. '94 (Chemistry) has taken a position as synthetic organic chemist with the Central Research Division of Pfizer Inc.

Aravind Immaneni, M.S. '95 (Chemical Engineering) has won the 1996 LAS College Award for Excellence in Undergraduate Teaching, given to Graduate Assistants for their contributions to undergraduate education.

Kelly Kiley B.S. '94 (Chemistry) has taken a position as a forensic scientist with the Illinois State Police in Rockford, IL.

Michael Krausz, B.S. '93 (Chemical Engineering) is a process engineer for Ashland Chemical's Dallas, TX facility. At this location the company produces ultra high purity chemicals for use in semiconductor manufacturing.

Evelyn J. Lin , B.S. '93 (Chemistry) is a graduate student and research assistant at the University of Wisconsin at Madison.

Jennifer Loebach, B.S. '90 (Chemistry) received her Ph.D. in Chemistry from MIT in June, 1995. She is currently doing postdoctoral research at Princeton University in Princeton, NJ.

Christopher O'Donnell is one of only three winners of a prestigious research scholarship from the NIH. He is pursuing a Ph.D. in chemistry at the University of Wisconsin at Madison.

Amir Riahi, '91 (Chemical Engineering) is working for his Ph.D. in Chemical Engineering at the Illinois Institute of Technology. His area of expertise is polymer processing.

Robert J. Turner, Ph.D. '96 (Biochemistry with Switzer) has been awarded an American Cancer Society Fellowship to pursue postdoctoral research with Professor Paul Schimmel in the Department of Biology at MIT.

Christopher Willis, B.S. '94 (Chemistry) has taken a position as chemist in technical services with Specialized Asseys, Inc. in Nashville, TN.

Excellence Needs Your Help

Help us to maintain and expand our programs by supporting Chemical Science Funds. We have listed below the most active funds in the three departments. If you would like to contribute to a fund not listed, please enter the name beside OTHER.

Matching gifts from your company multiply your dollars. If your company has a matching gift plan, please include a form from your company along with your contribution.

Remember — your contributions make a GREAT difference!

Mark the appropriate box. If sending a check, please make it out to UIF/(fund name). A preaddressed envelope is enclosed for your convenience.

- ☐ *School Facilities Fund:* Upgrades infrastructure, such as the chemistry library, machine and electronic shops, NMR, micro analytical, and mass spectrometry laboratories.
- ☐ *Carter Fellowship Fund:* Supports the first named fellowship in Biochemistry.
- ☐ *Roger Adams Fund:* Supports the Roger Adams Professorship and funds teaching awards, relocation allowances, and undergraduate scholarships.
- ☐ *Carl Shipp Marvel Fund:* Supports the annual Marvel Lecture and undergraduate research awards.
- ☐ *The ChE2000 Fund:* Supports educational enhancement in Chemical Engineering.
- ☐ *The Chemical Engineering Annual Fund:* Provides seed money, instructional and research support.
- ☐ *Unrestricted Fund/Chemistry:* Provides start-up funds for new faculty and for other vital needs.
- ☐ *Unrestricted Fund/Biochemistry:* Provides start-up funds for new faculty and for other vital needs.
- ☐ *Other* _____

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Your news (please include newspaper clippings, photos, extra sheets, etc.) _____

Congratulations to . . .

Continued from p. 10

Thomas M. Stevenson

Dr. Thomas Stevenson, Ph.D. '83 (Chemistry with Leonard) has won the prestigious Scientific Leadership Award given by DuPont Agricultural Products. In making the award, the company cited Stevenson, a Senior Research Chemist in Chemical Discovery at the Stine-Haskell Labs, for his contributions to lead discovery. Stevenson has produced a steady stream of chemical leads, patents and field candidates in the areas of insecticides, herbicides, and fungicides during his 10 years at DuPont. Stevenson is well known for his creativity in recognizing the criteria important for target selection and for inventing novel chemistry to meet these criteria.

For his award, Stevenson will receive funding for an academic sabbatical for a period of up to six months. He expects to spend next spring and summer in Marburg, Germany, doing independent research in organic chemistry unrelated to his work at DuPont.

Stevenson received his B.S. degree in chemistry from St. Louis University in '79, before embarking on a graduate degree at Illinois. After completing his Ph.D., he did postdoctoral research from '83-'85 at the University of Geneva in Switzerland. He began work at DuPont in '85 and is now a Research Associate in the Chemical Discovery Section.

The Award citation closed with a statement by Caryl P. Haskins, President, Carnegie Institute of Washington: "It is the gifted, unorthodox individual, in the laboratory, or the study, or the walk by the river at twilight, who has always brought to us, and must continue to bring to us, all the basic resources by which we live."

Stevenson

Richard Bond

Dr. Richard Bond, Ph.D. '84 (Biochemistry with Switzer), has received the Shering-Plough President's Award for his research. He is a principal scientist in the Tumor Biology Department. Bond's group is developing farnesyl transferase inhibitors as anti-tumor targets. Many tumor cells have an activated ras gene which is required for their transformation. The inhibitors block the modification (farnesylation) of ras, which is required for its activity. Thus, the inhibitors block the growth of ras transformed cells. One of the important advantages of this anti-tumor therapy is that it seems to be non toxic to normal cells, in contrast with most anti-tumor agents today.

Currently, Bond is trying to determine the structure of the enzyme. He is working with a structural chemistry group on making crystals of the protein and characterizing them by X-ray diffraction. The lead inhibitor is going into clinical trials this year and the group has great hopes for the outcome.

Bond has been at Shering Plough for six years. He took a position at the company after completing a postdoc at Washington University in the Anatomy and Neurology Department.

Bond

Ming-Chu Hsu

Dr. Hsu, Ph.D. '70 (Chemistry with Woody) received a 1995 TWIN Award for her significant contributions to industry in New Jersey. TWIN stands for Tribute to Women in Industry to honor women who have achieved responsible managerial, executive or professional positions and have made important contributions to their respective industries.

Dr. Ming-Chu Hsu is director of Molecular Biology in the Department of Oncology at Hoffmann-La Roche. She is responsible for guiding the discovery and development of novel therapeutics for use in oncology. Dr. Hsu joined La Roche in 1987 as a senior scientist in the Department of Oncology and Virology and has since earned positions of increasing responsibility, including research investigator, research leader, and, currently, director. Prior to joining La Roche she was on the faculty of Rockefeller University. She was among the recipients of a five-year award from the National Cooperative Discovery Group for "Discovery of Drugs Inhibiting HIV Regulatory Genes." Dr. Hsu has also served on the NIH AIDS Research Review Committee for four years.

Hsu

Chemistry Quartet Gave Delightful Performance

Chemists are talented. When the School needed a musical interlude, they sent out word, and three spare time musicians answered. The group lacked a cellist but found one through the School of Music. There was time for only two rehearsals but the performance was exceptional. As one of the musicians put it, "The Chemistry Department is a great resource because it encourages you to develop all your talents." And the musicians appreciated the very good music department at the U. of I. that allows its students to accept invitations to perform whenever possible.

All members of the quartet also play elsewhere. Deborah Bacon, furthest on the left, is a chemistry graduate student who finds time to play in the local community college orchestra. Next to her is Lauren Schweitzer, a sophomore in music who plays in the Danville orchestra. Kathleen Gross is a fourth year graduate student who plays on the U. of I. quad in the summer band. Finally, Kristen McCaleb on the right is a senior level chemistry major who has been playing in the band since her freshman year.

The Chemistry Quartet

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