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Chemistry at Brooklyn College

Spring 2009

Message from the Chair, by *James Howell*

Since the last edition of our newsletter there have been many significant changes within the Department of Chemistry. Some of them have been evolutionary; others have been rapid and dramatic. Overall most of them have been positive and encouraging. The purpose of this newsletter is to share these changes with you and to let you know how we are moving forward.

We hope you will become as enthused as we are about our ongoing programs; and that you enjoy the articles in this newsletter.

The Department

Over the past few years there have been a number of changes in the faculty. As the following articles illustrate, biochemistry is playing an increasingly important role in our curriculum and our research efforts.

Associate Professor Brian Gibney, who joined us from Columbia University, is finishing his first year in the Department. We are very excited about his research which he describes as "protein engineering" on page 5.

Assistant Professors Maria Contel, Laura Juszczak, and Stacey Brenner joined the department in 2006 and have been establishing a record for themselves. Professor Contel is an inorganic chemist working with gold catalysts, Professor Juszczak studies protein aggregation, and Professor Brenner is a synthetic organic chemist making organic (non-transition metal) catalysts.

The College

The College is undergoing a great deal of rebuilding. The new West Quad building is almost ready for occupancy, work on the Performing Arts Center will start shortly and, of great importance to the department, the design of the Science Center is well under way.

We would like to invite you to visit the department. During my past four years as chair of the department I have had the pleasure of talking to several returning graduates. We are very interested in how your lives have developed and how well your chemistry education has served you.

Chemistry Campaign

The department seeks to offer a well-grounded education with exposure to modern methodologies. For instance, our students use NMR, and GC instrumentation in their organic chemistry lab work.

We ask that you read the last page of this newsletter and consider helping in this important work.

A Funny Thing Happened on the Way to the Museum

by Laura Juszczak

It has been said that knowledge is never wasted. From my perspective, I can affirm that not only is this true, but that a diverse background connects seemingly disparate concepts and turbocharges research. Bear with me as I unravel this thread.

Following undergraduate study in art history and chemistry at Wellesley College, I entered the joint Masters of Science Program in Art Conservation at the University of Delaware and Winterthur Museum. Art conservation, of course, is the exacting science of protecting and restoring paintings, photographs, and other works of art. Under the tutelage of DuPont chemists and other material scientists, I learned about the chemical reaction of materials, both organic and inorganic, as catalyzed by environmental factors of light, temperature, and humidity. Because of the diversity of materials used by artists, topics ranged from the mordant dyeing of fabrics to the light-sensitive silver salts used to prepare daguerreotypes.

After some years of practice as an art conservator at the Los Angeles County Museum of Art and the Metropolitan Museum of Art, I longed for greater intellectual challenge, so I entered challenge, so I entered the New York University chemistry program with the intent of earning a Master of Science in Chemistry and resuming my museum career as a conservation scientist. But a funny thing happened on the way to the museum: once in the lab, I didn't want to leave. I completed my Ph.D. in spectroscopy with a dissertation on the light transfer properties of the light-harvesting, photosynthetic pigment-protein complex called a phycobilisome, found in blue-green algae. A common thread begins to emerge: the interaction of light with materials.

Professor Laura Juszczak in her laser laboratory.

Serendipitously, completion of my studies at NYU coincided with the assembly of a new laser lab at the Albert Einstein College of Medicine by a Brooklyn College alumnus, Dr. Joel M. Friedman. For over a decade, first as a post-doc and then as a nontenured faculty scientist, I learned laser spectroscopy from the best: spectroscopists trained at Princeton, Brown, and Stanford. I felt very lucky. I specialized in ultraviolet resonance Raman spectroscopy and raised a family.

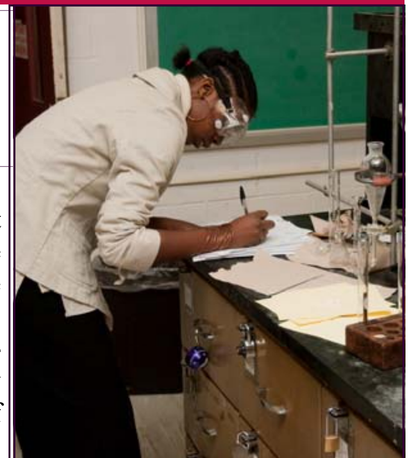
My career as an assistant professor in the Department of Chemistry at Brooklyn College began in 2006. My research interest in the pathogenic assembly of soluble peptides and proteins, as found in Alzheimer's disease, is informed by the material science of the metallic mordanting, or binding, of dyes to natural protein polymers such as silk. A dynamic flow of students, undergraduates, premeds, postbaccaulareates and graduate students, representing the global microcosm that is Brooklyn have become involved in this research.

You can see, then, why I feel strongly that knowledge is never wasted. As I currently teach and coordinate the Core chemistry class at Brooklyn College, I attempt to dispel the perception of some that science is this solid, dead lump of immutable facts. I feed my students appetizers where science and art overlap, such as the symmetry rule-defying fact of five-fold, nonperiodic crystallographic symmetry, Pendry tiles and the evidence of early knowledge of five-fold symmetry as it appears on medieval Islamic architecture.

Following the lead of Professor Eric Mazur at Harvard University, I test students throughout the lecture with "clicker" questions, which involves the use of a television channel-changer device for instant responses to questions. This method punches holes in the traditional concept of the lecture as a passive transfer of knowledge, prompting students to think and hopefully also to discuss concepts with other students. Again, one should never underestimate the surprising insights that can arise from the collision of different backgrounds and perspectives.

Teaching in the Twenty-First Century: Real, Virtual, and Embedded at Brooklyn College

by Mark Kobrak



Student working at bench in Chemistry 51, Organic I, lab.

From health care to entertainment, technology is creeping into our lives and embedding itself in increasingly small and unobtrusive boxes. The classroom is no exception, and where previous generations of students might have had to tolerate a stern look from an instructor as they chatted in the back row, class is now more likely to be interrupted by a musical ringtone. And whether faculty choose to chastise the perpetrator or dance to the beat, they have to adapt.

The classroom: Perhaps the most obvious change is the growing use of PowerPoint. On the face of it, this would appear to be a relatively trivial extension of the overhead projector, but in practice the differences are dramatic. The key is the enormous body of material available on the Web, from beautiful and detailed images to complex animations. A faculty member who is driving to work and hears a new report about water on Mars can walk into his or her office, download images from the Mars Rovers, and show them in the 9 a.m. freshman chemistry class as part of their discussion of solubility. Brooklyn College has wisely invested in creating an impressive array of "smart classrooms," ensuring that nearly all large lecture halls and many smaller classrooms can present such material easily and reliably.

> ***…the goal now is the same as it always has been: to create competent chemists in and out of the laboratory.***

A newer and less well-known technology is a set of handheld devices called "clickers," used to gauge student understanding and encourage participation. It is often difficult to get students to voice opinions in large lecture classrooms, which makes it a challenge for instructors to know how many are "getting it." But if each student has a clicker, and the classroom is equipped with a computer and receiver, instructors can poll students on key questions and assess their understanding in real time. Professor Laura Juszczak has implemented the use of clickers in her Core course, and reports that she finds it a great aid in the classroom (see page 2).

At home: Using the Web to post and disseminate course materials has become a habit for many faculty, vastly reducing the amount of paper that has to change hands. But BC has taken a step beyond that by adopting an online course management system called Blackboard. Blackboard is a Web-based environment designed to aid instructors. Every course at the College is automatically given a Blackboard site, and every student is automatically enrolled; the public at large, however, is kept out via password protection. This permits faculty to post copyrighted materials for fair use without worrying about responsibility for disseminating them beyond the course, a useful protection. Further, many textbook publishers distribute "cartridges" of supplementary materials to be uploaded to the site. This can include libraries of homework problems, making it possible to assign and grade homework automatically through the Blackboard site. The pros and cons of such an approach are still being worked out, but faculty continue to experiment with effective ways to make use of this new tool.

In the laboratory: The student laboratory experience is also changing. The department has recently invested considerable time and money in modernizing laboratories at all levels, from the introduction of nuclear magnetic resonance experiments in second-year organic chemistry to the incorporation of differential scanning calorimetry in the physical chemistry laboratory. Much of this instrumentation is computer-driven, and students are gaining experience in collecting and processing data in electronic format.

Equally important are departmental efforts to integrate modern computer software into the curriculum. The department has its own computer laboratory to support advanced courses, and students are introduced to specialized

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Patrick McGarraugh, a Ph.D. graduate student, helping students during a busy office hour before an exam.

Synthesis of Organocatalysts *by Stacey Brenner*

I was born and raised outside of Rochester, N.Y. From an early age, I was interested in, and excelled in, math and the sciences. When I started my studies at Brown University, I intended to major in mathematics. I soon learned that a professor can make all the difference! It wasn't until my sophomore year that I enrolled in a class in which I found both the subject and the enthusiasm of the professor engaging. That class was the first semester of organic chemistry, and that professor was Professor Zimmt. In a classroom filled mostly with premed students who seemingly did not enjoy their organic chemistry experience, I couldn't get enough of it! I found the homework challenging, and I enjoyed it. In the second semester of organic chemistry, Professor Zimmt remained as enthusiastic as ever as he excitedly explained intricate reaction mechanisms to us. I enjoyed taking Professor Zimmt's classes so much that I decided to major in chemistry and to join his research group during my senior year. Additionally, I made the important decision to pursue a career in academics, so that one day maybe I would inspire a student to become an organic chemist the way Professor Zimmt had inspired me to do so.

After college, I earned my Ph.D. at Stanford University, under the advisement of Prof. Paul Wender. Upon completion of my Ph.D. in January, 2005, I was a postdoctoral research associate for one year at the University of Cambridge in England in the lab of Professor Steven Ley. When I began applying for academic positions in fall, 2005, I noticed that Brooklyn College was hiring. I was intrigued by the fact that most of the faculty had only one or two Ph.D. students, but five or six undergraduate students, in their research groups. This seemed like a good fit for me. When I visited the College during my interview, I was even more impressed. Brooklyn College, especially during the current "Decade of Science," seemed like a place where a young professor just starting out could make a big difference.

I began teaching here in September 2006. Thus far, I have taught second-semester organic chemistry at Brooklyn College, and physical organic chemistry at the Graduate Center. I am still growing my research group and have earned an NIH SCORE pilot project grant, which has been invaluable in helping me do this.

At present, research in my lab is focused on organocatalysis. While the use of catalysts in organic reactions is commonplace these days, the idea behind organocatalysis is to use organic molecules as reaction catalysts, instead of the more typically used metal-based catalysts. This area is broadly applicable to industries ranging from pharmaceuticals to petroleum, and is gaining popularity due to its positive environmental implications.

Students in my lab learn classic organic synthesis laboratory techniques. I currently have one Ph.D. student and four undergraduate students working with me. A total of nine undergraduate students have worked in my lab at one time or another since I started here. I have had a very positive experience with all of them and continue to be amazed by how quickly they begin working independently! I have even had one undergraduate student who has gone on to pursue a Ph.D. in chemistry at the University of California at San Diego. Even if I didn't play a role in this particular student's career decision, I hope that one day a young organic chemistry professor, and former Brooklyn College undergraduate, will be writing a similar story about me.

Professor Brenner in her office.

Bioinorganic Chemistry and Metalloprotein Design

by Brian R. Gibney

A native of Florida, Brian R. Gibney earned an ACS-Certified B.S. in chemistry in 1990 from Florida State University and a Ph.D. in chemistry from the University of Michigan in 1994 under the mentorship of Professor Vincent L. Pecoraro. His thesis work focused on developing a novel class of metal-salt selective molecular recognition agents, the metallacrowns, which are inorganic analogues of the organic crown ethers. For his postdoctoral studies, Gibney decided to learn more about biochemistry and biophysics while he applied his coordination chemistry expertise in the emerging field of *de novo* metalloprotein design at the University of Pennsylvania with Professor P. Leslie Dutton. As an NIH Postdoctral Fellow, Gibney worked on both natural enzymes and synthetic proteins, or molecular maquettes. His work on the mitochondrial cytochrome *bc*1 complex focused on the bidirectional transfer of electrons from the Q_o-site quinone to an adjacent Reiske iron-sulfur center on one side and a heme on the other side. His work on synthetic metalloproteins produced the first synthetic iron-sulfur proteins, the ferredoxin maquettes. He was awarded the Young Bioenergeticist Award by the Biophysical Society in 1997.

Professor Brian Gibney studies the role of hemes in heart disease.

Professor Gibney began his independent career in 2000 at Columbia University and is a leading researcher in the design of synthetic proteins containing metal-ions. He was promoted to Associate Professor of Chemistry in 2005 and moved to Brooklyn College in 2008. Professor Gibney's current research is centered on the role of hemes in heart disease, and on the role of zinc in controlling gene expression in human cancer. His investigative tools center on measuring the thermodynamics of metal-peptide and metal-protein interactions. His near-term goal is to provide the basis for improvements in the computational design of metalloproteins toward his long-term goal of designing synthetic metalloenzymes. A leader in the field of *de novo* metalloprotein design, he has authored more than seventy papers, co-edited the *Inorganic Chemistry* Forum on Biomolecular Design, co-organized the first Protein and Metalloprotein Design Conference, and presented the Paul Saltman Memoral Lecture at the Metals in Biology Gordon Research Conference in 2007.

A leader in the field of* de novo *metalloprotein design, he has authored more than seventy papers.

Professor Gibney is also a dedicated teacher in the classroom and in the research laboratory. He is currently teaching Instrumental Analysis and has taught courses in Inorganic Chemistry, Group Theory, Physical Methods, and Bioinorganic Chemistry. In the laboratory, a dozen of his undergraduate trainees are now in top-tier graduate schools, and two were awarded Fulbright Fellowships upon his nomination. His teaching at Columbia University has been recognized by the receipt of a "golden nugget" from his students on the student-run professor evaluation site (the only one in the Department of Chemistry), and of a Teacher-Scholar Award from the Dreyfus Foundation in 2005.

Ms Harriet Weinrieb, Chemistry Department secretary for many years has been providing a warm welcome to thousands of students over the years.

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applications. Students in second-year organic chemistry now make use of electronic structure calculations to understand molecular geometry, while more advanced students use Mathematica or SigmaPlot to analyze data collected in the laboratory. Far from making students too reliant on computers, the opposite lesson is more often driven home: Garbage In, Garbage Out. A senior recently remarked that he did not trust computational results as much as he used to, and no higher compliment could be paid to a curriculum.

For all the pleasure these shiny new toys bring to faculty and students, the goal now is the same as it always has been: to create competent chemists in and out of the laboratory. The department has debated and rejected technologies where it was felt there was a danger that education could be undermined. A virtual reality experiment may be a useful teaching aid, but it is not a replacement for mixing chemicals and analyzing products. Reading a spectrum from an online library is not the same as taking and analyzing your own. And it is common sense, not technology, that turns bumps and wiggles in a data plot into a meaningful discussion of error.

And so every art or history major who registers for Core chemistry has to bend over and eyeball that meniscus, and every analytical chemistry student has to push the plunger down on that gastight syringe. Because chemistry is the science of making and understanding materials the smaller those embedded gadgets get the better we are going to have to be at it.

Be a catalyst for change!

Your gifts will help us to continue to transform and modernize our department in these critical times.

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