Greetings from the Chair

I often think of a university as a full oil tanker cruising on the ocean. It has a great deal of momentum in the direction it is traveling, and adjusting its course requires advance planning and a lot of lead-time. However, as I reflect back on the past two years, I am sincerely impressed with the increase in quality that our instructional programs have undergone in a relatively short period of time.

Perhaps the most noticeable change in the quality of our laboratory instruction comes from being awarded the National Science Foundation’s Transforming Undergraduate Education in Science grant to integrate liquid chromatography into our curriculum. This was truly a team effort. An idea in a faculty meeting led to proposal development under the leadership of Professor Palmer in collaboration with Professors Adams, Bolstad, DeGrandpre, and Smirnov. Our students will benefit tremendously from this curriculum revision.

We continue to collect evidence that our undergraduates receive an education of the same quality as at any state university, with our hardest-working students learning as much as chemistry students anywhere. Opportunities to participate in chemistry research abound, and measurements of student achievement in the classroom demonstrate that our students attain content knowledge well above national averages. The number of B.S. degrees awarded annually continues to stay at or near the all-time highs for our department. We also have evidence that the non-majors we serve receive excellent preparation for their careers. For example, pre-pharmacy students who take our general and organic chemistry sequences usually score extremely high on the chemistry subtest section of the Pharmacy College Admissions Test.

Our graduate students continue to benefit from the daily one-on-one mentoring with faculty that can only be achieved in a department of our size and character. Unfortunately, the number of graduate students currently in the program is less than we desire and significantly below our capacity. We are currently working to develop ideas on how to increase the number of graduate students. A promising step is the university’s decision to no longer charge out-of-state tuition to graduate students on teaching or research assistantships. This now allows our state and externally funded grant dollars to stretch a bit farther.

The most significant personnel development in the past two years is the resignation of Assistant Professor David Bolstad, who was hired only three years ago. Dave decided to change the direction of his career and move out of academia. We are currently engaged in a search for his successor, hoping to have a new assistant professor of organic chemistry in place by fall 2012.

We continue to appreciate your contributions to the department through your departmentally-designated gifts to the UM Foundation. One example of how we use your gifts is our annual sponsorship of a meeting of the American Indian Support and Development Council. This group provides a support network for faculty, staff, and students involved in programs that serve the interests of Native American students on campus.

I encourage you to check our website on occasion to keep up with the changes in the department. Just Google “Montana Chemistry,” and we will be the first link. Please keep in touch. A quick email to our departmental administrative associate or any faculty member you know with an update about your life is always appreciated!
Kurt Mendelssohn subtitled his remarkable little book “The World of Walther Nernst” with “The Rise and Fall of German Science 1864 - 1941”. Indeed, Nernst’s life span does fit with the Golden Years of German science, which in fact didn’t fall but instead simply left Germany in the later 1930s. Students of introductory chemistry think of Walther Nernst mainly in terms of his equation linking the potential of an electrochemical cell to its chemical composition. However, his many contributions to physics/physical chemistry are so profound and so fundamental that we have forgotten where they come from.

Walther Hermann Nernst was born in Briesen, West Prussia, on June 25, 1864. After studying with Boltzmann and von Ettingshausen in Zurich, Berlin, and Graz, Nernst earned his PhD in 1887 with Friedrich Kohlrausch at Universität Würzburg. He then joined Ostwald, Van’t Hoff, and Arrhenius in Leipzig. This collection of mentors was largely responsible for the founding of classical physical chemistry. After some very productive time as Professor of Physical Chemistry at Universität Göttingen, Nernst was appointed Professor of Physical Chemistry/Physics at Universität Berlin (the top of the German heap) in 1905. He became the director of his Physikalische-Chemisches Institut in Berlin in 1924. The photo above is of Nernst in his Berlin classroom, 1926.

Nernst’s early work involved electrochemistry, electrical potential, and ionic dissociation. Along the way he also defined the now well-known solubility product. However, his most important early work involved low-temperature physical chemistry. By liquefying hydrogen, he was able to study the thermodynamics of chemical reactions near absolute zero. This work led to the Nernst Heat Theorem in 1906, otherwise known as the Third Law of Thermodynamics, for which he was awarded the 1920 Nobel Prize in chemistry. With typical “modesty” Nernst announced, “that there can be only three laws of thermodynamics because it took three people (Mayer, Joule, Helmholtz) to formulate the First Law, two people (Carnot and Clausius) to formulate the Second law, but I discovered the Third Law all by myself”. The Third Law demonstrates that the maximum work obtainable from a process can be calculated from its heat evolution near absolute zero.

Nernst (and others) noted in his low temperature work that the heat capacity of a solid goes to zero well before absolute zero is reached. Einstein used this observation to demonstrate that Planck’s treatment of black-body radiation assuming the quantization of energy was indeed correct. Nernst himself applied quantum mechanical methods to rationalize the vapor density and heat capacity of gases at high temperatures. He also discovered the long-chain radical mechanism of photochemical reactions.
Walther Nernst was a strong personality who attracted a lot of attention. Later in life, he was overweight and bald. It was said that one morning God crafted the perfect human brain. It was hard work, and God then went to lunch, leaving the brain on his workbench. The angel Gabriel happened by and recognized the perfect brain. As a joke, he crafted the ugliest human body and put the brain into it. This was suggested as the origin of Walther Nernst. He once suggested to his brilliant graduate student F. W. Lindemann (later Lord Cherwell), who often played tennis with his brother, that they should get their rich Dad to buy them another ball so that they wouldn’t need to keep batting the one they have back and forth.

Nernst’s father was a mid-level Prussian bureaucrat, and Nernst was a practical man with personal interests in mechanical things and making money. His favorite recreations were hunting and fishing. He once bought a cattle farm in East Prussia. German cows, even today, tend to live in barns. When he first visited his farm, the manager took him into the cattle barn, and Nernst asked why it was so warm inside. The manager replied it was a result of the metabolic heat of the cattle. Nernst thought that to be wasteful; he wasn’t feeding the cows to heat the barn. He sold the cattle ranch and went into raising fish, which don’t suffer such a heat-loss problem. He made a lot of money on the fish. He invented the so-called Nernst glower, a ceramic resistor that glowed red. It was a very good IR-source, but didn’t work for lighting. He sold the glower outright to Siemens for a million golden marks. Meanwhile, the American Irving Langmuir was working in Nernst’s back laboratory on metal-wire filament electric lights. Nernst had the idea of replacing the sounding board of a piano with radio amplifiers. The electric piano didn’t catch on, but it was an idea with a great future. Nernst’s hydrogen liquefier was built by his instrument technician, and copies were made and sold around Europe. Unfortunately, none ever ran successfully outside of Berlin.

While Walther Nernst could be sharp and egotistical, he was well-liked, apparently because of his concern for the people around him. Despite (or perhaps because of) his Prussian nature, he worked hard to protect his Jewish colleagues in the 1930s, especially his rival Fritz Haber. Two of his daughters married Jewish men. He never accepted the Nazis, and retired in 1934 rather than work with them.

New Interdepartmental Biochemistry Program

In the spring of 2009, the Board of Regents approved a new interdepartmental biochemistry program that brings together eleven faculty members from the Department of Chemistry & Biochemistry, the Division of Biological Sciences, and the Department of Computer Science. Starting in the fall of 2009, the program offered a BS in biochemistry. This degree replaced our biochemistry option within the BS in chemistry. The program also created MS and PhD degrees in biochemistry and biophysics. The program retains the rigorous training in chemistry and biochemistry but adds broader requirements in biology and computer science. Our biochemistry program has grown rapidly in two years with more than 40 majors declared as of this fall. The first class of the Biochemistry and Biophysics Graduate Program entered in fall 2009, with the graduate school providing new teaching assistant positions to help the program grow. The graduate program emphasizes research training that focuses on understanding biology at the molecular level. Graduate students can tackle problems such as the biochemistry of HIV, the cause of prion diseases such as “Mad Cow” disease, and the mechanism of information-transfer across cellular membranes. Techniques ranging from mass spectrometry to single-molecule fluorescence spectroscopy, X-ray crystallography and NMR spectroscopy are available to help with this research. We are very excited about the new educational opportunities for both undergraduate and graduate students in biochemistry at the University of Montana and look forward to seeing the impact that our research and our graduates will have in the state of Montana.

NSF Grants Fund New Instrumentation for Chemistry & Biochemistry

- Our faculty has been exceptionally successful in competing for instrumentation grants to enhance their research and teaching. A Bruker microflex LRF MALDI-TOF mass spectrometer was installed in August 2011 in the University of Montana Mass Spectrometry Core Facility in the Interdisciplinary Science Building. The purchase was funded by a $238,580 grant from the NSF Chemistry division. The new mass spectrometer will benefit more than a dozen laboratories from the Division of Biological Sciences, the Department of Chemistry & Biochemistry, and the Department of Biomedical and Pharmaceutical Sciences. It will be used for many applications, research on protein folding and dynamics being only one. With the assistance of the Native American Research Laboratory (NARL), we will also be developing educational materials for outreach to tribal colleges on reservations in Montana.

- NSF’s Chemistry Research Instrumentation and Facilities Program has awarded a $221,915 grant to purchase an Electron Paramagnetic Resonance (EPR) Spectrometer. An EPR spectrometer detects the presence of unpaired electrons in molecules and materials. This information can be used to establish the electronic and geometric structure of compounds in solution and frozen solids as well as the nature of free radicals. Our studies employing the EPR spectrometer will impact a number of areas, from environmental and biological chemistry to health sciences. The instrument will also be used by several academic units within the university, and will be particularly important for tapping the intellectual and creative resources of students who have been underrepresented in the sciences.

- A $169,998 grant from NSF’s Transforming Undergraduate Education in the Sciences Program has allowed us to purchase four new liquid chromatography (LC) systems. These LC systems, which have varying levels of capabilities, will be integrated into the introductory and advanced chemistry lab courses. Because all of the LCs use the same software, students will continue to build upon their past LC experience as they progress through our curriculum.
The Piedmont region of Italy, known for its excellent wines, cheeses, and culinary traditions, is located in the northwest part of the country. It’s surrounded by the Alps in the north and west (Piemonte in Italian = foot hills) and by the Po River Valley in the east and south. This region is home to the city of Turin. Like Missoula, it is a city of rivers. Four major rivers pass through it: the Po and two of its tributaries, the Dora, the Stura di Lanzo, and the Sangone. The city dates back to Roman times and started as a military camp (Castra Taurinorum); the typical rectangular Roman street grid can still be seen in the modern city. Turin reached about 5,000 inhabitants in Roman times, with the entire population living inside high walls. Today, Turin is a city of 900,000, home to Fabrika Italiana Automobile Torinese, or FIAT, and was the first capital of Italy after unification in 1861. This year, 2011, is the 150th anniversary of the unification of Italy and so the fall semester 2010 leading up to the celebration was a special time to do a faculty exchange there. My wife Trina and I found Turin to be an elegant and culturally rich city. We spent four months, from September 2010 to January 2011, enjoying the Northern Italian lifestyle.

I taught a version of an honors/graduate level course that I offer at UM entitled “Industrial Chemistry and Its Impact on Society.” Here the course consists of an investigation of chemically based Montana industries. It emphasizes a detailed description of the process chemistry at each plant, a visit to the plant, a visit by a manager or scientist from the industry and an evaluation of the political, cultural and environmental impact of the industry on the community where it is located. In Italy, I taught a shorter version of this course to doctoral students at two Universities, the University of Turin (UT) and the University of Eastern Piedmont (UPO), two very different institutions. UT is one of the oldest and most respected research universities in Italy while UPO is relatively new and represents a recent expansion of the Italian University system to include more rural communities. The science departments of UPO are located in the much smaller city of Alessandria (population 93,000), about an hour’s train ride from central Turin. I had seven doctoral students in my Turin class and 12 doctoral students in my Alessandria class. Teaching in these two different environments enriched my experience and exposed me to the cultural differences between the universities. The UPO students were local inhabitants and, overall, were younger and more provincial. UT students came from all over the region and the nation. There was also a significant international contingent. The UPO students knew less English and consequently were a bit more reluctant to ask questions. On the other hand, they were more punctual and attended class more regularly than the UT students.

Overall, the exchange award made for a truly memorable experience from every point of view. I have had many short visits to Turin for research in the past but they were just that: visits. This time my wife and I had the chance to truly experience this elegant city that has become my second home. This was also the first time I was able to hold some simple but meaningful conversations in Italian, thanks to Evelina Baderi’s excellent Italian class which I sat in on last year. Most importantly, I was able to order food and wine with aplomb in many of Turin’s excellent restaurants. I want to express my gratitude to the International Committee at UM for making these wonderful experiences possible.
Gaining admission to study chemistry at the University of Ibadan (UI) is a two-step process. The first step involves taking a nationwide examination in an attempt to obtain a score that meets the university’s and the chemistry department’s cutoff. The number of students admitted depends on the number of applications and available positions. Normally, there are around 30 to 50 spaces. The second step entails an individual interview with each applicant to evaluate that person’s science background and general knowledge. Successful applicants are admitted, without financial support, to the four-year program that fulfills the requirements for a baccalaureate. The chemistry program is structured such that the students take compulsory courses with few electives. It’s intended to give students maximum chemistry education with little options for a minor in other areas. However, the system is very flexible within the areas of chemistry itself and allows students to take courses in their area(s) of interest.

The freshmen and sophomore years are used to meet the basic science requirements in chemistry, physics, mathematics, and biology. Usually three to four classes per subject are required. In addition, students are expected to pass all general courses within these first two years. At the end of the second year, students participate in an internship. They spend the summer in an industry working in labs and gaining pertinent experience in their field. The internship is designed to be a learning process for the students, exposing them to quality control operation techniques and other industrial procedures dependent on the type of industrial placement they get. A write-up and presentation of their experience is expected at the start of the third year.

Students now quickly rack up as many chemistry courses as possible in the third and fourth years, taking more area-directed classes in the senior year. The program is concluded with a research project, supervised by a professor, in an area of interest to the student. Each student takes part in an ongoing research project in the lab after a period of deep literature review on the research problem. Depending on the lab, they might be involved in measuring metal content of aquifers near a battery production plant or in the extraction of some natural product. The projects last for about three to four months, and students have to write-up a research project report and defend it before a chosen committee.

The department is comprised of 10 to 12 professors, 11 senior lecturers, and a good number of assistant lecturers and non-teaching positions, all working together for the students. Two to six lecturers teach each class. The first professor might teach the course for a couple of weeks. Then another professor comes in and teaches the next couple of weeks and so on. The final exam will include each professor’s teachings. Also, the grading system is cumulative with a max of 7.0. Students are not allowed to retake a course except if they fail it with an F grade. However, one can call for a re-grade of the final if so desired. Students usually study in groups to prevent this from happening.

Generally, a chemistry degree in Ibadan requires hard work, focus, and dedication. The student must strive to meet all the challenges inherent in the program. After four years of dedicated learning, the graduation ceremonies are usually big. Families and friends from all over the country come to honor the occasion with colorful attire, local cuisine, and cultural displays. The drums and laughter of people can be heard miles away and the campus takes on a paparazzi demeanor to document the graduates’ success.
Callie Cole (BS 2010) is a graduate student in chemistry at the University of Colorado in Boulder, CO.

Hunter Jones (BS 2010) is a staff scientist at the Puget Sound Naval Shipyard in Bremerton, WA.

Michaela Finnegan (BS 2009) is working as a research technician at biotech start-up Blue Marble Biomaterials in Missoula, MT.

Mike Williams (BS 2009) is a PhD candidate in chemistry at Washington State University in Pullman, WA.

Swati Bandi (PhD 2009) is a postdoctoral fellow at the University of Colorado Health Sciences Center in Denver, CO.

Franco Tzul (PhD 2009) is a postdoctoral fellow at Rensselaer Polytechnic Institute in Troy, NY.

Katie Payne (BS 2008) is a PhD candidate in chemistry at Portland State University, Portland, OR.

Vincent Schee (PhD, 2007) is a scientist at the US Army Night Vision and Electronic Sensors Directorate in Fort Belvoir, VA. He recently won a 2010 Army Research and Development Achievement Award for his contributions to “Fluorescent Polymer Sensor Array for Detection and Discrimination of Explosives in Water.”

Our new PhD grads are aspiring to academia! Here are our recent PhD students who now have faculty positions. Many have found jobs in the Big Sky Country—passing on their knowledge of chemistry to the youth of Montana. Inspiring!

- Chrissie Carpenter (PhD 2009), Department of Sciences and Humanities, University of Great Falls, Great Falls, MT.
- Travis Denton (PhD 2002, Post-doc at UM), Department of Chemistry and Biochemistry, Eastern Washington University, Cheney, WA.
- Katie Hailer (PhD 2006), Department of Chemistry and Geochemistry, Montana Tech, Butte, MT.
- Todd Martz (PhD 2005), Scripps Institution of Oceanography, University of California - San Diego, La Jolla, CA.
- Jason Mullins (PhD 2007), Department of Chemistry, Western State College of Colorado, Gunnison, CO.
- Steve Parker (PhD 2005), Department of Chemistry and Geochemistry, Montana Tech, Butte, MT.
- Jesse Stein (PhD 2010), Department of Life Sciences, Salish Kootenai College, Pablo, MT.
- Dahlia Rohksana, Department of Chemistry, Whitman College, Walla Walla, WA.
- Ayesha Sharmin (PhD 2010), Department of Chemistry, Jahangirnagar University, Savar, Dhalka, Bangladesh.
- Forrest Towne (PhD 2010), Department of Arts and Sciences, Montana State University Northern, Havre, MT.
- Jared Baker (BS 2006) is an Assistant Professor at Elmira College in Elmira, NY. He earned his PhD in Analytical Chemistry at University of Buffalo, State University of New York this year.