THE NUCLEUS

March 1989 *Of the Northeastern Section of the American Chemical Society* *Vol. LXVII, No. 6*

Monthly Meeting:

The Application of Chemistry to the Examination of Works of Art

Historical Notes

John Donovan Strong

Chemical Education

For All or for the Elite?

NESACS

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Cover: *Dr. Suzanne Quillan Lomax of the National Gallery of Art*

April Issue Deadline: *February 20, 1989*

THE NUCLEUS

Dedicated to the Memory of James Flack Norris
Published monthly from October to May by the Northeastern Section of the American Chemical Society, Inc.

THE NUCLEUS is distributed to the members of the Northeastern Section of the American Chemical Society, to the secretaries of the Local Sections, and to editors of all local publications. Forms close for advertising on the 1st of the month of the preceding issue. Text must be received by the editor six weeks before the date of issue.

Editor: Adrienne S. Dey, 35 Laurel Dr., Needham, MA 02192, Tel: 449-9204
Board of Publications: Jean Vnenchak (Chair), Catherine E. Costello, Michael E. Strem
Business Manager: Russell F. McCann, 10 Bassett St., Foxborough, MA 02035, Tel: 543-2155
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Associate Editors: Michael Santorsa, Myron Simon
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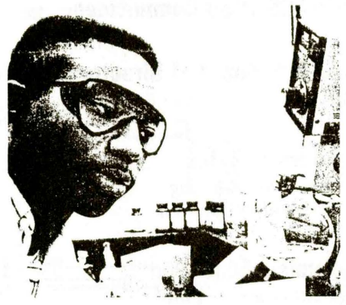
Circulation Manager: Mark A. Druy, 38 Bonad Rd., Arlington, MA 02174, Tel: 641-1957
Proofreaders: Arno H.A. Heyn, Donald Rickter, G. Richard Handrick

Letters to the Editor

Ricocheting Bullets

A potential "ricocheting bullet" (Gibb, Nucleus LXVII, 4, 14) is intended by this brief note.

My enclosure is meant to highlight the commitment that all chemists should have to matters of lab safety.



I would have liked this one better.

Kevin D. Whitburn
Department of Chemistry
Framingham State College

Why no safety glasses?

Dr. Ruth Tanner
University of Lowell
Department of Chemistry
(The writer is referring to the photo mentioned above.)

We wish to express a concern about the publication "The Nucleus," January 1989 issue.

We note that the photograph used on the cover shows a chemist working in a laboratory without proper eye protection and we wish to bring this to your attention.

Whenever possible, the Laboratory Safety Workshop tries to encourage the setting of consistent and appropriate examples for science students. Hopefully, you'll agree and wish to establish a policy that prohibits the use of photographs which unintentionally show unsafe practices.

James A. Kaufman
Director, Laboratory Safety Workshop
Curry College

(***Editor's Note:*** Let us hope that the folks at Stonehill College get the message! The editor has no regrets about using the "offending" photograph which shows an African student who was awarded one of the 1988 Norris Summer Research Scholarships. It happened that there was no other photograph on hand for the cover that month since the Medicinal Chemistry Group [which organized the January symposium] was unable to provide photos of speakers or any other related matters. Readers who may have black and white photos suitable for future covers are urged to send them to the editor.)

On Forced Early Retirements

As a product of "early retirement" from the GTE Laboratories of Waltham, MA after 39 years of unparalleled successes, I want to commend you on your assessment of "The Employment Scene" which appeared in the January 1989 issue of the Nucleus—except for one obvious misconception!!

Your description of the spectre of early retirement as applicable to chemists employed in industry is valid. However, I do not agree that correction of the situation has been prevented by the lack of expression by ACS members via your Letters to the Editor of the Nucleus. Instead, I believe that industrial chemists have never been provided with confidence in the effectiveness of the ACS in discouraging the mass terminations and early retirements by the chemical firms involved.

Indeed, the ACS has not functioned as an organization such as the academicians AAUP union mentioned in your editorial. Your suggestion now to enroll in the ACS Division of Professional Relations seems a little too late.

Frank C. Palilla
Framingham, MA

March Meeting

The 715th Meeting of the Northeastern Section of the American Chemical Society

Thursday, March 9, 1989

Simmons College, Main College Building
300 The Fenway, Boston Massachusetts

5:30 p.m. Social Hour, The Fens Room

6:15 p.m. Dinner, The Fens Room

7:30 p.m. LECTURE, Room C103
"Application of Chemistry to the Examination of Works of Art"
Suzanne Quillen Lomax, National Gallery of Art, Washington, D.C.

Refreshments will be served after the program.

Dinner reservations must be made no later than March 3, 1989. Please call Mrs. Piper at (800) 872-2054 or (508) 456-8227. Reservations not cancelled at least 24 hours in advance must be paid. Members: $16.00; Non-members: $20.00; Students and Retired Chemists: $5.00. THE PUBLIC IS INVITED.

Abstract

The Application of Chemistry to the Examination of Works of Art

Scientists have been associated with museum conservation laboratories for many years. Only recently, however, have art curators and conservators begun to appreciate the contributions that scientists can make in the preservation and restoration of art objects. At present, about a dozen museums in the United States have conservation science departments, employing approximately fifty conservation scientists.

Art conservators frequently require specific information about the component materials of a painting or object prior to treatment. Due to their complex stratification, most questions which arise concern the nature of the components of paintings. Microscopic cross sections of a painting are frequently taken and viewed with a polarizing microscope to understand the different layers that make up the object. Pigment identification is frequently employed to determine if the pigments are in keeping with the time period of the object, as well as to understand the artists' materials and methods. They are performed using polarized light microscopy and x-ray diffraction of powdered samples, or x-ray fluorescence, which is well suited to this task due to its non-invasive nature. To study the identity of binding media, the conservation scientist uses GC, HPLC, and infrared spectroscopy. Ultraviolet radiation can be used to examine the varnish layer of a painting as well as to identify areas retouched in previous conservation treatments. Infrared reflectography is frequently used to examine underdrawing on a painting. In addition, x-rays are often used to determine where lead white has been used on a painting, as well as to reveal damaged areas beneath the painting's surface.

The talk will focus on the application of these various techniques to the examination of paintings and sculpture. Examples will be presented from the National Gallery collection. ◊

Biography

Suzanne Quillen Lomax

Suzanne Quillen Lomax received her Ph.D in Organic Chemistry in 1984 from the University of Maryland, working with Patrick Mariano exploring the photochemistry of iminium salts. She then went to Northwestern University, where she performed postdoctoral research with Frederick Lewis, examining intermolecular photoaddition reactions. Before beginning her work at the National Gallery, Dr. Lomax worked in the Office of Toxic Substances of the EPA. She has been at the National Gallery since February, 1986, investigating the identification and aging behavior of artists' materials. ◊

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NESACS Board of Directors

Minutes, December 8, 1988

The following members of the Board were in attendance: P. Brauner, M. Chen, C. Costello, A. Dey, Wm. Foye, T. Gilbert, W. Gleekman, I. Hartman, A. Heyn, E.A.H. Hopkins, D. Howell, T. Light, J. Perkins, J. Piper, P. Samuel, M.A. Solstad, R. Stolow, M. Simon, M. Strem, K. Stygall, L. Taylor, A. Viola, V. Wilcox. Also present were D. Lewis, M. Ryan, and J. Vnenchak.

The Meeting was called to order at 4:15 PM by Thomas Gilbert, Chairman of the Section.

The Treasurer, James Piper, presented his report which was approved. In order to cover for donations which were budgeted as income and never received, funds will need to be taken from the Income Accounts of the Trust Funds. Detailed breakdowns of expenses for the year will be available in the Annual Report in January.

The Treasurer announced that the deadline for submitting projected expenses and requests to the Budget Committee is December 15. The budget Committee includes the Treasurer, the Chair, the Chair-Elect, the Chair Elect-elect, and one member of the Board of Trustees.

Committee reports, both written for the annual report and oral presentations to the Board are requested for the meeting of January 12, the Annual Meeting of the Board of Directors.

Committee Reports:

(1) *Public Services Committee.* K. Stygall reported on the SARA Title III Syposium of Saturday, December 3, 1988 at Framingham State College. Approximately 80 people attended, including several firechiefs and county safety personnel.

V. Wilcox announced that $200 was awarded to the Section by National ACS toward National Chemistry Week, 1989.

(2) *Chairman-Elect.* M. Strem raised the question of how the Section Handbook would be kept up to date. It was suggested that changes be submitted with the materials for the Annual report.

M. Strem read a tentative list of committee assignments for 1989 to the Board. Additional suggestions were made by the group.

(3) *Continuing Education Committee.* It was pointed out that this committee has had no activity recently. M. Ryan reminded us of the Video tapes the section has for member use.

(4) *Professional Relations.* M. Simon discussed the state of intercommunication between our Councilors on the National Professional Relations committee, the Professional Relations Division, and our local Section committee. It was suggested that some of these Councilors serve on the local committee.

(5) *The 1990 National Meeting in Boston:* P. Samuel pointed out that the Division of Chemical Education will have some functions at the 1990 National meeting which will need help from the local section: for example, High School Chemistry and Chemistry for younger children.

Alfred Viola stated that although his term as Councilor is ending and he was not renominated last year, he is still interested in serving and in being nominated for next year.

Schedule of meetings coming up:

April 6. Esselen Award Presentation, Harvard. This date was set to avoid conflicting with the National Meeting.

May 11. David Harpp, McGill University, "Miracle Materials," Simmons

October. Professional Relations meeting and the Hill Award Presentation.

November. Norris Award Presentation.

December. open.

The meeting adjourned at 5:30 PM.

Respectfully submitted,
David M. Howell
Secretary

Historical Notes

John Donovan Strong

by Edward R. Atkinson
Amherst, Massachusetts

This is a tale about a chemist who went astray and became one of the world's greatest optical scientists. The physical chemists and spectroscopists among us will immediately recognize the name of **John Donovan Strong** whose first book, "Procedures in Experimental Physics" (Prentice-Hall, 1938) went through 35 printings.

When we moved to Amherst in 1977 I became aware of the fact that our neighbor on Gray Street was someone of note because the local paper occasionally told of how he travelled here and there collecting honors, including an Sc.D. degree from the University of Massachusetts on the occasion of his becoming Five-College Professor of Astronomy Emeritus in 1981. As he walked by our house smoking his pipe he often seemed to be listening into a tape recorder attached to his belt. When I asked him what his favorite recordings were he replied that he was actually "reading" a book that he could not read because of his severely impaired eyesight.

One day when John and his wife Bethany June (a native of Indian Territory) were entertaining the Atkinsons at lunch I noticed that Mrs. Strong wore a hexagonal-shaped pin that I recognized as an Alpha Chi Sigma badge. That's how we discovered that John was once a chemist. The badge had served as an engagement ring for an indigent graduate student.

John Strong was born on January 15, 1905 in Riverdale, Kansas, the son of a grain dealer and cattleman. His collegiate education began at Friends University in Wichita, but he had to drop out after one year because of the effects of the depression of 1921. During the next year he took correspondence courses in chemistry from the University of Kansas and supported himself by working as a timekeeper on a local highway construction project. He got the job by making what he considers his most outstanding contribution during a lifetime of consulting work for many major corporations and government agencies. Someone in the construction crew had painted the steel reinforcing rods with red lead so that they did not adhere tightly to the poured concrete. The construction engineer refused to use the rods until the red lead was removed. No amount of physical abrasion worked, but John, relying on his

continued on page 10.

John Donovan Strong. *Sketch by Roger W. Porter who was Artist-in-Residence for the Mount Palomar 200-inch telescope project. His sketches based on engineering drawings were used to show how the installation would look when completed. For his services he had a crater on the moon named after him.*

Historical Notes

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elementary chemistry, told the engineer to fill a barrel with lye solution, heat it with steam from the steam roller, and then dip the rods into the solution. The red lead coating then came off easily.

Riverdale lay at the junction of the Rock Island and Missouri Pacific railroads. One day Hamilton Perkins Cady, head of the U of K chemistry department, met John's father while changing trains at Riverdale; Cady travelled all over Kansas putting on a very popular liquid air lecture. Cady convinced the elder Strong that chemistry was a legitimate life's work so that when John resumed academic work at the University he obtained the B.S. in chemistry in 1926. He almost didn't get the degree when F.B. Dains noted that his course work had included no organic chemistry! Cady's son George was a contemporary of Strong's and went on to a long career at the University of Washington. In 1988 he received an award for his contributions to fluorine chemistry.

After a summer at the Bell Laboratories in New York, John spent a year as a graduate assistant in chemistry at Kansas during which he found a wife among his students in qualitative analysis. Following a summer at the General Electric laboratories in Schenectady John yielded to the lure of an old friend doing graduate work in physics at the University of Michigan and enrolled for work for the Ph.D. that he received in 1930.

During his graduate work Strong invented a method for growing large potassium bromide crystals for use in infrared spectroscopy. The publication of this work earned him a National Research Fellowship that he elected to serve at Cal Tech rather than at Berlin (because Bethany June was pregnant with the first of their two daughters). After the expiration of the fellowship in 1932 there followed a five-year appointment to the Mount Palomar 200-inch telescope project. In 1932 Strong invented the first method for aluminizing mirrors by vacuum evaporation of aluminum. In 1934 he coated the 100-inch mirror, using just 10 cm of 1 mm wire. For this contribution he was awarded the use of the telescope for one night per month. During the coating a moth was trapped in the vacuum chamber and its silhouette remained on the mirror until the next coating seven years later. The 200-inch mirror at Palomar was coated in 1947.

During World War II Strong was at Harvard where he worked on problems of atmospheric transmission, bolometer construction, and an infrared rangefinder.

From 1945 to 1957 Strong was a member of the faculty at Johns Hopkins University where he succeeded H.A. Rowland, J.A. Anderson, R.W. Wood and A.H. Pfund as professor of experimental physics in charge of the manufacture of diffraction gratings. During this period he developed new ruling engines for the preparation of gratings and studied the application of experimental physics to meteorology and astrophysics. With the support of the Office of Naval Research he became involved in balloon astronomy at elevations of about 100,000 feet. While sealed in the gondola for his first ascent he saw the balloon envelope tear apart just before liftoff. He studied atmospheric absorption using a metal tube 3 feet in diameter and 100 feet long.

In 1967 Strong became Emeritus at Hopkins and Five-College professor of astronomy at the University of Massachusetts. He brought along with him, with the consent of the Hopkins administration, about a million dollars' worth of machinery, including the 100-foot tube. The unusual transaction elicited a notice in *Time* magazine. After becoming Emeritus Professor at the University in 1975 John has continued to serve as a consultant to academic, government and industrial laboratories.

John Strong is a past President of the Optical Society of America. Among his many honors are the Longstreth Medal of the Franklin Institute (1939), the Frederic Ives Medal of the Optical Society (1956) and the Gold Medal of the Society of Photo-Optical Instrumentation Engineers (1977). He has published over 150 scientific papers, reports, and book reviews; 14 patents; and a second book, "Concepts of Classical Optics," (Freeman, 1958). When he decided to update his "Procedures in Experimental Physics" he elected to eliminate chapters that had become obsolete and replace some of them with chapters on the history of optics. He thought that the title, "Appreciation of Experimental Physics," was appropriate. One publisher objected to the inclusion of such material, so John persuaded Marcel Dekker to publish the revision in 1988, now named "Procedures in Applied Optics." His best publication is still to come, an autobiography now being written. A shorter biography was recorded in 1985 in the oral history project of the National Air and Space Museum of the Smithsonian Institution.

John told me that in Chapter 1 of his autobiography he compares the account of the Creation given in Genesis with that described as "Big Bang" theory. I asked whether he had seen the concise account of the "Big Bang" given in a recent issue of *Modern Maturity*, a publication of the American Association of Retired Persons. He said he had seen it and had phoned several of his astronomy colleagues to inquire what the present status of the theory was. One replied, "The Hubble Constant isn't constant any more." Another said, "Even *space* is expanding." John decided to hold fast to the classic "Big Bang" with the remark that, "Anything that is good enough for the AARP is good enough for me!"

For future issues of our column I hope to have John contribute some of his fascinating accounts of the scientific establishment of this century. ◇

Chemical Education

For All or For the Elite?

by M.A. Solstad

At a meeting of the NEACS Board a brief discussion about an award given for chemistry teachers illuminated the division that has developed over the last two decades between those who would teach rigorous chemistry so that elite students will have a firm foundation for studying even more advanced chemistry, and those who see their mission to reach as many students as possible with enough information to give them some appreciation of how the world is put together. In the ideal world the two missions would not be mutually exclusive, but they have become so.

The students of the first group of teachers became chemistry majors in college, pressed on to graduate school, and eventually into industrial laboratories, large or small, where the exciting advances that made us an industrial giant of post World War II were made. Students of the latter type of teacher are probably fewer; it's hard to identify them after they leave school, but I suspect at least some of them became environmental activists, went into technical careers, or are still interested laypersons. Probably the majority of teachers do a yeoman's job with an often disinterested audience.

The majority of students who never take chemistry, and the large minority who take only one course in high school or college constitute the bulk of our citizenry who daily hear about environmental disasters, read about pesticides in our food, toxic metals or organics in our water, harmful vapors in our buildings, and frankly are scared or indifferent. Some of these chemically illiterate students go on to become lawyers, and then legislators who draft laws governing the use or disposal of chemicals, or bureaucrats who write the regulations to implement the legislation.

Many of the others take jobs in industry. It is hard to find an industrial workplace today that does not use a "chemical" as solvent, cleaner, lubricant, or coating. A large subset of workers are involved with chemicals at a level more comfortable to the chemical engineer than to the laboratory chemist.

Both these groups are required by OSHA's Hazard Communication Standard to receive training in how to read an MSDS, or Material Safety Data Sheet. The MSDS for each chemical or mixture contains information useful to purchasing agents, firemen, industrial hygienists, safety engineers and emergency room staff. Very little of the information, except for physical constants, is familiar to the laboratory research chemist. And yet the regulations require that the workers have a basic understanding of certain parts of the MSDS, namely how the material will affect his health and safety.

Under EPA, SARA III regulations have decreed that information on inventory, use and "release into the environment" of a wide range of chemicals is available to anyone in the community. Who is there to read and correctly assess this information? Not enough.

The research chemist falls short because of the generally narrow focus of his education and work. Many of those who have had some environmental courses fall short because of the sweeping nature of their perspective, which may fall short in facts of science. Joe Citizen has not been given the scientific tools by his secondary school, nor even his college. If he has taken college chemistry and learned about molecular orbitals, or stoichiometry, this does not serve him either in using an MSDS, nor in assessing risks to the environment or citizenry of chemical releases.

There are to be sure Joe Citizens among us who have self-educated themselves on the various issues we might term interactions of "chemicals" with the biosphere, including man. And some have done very well; just as have prisoners who have studied law in prison, they've had a focus and reason for studying. Chemical engineers have the technical background, often are pragmatic, and are accustomed to thinking of chemicals in bulk quantities, and of dealing in cost/benefit ratios. Industrial hygienists are suited because they have a science background, often in chemistry, they are usually out on the factory floor, and like the occupational physician's, their first concern must be the well-being of the worker, and I suppose by extension, the community. Others entering this void are occupational nurses, safety engineers, and some environmental majors. Because the field is a regulatory thicket, some lawyers have plunged in. They are helpful in dealing with interpretations of rules, but unless they also have a degree in the hard sciences the chemistry and toxicology are usually given a rote reading.

One could imagine workers who learned enough practical science from their shop teachers, and general science teachers, that they could be taught adequately basic chemical handling, toxicology and fire and explosion prevention in the short time small businesses generally feel they can allot for these lessons.

One could dream of an informed electorate who had the background and interest in science to understand the complexities of the fate of chemicals in the environment, relative risks of exposure to a given chemical, or why synthetic vitamins are equivalent to "natural" ones. One could dream. The reality will fall far short. That should not prevent us from trying.

At the elementary level we need teachers who are knowledgeable in and comfortable with simple science concepts. At the secondary level we need teachers who can see the connections between the sciences, and have the freedom to explore that with their students, and the freedom to not teach only to the exam.

At the collegiate level we need inspired teaching to be valued equally as inspired research. Linus Pauling and Norris Rakestraw are two I knew, each brilliant, each excellent with students. Mount Holyoke in the fifties had a quartet of distinguished teachers and researchers in the chemistry department: Emma Carr, Lucy Pickett, Mary Sherrill and Anna J. Harrison. It was customary there to call them Miss, rather than Doctor or professor.

Miss Harrison, then in her early years of teaching at Mount Holyoke, was, like many young teachers, exceedingly demanding; I was certainly intimidated. (She agrees she has mellowed since.) Miss Harrison went on to become the first woman president of the ACS, and then president of other distinguished scientific organizations. She has recently co-authored a chemistry text for the humanities major, which I happened on at our national meeting this year. It is filled with accurate, rigorous, but accessible chemistry, written in a friendly, but not condescending way. Sidebars give historical background, or personal vignettes of chemists. In the forword the authors say:

> There are two searches to understand:
>
> - the search to understand chemical phenomena, and
> - the search to understand the relation of chemicals and chemical technology to social, economic, and political issues.
>
> This book is the pursuit of the first in order that individuals may pursue the second throughout their life spans.[1]

The students who have the good fortune to be taught with such a text as base will be well on their way to scientific literacy. Let's stretch the horizons of our chem majors and let them use such a text.

This approach may not increase the numbers eligible for membership in the ACS, but it may make our careers more rewarding, changing the atitudes of chemists towards the environment and community, and changing the attitudes of the electorate and legislators towards chemists and the chemical industry. ◊

[1] A J Harrison & E S Weaver, *Chemistry, A Search to Understand,* Harcourt Brace Jovanovich Pub., 1989.

NESACS Medicinal Chemistry Group Contributors to the 1988 Program

The officers and members of the NESACS Medicinal Chemistry Group wish to acknowledge the following sponsors for their generous support of the 1988 symposium and seminar program:

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These contributions are the major means of support of the Group's seminar program. This support has allowed the Group to again provide a high quality educational program.

Nominations Sought

1989 James Flack Norris Award

Nominations are being received for the 1989 James Flack Norris Award for Outstanding Achievement in the Teaching of Chemistry. The annual award, consisting of an appropriate scroll and honorarium, is presented by the ACS Northeastern Section. Nominees must have served with distinction as teachers of chemistry in a university, college or secondary school.

Nominating materials should include a curriculum vitae and a listing of honors, awards, and publications, especially those germane to the Norris Award, a nominating letter, and as many seconding letters as are necessary to convey the nominee's qualifications for this award. These letters should outline, in narrative form, the reasons why the candidate is deserving of the Norris Award. They could include comments on the impact of the nominee's teaching at the high school or college level, the influence of the nominee's textbooks, articles or activities on chemical education at the national or international level, and the success of the nominee in inspiring students to spend their professional lives in chemistry. Materials should be of the usual 8½ by 11 size, but should not include reprints of published materials.

Nominating materials should be sent before April 15 to Dr. James B. Hendrickson, Department of Chemistry, Brandeis University, P.O. Box 9110, Waltham, MA 02254-9110.

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The National Technology Medal

All ACS members are invited by the Committee on Patents and Related Matters (CP&RM) to suggest possible candidates for nomination for the National Technology Medal. Recently funded by the United States Department of Commerce and established by the Stevenson-Wydler Innovation Act of 1980, the medal is awarded annually by the President. It may be awarded to individuals, groups, companies or to institutions within the United States for outstanding contributions to technology or for the promotion of the technological workforce.

Nomination documents may be obtained by contacting the staff liaison to CP&RM, Ms. Nancy Mullens (202/872-4479); they will need to be submitted to Ms. Mullens by March 1, 1989.

Calendar

For additional information, call:
Boston College – (617) 552-3606
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Tufts University, Department of Chemistry – (617) 628-5000
University of New Hampshire – (603) 862-1550
Wellesley College – (617) 235-0320 ext. 3149

Wednesday, March 1

Dr. Leah Frye
(Rensselaer Polytechnic Institute)
"Inhibitors of Cholesterol Biosynthesis"
Southeastern Massachusetts University
Science & Engineering Building
(Group II) room 305 at 4:00 pm

Friday, March 3

Mary Shultz (Tufts University)
"Laser-Induced Reactions"
Wellesley College
Science Center (Sage Hall) room 278
at 1:30 pm

Tuesday, March 7

Richard B. Silverman
(Northwestern University)
TBA
Tufts University
Pearson Memorial Laboratory room 104
at 4:30 pm

Thursday, March 9

Professor Thomas J. Meyer (University of North Carolina, Chapel Hill)
HARVARD/MIT INORGANIC SEMINAR
"Intramolecular Control of Light-Induced Electron and Energy Transfer"
Massachusetts Institute of Technology
Room 6-120 at 5:00 pm

Professor Michael Henchman
(Brandeis University)
"The Strange Story of PO_3^-"
Boston College
Gasson Hall room 305 at 4:00 pm

Friday, March 10

Professor Gordon Gribble
(Dartmouth College)
"Adventures in Alkaloid Synthesis"
Wellesley College
Science Center (Sage Hall) room 278
at 1:30 pm

Monday, March 13

Dr. James E. Butler
(Naval Research Laboratory)
"Alchemy: The Chemistry of Diamond CVD"
Brandeis University
Gerstenzang 122 at 4:00 pm

Tuesday, March 14

Professor Paul Sigler (Yale University)
"Transcriptional Regulation: Bending the Rules"
Boston College
Gasson Hall room 305 at 4:00 pm

Wednesday, March 15

Professor Paul Sigler (Yale University)
"The 1.9 A Crystal Structure of the trp Repressor/Operator Complex: Mechanisms in a Ligand-Activated System"
Boston College
Gasson Hall room 305 at 4:00 pm

Thursday, March 16

Professor Paul Sigler (Yale University)
"Facing Up to the Interfacial Enzymology of Transmembrane Signaling Events"
Boston College
Gasson Hall room 305 at 4:00 pm

Monday, March 20

Professor Iwao Ojima
(SUNY Stony Brook)
"Assymmetric Synthesis of Non-protein Amino Acids"
Brandeis University
Gerstenzang 122 at 4:00 pm

Wednesday, March 22

Dr. William E. Ohnesorge
(Lehigh University)
"Chemical Analysis by Luminescence"
Southeastern Massachusetts University
Science & Engineering Building
(Group II) room 305 at 4:00 pm

Monday, March 27

Professor Ray Funk
(Pennsylvania State University)
"On The Way To Periplanone A..."
Brandeis University
Gerstenzang 122 at 4:00 pm

Thursday, March 30

Dr. Robert E. McCarley (Ames Laboratory of Iowa State University)
"Unusual Structures in Metal Oxide Systems. Metal Clusters and Extended Arrays with Strong Metal-Metal Bonding."
Parson Hall room L101 at 11:00 am

Notices for the NUCLEUS Calendar should be sent to:
Cynthia B. McGowan
Department of Chemistry
Wellesley College
Wellesley, MA 02181
Phone: (617) 235-0320 ext 3112

(Note: Material should be sent so that it arrives before the first of the month prior to the month for which the event is scheduled.)

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