TUFTS UNIVERSITY CHEMISTRY DEPARTMENT

ChemNotes

FALL 1993

CHAIRMAN'S CORNER

David R. Walt

The approach of a new academic year causes one to reflect on the previous year. This past year was nothing less than spectacular regarding progress in the Chemistry Department. In our last newsletter I described the department's new areas of focus in materials, biomedical, and environmental chemistry. In recognition of the strength of the department's efforts, we have received a $444,000 grant from NSF to support the training of graduate students in the specific area of environmental chemistry. In addition, the spring funding cycle has brought the department an additional $2 million in outside research grants. Our Research Experience for Undergraduates program (described in detail in a separate article) has been extended for an additional two years by the National Science Foundation in recognition of our strong commitment to undergraduate research and training for women and minority students. Finally the National Science Foundation has awarded the department $2 million to renovate a major portion of the Pearson-Michael complex. These awards, coupled with our receipt of both the Hughes and Kresge Foundation Instrumentation Awards over the last two years, demonstrate a national level endorsement of our faculty and program.

On the curriculum side, the department is now offering a Biochemistry major in conjunction with the Biology department. The department

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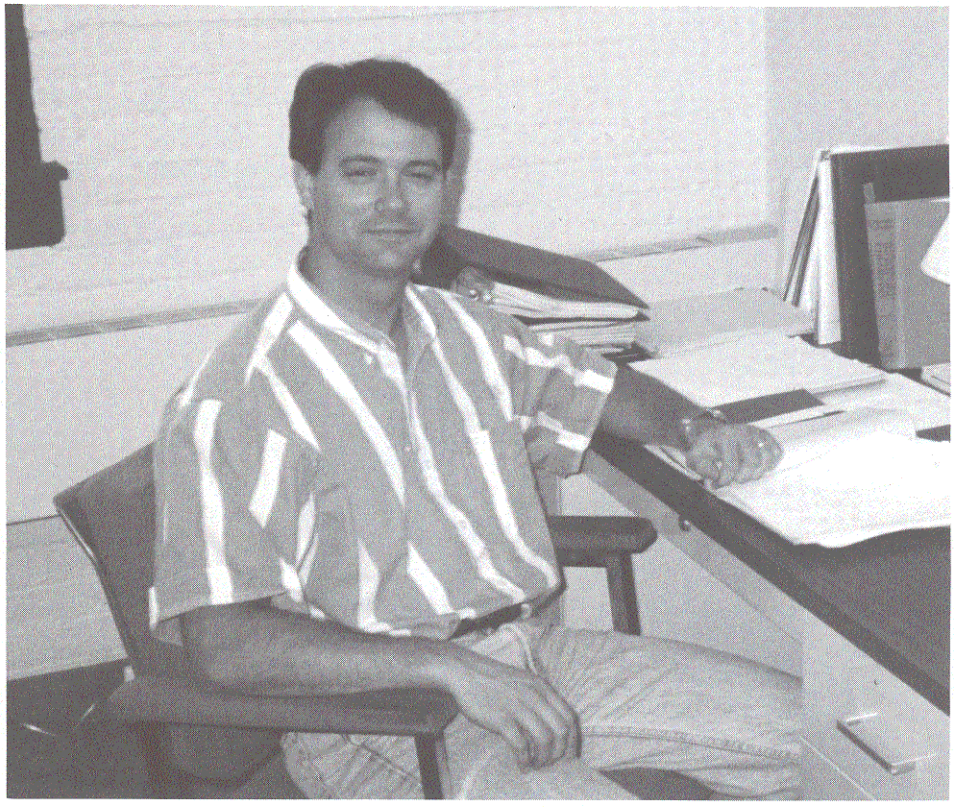

FACULTY PROFILE

Edgar Harlan, Assistant Professor

Dr. Harlan joined the Department of Chemistry in 1990. Raised in northwest Florida, he received his undergraduate education at Davidson College, in North Carolina, where he conducted research on the mechanism of fluorescence quenching by dioxygen. He also engaged in undergraduate research with Prof. R. Crouch at the Medical University of South Carolina on the characterization of the enzyme superoxide dismutase from retinal tissue. Dr. Harlan received his graduate training at Harvard University, working with Prof. R.H. Holm in the area of molybdenum biochemistry, using biomimetic complexes as probes of molybdoenzyme reaction mechanisms. From Harvard he moved to the College of William and Mary in Virginia, where he was a Camille and Henry Dreyfus Foundation research fellow and Visiting Assistant Professor. There he collaborated in research with Prof. G.C. DeFotis on studies of materials displaying low-dimensional magnetic properties.

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Research Experiences for Undergraduates in Chemistry

Edward J. Brush and Edgar W. Harlan

An important educational mission of the chemistry department is to thoroughly prepare undergraduate students for pursuing careers in academia, industry, or medicine. However, a crucial aspect of this training which helps to determine whether or not a student will embark on a career in the natural sciences does not take place in the classroom, but in the chemistry research laboratory. The opportunity to participate in undergraduate research training provides the impetus for undecided or unmotivated students to seek graduate education, while providing valuable experience and career direction for those students already committed to a chemistry career. Furthermore, by participating in faculty-directed research projects, and having fun with science, undergraduates get to experience what research is all about. Of the forty-four chemistry students who have participated in facultysponsored research projects at Tufts since 1989, 52 percent are either currently attending or plan to enroll in Ph.D. graduate school programs.

As a result of this strong commitment to undergraduate research training, the chemistry department was awarded a "Research Experiences for Undergraduates" (REU) site grant from the National Science Foundation. The REU program was established by the NSF in 1987 with the goal of attracting talented undergraduates to careers in mathematics, science, and engineering by actively involving them in summer research projects at colleges and universities across the nation. Once these students are in a lab, they realize that the things they've learned in the classroom fit into a bigger picture. This experience leads to a better understanding of the planning, discipline, and teamwork involved in solving problems in chemical research. Furthermore, the students who participate in an REU program will have an advantage once they go on to graduate school since they've already spent a summer doing research and developing their independent research abilities.

The ***TUFTS-REU*** program was initiated in the summer of 1992, and is directed by assistant professors Ed Brush and Ed Harlan. The program provides summer stipends for ten highly-motivated, undergraduate students to conduct full-time research for ten weeks with the chemistry faculty. Students are recruited from Tufts and from colleges in the New England area, especially from schools which may not have the resources to provide extensive research opportunities. The program is very competitive, with over eighty applications received for the 1993 program alone! Tufts University has shown strong support for the REU program by providing free dormitory housing for the student participants, while the NSF awards each faculty sponsor with a small allowance to help defray the costs of conducting research.

The summer program also features a series of weekly seminars which all undergraduate research participants are required to attend. These seminars introduce the students to the "nuts and bolts" of conducting chemical research, while presentations by the Tufts chemistry faculty highlight ongoing research in the areas of bioorganic, environmental, and materials chemistry. Group recreational events are also important in promoting interactions between the participants and the Tufts chemistry community. These include organized sporting activities, attractions in the city of Boston, and the "Gloucester Seminar," an outing to Stage Fort Park in Gloucester, Massachusetts. An undergraduate research symposium is held during the last week of the ***TUFTS-REU*** program, where each participant has the opportunity to formally present the results of their summer research.

The National Science Foundation has provided an additional two years of support for ***TUFTS-REU.*** It is rare for one department to be funded for three years in this competitive program, and is a testimony to the quality of the faculty research efforts, and to our success and attention to undergraduates. ***TUFTS-REU*** has also been very successful in increasing opportunities for women and underrepresented minority students to participate in chemical research. Of the twenty-one students who have been selected to participate in ***TUFTS-REU*** since 1992, fourteen have been female, and five represent minority groups.

Tracking the post-graduate career paths of the ***TUFTS-REU*** participants is particularly crucial in order to determine the success of this program in enticing students to enter into research careers. The program directors have initiated a newsletter directed toward all undergraduate researchers at Tufts, which is published at the beginning and end of each summer program. The newsletter summarizes the research conducted during the most recent academic and summer sessions, and is sent to all undergraduate students who have conducted research in the department of chemistry. The newsletter will help the program directors maintain an "alumni" record of the eventual career choice of undergraduate research participants from Tufts. Contributed articles from alumni documenting individual career experiences will be particularly welcome, and potentially helpful in attracting women and minority students to Tufts. Should you desire to receive the ***TUFTS-REU*** Newsletter, or wish to contribute an article relating your own experiences from Tufts or in your current career, please contact ***TUFTS-REU*** at (617) 627-3475.

NSF Graduate Research Traineeship Program in Environmental Chemistry

Samuel P. Kounaves

The ability of American universities to produce trained scientists in the critical areas of environmental chemistry is not only vital to the health of our environment, but also to our scientific and economic leadership. In order to wisely manage the environment we need chemists who have been ***effectively*** trained to work on avoiding, solving, analyzing, or managing environmental problems. Chemistry not only plays a pivotal role in technologies such as manufacturing process control, advanced environmental sensors and monitoring, waste management, biodegradation, and energy production and storage, but is the main contributor in understanding the interactions between the chemical constituents of the atmosphere, natural waters, and soil. For at least a decade now it has been evident that industry and government have had a need for Ph.D. level chemists with a much greater depth and breadth of expertise in environmental chemistry than provided by traditional graduate chemistry programs.

There are several factors pointing to an increasing need for chemists formally trained in the various aspects of environmental chemistry. For example, at the federal regulatory level, a large number of graduate level professionals who hold positions that deal with chemical/environmental issues have been drawn from the biological, medical, and legal professions. In industry, many chemists responsible for design or operation of production processes were originally trained as pure organic or inorganic chemists with incomplete knowledge of environmental issues. At almost all universities, environmental chemistry is not a rigorously-defined discipline or subdiscipline. Many students who have an interest in environmental chemistry will usually train in one of the traditional areas of chemistry and take several courses in related fields (biology, geology, or engineering) in an attempt to "qualify" themselves as environmental chemists.

In the Chemistry Department at Tufts we have recognized the need to break away from the classical disciplines of analytical, inorganic, physical and organic chemistry, and reorganize our research and teaching programs to take advantage of our ***areas of excellence.*** Traditionally our graduate students in chemistry would concentrate in one of the four subdisciplines, sharing interests mostly with other students and faculty in the same subdiscipline. However, with the emergence of these areas of excellence, and especially environmental chemistry, we saw the subdisciplinary boundaries fading or becoming irrelevant. With at least eight faculty members currently involved in externally funded programs either wholly or in part dealing with environmental issues, students have found themselves in an expanded intellectual and research environment which encompasses the faculty and students from all the other subdisciplines. By the end of their doctoral studies most of our graduates have gained a unique understanding of how the methodologies of the different areas of chemistry can be brought to bear on environmental problems.

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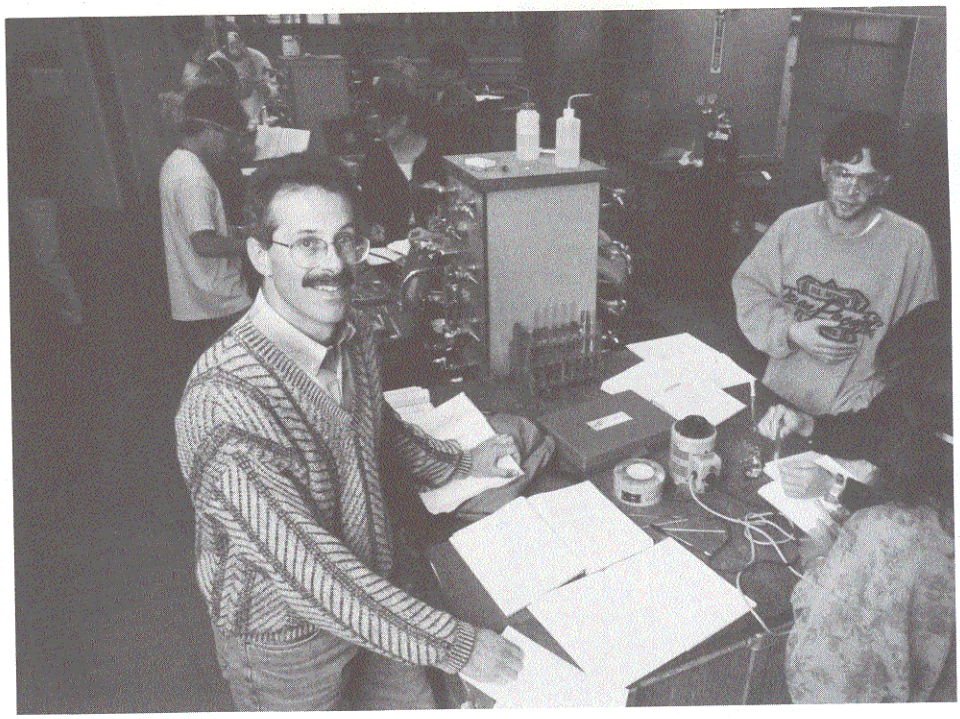
Chairman's Corner: cont. from page 1



has also initiated discussions and is formulating a plan to reconfigure the General Chemistry offerings, with the goal of decreasing class size by dividing students into ability and interest appropriate sections. Finally, our Advanced Organic Laboratory has been redesigned as an Advanced Synthesis Laboratory in which intermediate and advanced techniques in both inorganic and organic chemistry will be taught to research bound majors.

The department outreach program in which students enrolled in organic chemistry fan out to local elementary schools has grown extensively over the last two years. This year approximately fifty undergraduates performed chemistry demonstrations at over fifty local elementary schools. The letters I received from teachers and students were glowingly positive. The Tufts undergraduates were overwhelmed by the positive response they received from students and teachers during the demonstrations which included a methanol cannon, chemiluminescence, slime, oscillating reaction and other visually stimulating yet informative demonstrations.

The last few years have seen tremendous strides in the quality of our program. This quality pervades the department from the innovations that have gone on in the undergraduate laboratories to the substantial increase in outside recognition and funding for our graduate program. It is now critical that we match the excellence of our faculty, equipment, students, and program with modern facilities. Mel Bernstein, Vice President for Arts, Science and Technology, has authorized an architectural design and space plan for the chemistry department. This plan is complete and will be a blueprint to allow us to develop modern research and teaching space that should carry us well into the next century. The plan calls for the consolidation of all teaching laboratories on the second floor of Pearson, with the Michael Building being occupied exclusively by research as will be the third floor of Pearson. It calls for the construction of modern undergraduate laboratories that should meet the needs of the department for many decades. By the time you receive this newsletter, construction of new General Chemistry labs will be in full swing. With the department having experienced three retirements over the last three years, we have the exciting prospect of adding three or more new faculty members in the next several years. These faculty will need modern space to conduct their research programs and continue the expansion in our research focus areas. In addition to the planning commitment, the university has committed a significant amount of internal funds to match contributions on a dollar-for-dollar basis to upgrade the facilities. Combined with the $2 million NSF award, this commitment brings us more than halfway toward our $8 million goal.

This newsletter, in addition to bringing you up to date on recent developments in the department is intended to launch a major fundraising effort for the department. This effort will be the only time during my career, as well as your lifetime, in which such a major fundraising effort will be directed toward the chemistry department. I call upon each of you to return to the department and the university a small piece of what it has provided to you. Some of you may be in positions to donate enough to build an entire laboratory, while others may only provide enough to purchase a drawer or cabinet. The important thing is that each and every one of us contribute to this effort. Our alumni base is not large enough that we can afford anything other than full participation. I must stress that this is a **onetime effort.** Your opportunity to contribute to the department in a meaningful way is now! If successful, we will end up with a beautifully renovated, modern teaching and research facility of which we can all be proud. You will be receiving a more comprehensive mailing within the next few months. It will contain more detailed building plans as well as specific fund raising goals. I hope all of you will think seriously about contributing as generously to the project as you possibly can so that we may have a facility that we can be as proud of as we are of our students, alumni, faculty, and program.

From the Curriculum Committee:

Mary Jane Shultz

This has been a busy year of development for the department's curriculum. In the fall, the Pew foundation funded two projects: one a challenge program (more about that below) for introductory teaching and the other a bridge project between the department and local high schools. In addition to this funding activity, we have introduced a new major, biochemistry, and continue the process of innovation and growth in the introductory program.

Pew Challenge. The challenge portion of the Pew grant represents an exciting opportunity for the department. The Pew charitable trusts have allocated up to $30K for the department on a one-to-one matching basis: that is for every $1 contributed to the department, Pew will match this with $1. This is a painless way to double the impact of your contributions to the department! The goal of the program is two fold: first to encourage science majors, chemistry majors specifically, to get involved in the process of education and secondly, to attract education majors into science courses. The model is to bring a small group of students together in the summer under the direction of faculty members from both the chemistry and education departments to devise open ended, challenging laboratory exercises focusing on a topical subject, e.g. environmental issues. During the following academic year, these same students will be involved in teaching laboratory sections using their own generated experiments. Pilot programs of this sort that we have run in the past have proven that recent consumers, i.e. students, have great insight into what makes an experiment both engaging and informative. By adding students with career aspirations in education to this mix, word about the joys of chemistry should spread beyond our walls! To be eligible for matching, just indicate the Pew challenge grant on your contribution check.

Bridge Program. The Bridge portion of the Pew grant will run this summer. The aim of the program is to reinforce ties between the university and local high school science teachers. In addition to featured participation by chemistry and education majors, the bridge program adds local high school teachers to the mix. Our goal will be to create modules for hands-on learning of chemical concepts by high school students. During the fall semester, the Tufts participants will travel to the participating schools to implement the exercises that they have helped to create. An old adage has it that the best way to learn a subject is to teach it: these students will experience this first hand! This is an exciting opportunity for both our education and our chemistry majors.

Biochemistry Major. The chemistry and biology departments have collaborated on the introduction of a new major to Tufts: biochemistry. This is a challenging major which features courses from both departments including organic, physical, and biochemistry in the chemistry department; genetics, molecular biology, and biochemistry in biology. In addition, it requires calculus and calculus-based physics. Despite the rigor of the major, early indications are that this will be a very popular major that will prepare students for careers in growth areas such as biomedical research and biotechnology as well as more traditional medically-related fields. While other institutions have a biochemistry major, most do not feature the intimate collaboration between chemistry and biology that the major at Tufts has. Although the biochemistry major will appear in the catalogue for the first time this fall, the first majors could graduate as early as next year if they have the needed courses.

Introductory Chemistry News. On the introductory chemistry level, we expect to introduce a new, one-semester course with an emphasis on materials chemistry. This course would rely on modern materials such as thin films, batteries, polymers, superconductors, and solid state devices to teach the fundamental concepts such as structure, bonding, electronegativity, and size. This is but one example of the continuing innovation and growth within the department's curriculum. Keep your eye on this column to see what has blossomed and what is brewing next year!

LABORATORY SAFETY

Marc d'Alarcao

We in the chemistry department cherish our safe working and learning environment. The last several years in the Pearson and Michael Chemistry Laboratories have been happy and productive times unmarred by any serious laboratory accidents. However, maintaining laboratory safety is a continuing and expanding effort which we are pursuing aggressively.

The core of our safety program is the Chemistry Safety Committee. Comprised of a team of students, faculty, and staff, the committee oversees all aspects of laboratory safety and has established a number of programs to educate laboratory occupants and monitor conditions within the labs. Jennifer Burrill, Laboratory Services Director, has taken a lead role in designing and implementing these programs.

We believe that the key to maintaining a safe environment is education. Since safety is obviously in everyone's best interest, people who know how to work safely will tend to do so. Therefore every researcher, prior to gaining access to a lab must attend a safety seminar and demonstrate an understanding of the more common laboratory hazards and how to avoid them by passing a safety quiz.

The Safety Committee also monitors working conditions in laboratories by performing periodic safety inspections. These are friendly visits to each laboratory with the goal of identifying unsafe conditions that may have escaped the lab worker's notice.

The chemistry department, as well as the University as a whole, is trying to raise awareness that we must conserve our natural resources and minimize the production of waste of any kind. For the department this means drastically reducing our inventory of chemicals on hand by insisting on shared usage of chemical stocks. Rather than each of the thirteen research groups in the department having a bottle of an infrequently used chemical in their labs, we would like one or two bottles available in the department for shared use. Aside from the obvious safety benefit of reducing the total amount of each chemical in the department, this policy has the added benefit of minimizing the possibility that a chemical will go unused (and unmonitored) for a long period and ultimately become unnecessary waste.

To establish this shared usage policy, we are currently bar-coding all chemicals in the Pearson-Michael complex. This will generate a database including location, quantity, and age of each chemical which may be searched before ordering a new bottle of that chemical. The database will also allow thorough monitoring of hazards associated with a compound's age (such as peroxide formation in ethers).

Our ultimate goal is to engender a partnership between all members of the Pearson-Michael community to work together for a safe and environmentally sound working environment. We have made significant progress toward this goal, but we can and will do more.

Faculty Profile: continued from page 1

At Tufts, Dr. Harlan's research has focused on two problems. The first involves the development of catalytic systems for the oxidative formation of C-N bonds. This is currently an important problem in oxidation chemistry and its solution would allow more efficient syntheses of many important compounds directly from hydrocarbon precursors. Once the basic reaction chemistry is elucidated, such catalysts may then be elaborated to perform asymmetric reactions, resulting in a chiral product significantly enriched in one enantiomer. A second area of interest is in the preparation of solid state materials from soluble precursors under mild conditions. Traditional high-temperature techniques for the synthesis of inorganic solids typically result in the formation of the thermodynamic product only. Metastable phases may have very interesting and useful properties as well, but can be accessed only via novel synthetic approaches.

Dr. Harlan also maintains an active interest in chemical education. He has taught general chemistry as well as undergraduate and graduate-level courses in inorganic chemistry. This spring he introduced a graduate course on the chemistry of the transition metals which considered topics of current interest in this rapidly evolving area.

Doctoral Degrees Awarded

Brian Abraham (Robbat), "Development of an On-Site Gas Chromatography/Mass Spectrometer for Rapid Detection of Polycyclic Aromatic Hydrocarbons and Polychlorinated Biphenyls at Hazardous Waste Sites."

Michael Crimmins (Urry), "Surface Reactions of Graphite."

Julie Lussier Cullen (Urry), "Some Reactions of Carbodiimides with Selected Metal Carbonyls."

John Flynn (Dewald), "Kinetic Study of the Reduction of Triethyl Phosphite, Trimethyl Phosphite, and Trimethylene Oxide by Sodium in Liquid Ammonia."

Shuh-Ren Lai (Stolow), "Mechanistic Studies of Metal-Ammonia Reductions."

Robert Plourde (d'Alarcao), "Synthetic Probes of Insulin Signal Transduction."

UNDERGRADUATE AWARDS

The Karapatoff-Cobb Award for the Jackson junior with the highest standing in chemistry was given jointly to **Suzanne Fox** and **Kirsten Overoye.**

◆

Nadia Fuleihan received the Angel and Durkee Award that is presented to a Jackson junior.

◆

Joel Goldberg and **Ali Saleem** shared the Tishler Award given to a chemistry student entering senior year.

◆

Robert Whitehouse received the Durkee Award for Research in Chemistry.

◆

MASTER'S DEGREES AWARDED

Roushan A. Hussoin
Clifford Bryant
Martin Dunne
Wei Liu
David Wheeler

BACHELOR'S DEGREES AWARDED

Anatoly Braylovsky
Tai Cho
John Dali
Daniel Damelin
Amy Dennis
Michele Flores
Garrett Forbes
Nadia Fuleihan
Joseph Harb
Jason Howard
Christine Jaworek
Courtney Jenkins
Douglas Lang
David LaValley
Michelle Littleton
Jeffrey Mathieu
Jennifer O'Brien
Jennifer Occhipinti
Andrew Page
Glen Pearlstein
Laura Rozan
Phieng Siliphaivanh
Audre Van Story
Robert Whitehouse
Nicolas Winssinger
Peter Wong
Valerie Wriede
Ryan Zucker

NSF Grants: continued from page 3

In the spring of 1992 the National Science Foundation announced a new $20 million program whose objective was to increase the number of talented American undergraduates enrolling in critical and emerging areas of science. The program requested proposals developed around a selected, and fully justified, critical area of anticipated national human resource priorities. The chemistry department application, submitted by Professor Kounaves on behalf of the department, focused on the commitment of our faculty to environmental chemistry, the quality of research and teaching at Tufts, the available resources and our need for more graduate student support. The proposal requested, in addition to twenty graduate Research Assistant stipends ($14,000 per year each), funds for **(i)** strengthening the department's research capabilities in environmental chemistry; **(ii)** designing and implementing new graduate level lecture and laboratory courses in environmental chemistry, and **(iii)** expanding our recruiting programs to attract higher quality students and larger numbers of minority and women applicants.

On January 23, 1993 the NSF announced the awarding of a fully funded five-year $444,000 Graduate Research Traineeship Grant in Environmental Chemistry to the chemistry department at Tufts University. In response to the program announcement, NSF had received a total of **782** proposals from universities throughout the country. Of the 55 which had their primary focus in chemistry, only ***three*** were funded. This grant is in recognition not only of the quality of our current research programs and faculty but also of our overall goals as a department.

CLASS NOTES

Robert Tricca (Shultz Ph.D. 1985) has moved to Oral B Labs in California.

◆

K.M. Abraham (Urry Ph.D. 1971) has been promoted to Vice President at EIC Labs, Inc. of Norwood, MA.

◆

PLEASE SEND US ANY NEWS ABOUT YOU SO WE CAN EXPAND THIS SECTION IN FUTURE ISSUES

UPCOMING EVENTS

SEMINARS

NOVEMBER 16

Jay Patel
Bellcore

"Liquid Crystal Structures: From Molecules to Devices"

DECEMBER 7

Dr. Arthur Utz
Massachusetts Institute of Technology

"Hydrogenation Studies of Simple Hydrocarbons on Ni(111): The Role of Bulk Hydrogens"

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