

THE NUCLEUS

December 1997

Of the Northeastern Section of the American Chemical Society

Vol. LXXVI, No. 4

Monthly Meeting

*Joint with the M. C. G.
Developing Drugs from
Genes*

Book Review

*Organizing Genius by
Bennis and Biederman*

Norris Award Lecture

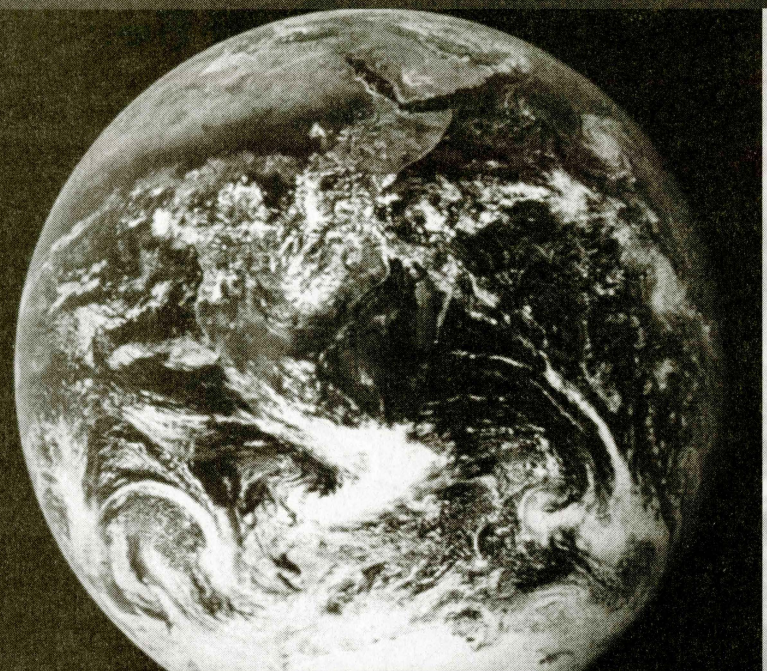
*Text of Dr. Schwartz' address
at the November 13, 1997
meeting*

C&B Amendments

*Amending NESACS
Bylaw III*



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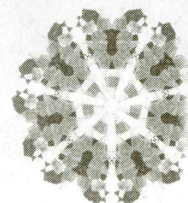
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Cover: *Winter Scene at Boston College*
(photo by G. Gilbert, B.C.)

Deadlines:
February 1998 issue: December 19, 1997 (special Centennial Issue)
March 1998 issue: January 19, 1997

THE NUCLEUS

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Proposed Amendments to the Bylaws

(deletions in brackets []; additions underlined)

Bylaw III, Sec. 4. The Program Committee shall have charge of [all] the regular meetings of the Northeastern Section, and shall secure speakers as needed. [therefor, and shall arrange for a suitable meeting place.] (no change to the balance of this section)

Bylaw III, Sec. 9. It shall be the responsibility of the Professional Relations Committee to make recommendations to the Board of Directors concerning matters bearing on the professional relations and professional status of the membership of the Northeastern Section and career services for these members. The Chair of the Northeastern Section may, with the approval of the Board of Directors, appoint a subcommittee to be known as the Committee on Career Services.

Bylaw III, Sec. 11. The [Hospitality] Local Arrangements Committee, shall, in cooperation with the Program Committee, arrange for a suitable meeting place and the accommodation of speakers. It shall also arrange for the greeting of new members and for [all] social functions of the Northeastern Section. [The Chairman of the Northeastern Section may, with the approval of the Board of Directors, appoint subcommittees to be known as the Preprandial Committee, the Dinner Committee, and the like, which subcommittees shall be responsible to the Hospitality Committee.]

Explanation

Sec. 4. This change makes the bylaws consistent with long-standing practice.

Sec. 9. The addition of the phrase "and career services for these members" to the duties of the Professional Relations Committee is a reflection of the fact that "Career Services" is the title of a recently-created Department of the

Nominations

Philip L. Levins Memorial Prize

Nominations for the Philip L. Levins Memorial Prize for outstanding performance by a graduate student on the way to a career in chemical science should be sent to the Executive Secretary, NESACS, 23 Cottage St., Natick, MA 01760 by **March 1, 1998**. The graduate student's research should be in the area of organic analytical chemistry and may include other areas of organic analytical chemistry such as environmental analysis, biochemical analysis, or polymer analysis.

Nominations may be made by a faculty member, or the student may submit an application. A biographical sketch, transcripts of graduate and undergraduate grades, a description of present research activity and three references must be included. The nomination should be specific concerning the contribution the student has made to the research and publications (if any) with multiple authors.

The award will be presented at the May 1998 Section Meeting. ◇

National ACS, signifying the increased emphasis on this service. The existing NESACS Committee, now known as the Committee on Employment Services would have its name changed to Committee on Career Services and would appear to be properly placed as a function under the Professional Relations Committee.

Sec. 11. The existing title of the Committee, "Hospitality" does not adequately convey the scope of the duties and the importance of its function. It has resulted in difficulty in finding persons to appoint to this position.

Note: Coincident with adoption of these amendments, the replacement of the term Chairman with Chair, etc. can be implemented throughout the bylaws.

These amendments have been approved by the Board of Directors and can be voted at any Section meeting which occurs at least 30 days after publication of this notice. ◇

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Take Beacon Street outbound from Cleveland Circle. After rounding the reservoir, take the second right, into the BC Campus. Park in the garage on your right. The Conte Forum is 300 feet along the same drive-way. Enter and take a stairway on the right to the second floor, to the Shea room.

With the "T", take the "B" line to the end and ask at the guard booth at the Commonwealth Ave. entrance for directions. It's about a 5 min. walk more or less diagonally across the campus toward the stadium and the Conte Forum. ◇

CHICKENS AND EGGS

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Monthly Meeting

The 793rd Meeting of the Northeastern Section of the American Chemical Society

Joint Meeting with the Medicinal Chemistry Group
Developing Drugs from Genes: Finding Drug Leads in DNA Sequences
Thursday, December 11, 1997

Boston College, Chestnut Hill, MA, Shea Room, Conte Forum

- 3:30 Dr. David Merberg, Astra Research Center-Boston
Bioinformatics at Astra Research
- 4:30 Dr. Gerald F. Vovis, Genome Therapeutics Corporation
Using Genomics to Go From Gene to Screen
- 5:30 Social Hour; a table of Career Services Literature and Aids will be available.
- 6:30 Dinner
- 7:30 Evening Meeting, Dr. M. Idelson, Chair, presiding
Speaker and title to be announced

Dinner reservations should be made no later than noon, December 4. Please call or fax Marilou Cashman at (800) 872-2054. Reservations not cancelled at least 24 hours in advance must be paid. Members, \$25.00; Non-members, \$28.00; Retirees, \$15.00; Students, \$ 8.00. THE PUBLIC IS INVITED.

Anyone who needs special services or transportation, please call Marilou Cashman a few days in advance so that suitable arrangements can be made. **Free Parking** In the parking garage off Beacon St. See directions on page 4.

Next meeting: January 8, 1998 at the Holiday Inn, 1200 Beacon Street, Brookline, MA. Speaker from Arthur D. Little Company on Fuel cells.

Career Services

The Northeastern Section Career Services Committee has the following aids to both Employers and Applicants: (For a complete list, see the October issue, page 17)

Videos on Career Transitions, Job Searches, Résumé preparation, Job Interviews
These may be borrowed for a one week period

Brochures on Targeting the Job Market, Current Trends in chemical technology, business, and employment. How-to books on resume preparation, and job interviews
All of the above are available free of charge.

Listings: Employer mailing lists, list of positions available and employers registered at the Las Vegas ACS meeting
Résumés are solicited from members who are seeking positions and will be kept on file for six months, unless renewed. Résumés that have not been confirmed will be deleted January 1, 1998.

ACS News

ACS Congressional Fellowship

The ACS Office of Legislative and Government Affairs is seeking applicants for its Congressional Fellowship Program for the 1998-99 term. The Program places an ACS member in a congressional office to:

- gain first-hand knowledge of the operation of the legislative branch;
- make scientific and technical expertise available to the government; and
- forge links between the scientific and Government communities.

Applications are due January 1, 1998 and must include a letter of intent, a resume, and two letters of reference. The letter of intent should be two pages in length explaining your reasons for applying and your background in science and public policy, as well as what you would seek to accomplish as a Fellow. The letters of reference are to be sent directly to ACS. ACS provides a stipend in the high \$40,000s and an additional allowance for relocation expenses. Support from other sources, such as a present employer, may be allowed. The position is available in the fall of 1998.

Application materials should be sent to: Congressional Fellowship Program Office of Legislative and Government Affairs

American Chemical Society
1155 16th Street, NW
Washington, DC 20036
For more information, contact Margaret Carey, 202-872-4467 or m_carey@acs.org. ◇

Employers may list positions available.

For information on any of the above, call Truman or Arlene Light, (781) 862-3048; e-mail: tslight@aol.com. In New Hampshire, call Sonja Fetela at (603) 352-1415; info@polyonics.com ◇



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For Additional Information contact: Professor John Roebber, Executive Officer
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Book Review

Organizing Genius. The Secrets of Creative Collaboration,

by Warren T. Bennis and Patricia Ward Biederman (Addison Wesley, 1997, 238 pp., \$24.00 hardcover)

Reviewed by Dennis J. Sardella, Department of Chemistry, Boston College

About a year ago, someone in our department posted the title page of a particle physics paper on our departmental bulletin board. The list of authors occupied three-quarters of the page and contained nearly a hundred names. Posting it was, I suppose, intended as a wry commentary on the tendency in our society to demand explicit recognition of everyone who has made any contribution, however minuscule, to the achievement of some purpose - not unlike the bemusement I sometimes feel when watching the credits of a film in which even the catering service is acknowledged! It seemed to me to highlight two apparently inconsistent characteristics of contemporary society: its increasingly radically individual character (first pointed out so forcefully by sociologist Robert Bellah and his colleagues in *Habits of the Heart*) and its increasing complexity and interconnectedness (see, for example, Stephen Covey's *The 7 Habits of Highly Effective People*). Speaking metaphorically, Americans all want to be Mikhail Baryshnikov, but most of us labor in the relative obscurity of the *corps de ballet*. A stage full of prima donnas, all competing for the limelight, becomes chaotic and unmanageable, but the alternative, in which only one person's ambitions are fulfilled while everyone else's are frustrated, seems no more palatable.

Warren Bennis and Patricia Ward Biederman, in *Organizing Genius. The Secrets of Creative Collaboration*, examine the question of how individuality and collaboration can coexist, and even thrive, in the contemporary workplace. They point out that "even as the lone hero continues to gallop through

our imaginations, shattering obstacles with silver bullets, leaping tall buildings in a single bound, we know there is an alternate reality. Throughout history groups of people, often without conscious design, have successfully blended individual and collective effort to create something wonderful."

Such groups, whose work has led to a fundamental change in some aspect of society (or in the words of Apple founder Steven Jobs, have "Put a dent in the universe"), they call *Great Groups*.

The rationale for studying Great Groups, according to the authors, is clear and the potential payoff great: "Great Groups rarely have morale problems. Intrinsically motivated, for the most part, people in them are buoyed by the joy of problem solving. Focused on a fascinating project, they are oblivious to the nettles of working together in ordinary circumstances."

What group leader, manager, or department chair would not like to lead such a group? *Organizing Genius* consists of a series of detailed case studies

of seven disparate groups, designed to elicit inductively the underlying principles and conditions that create and sustain the Great Group. They are the Walt Disney animation organization, the PARC Group at Xerox and the development group at Apple that ushered in the age of the personal computer, the Clinton election team, the Lockheed team that designed a whole series of revolutionary military planes, including the Stealth Fighter, the innovative and quirky Black Mountain College in the hills of western North Carolina, and the Manhattan Project. While Bennis and Biederman do not describe their method of investigation in detail, each profile appears to have been based on a combination of newspaper and magazine articles, along with personal interviews with group members and leaders. Each group (except for the Xerox and Apple groups, which are treated together) is profiled in a chapter that surveys their achievements, makeup, characteristics and *modus operandi*.

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Book Review

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"Troupe Disney" describes the Walt Disney animation organization that, beginning with its 1937 release of *Snow White and the Seven Dwarfs*, virtually created the animated feature film and has consistently been its most innovative practitioner. The impact upon contemporary life - for good or ill - is clear to anyone with access to a television set and children. On a more substantive level, one might even argue (Bennis and Biederman do not) that by allowing the film-maker to visually create a world unbounded by the constraints of physical reality, it was a pre-computer forerunner of virtual reality.

"A Computer With a Rebel Heart" focuses on the PARC Group at Xerox that initiated the idea of the personal computer and the group at Apple that perfected and brought it to market, triggering what is perhaps the most pervasive social change in contemporary life, an ongoing change whose

final form is yet to be determined. Perhaps more than anything else, the proliferation of personal computers and their networking has intensified the interdependence of modern socio-economic life.

"Selling a Place Called Hope" deals with the election team that installed a Democrat in the White House for the first time in nearly a generation. As much as anything else, its success is attributable to the team's internal coordination and its effective exploitation of computer-based information and communication systems.

"The Skunk Works" describes the top-secret division at Lockheed founded by Clarence "Kelly" Johnson in 1943 to develop the first US jet fighter. In the intervening five decades its remarkable achievements, including the U-2 reconnaissance plane and the F-117A Stealth fighter-bomber, relied on its ability to develop methods and materials that did not exist when the planes were first envisioned.

"Experiment at Black Mountain,"

the most unusual chapter in the book, deals with Black Mountain College, a perpetually underfunded, progressive school founded during the Depression and staffed by a series of idiosyncratic artists and writers, and attended by a small cadre of students, most of whom never bothered to graduate. In its brief life span of twenty-three years, it exercised an influence in artistic and literary circles out of all proportion to its size.

"The Manhattan Project" covers ground that will be familiar to most scientists, although Bennis and Biederman's view of Oppenheimer and General Groves as complementary leaders is more even-handed than most treatments I have seen.

In a summary chapter entitled "Take-Home Lessons," Bennis and Biederman articulate fifteen characteristics of Great Groups. Several deal with the individuals that make up the group: outstanding people with the ability to work together, and a strong leader skilled at recognizing and recruiting great talent, in placing each person in the most appropriate job, and in acting as a buffer between the group and the wider bureaucracy. Others pertain to the group as a whole, and its culture: highly focused, with a transcendent sense of mission supplemented by a level of paranoia that provides an external impetus to the work, and an atmosphere that encourages each member to express his or her own individuality in service to the group. (There can also be a darker side to Great Groups: an absorption in the project that can work to the detriment of family lives, a fascination with achieving the goal of the project that can ignore its moral implications, or even just a culture that can become rather juvenile in its behavior.)

Organizing Genius makes interesting reading if only for the glimpse it provides of the inner dynamics of several Great Groups. It also has the potential to stimulate reflection on groups (Great or otherwise) with which the reader may have been associated, and perhaps to suggest stratagems by which each of us can help to nudge our own work groups in the direction of greatness. ♦

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Meeting Report

Text of the James Flack Norris Award Lecture, November 13, 1997

What I've Learned from My Students

by A. Truman Schwartz

Modified by the author for the purpose of publication

I am obviously very pleased and honored to accept the James Flack Norris Award, and I will strive to be worthy of the standard set by my illustrious predecessors. I would not be here tonight were it not for a group of outstanding colleagues and friends. I am particularly grateful to the members of the Macalester College chemistry department for their unfailing support and for creating an environment where excellent teaching is modeled,

expected, and rewarded. The Norris Award honors their contributions as well as mine. I have also had the pleasure of working closely with many chemists from across the country, far too many to mention by name. Some of them, who are equally qualified for this honor, wrote letters on my behalf, and I thank them most sincerely.

I have learned much from my teachers, my colleagues, my friends, and my family, and I am deeply in their debt. But I want to share with you a few of the many things that I have learned from my severest critics—my students. One of the most important lessons came early in my career. **It is possible to teach students who are smarter than you are.** Thank goodness! Otherwise I would be out of a job. This moment of truth came during my second year at Macalester, when David Huestis was one of only two students in a seminar in advanced physical chemistry. It soon became apparent to me that David's brain could do all sorts of things mine could not. Of course I had

met many of my intellectual superiors before, but I had never admitted to myself that such a person might be in my classroom. After a brief moment of panic, I rationalized that I was older, had more education and experience, and had acquired a few tricks along the way. So I assigned David problems in quantum mechanics that I could not solve. At least I knew enough to recognize the correct answers when I saw them and to make occasional suggestions. David did not appear to suffer from this method of instruction, as an NSF Graduate Fellowship and a Ph.D. in chemical physics from CalTech subsequently confirmed.

Since the days of David Huestis I have encountered a legion of students who have mental equipment that is better than mine, or at least in better working order. Such students are wonderful resources. Taking advantage of their knowledge can be of great benefit to the instructor, the other students, and especially the bright students themselves. I have always had students with computer skills far superior

to mine, and I have exploited them unmercifully. Some students are particularly well informed about topics they have been investigating in their undergraduate research projects. I do not hesitate to invite such students to give guest lectures. For example, I recall a beautifully lucid lecture that Chad Rienstra, now a Howard Hughes Fellow at MIT, gave to my physical chemistry class. He was more familiar with some of the newer techniques and the associated theory than I was, and he did a better job than I could have.

Although it is great fun to teach outstanding students like Chad, no great skill is required. It is difficult to mess them up; they teach themselves. They learn in spite of you, and occasionally because of you. But the instructor does need to know when to help and when to get out of the way.

Unfortunately, the great majority of students are not as well equipped, prepared, and motivated, and those students present a different sort of challenge. Once while correcting an examination I complained to my wife that I was pretty good at teaching students who were able and interested, but I was frustratingly unsuccessful with those who neither knew nor cared. "You're in the wrong business," she said. Beverly teaches adolescents with learning disabilities, a task that makes my job trivially simple. I envy and admire her patience, tolerance, compassion, and effectiveness. She deserves a teaching award far more than I do.

In spite of Bev's advice, I persisted and I have learned much from my less-than-stellar students. Among other things, they have challenged me to find new ways of presenting ideas, fresh analogies, and clearer explanations. Some of these strategies have evolved slowly and painstakingly; some have come in a flash during a class or conversation. In short, **my students have helped me understand learning and thus they have improved my teaching.**

I have also found that students who are beginners in chemistry can ask profound and insightful questions that would never occur to a major.

That is one reason why I have dedicated so much of my career to non-science majors. **Never underestimate the insight of students**, including those who do not aspire to careers in science and technology.

Let me offer only one instance out of many. My initial pedagogical approach with non-science majors was to present the important ideas of chemistry in an historical context, generally moving from phenomena to theory. This meant that I taught elementary periodicity before I introduced the details of modern atomic structure—a sequence that I continue to advocate and use. In the process, I describe how Mendeleev's system was able to accommodate newly discovered elements such as the inert gases and the actinides. One year a philosophy major asked what seemed a naive question: "How do we know that there aren't any elements with atomic weights lighter than that of hydrogen?" I replied that the answer would be clear when we got to atomic structure.

It so happened that later that week I was reading the English translation of the sixth edition of Mendeleev's textbook, written after the discovery of argon and helium. In a footnote, the great Russian chemist speculated that there might be undiscovered inert gases, with atomic weights less than that of hydrogen, and that such an element or elements might make up the luminiferous ether. In terms of his knowledge of atomic structure, my student was about where Mendeleev had been, and he had reached the same conclusion. That's pretty impressive! It reminds me of an eloquent statement by J. Robert Oppenheimer:

We have learned that wonder resides, and paradox and puzzlement and harmony and order, in many ordinary things; in the stuff that matter is made of, in the flow of the ocean's currents, in the migration of the birds, in bubble and drop and clod. We have come to respect the most pedestrian curiosity as a likely origin of learning unexpected a lovely

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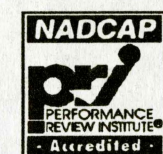
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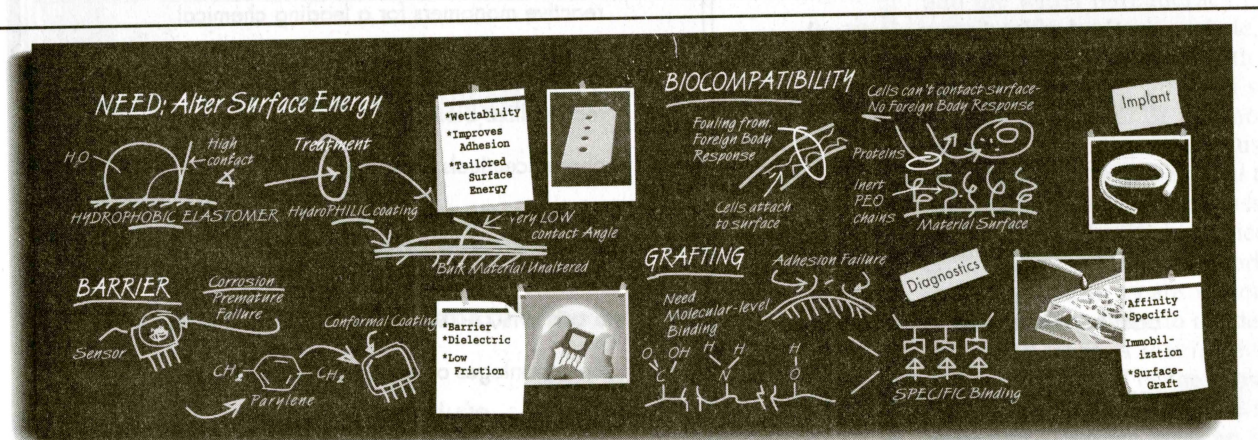
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Norris Award Lecture

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things about our world.

This experience, and many others, have led me to realize that **it is a grave mistake to be condescending and patronizing to any students.** They must all be treated with empathy and respect. Indeed, I suspect that much of the chemophobia that we decry may have its origins in our attitudes. The most telling indictment of the image projected by chemists came from a political science major in my course for nonscientists. On the first day of class, I generally ask the students to call out words that they associate with chemistry and I record them on the board. Some of the responses are negative: "difficult, smelly, boring, dangerous." Other students, who have had good experiences with chemistry in high school or are attempting to curry favor call out: "interesting, challenging, important." But I was completely unprepared for "antiseptically arrogant." It stopped me cold. Think of

the meaning of those two words. If that is how we project chemistry to our students and to the public, we are doing our science a terrible disservice.

I have come to the conclusion that the attitudes we model as teachers and, by extension, **the attitudes our students acquire are probably at least as important as the specific facts we convey.** For one thing, attitudes are generally longer lasting. All students bring them as part of their baggage, but we need not passively and grudgingly accept them. Where necessary, we must endeavor to change preconceived notions—that is what education is all about. And chemistry is a superb catalyst for such transformations.

My list of desirable outcomes of chemistry teaching includes the development and reinforcement of certain characteristics. **Curiosity** motivates what chemists do. But we cannot satisfy that curiosity without **disciplined hard work** and **imagination.** I have on the wall of my office a poster published by the ACS. It quotes Vladimir Nabokov—literary scholar, novelist,

and lepidopterist: "There is no science without fancy, and no art without fact." All our courses must fan the flame of fancy. Science and society also require citizens who are willing to take **intellectual risks**, to think for themselves, to learn by themselves, and to be prepared to live in a world that does not yet exist. Many of our students are frightened and insecure. We must model risk taking, and how better to do so than by taking risks in our teaching.

I am convinced that what the world needs more than anything else is a well developed **sense of responsibility** in each of its inhabitants. As teachers, one of *our* major responsibilities is to convince young people of their obligations to themselves, to their fellow human beings, to our planet, and to the truth. Those obligations include establishing priorities and making difficult decisions. A **sense of perspective** can keep the alternatives in **balance**, a **sense of humor** can make the choices tolerable.

Many of the choices we face in modern society are filled with perplex-

ing **ambiguity.** Anyone who hopes to exist in our complex world with any degree of equanimity must at least learn to live with ambiguity. Like martinis and the olives in them, ambiguity is an acquired taste, and not particularly appealing to many literal-minded freshmen. A chemistry course can be a wonderful place to acquire a tolerance for ambiguity—maybe even a delight in it. The equation $\lambda = h/mv$ is as full of multiple meanings as a Wallace Stevens poem. But unfortunately, chemistry is too often taught *ex cathedra*, as if totally bereft of the beauty of ambiguity. Roald Hoffmann has observed that "the vaunted openness of science is not obvious to our apprentices." I suspect some thoughtful students flee chemistry because we mistakenly protect them from the uncertainty and controversy that fascinates and stimulates us as professional chemists. This misrepresents chemistry and hardly prepares our students for the contemporary world. "Not to be absolutely certain," Bertrand Russell once wrote, "is one of the essential things of reality."

I believe that the final test of a college education is whether the students have discovered the **ultimate human high.** Other old timers will know that super satisfaction is not provided by sex, booze, or baseball. I love all three of these great ameliorations of the human condition. But when it comes to kicks, nothing beats learning something new. It is, above all, the acquisition and utilization of knowledge that make us human. That is what human life is all about—the irrepensible itch to learn. As important as this wonderful insight is, it cannot be taught, it must be discovered. But as teachers, we can create the environment and model the behavior that facilitates this self-discovery.

Another characteristic we can share with our students is compassion. **Students are often starved for concern and compassion**, especially in large, impersonal institutions. I learned this the year I taught as a visiting professor at the University of Wisconsin. At Macalester, sections of general chemistry usually have about

35 or 40 students, and advanced courses are smaller. At Madison I faced a general chemistry class of 350. I enjoyed the great support I received there, but by the end of the semester I was frustrated. Twice a week I stood before a sea of anonymous faces and performed—part evangelist, part huckster, part magician. But I questioned whether I was teaching. My TA's were doing that. Very few students visited me during office hours and I did not know many names.

At the end of the term I administered the standard departmental course evaluation, expecting the worst. I was amazed at the response. Many students, most of whom I had never spoken to, commented on my availability, my willingness to be of help, my genuine interest in their learning and their personal well-being. "It is wonderful," someone wrote, "to have a professor who really cares about me." It was really rather poignant. My time investment beyond the formal lectures was really quite modest. I conducted optional weekly review sessions, visited each laboratory and recitation section once or twice during the semester, and was present but generally undisturbed during my lonely office hours. The fact that even these few gestures were viewed as an uncommon commitment to students was deeply troubling. And I remind you that this was in a department that has a long tradition and well-deserved reputation for excellent undergraduate teaching. A cynic might conclude that all a professor needs to do is just appear interested in his or her students. That's enough. They'll love you for it, and they'll leave you alone.

Of course I recognize that the mission of a research university is not that of a liberal arts college. At the latter, our primary product is educated men and women. New knowledge is a gratifying by-product that sometimes emerges, but it is not our *raison d'être*. I teach students; chemistry is simply the vehicle. Because we are teachers, first and foremost, and because our classes are small, we have the luxury and joy of knowing our undergraduates well.

Something else course evaluations have taught me is that **students love and learn from demonstrations.** Indeed, a demonstration may be worth more than a thousand words. Perhaps part of the fascination lies in the remote possibility that the demonstrator might self-destruct or the greater likelihood that the demonstration won't work. When I was younger, I was a little offended that my demonstrations always won higher praise than my lucid lectures. But I have long since learned that I should be grateful to have nature as an ally in my teaching. Demonstrations not only serve the important function of keeping students awake, they can provide a nexus between phenomena and theory. I am convinced that many people find chemistry difficult because to understand it one must simultaneously inhabit the tangible world of stuff and the realm of the abstractions that we have invented to make the stuff intelligible. Demonstrations and experiments can help facilitate that synthesis.

I grant that multi-media technology can capture and transmit images of the reactions we do at the lecture table

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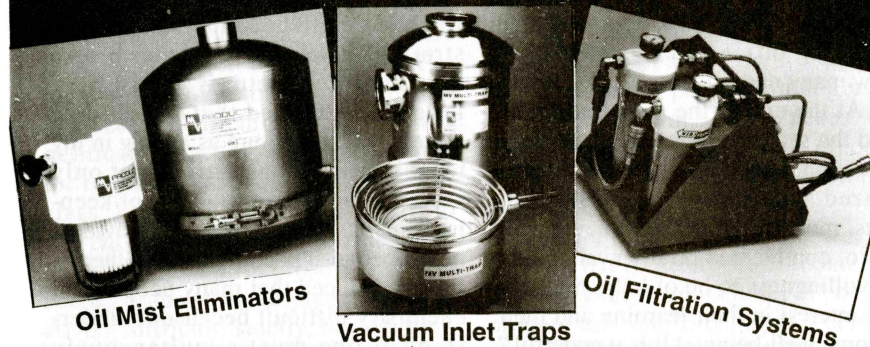
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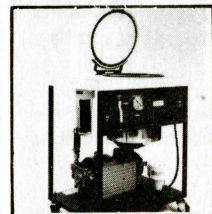


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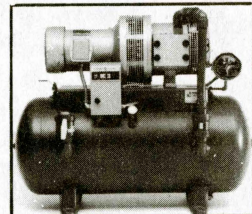


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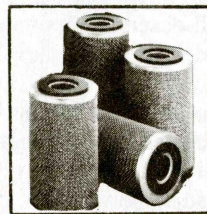
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Norris Award Lecture

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and some that we cannot do, but I think videos are a poor substitute for the real thing. If OSHA regulations, college and university financial officers, and the publishers of slick software ever succeed in stamping out demonstrations and the undergraduate teaching laboratory, it will be a dark day for chemistry. To be sure, the computer jocks have done some pretty spectacular stuff, but simulated chemistry is about as much fun as simulated sex. Why settle for virtual reality and artificial intelligence while some of the old fashioned kind still exists?

I have found that when I visit with my former students, they almost never comment on specific facts that I tried to teach them. They do mention the skills they have acquired and continue to use daily. Like attitudes, **skills are probably more significant than course content.** Very often, ex-students who have entered challenging Ph.D. programs report that some of their fellow graduate students, who did their undergraduate work at research institutions offering more advanced courses than Macalester can provide, arrived with a stronger factual base. However, after a semester or so, the advantage is erased, and the ability to think, study, and learn becomes more important.

Probably the three most useful skills I acquired in high school were parsing sentences, doing proofs in plane geometry, and typing. I use them all every day, but only one of them, typing, directly. Every time I write or speak, part of my brain is diagramming sentences the way Miss Walters taught me my high school of one hundred students in Freeman, South Dakota. And whenever I try to solve a problem or analyze an argument I am using skills that my father demonstrated in his geometry class.

I believe that there are a handful of skills that should be part of the intellectual equipment of any educated man or woman. There are many ways to acquire these skills, but a chemistry course is as good as any and better

than most. Consider, for example, **problem solving.** Not all problems are quantitative, though many in chemistry are. To pretend otherwise is to misrepresent the science. Some students may not like it, but numbers are part of what we do. If they see the point of the calculations, students will do them. Words are also part of chemistry, and my colleagues and I require written and oral reports throughout our curriculum. **Careful reading and clear communication** are too important to be left to English and speech departments. And the essential attributes of **logical and critical thinking** can be practiced in a chemistry class as well as in a philosophy course. You will also note that not all of these skills are equally easy to acquire. It may be too much to hope for *graceful* writing and speaking from all Americans—there are too many counter examples—but it is a consummation devoutly to be wished.

Chemistry and the other physical sciences are particularly effective in teaching the last two entries on my list. The first step of discovery is identifying the significant variables. Therefore, learning to **discriminate between important and unimportant information**, between sense and nonsense, between signal and noise is essential. Please note that I am talking about more than the manipulation of information. Modern technology and modern students very good at that. The web is overflowing with information of variable veracity, but even reliable information is not enough. My fear is that knowledge will be lost in an excess of information and wisdom obscured by what we take for knowledge. But I am not so foolhardy as to claim that a study of chemistry is the key to wisdom. Achieving knowledge is difficult enough.

Finally, the development of a **sense of what is physically reasonable and possible** can best come via laboratory and experimental activities. Hence, I conclude that a *well-designed* laboratory component should be part of all introductory chemistry courses for all audiences. Note the emphasis on well-designed. A poorly conceived

and implemented laboratory experiment may not be an experiment at all, but rather an exercise in mindless manipulation or rote recipe reading. Participating in a research project is probably the best way for an undergraduate to come to understand the physical universe and our strategies for interrogating it.

Although skills and attitudes are vitally important, they cannot be taught in isolation. **Content is the necessary substrate on which these attributes must be developed.** I happen to believe that not all facts, all works, and all subjects are equally fruitful in generating these habits of mind. **Some sources are simply richer than others**, and to substitute John Updike for William Shakespeare denies this fundamental fact. To me, the phenomena and concepts of chemistry are particularly fertile ground for conveying essential attributes of the examined life.

Those of us who teach chemistry are well advised to listen to our students and develop some understanding of what they hope to achieve. Of course we must also have a vision of what we, as teachers, wish to accomplish. We are in serious trouble if those two wave functions are orthogonal. I am not suggesting that the teacher must simply provide what the students think they want. Education, experience, and maturity do carry obligations. But they do not give us the right to completely ignore the wishes of others.

Over the past 31 years I have seen some interesting changes in my students. My favorites were those of the late sixties and early seventies. In many ways, they were a collective pain in the posterior—not only rebelling, but revolting as well. Their legitimate opposition to the American involvement in Vietnam and their distrust of authority led them to question everything and everyone, including their professors. That was their greatest contribution. The questions were usually impertinent, but sometimes pertinent as well. One such question came from Bob Elwell, a member of my physical chemistry class in 1969.

Toward the end of my derivation of the Carnot cycle, Bob burst in with the memorable words, "What's the use of all this thermodynamics crap?"—only he didn't say "crap." He wasn't quite that polite. I suppose Bob thought he was being provocative, but in fact he had lobbed me a fat pitch that I managed to hit out of the park. After all, it is difficult to think of anything more useful than the laws of thermodynamics. But, intoxicated as I was by the elegant formalism of J. Willard Gibbs and James Beattie, I was not bothering with practicalities like steam engines and spontaneous chemical reactions.

By the way, Bob Elwell went on to earn a Ph.D. in analytical chemistry, found and manage his own analytical laboratory, and later add a law degree to help him cope with the explosion of regulatory entropy. Like the great majority of his classmates, he turned out to be a very solid contributing citizen. I am grateful to Bob because his impolite and impolitic question led me to emphasize the utility of chemistry and its societal significance. This strategy has influenced all of my teaching and is particularly evident in *Chemistry in Context*. In this ACS-sponsored college-level text for non-scientists, my colleagues and I present chemistry via such contemporary issues as ozone depletion, global warming, alternate energy sources, and genetic engineering. The chemistry is introduced as it is needed to inform an understanding of these issues and the science is closely coupled to political, social, and economic considerations.

Paying attention to the applications and misapplications of chemistry does not trivialize or debase the discipline. What it does do is to help motivate students. The *Chemistry in Context* approach has proved to be successful with nonscience majors, but some of us have found that it also works well for science majors, including chemists. A knowledge of the promise and peril of the chemical sciences is, if anything, more important in the chemist than in the general public. Of course, the great majority of those enrolled in introductory chemistry

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Norris Award Lecture

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classes have no intention of becoming chemists. Nevertheless, the traditional chemistry curriculum, from high school through graduate school, appears to have been designed to provide a chemistry faculty for Harvard and MIT. That is a very small tail trying to wag a very large dog.

My students have been guinea pigs for a number of educational experiments. For the most part, they have acquiesced with generosity and good humor. No doubt new generations of students will face similar challenges in the future. I do not recall any time in my career where there has been more ferment in chemical education. We are confronted with a dazzling array of educational philosophy, pedagogical theory, instructional strategy, hardware and software. Half a dozen multi-million dollar NSF-sponsored curriculum reform projects are underway. I am involved with two of these, ChemLinks (based at Beloit College) and the Modular Chemistry Consortium (based in Berkeley). Both of these consortial projects are developing, testing, and using modules to teach introductory college chemistry. As a result of such activities, chemistry curricula in American colleges and universities are no longer identical. It is even possible that chemistry textbooks may some day become distinguishable in ways that are more significant than the color of their covers.

These are heady times, but I am convinced that we must resist the temptation to succumb to fashion and assume that there is some single ideal way to teach our complex and beautiful subject. That notion is clearly naive. A good teacher will take the best that the educational researchers, the curriculum innovators, the textbook authors, and the software developers have to offer. He or she will adopt and adapt new strategies to complement pre-existing instructional strengths and to develop new ones. The teacher must grow with the discipline, but in order to be effective, the teacher must be comfortable with the style and strate-

gies employed. Chemistry is the study of change, but keep in mind that not all change is necessarily for the good.

There is one final lesson that I hope my students will teach me, and that is **when it is time to retire**. One of the greatest joys of the academic life is its annual cycle. During the three years I spent as an industrial chemist I never fully adapted to a life that was simply one damn thing after another. Every May, the academic year ends with a whimper (never a bang in my experience). But no matter how depressing those final examinations and term papers might be, a professor can always look forward to September, a literally clean slate, and one more chance to get it right. Unfortunately, there is a risk associated with this rejuvenating rhythm—the risk of staying on when our powers have faded, like Frank Sinatra on yet another concert tour. When I no longer feel a rush of adrenaline and anticipation as the new students start moving into their residence halls, I hope I have the good sense to put down my chalk and hang up my lab coat. I am counting on my students to tell me when that time comes.

Let me end by offering a few scattered aphorisms, again informed by my experience with my students. Most chemistry teachers are obsessed with covering the course content. Completing the syllabus makes us feel good, satisfied, fulfilled. We've done our job. But when the metaphor implicit in the idea of coverage is examined, its weaknesses become apparent. It suggests that a coat of paint has been applied. Unfortunately, that coat may be very superficial, only thick enough to get through the final examination. It could peel off next week. **It's not what we cover that counts; it's what we uncover. What matters is not so much what we give to our students, but what they take from us**, though I would like to think that the two are not unrelated. Ultimately the test of education and educational innovation is this: **Are the students thinking? Are they intellectually engaged? Are they learning?**

Incidentally, such concerns are not

exclusive to the United States. Last June I spent 12 days in Russia, speaking to faculty, students, and teachers at four universities. I was invited to talk about recent developments in undergraduate chemical education in this country. Although the Russians manage to pack a good deal more chemistry into their secondary education than we do, I heard some familiar complaints. Members of the public are fearful and suspicious of chemistry, chemicals, and chemists; and they do not know enough to weigh the risks and benefits of chemical technology. Obviously, **exposure to chemistry is insufficient**; exposure does not equal education.

This is an exciting time to be a chemistry teacher. We have overcome some formidable activation energy barriers, and some interesting reactions are taking place. I predict that within the next decade some exciting new products will appear—new books, tapes, disks, and software. But I repeat, our most important products are educated men and women. Finally, with all my previous emphasis on making chemistry relevant to students, please remember that **some things are worth knowing** not just because they are useful, but because they are profound and beautiful and enrich human existence. Teachers are transmitters of this knowledge, insight, and wonder.

I said earlier that the greatest human delight comes from learning something new. If that is true, the second greatest thrill certainly must be teaching someone something new. I have been blessed with a career that has given me the opportunity to experience both of these joys. I thank you for the honor you have paid me. I am fully aware of the great tradition of the James Flack Norris Award. I hope I will not appear ungrateful when I say that I have received hundreds of awards that I value even more highly than this. They are human rewards with names like Chad Rienstra and Hemaka Rajapakse and Holly Vande Wall. My students represent my best and perhaps only chance for immortality; it would be greedy to expect more.

◇

Historical Notes

Biographies of recently deceased members, continued from the October, 1997 issue.

by Edward R. Atkinson,
Amherst, Mass.

A.M. Pappenheimer, Jr., 87, known to his colleagues as "Pap", died on March 21, 1995 (but the ACS was only recently notified). He and his students were recognized as authorities on the bacterial disease diphtheria, and on the mechanism of bacterial diseases, in general.

The son of a professor of pathology at Columbia University, Pap entered Harvard University in 1926 as a major in biological science. He became aware of the importance of organic chemistry in this field and so, on the advice of James B. Conant, obtained the Ph.D. under Conant in 1932. After postdoctoral work in bacteriology he joined the Massachusetts Antitoxin Laboratory in 1935 and there made his first major discovery which led to the production of gram amounts of pure diphtheria toxin. In 1941 he joined the faculty of the New York University medical school. In 1958 he returned to Harvard as Professor of Biology. He retired in 1979 but remained active in laboratory work in the Department of Molecular and Cellular Biology.

Pap's extracurricular activities were notable: As Master of Dunster House for nine years he shared his enthusiasm for music, literature, and sports with undergraduate students. He insisted that the atmosphere in the House remain conducive to academic pursuits despite the turmoil of the Vietnam War years. As a player of clarinet and viola he was responsible for the now famous Dunster House chamber music series that has delighted music lovers in the Boston area.

The above account is but a small excerpt from a Memorial Minute published by the Faculty of Arts and Science at Harvard. It was written by six of Pap's colleagues. I shall be glad to

send a copy on request.

John E. Roberts, 77, died on June 9, 1997. He was a native of Laconia, N.H. and received the B.S. in chemistry at the University of New Hampshire in 1942, the M.S. a year later, and the Ph.D. from Cornell University in 1947. His entire professional career was as a faculty member of the chemistry department at the University of Massachusetts, Amherst, where he taught analytical chemistry. He retired to Keene, N.H. in 1986. During his graduate year at UNH John acquired some notoriety as a devil's advocate in a seminar in which faculty from the education department tried to tell chemists how to teach chemistry. Roberts was a member of several professional societies and of Mu of Alpha Chi Sigma.

Nils O. Sandner, 70, died on May 16, 1997. He was a native of Waterbury, Conn., a World War II veteran, and a chemical engineering graduate of Yale University in 1951. He was employed by the U.S. Rubber Co. in Naugatuck, Conn. and later by the Stow-Woodward Co. in Newton, Mass. From 1971 until the early 1980's he was employed by the Converse Rubber Co. in Winchester, Mass. He then was a co-founder of the KRC Co. in Andover, Mass. Following the sale of that company in 1989 he became a consulting engineer for SAMCO in New Hampshire. He was a member of Chi of Alpha Chi Sigma.

Robina Murdock Suby, 81, died on December 16, 1996. She was a native of Glasgow who came to the USA as a child. She was a chemistry major at Wellesley College and was at one time employed in chemical research at the Massachusetts General Hospital. As the wife of Dr. Howard Suby she raised a family of two sons and two daughters and was active in the alumnae activities of her alma mater.

George Wald, 90, a Nobel Laureate and a well-known peace advocate, died on April 12, 1997 after a long period of declining health. He was a New York native who received the B.S. at New York University (1927), the A.M. (1928), and Ph.D. (1932) from Columbia University. He joined the Harvard University faculty as a bio-

chemist in 1934 and there carried out research on the chemistry of sight, with emphasis on the role of vitamin A. He received the Nobel Prize in Physiology and Medicine in 1967. He retired as Higgins Professor of Biology at Harvard in 1977.

Professor Wald was the recipient of many honors and was a Fellow and chairman of several scientific societies. He achieved fame as an educator (he taught freshman biology at Harvard for 16 years) and author, including a series on the origin of life. He was one of the first academics to condemn the U.S. activity in Vietnam when he defined that activity as "the most shameful episode in the whole of American history." He later was a member of a U.S. delegation to a "Crimes Against Iran" conference in Teheran. A memorial gathering for George Wald was held on May 9 in the courtyard of the Harvard Biological Laboratories.

It is likely that a more complete account of Wald's life will appear as a Memorial Minute of Harvard's Faculty of Arts and Science in the *Harvard Gazette*.

Karen E. Wetterhahn, 48, died on June 8, 1997 from the delayed effects of accidental exposure to dimethylmercury. Because of its unusual features her death attracted much notice in the press and in ACS publications. The biographical data and tributes found there need not be repeated here. For details see: *Chem. and Engin. News*, June 16, 1997, p. 11; June 23, 1997, pp. 5 and 81; the *Boston Globe*, June 10, 1997; *The Nucleus* 76, (1) (September, 1997), p. 12.

A memorial symposium was held at Dartmouth College on September 25, 1997. ◇

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Calendar

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Check the NESACS Homepage for late additions:
<http://www.tiac.net/users/obermayr/nescacs>

Nov. 18

Prof. John Straub (Boston Univ.)
"Finding the Needle in the Haystack: Algorithms for Global Energy Minimization of Complex Molecular Systems"
Brandeis University
Gerstenzang, Rm 122, at 4:00 PM

Prof. Dudley Herschbach (Harvard Univ.)
"Liberating Catalysis from Thermodynamics: An Easy Way to Make Benzene from Ethane"
Tufts University
Pearson Hall, Rm 106, at 4:30 PM

Nov. 19

Dr. Paul G. Willard (Brown Univ.)
"TBA"
UMass Dartmouth
Sci. & Eng. Bldg., Rm. 305, at 4:00 PM

Nov. 20

Prof. Thomas Katz (Columbia Univ.)
"Helical Conjugated Molecules"
Boston College
Merkert Chemistry Ctr., Rm 127, at 4:00 PM
Prof. Paul Goetinck (Harvard Med. School)
"C-Terminal G-3 Domain of Aggregan: Its Influence on Glycosaminoglycan Addition"
Mass. Inst. of Technology
Faculty Club, Glycobiology Dinner Meeting at 6:30 PM
Call (617) 642-0025 for reservations

Dr. Michael Laposata (Mass. General Hospital)
"Chemical Diagnosis of Alcoholism"
NEAACC Educational Program
DoubleTree Guest Suites Hotel, Waltham, 6:00-9:00 PM
Reservations, call Dr. David Drum (617) 732-6987, page 11161 or fax 617-235-3873

Nov. 24

Nakanishi Symposium

Prof. David Cane (Brown Univ.)
"Selectivity and Versatility in Erythromycin Biosynthesis: From Natural to 'Unnatural' Natural Products"
Prof. Gregory Verdine (Harvard Univ.)
"Chemical Biology of DNA Repair and Transcriptional Activation"
Prof. Koji Nakanishi (Columbia Univ.)
"TBA"
Harvard Univ.
Pfizer Lecture Hall, 12 Oxford St., at 2:00 PM
Dr. Paul Meenen (Dupont, Wilmington, DE)
"Predictive Simulation Techniques for Crystal Morphology"
Tufts Univ.
Sci. & Tech. Ctr., AV Rm., at 2:30 PM

Dec. 1

Prof. George Belfort (Rensselaer Polytechnic Inst.)
"Microfiltration of Suspensions with Self-cleaning Spiral Vortices or 'What Did Leonardo See?'"
Tufts Univ.
Sci. & Tech. Ctr., AV Rm., at 2:30 PM

Dec. 2

Prof. John Bushweller (Dartmouth College)
"NMR Structural and Biophysical Characterization of Glutaredoxin and Core Binding Factor Proteins"
Brandeis University
Gerstenzang, Rm 122, at 4:00 PM
Sci. & Tech. Ctr., AV Rm., at 2:30 PM

Dec. 3

Prof. Andrew Myers (California Inst. of Technology)
"TBA"
Harvard Univ.
Pfizer Lecture Hall, 12 Oxford St., at 4:15 PM

Dec. 4

Prof. Carol Fierke (Duke Univ.)
"Structure and Function of Catalytic Zinc Sites in Carbonic Anhydrase and Protein Farnesyltransferase"
Boston College
Merkert Chemistry Ctr., Rm 127, at 4:00 PM

Dec. 9

Prof. Greg Sitz (Univ. Texas, Austin)
"Dynamics of a Simple Surface Reaction: the Dissociation of H₂ on Palladium"
Tufts Univ.
Pearson Bldg., Rm. 106, at 4:30 PM

Dec. 10

Dr. Edward Grabowski (Merck)
"Practical Enantioselective Syntheses: Addition of Lithium Acetylides to Prochiral Imines and Ketones Mediated by Chiral Lithium Aminoalkoxides"
Boston College
Merkert Chemistry Ctr., Rm 127, at 4:00 PM

Dec. 11

Dr. Doug Hoffman (Dartmouth Hitchcock Med. Ctr.)
"TDM for Antipsychotics and Antidepressants"
NEAACC Educational Program
DoubleTree Guest Suites Hotel, Waltham, 6:00-9:00 PM
Reservations, call Dr. David Drum (617) 732-6987, page 11161 or fax 617-235-3873

Dec. 17

Dr. Eric Brown (Astra Research, Cambridge)
"Peptidoglycan of *Helicobacter Pylori*"
Mass. Inst. of Technology
Faculty Club, Glycobiology Dinner Meeting at 6:30 PM
Call (617) 642-0025 for reservations

Notices for the Nucleus Calendar should be sent to:

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