Biochemistry 2013-2016 NEWSLETTER

University of Wisconsin-Madison

For Friends of the Department of Biochemistry at the University of Wisconsin–Madison

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From the Chair

By Professor Brian Fox

I have experienced the great honor of being Chair of the Department of Biochemistry at the University of Wisconsin-Madison since July 2015. I would like to personally thank Prof. Betty Craig for 10 years of outstanding leadership of the Department. She provided a strong foundation for hiring and investment in the department, and we (faculty, staff, and students) are now pursuing the many avenues laid out by her efforts.

I would also like to thank Prof. Hector Deluca, who has been a great friend and counselor since I met him 24 years ago. His unwavering support as I have learned the complexities of being Chair has been immensely helpful, and I sincerely appreciate it.

The following provides a brief outline of noteworthy occurrences since our last print newsletter. I hope you will recognize that the Department continues to flourish and innovate even in these challenging times for research and higher education.

Staff Accomplishments

In 2015, the Department Administrative team (Charlie Lor, Cathy Michael, David Parker and Kerry Tobin) won our first campus-wide Administrative Improvement Award. Their contribution was the Biochemistry Logistics Tool. This is a portable bar-code scanning and tracking app that allows efficient handling of packaging invoices. The BLT arose from necessity, as over 15,000 packages are now coming into the Biochemistry Department each year. We use this staff-created tool for inventory, tracking and distribution throughout the entire Hector F. DeLuca Biochemical Sciences Complex, which has more square footage than the main floor of the Kohl Center!

Research Infrastructure

After several fits and starts, we have begun the second phase of remodeling to hold the combined Biophysics Instrumentation Facility/Biophysics Optical Core (BIF/BOC). When complete, the BIF/BOC space will hold state-of-the-art instrumentation and microscopes used to support the cutting-edge research being carried out in the Department. Our operating plan for this facility also includes making it accessible to researchers from across the campus.

A new Biochemistry website was created and launched in December 2014. We also now have an active social media presence, and our website and social media channels are continually updated with new stories and features that we encourage you to check out. We hope you enjoy the more frequent and diverse forms of electronic and print communications that keep you up to date on our Department's impact. Please let us know your thoughts on these so that we may continue to improve.

Student Accomplishments

Our undergraduate students continue to be remarkably successful. We have over 650 undergraduates who received a Bachelor's degree in Biochemistry since May 2013. Among these, 28 have received prestigious Hilldale Fellowships to perform research with Biochemistry faculty advisors. The Department supports the research and travel of outstanding undergraduates through our Biochemistry Scholars Program (led by Prof. Mike Cox). The Department also provides opportunities for international experiences through our Uganda Program (led by Prof. James Ntambi); the SCORE and Super G programs (led by Prof. Marv Wickens); and the Khorana/Bose programs (led by Prof. Aseem Ansari), which also brings many undergraduate interns from India into the department.

There were 69 graduate students who received a Ph.D. in Biochemistry since our last newsletter in 2012, and 116 postdoctoral fellows have trained with Biochemistry faculty. Our trainees are going on to successful careers in industry, academia, government and many other professions.

Our most recent winners of the Boyer Awards for Postdoctoral Excellence, provided by an endowment from Nobel laureate Paul D. Boyer, have been Dr. Zak Campbell (Prof. Wickens), Dr. Eric Montemayor (Prof. Butcher), Dr. Melkam Kebede (Prof. Attie), Dr. Kevin Desai (Prof. Raines), and Dr. Scott Aoki (Prof. Kimble).

The Sigrid Leirmo Award, provided by a memorial endowment from the family, is given each year to a graduate student for excellence in research and outstanding service, and so honors Dr. Leirmo's spirit and achievements. The most recent winners of this award have been Kim Haupt in 2016 (Prof. Kimble), Raashi Sreenivasan in 2015 (Prof. Record), Emily Ruff in 2014 (Prof. Record), and Amber Schuh in 2013 (Prof. Audhya).

Faculty Accomplishments

The Biochemistry faculty have active federal and non-federal grants and contracts in excess of $15M, speaking to the breadth of research being carried out in the Department today. Collectively, the Department has published over 350 articles and chapters in the past two years. Despite the highly competitive nature of extramurally funded research in these times, our faculty have continued to do well, which is a testament to their dedication and excellence in research. There have also been 46 new patents issued to nine different Biochemistry faculty since 2015, and several start-up companies have been formed, a demonstration of the continued focus on merging basic research with practical discovery that has always been near to the heart of this Department.

Several of our faculty had notable career achievements. These include David Pagliarini, who was promoted to Associate Professor and appointed Director and Nielsen Chair of Metabolism, Morgridge Institute for Research; Alan Attie, American Association for the Advancement of Science Fellow; Laura Kiessling, Alexander M. Cruickshank Award, Gordon Research Conferences; Judith Kimble, Chair, President's Committee on the National Medal of Science, 2015-2017; Ann Palmenberg, WARF Roland Rueckert Professor in Biochemistry and Molecular Virology; Ronald Raines, Humboldt Research Award, Alexander von Humboldt Foundation; John Ralph, Distinguished Professor, University of Tokyo, Japan; Michael Sussman, Wisconsin Alumni Research Foundation Innovation Award; and Douglas Weibel, Scialog Fellow, Research Corporation and Gordon & Betty Moore Foundation.

Dave Nelson (emeritus) founded the new Madison Science Museum, and Paul

Ludden (retired from being Provost at Southern Methodist University), was named emeritus faculty and is now a member of the CALS Board of Visitors. We also continue to benefit from seeing Perry Frey, George Reed, Julius Adler, John Suttie and Heinrich Schnoes in the building on a frequent basis.

Programmatic Advancement

The Department has committed your generous gifts to provide graduate and undergraduate research fellowships; undergraduate, graduate and postdoctoral travel funds; campus-wide symposia, lecture series and individual seminars; and unrestricted funds to support other needs of the Department. We sincerely appreciate your continued support of the Department by whatever means you choose, including advocacy on the impact of the University of Wisconsin on your life and those around you. Please contact us at ***chair@biochem.wisc.edu*** or the University of Wisconsin Foundation (***giving@supportuw.org***) if you would like to talk more.

Looking Ahead

To end this brief introduction to the 2017 Newsletter, I would like to let you know about a new scientific initiative and then introduce the newest members of our faculty.

Cryo-electron microscopy is a structural biology technique that is already contributing to a remarkable breadth of scientific problems. Recent technological advances have provided the capability to obtain high-resolution structural information from organelles to intact virus to single proteins. Coupled with advances in computing and image processing, cryo-electron microscopy offers the potential to visualize an unprecedented number of biological phenomena, and so will enhance opportunities across the entire spectrum of life sciences research carried out at UW-Madison. The Biochemistry Department and faculty have taken the campus lead in bringing cryo-electron microscopy to campus. Our first efforts, now underway, include hiring a faculty member into the department to lead this new initiative and siting the new instrumentation and research support facilities in the Hector F. DeLuca Biochemical Sciences Complex. We will keep you apprised on the progress in future communications.

The Department has had great fortune to hire four new faculty since 2014, including Katie Henzler-Wildman, Vatsan Raman, Ophelia Venturelli, and Philip Romero. You will be able to read about their interests and accomplishments elsewhere in this newsletter.

To end, please accept our best wishes and an offer to visit any time. There are now many easy ways to get in contact with us – check out our website or social media (***www.biochem.wisc.edu, Facebook.com/UWBiochem, Twitter.com/UWBiochem***).

We look forward to hearing from you.

View of the Biochemistry buildings - 1912 through 1985 tower - from University Avenue.
Photo by Wolfgang Hoffman, taken sometime between 1986 and 1997.
Courtesy of the University of Wisconsin-Madison Archives (ID S12726)

The Hector F. DeLuca Biochemical Sciences Complex

State-of-the-art facilities established and celebrated

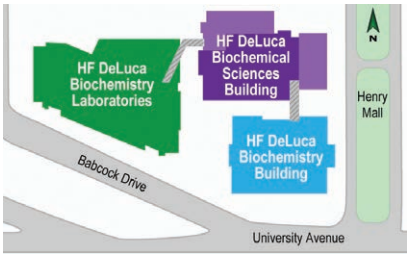
By Professor Mike Cox

Now that the 2010 research tower and remodeled 1912 wing have been occupied, building projects have slowed down. In 2013, the department took stock and held a celebration to honor Hector DeLuca, the individual who, more than anyone else, is responsible for the incredible facilities we now occupy. The event was held on April 24, 2014, and was attended by many hundreds of faculty, students, alumni, and university officials. It was a special occasion and a chance for the department both to honor our longtime Chair and colleague and appreciate our broader accomplishments.

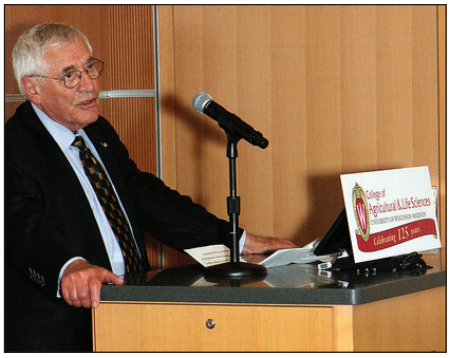
Approved by the board of Regents, the complex is now named the Hector F. DeLuca Biochemical Sciences Complex. It consists of three separate buildings, all interconnected with enclosed bridges as shown in the map below right. The Hector F. DeLuca Biochemistry Building is the now completely remodeled and historic 1912/1937 wings. These have been almost entirely given over to instructional functions, with new teaching labs and classrooms. The Hector F. DeLuca Biochemical Sciences Building is a merger of the 1985 wing, the 2010 tower, and the 1906 Ag Journalism building. The upper three floors of the 2010 tower are occupied by the Biomolecular Chemistry Department, joining us in the complex. The Hector F. DeLuca Biochemistry Laboratories is the 433 Babcock Drive building that used to be referred to as the 1998 Addition. Few departments anywhere can match these facilities, and we encourage you to visit if you have not seen us recently.

View of the Hector F. DeLuca Biochemical Sciences Complex from University Avenue

Nearly every square inch of this larger Biochemistry complex is either new or newly renovated. One exception is the ground floor of the 1985 wing, which houses the Biophysics Instrumentation Facility (BIF). This will be rectified with a project that should be initiated later this year, providing us with a new instrumentation facility destined to be a departmental showplace.



Map of the Complex



Hector DeLuca speaking at the dedication of the Hector F. DeLuca Biochemical Sciences Complex
Photo by Sevie Kenyon

CALS Dean Kate VandenBosch, Hector DeLuca and Chancellor Rebecca Blank
Photo by Sevie Kenyon

View from the connecting sky bridge,clockwise from left: HF DeLuca Biochemistry Building (1912 and 1937 buildings), 1998 HF DeLuca Biochemistry Laboratories (center), 2010 HF DeLuca Biochemical Sciences Building. Photo by Robin Davies

New Discoveries

A sampling of the Department's pioneering research

Newly discovered intermediate Drosophila mechanism. The mechanism between receptors and response in *Drosophila* has been studied by the **Adler** lab. Many undergraduates, Lar Vang, and Julius Adler isolated mutants which, although motile, failed to respond to all stimuli tested (*bioRxiv, July 27, 2016*). This is caused by a defect in the central brain at a newly discovered intermediate called "inbetween," presumably missing in the mutants.

At the start - 1961

Julius Adler, Vera Waska Scott, John Armstrong, Marge Dahl, Mel DePamphilis & Sylvia Zottu Schade

At the end - 2016

Lar Vang, Julius Adler, Megan Cohen, Laura Burbach, Sarah Drewes, Amelia Remiarz & Alison Heydorn

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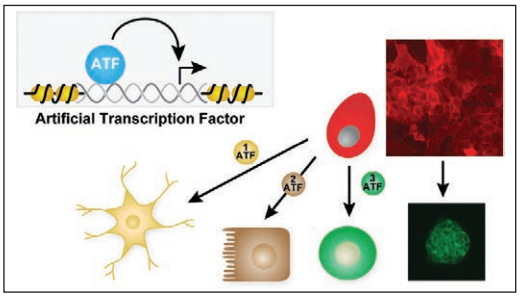
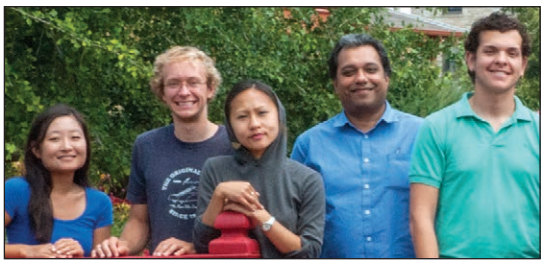
Day-length perception and flowering. The **Amasino** lab identified a specific light receptor in the phytochrome class (PHYC) that is required for flowering in the model grass Brachypodium; mutation of PHYC results in plants that are extremely delayed in flowering and consequently produce much more biomass. This study highlights the evolutionary differences in flowering pathways in different groups of plants (PHYC has no role in flowering in the well-studied model dicot plant Arabidopsis) and provides a potential strategy for engineering grasses for increased biomass production.

Daniel Woods & Rick Amasino

'wild type' (left, small plant) & phyC mutant (big plant)

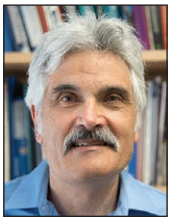
Furthering precision medicine at the molecular level. The **Ansari** lab wrapped up several exciting projects over the last year. We developed a facile strategy to reprogram cells from one type to another in a more efficient and unbiased manner. Asuka Eguchi created a genome-scale library of artificial transcription factors to control cell fate (*Eguchi et al. PNAS. 2016;113(51) E8257*). Graham Erwin meanwhile charted the genome-wide binding patterns of sequence-specific small molecules in human embryonic stem cells thereby generating the first atlas of these genome readers in live cells (*Erwin et al. PNAS. 2016;113(47) E7418*). Earlier in the year, Juan Rodriguez-Molina and Sandy Tseng published their innovative chemical-genetic approach to freeze the catalytic activity of a targeted kinase in living cells and by doing so revealed a masked role of a well-known kinase in the synthesis of full length mRNA (*Rodriguez-Molina & Tseng et al. Mol Cell. 2016;63(3):433*).

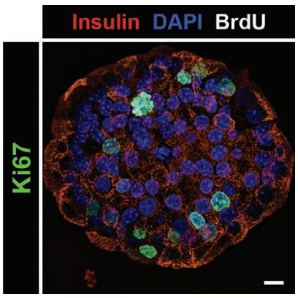




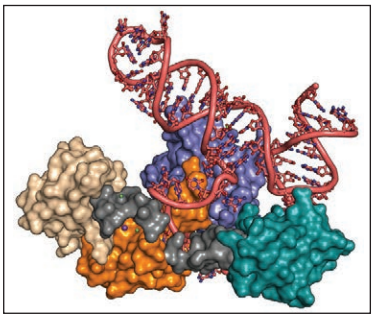
Asuka Eguchi, Graham Erwin, Sandy Tseng, Aseem Ansari & Juan Rodriguez-Molina

Single transcription factor associated with diabetes risk. In a paper in *PLoS Genetics*, the **Attie** lab asked if genes identified in human populations to play a role in type 2 diabetes might have a common transcriptional driver. We used our own expression quantitative trait locus mapping data and found that 40% of these genes are regulated by a single transcription factor NFATc2. Coincident with our genetic findings, others have shown that drugs that activate this transcription factor protect against diabetes in animal models. *PLoS Genet. 2016 Dec 9;12(12) : e1006466.*



Mark Keller & Alan Attie



Crystallography through collaboration. In the **Butcher** lab, Eric Montemayor determined the high-resolution crystal structure of the core of the U6 small nuclear ribonucleoprotein particle (U6 snRNP). Allison Didychuk described the structural requirements for protein-catalyzed annealing of U4 and U6 RNAs, an essential process in all eukaryotes. Lots of other excitement as well! We continue to enjoy our strong collaborations with Aaron Hoskin's group and Dave Brow's group in Biomolecular Chemistry.






Eric Montemayor, Allison Didychuk & Sam Butcher

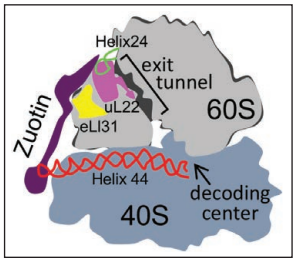
Breakthroughs in directed evolution of E. coli. In the **Cox** lab several projects have been moving forward. We are using directed evolution to generate populations of *E. coli* that are highly resistant to the effects of ionizing radiation. These populations adapt by streamlining their DNA repair mechanisms and enhancing processes that ameliorate the effects of reactive oxygen species. This project has been pursued by a series of graduate students, most recently Rose Byrne Nash and Steve Bruckbauer. T.J. Kim generated RecA proteins with enhanced function, but these bind to DNA more tenaciously and slow cell growth. Functional balance is important for the multiple proteins that share the DNA substrate. A six-year effort by Asher Page and Tyler Stanage to elucidate the function of the *E. coli* RarA/MgsA protein has borne fruit. This protein, a AAA+ ATPase in the clamp-loader clade with close homologues in yeast and humans, is part of a switch that replaces the normal DNA polymerase at the replisome with translesion DNA polymerases. Stefanie Chen led our effort to characterize a new protein involved in double-strand break repair, now called RadD. Finally Angie Gruber and Erin Ronayne made great progress characterizing the activity of the RecA-dependent nuclease Ref.


Rose Byrne Nash


Back: Tyler Stanage, Wellington Leite, Liz Wood, Mike Cox, Stefanie Chen
Front: Erin Ronayne, Steve Bruckbauer, Angie Gruber & TaeJin Kim


Asher Page

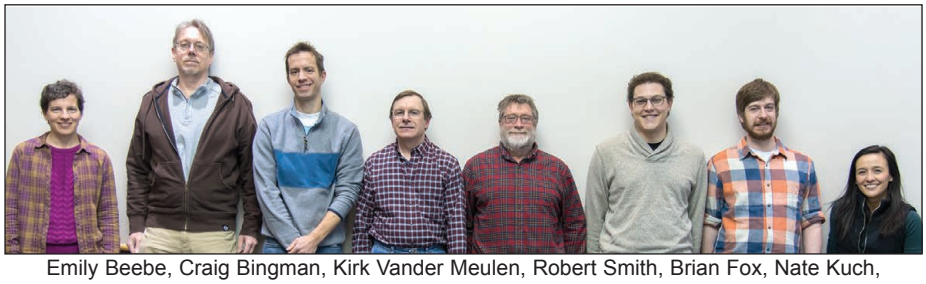
Spanning the ribosome subunits. The **Craig** lab has uncovered a means by which a J-protein/Hsp70 molecular chaperone system may coordinate protein translation and protein folding by interacting with both the 40S and 60S ribosomal subunits. Using a combination of site-specific crosslinking, X-ray crystallography, cell biology and molecular modeling, sites of interaction of the J-protein Zuotin at the nascent chain exit site on the 60S and with the rRNA helix that emanates from the 40S decoding center were defined.



Kanghyun Lee, Ruchika Sharma, Om Shrestha, Craig Bingman & Betty Craig

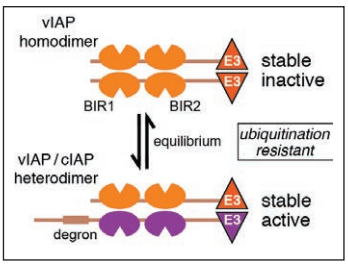
Solving the mysteries of metalloenzymes. The **Fox** lab achieved three structure/function research milestones in the recent past. We reported the crystal structure of stearoyl-CoA desaturase in *Nature* with Ming Zhou's group, including former UW-Madison students Jason McCoy and Elena Levin and Pablo Sobrado (former AHA postdoctoral fellow in the lab and now Professor of Biochemistry at Virginia Tech University). In a second work, postdoctoral fellow Michael Mbughuni collaborated with the Joint Bioenergy Institute to report in *PNAS* the structure of an oxygenated intermediate and a proposal for the mechanism of a new enzyme that helps metabolize aromatic compounds derived from plant lignin. In the third publication, also in *Nature*, we (Justin Acheson, Lucas Bailey and Thomas Brunold from Chemistry) reported the in-crystal reaction cycle of a toluene-bound diiron hydroxylase, which provides an unprecedented view into the nature of a reactive intermediate in an oxygenase reaction. Each of these works provides a foundational shift in the way we think about how metalloenzymes carry out difficult oxidation reactions.

Justin Acheson



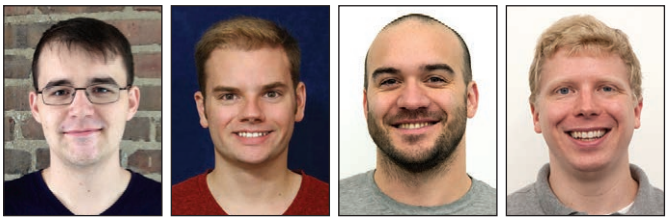
Emily Beebe, Craig Bingman, Kirk Vander Meulen, Robert Smith, Brian Fox, Nate Kuch, Evan Glasgow & Stephanie Dillon

How viruses defeat host cell defenses. Nate Byers and collaborator Rianna Vandergaast in **Paul Friesen's** lab recently solved a twenty-year-old puzzle in the field of viral apoptosis by being the first to explain the molecular mechanism by which viral inhibitor-of-apoptosis (IAP) proteins prevent cell death during virus infection. These Ph.D. students discovered that the baculovirus-encoded IAP binds to and prevents degron-mediated destruction of the host cell's IAP, thereby enabling the host IAP to continue to block apoptosis during infection and thus facilitate virus multiplication. This novel virus strategy sheds important insight into mechanisms of virus pathogenesis and the function of cellular IAPs in human disease, including cancer. *J. Virol. 90:533-544. PMID: 26491164.*

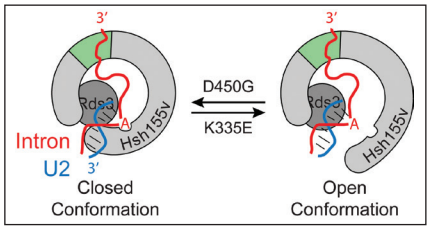


Nathaniel Byers, Rianna Vandergaast & Paul Friesen

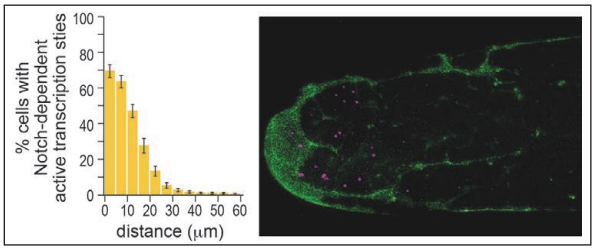
How cancer mutations change RNA processing. Tucker Carrocci in the **Hoskins** lab, working with undergraduate Doug Zoerner (now in medical school at University of Kentucky) and lab manager Josh Paulson, uncovered how mutations in the spliceosome implicated in myelodysplastic syndrome (MDS) and chronic lymphocytic leukemia (CLL) change pre-mRNA splicing. These mutations change spliceosome fidelity--in other words, how the spliceosome recognizes some RNA sequences and not others. Changes in fidelity influence how RNA sequences compete with one another for the splicing machinery and ultimately may impact alternative splicing and gene expression.

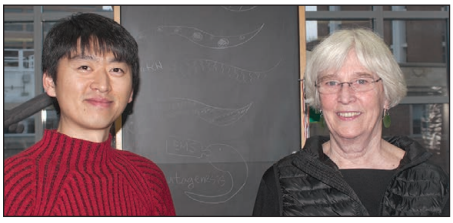


Tucker Carrocci, Doug Zoerner, Josh Paulson & Aaron Hoskins



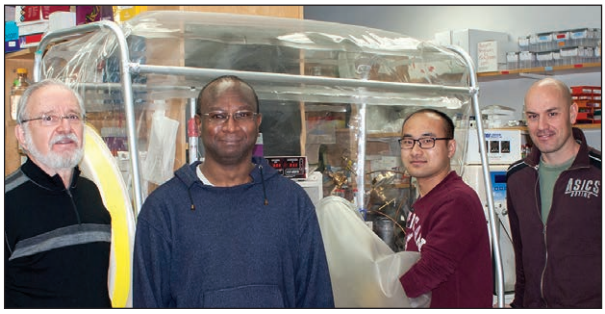
Using single molecule fluorescence in situ hybridization to analyze cell signaling in stem cells. The **Kimble** lab assayed the Notch-dependent transcriptional response of stem cells to signaling from their niche. Our analysis used single molecule fluorescence *in situ* hybridization to nascent transcripts from individual chromosomal loci in wild-type animals, which permitted quantitation of the transcriptional response at single molecule resolution. We found to our surprise that the transcriptional response to Notch signaling occurred with a graded and position-specific probability. Our results demonstrate for the first time that a canonical signaling pathway induces transcription in a probabilistic fashion and that a pool of biologically equivalent stem cells can be graded with respect to their response to signaling. We suggest that this probabilistic response to signaling is likely a common phenomenon.



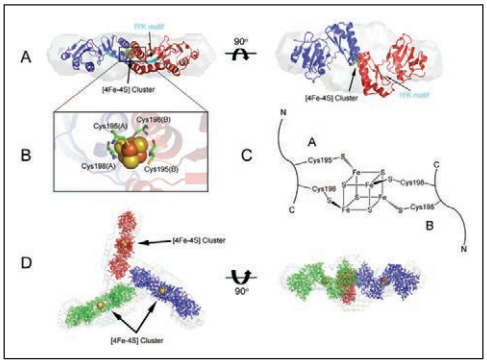


ChangHwan Lee & Judith Kimble

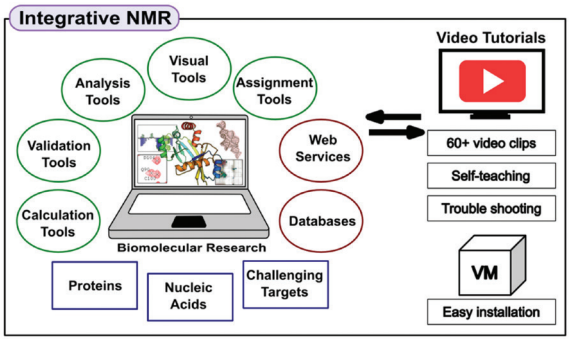
Mitochondrial protein structures. The **Markley** lab collaborated with Rutgers University on structures of mitochondrial proteins. One of the challenging structures was NFU1, which functions as an intermediate carrier of [4Fe-4S] clusters in the biosynthesis of iron-sulfur proteins and whose defects lead to human diseases (A). The cluster binds to the side chains of the two cysteine residues located in the C-terminal domain of each subunit and bridges the two subunits (B). The modeling exercise showed that of the two possible ligation configurations, only one fit the SAXS density (C). SAXS data obtained for holo-NFU1 showed that the protein is a trimer of dimers, with a tripartite junction formed by the N-terminal domains of three dimers (D). According to this model, each dimer contains two classes of N-terminal domain: one free and one involved in the tripartite interaction. The work appeared in *Structure 24(12), 2080–2091 (2016).*



John Markley, Ronnie Frederick, Kai Cai & Marco Tonelli



Data management solutions for NMR. One of the challenges of biomolecular NMR spectroscopy, says John **Markley**, is that a wide variety of computer software packages, computer servers, and databases need to be used in data processing and analysis, spectral assignments, structure determination, structure refinement, and validation. Different software packages require different operating systems and thus may not be easily interoperable. To make biomolecular NMR spectroscopy much more accessible, we have created a platform called Integrative NMR that consolidates software tools so that they interact efficiently in ways that support both manual and automated approaches to data analysis, validation, and visualization. Also included are links to web services, databases, and video tutorials. Although the component software packages are available for separate installation, we provide, as an option, all of them pre-installed in a virtual machine that runs on any standard laptop or desktop computer. The virtual machine avoids the necessity of installing the separate required software programs within different operating systems. For details, see *J. Biomol. NMR, 64:307-32 (2016).*



Wonghee Lee, Gabriel Cornilescu, Hesan Dashti, Hamid Eghbalnia, Marco Tonelli, Milo Westler, Sam Butcher, Katie Henzler-Wildman & John Markley

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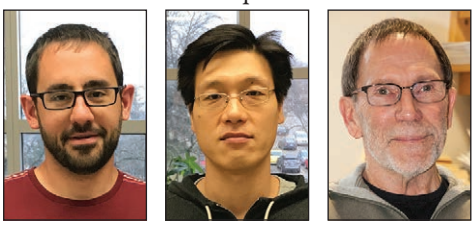
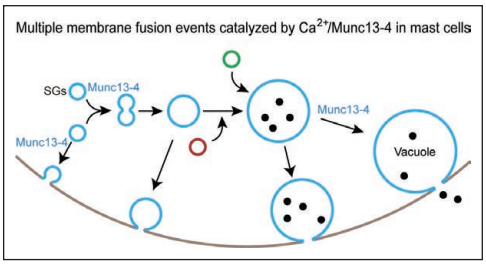
Prime time for fusion in the Martin lab. A hallmark feature of eukaryotic cells is membrane compartmentalization. Cargo flow from ER to cell surface is mediated by vesicle budding from a donor compartment and vesicle fusion at an acceptor compartment. Highly-regulated membrane fusion resides at the end of the secretory pathway in neurons, endocrine cells, and mast cells where protein-loaded secretory granules fuse with the plasma membrane in calcium-triggered fusion reactions (exocytosis). We study the actions of proteins that prime the exocytic machinery for membrane fusion: CAPS and Munc13-4. CAPS, a large soluble protein with C2, PH and CATCHR domains, is essential for neural/endocrine secretion. Studies showed that CAPS functions by binding to plasma membrane PI(4,5)P2 and SNARE proteins to promote assembly of trans SNARE complexes that mediate membrane apposition and fusion. CAPS resides on secretory granules and the basis for its peripheral membrane attachment is under study. Munc13-4, which contains two calcium-binding C2 domains bracketing a CATCHR domain, is the major priming factor for granule exocytosis in mast cells. Its actions resemble those of CAPS in binding membrane and SNARE proteins to assemble fusogenic SNARE complexes but its activity is calcium-dependent. We found that Munc13-4 is multifunctional and also regulates calcium-dependent endosome fusion and exosome secretion. Priming factors exhibit similar fundamental properties; a challenge will be their structural elucidation in the context of SNARE complexes.

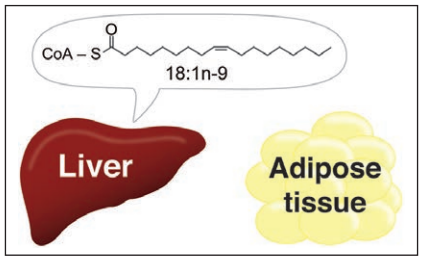


Scott Messenger, Sang Su Woo & Tom Martin

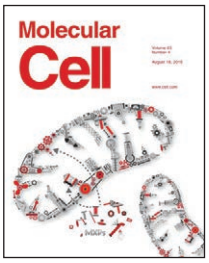


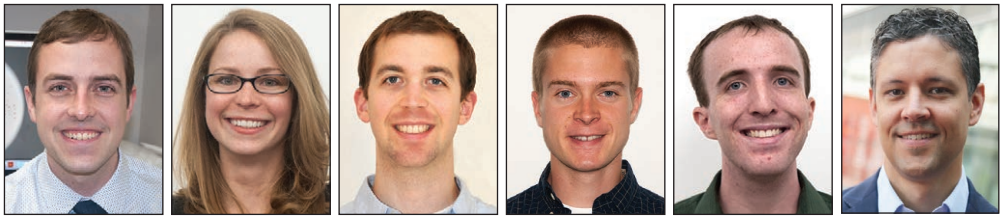
Finding new fatty acid functions. The **Ntambi** lab discovered that the monounsaturated fatty acid oleate, 18:1n9, has important metabolic functions in both white adipose tissue and liver. Graduate student Maggie Burhans revealed that hepatic oleate represses both fatty acid synthesis and oxidation in white adipose tissue. Additionally, liver-derived oleate partially protects mice from hepatic ER stress and inflammation.

James Ntambi & Maggie Burhans



Systematically defining mitochondrial protein functions. Mitochondria are central hubs of cellular metabolism, and more than 150 diseases can arise when they do not work properly. However, the functions of hundreds of mitochondrial protein "parts" remain undefined. By combining mass spectrometry-based proteomics and metabolomics with machine learning, yeast genetics, *in vitro* biochemistry, and structural biology, the **Pagliarini** lab has defined new roles for orphan mitochondrial proteins in oxidative phosphorylation and coenzyme Q biosynthesis.





Brendan Floyd, Danielle Lohman, Andrew Reidenbach, Jonathan Stefely, Michael Veling & Dave Pagliarini

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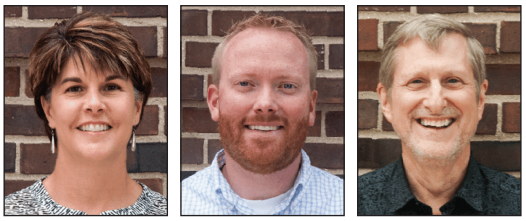
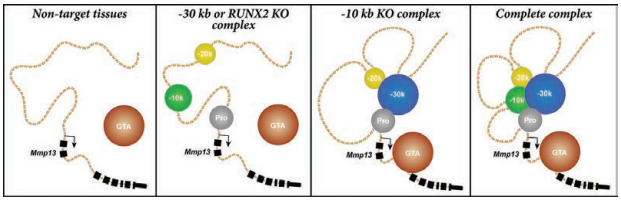
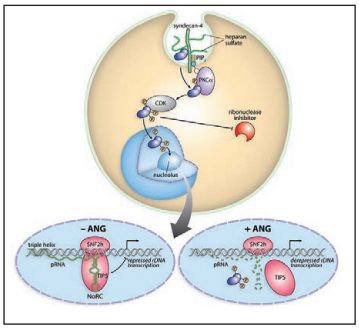
Regulation of the Mmp13 gene. The **Pike** Group discovered through ChIP-seq and other analyses that the regulation of *Mmp13* gene expression in bone cells is governed by multiple distal intergenic enhancers. One of these control elements which is occupied by the bone cell master differentiation factor RUNX2 exerts hierarchical control over the others by altering their capacity to recruit factors such as the vitamin D receptor. This finding highlights the central role of key transcription factors in cell-type specific gene expression.



Nancy Benkusky, Mark Meyer & Wes Pike



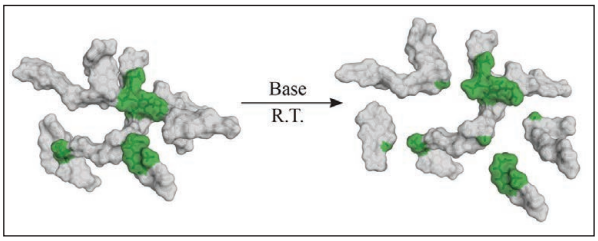
A remarkable growth factor. Angiogenin was the first substance shown to promote organogenesis. Thirty years after that discovery, the **Raines** lab has shown that this protein acts by an autonomous mechanism that begins outside of the cell and ends with its catalyzing the cleavage of a particular bond in a nucleolar RNA.



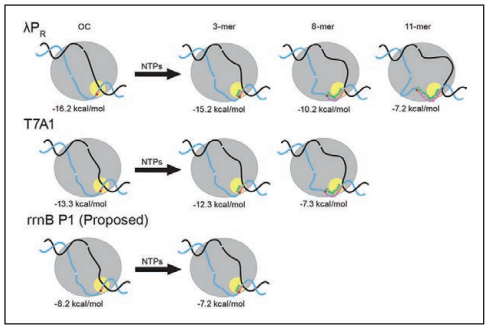
Trish Hoang & Ron Raines

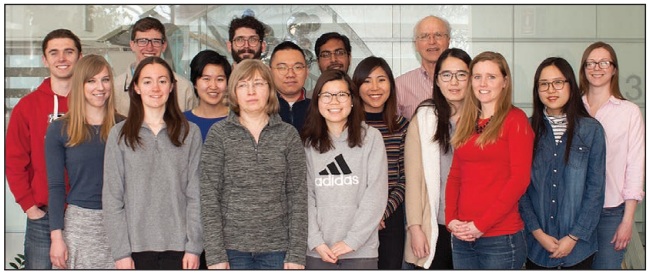
Making plant lignin polymers easier to chemically degrade. The **Ralph** group has been working on modifying plant lignins so that they fall apart more readily during chemical processing to derive value from the polysaccharides. With collaborators working on gene discovery (Wilkins, MSU) and on poplar transformations (Mansfield, UBC), success in bioengineering 'zip-lignins' into trees was described [*Science, 344(6179), 90-93 (2014)*]. Then, armed with new and more sensitive analytical methods for detecting zip-lignins, the group has now shown that Nature is already employing such pathways in a variety of plants [*Science Advances, 2(10), e1600393 (2016)*]. In new collaborations with the Fox lab and Shawn Kaeppler's group in Agronomy, the group is now searching for the best genes/enzymes to express the highest possible zip-levels in various crop plants without incurring agronomic penalties. At the same time, various studies illustrating the improved processing of the original zip-lignin poplars are beginning to emerge. For more on this story, see... *https://biochem.wisc.edu/news/2016/news-designer-lignin-2016-10-17*

Steve Karlen & John Ralph



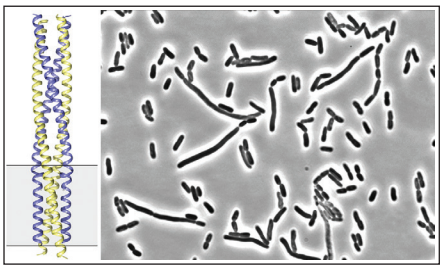
New functions of discriminator region of promoter DNA. The **Record** laboratory studies the mechanism and regulation of transcription initiation by the multi-subunit *E. coli* RNA polymerase, as well as the thermodynamics of solute-solute interactions in water. We've recently found that the discriminator region of promoter DNA, a major determinant of open complex lifetime and stability located immediately upstream of the transcription start site, also determines the RNA-DNA hybrid length for promoter escape and therefore the amount and length distribution of short (abortive, presumably regulatory) RNA synthesized. Consequences of changing discriminator length and sequence on initiation *in vitro* and on GFP expression *in vivo* are being determined, the latter a collaboration with Vatsan Raman's laboratory.

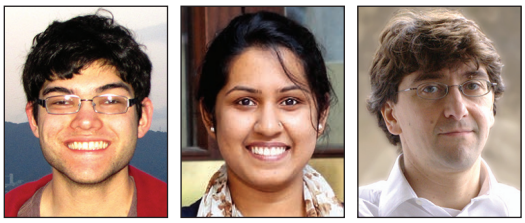




Tom Record Lab

Structural organization of a bacterial cell-division protein complex. Using a combination of computational, biophysical and biological experiments, the **Senes** lab and collaborators in the Hoskins, Weibel and Cui labs, determined the structural organization of the FtsBL complex, which forms a tetrameric helical bundle that spans the bacterial inner membrane and the periplasmic space. The structure is important for understanding the biological function of the complex, and why mutations impair cell division and induce filamentation of the bacterial cell. In the long term, this knowledge may be important for the design of novel antibiotics.

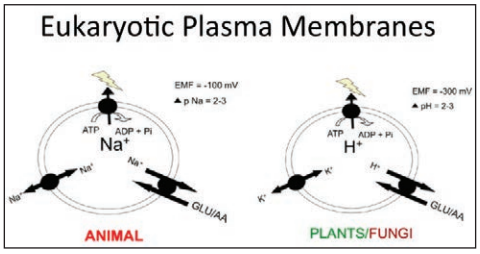




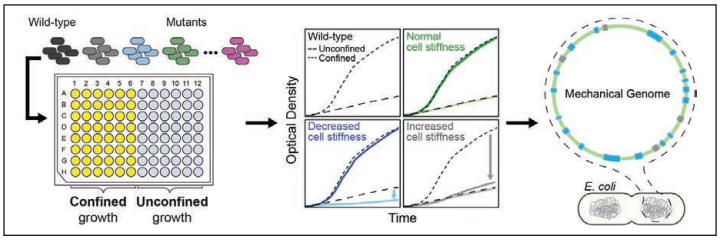
Sam Condon, Deena-Al Mahbuba & Alessandro Senes

New kinase-peptide ligand pair provides insights to plant growth. At the plasma membrane, plants and fungi utilize protons in the same manner that animals use sodium, i.e., to energize the plasma membrane and control the membrane potential and rates of transport. The **Sussman** lab has recently identified a new receptor kinase-peptide ligand pair that controls the rate of cell expansion in plants by controlling the proton pump. The work shows that within a few minutes of applying the ligand to plant roots, the plasma membrane proton pump is inhibited, resulting in reduced rates of cell expansion and growth of roots.

Miyoshi Haruta, Ben Minkoff, Thao Nguyen & Michael Sussman

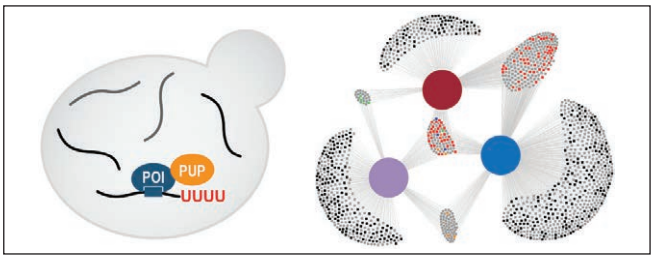


The mechanical genome. The **Weibel** lab has developed a method for rapidly identifying and studying global genes and mutations that alter bacterial cell stiffness. Using this technique they are discovering regulators of control cell wall synthesis and cell mechanical properties that provide opportunities to develop new antibiotic strategies.



George Auer & Doug Weibel

Understanding the RNA-protein plexus. RNAs are regulated by proteins to which they bind. These interactions determine when, where and how much protein an mRNA produces. The **Wickens** lab developed a new approach – "RNA tagging" – that identifies the collection of RNAs a protein binds. In this strategy, the protein covalently marks the RNA, which permanently identifies it. We have found that single proteins bind 100's to 1000's of mRNAs, that these mega-networks are balanced with one another, to create a super-network, and that they contribute critically to metabolic regulation.



In the image left, a protein of interest (POI) is linked to an agent that covalently marks any RNA to which the POI binds. In this case, the "marker", a poly(U) polymerase (PUP) that we discovered, adds U's the end of the RNA. Right, a super-network composed of multiple smaller sets of RNAs. Each large circle is a different protein that binds mRNAs (small dots).

Marv Wickens & Chris Lapointe

New intracellular transport mechanisms. Neuronal function relies on organelles, vesicles, and macromolecules getting to right place at the right time. Capitalizing on CRISPR gene editing to manipulate molecular motors *in vivo*, the **Wildonger** lab identified a new mechanism that controls motor activity to keep dendritic organelles from invading axons, maintaining neuronal polarity.

Brian Jenkins, Harriet Saunders, Helena Record,
Jill Wildonger, Mike Kelliher, Ashley Ng & Sihui Yang

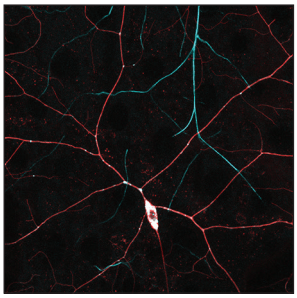


Photo by Robin Davies

New Faculty Profiles

Four new faculty span structural biology, allostery, protein design and dynamics, and microbiological communities – and build on the department's long-standing breadth

Professor Katie Henzler-Wildman

Understanding the dynamics of membrane proteins and transport, exploiting NMR

I am most interested in understanding how things work on a molecular level. How the specific features of individual molecules lead to their particular function, and how this molecular activity underlies macroscopic biological processes. I love quantitative data analysis: what will each data set reveal about the chemical and physical principles governing biological processes? Will our hypothesis be supported or does the data suggest a different explanation? I really enjoy defining, testing, and refining hypotheses in the lab and helping students learn to do the same. Figuring out how the world works has always fascinated me, but I also want to study something useful. My lab studies small multidrug resistance transporters because the basic biology is interesting and they contribute to antibiotic resistance. How do multidrug transporters harness the proton motive force in order to actively pump antibiotics out of bacteria so that the bacteria can survive? How do these tiny pumps recognize and pump out such a broad array of substrates leading to their multidrug transport activity? More recently, I have gotten interested in ion channels and we are now investigating ion selectivity and gating. Our discoveries will help us understand allosteric regulation of channels – how gating conditions are sensed by the channel and communicated to the pore domain to open or close the channel. The overarching theme of the lab is a focus on how protein structure and dynamics enable membrane proteins to carry out their functions.

I started my undergraduate career at Cornell as a Chemical Engineering major. I worked in a lab the summer after my freshman year, stripping toluene from water in a packed column, and realizing that I didn't really like engineering after all. This experience convinced me of the importance of getting undergraduate students into research early! In order to transfer to Arts and Sciences to become a Chemistry major, I needed signed permission from five Chemical Engineering professors, four of whom simply told me I was making a terrible decision and would never make any money. Only one, Paulette Clancy, said "I understand you don't want to be a ChemE, what DO you want to do?" I wasn't really sure, but I told her about a booklet we'd read in AP biology in High School that had piqued my interest. It was an HHMI booklet on blood, but most interesting to me was an entire section on x-ray crystallography and the structure of myoglobin. Without missing a beat, Prof. Clancy told me that she didn't know any crystallographers, but she did know an NMR spectroscopist, and proceeded to call Linda Nicholson on the spot. When I left her office, I had my fully signed transfer form and my first research position in an NMR lab, and I didn't even know what NMR was! I spent the rest of my time at Cornell working in the Nicholson lab and became hooked on NMR as a tool to study not just protein structure, but also motion. How do proteins move? On what time scales, and how large are the motions? How is the motion regulated by phosphorylation or other modifications (we were studying Src domains), or changes in the environment? How does the motion vary across the protein and how does that facilitate or inhibit the function of the protein?

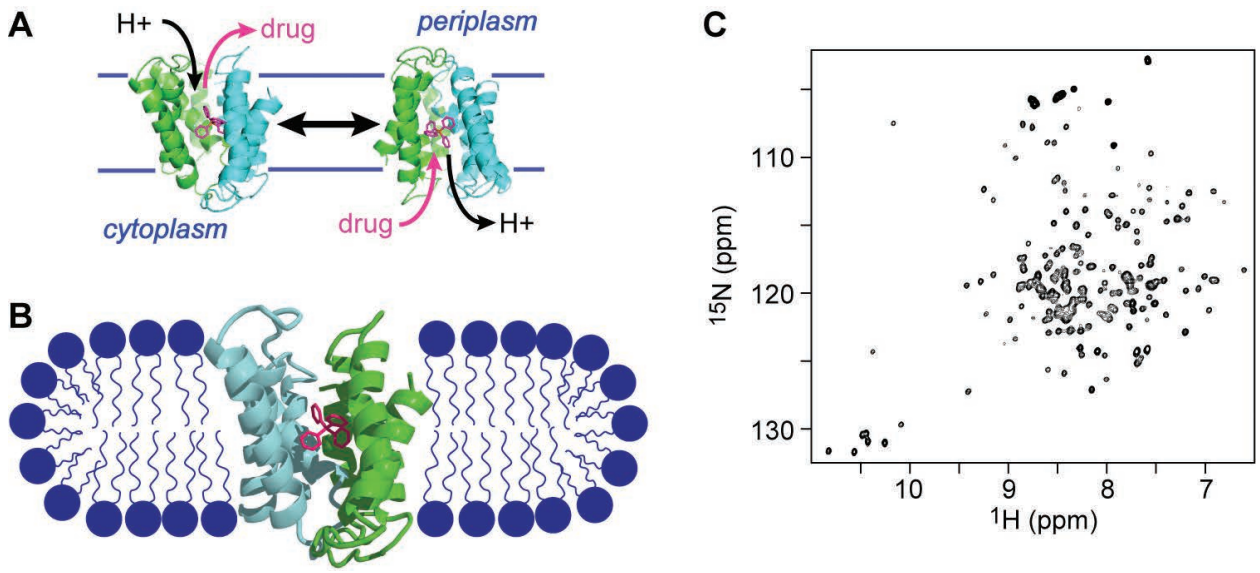
To develop a deeper understanding of NMR spectroscopy, I joined the solid-state NMR lab of A. "Rams" Ramamoorthy as a graduate student at the University of Michigan. For my thesis research, I used solid-state NMR to investigate the interaction of the human antimicrobial peptide, LL-37, with lipid bilayers – both how lipid composition affects peptide orientation and insertion depth, and how the peptide affects the structure and organization of the lipid headgroups and acyl chains to create defects in the membrane structure. This was my first experience with lipid bilayers and membranes, which are always a bit temperamental to work with. While I loved the complexity and challenge, there was so much unknown and the experimental tools were so limited I didn't think it would be possible to really examine protein structure-dynamics-function relationship in the detail I wanted in a membrane environment anytime soon. So I returned to my interest in protein dynamics as a postdoc, joining the lab of Dorothee Kern at Brandeis University, studying the functional importance of protein motion for catalytic activity in the soluble enzyme adenylate kinase

My postdoc research addressed two distinct questions: Is the lid-opening motion of adenylate kinase, which is rate-limiting for catalysis, an intrinsic property of the protein itself? If so, how are such slow, large-scale collective motions encoded in the protein sequence? Combining solution NMR dynamics, single-molecule FRET, crystallography, and MD simulations provided the necessary resolution in both time and space to answer the first question, revealing inherent motion along the opening/closing trajectory in the absence of substrate. Further comparison of thermophilic and mesophilic homologs of adenylate kinase highlighted localized "hinge" regions that enabled the larger functional domain motions. This provided the first insight into how the amino acid sequence and structure encoded local regions of enhanced flexibility that in turn facilitated specific, functionally important domain motions. This experience showed me the power of bringing multiple experimental techniques together to examine the same question from multiple perspectives. I also learned to ask big biological questions – using new technology to go after problems that had previously been impossible to address experimentally.

Right across the hall from the Kern lab, Chris Miller's lab was studying the

mechanism of transporters and channels, and Chris convinced me to try NMR dynamics studies of transporters. It was a logical next step, since conformational change is central to the transport process – the transporter protein must switch between states open to opposite sides of the membrane in order to move molecules from one aqueous compartment to another. Smaller is better for the high-resolution solution NMR needed to measure the conformational exchange process, so I chose to work on the only small transporter with a known structure, the small multidrug resistance transporter EmrE. My preliminary experiments yielded beautiful spectra and I now had a research project that drew on both my Ph.D. and postdoc experiences to study the functional dynamics of an integral membrane protein.

In 2008 I started my own laboratory at Washington University in St. Louis, fearlessly tackling my new project on EmrE. My lab demonstrated that solution NMR could indeed directly monitor open-in to open-out conformational exchange in a transporter. The data we could obtain with this new approach allowed us resolve the controversy surrounding the antiparallel topology of the EmrE homodimer and experimentally demonstrated that the two monomers of the antiparallel EmrE homodimer swap conformations to transport substrate across the membrane. More recently, we have used NMR experiments at different pH and with different substrates to "walk" through various steps in the transport cycle. Our results demonstrate that EmrE breaks all the rules for proton-coupled antiport in the currently accepted, decades-old mechanistic model. We are developing a new model for proton-coupled transport, using our quantitative NMR data on populations and transition rates to build a kinetic model for net flux, and comparing these predictions with liposomal transport assays. Our current working model suggests that it may be possible to target antibiotic resistance in an entirely novel way through the efflux pumps. It will be fun to see if this works!



A) Cartoon model of EmrE transport, protons are moved down their electrochemical gradient into the bacterial cytoplasm in order to pump drugs in the opposite direction. This lowers the drug concentration inside the bacteria, enabling them to survive drug exposure and causing antibiotic resistance.

B) Cartoon cross section of a protein embedded in a bicelle.

C) NMR spectrum of a membrane protein solubilized in a bicelle. Each spot is a contour plot of a peak in the NMR spectrum and represents the NH group of a different amino acid. By varying the parameters of the NMR experiment and monitoring the change in peak position, intensity, or width we can determine the relative populations of different states and the rates of conformational exchange with amino acid level resolution.

Professor Vatsan Raman

Using synthetic and systems biology to understand and exploit protein design and allostery

The last 18 months have been a rewarding and thrilling experience. When I joined the department in September 2015, I remember walking into an empty laboratory and feeling a bit overwhelmed at the task that lay ahead of me. Today, we are a vibrant laboratory of biochemists, microbiologists and engineers with research interests in systems and synthetic biology.

The goal of our laboratory is to understand the molecular basis of protein allostery and to design new allosteric proteins with new function. We use designed allosteric proteins as biosensors and switches to engineer cellular pathways and microbial communities. Allostery is regulation from a distance. It is a fundamental biological property by which perturbation at one site of a protein leads to a functional response at a faraway site.

The best analogy for allostery is to imagine someone tapping your head, and in response you kick your foot. The site of response (foot) is far from site of perturbation (head). Allosteric proteins are nature's switches; they control virtually every biological process including catalysis, transcription, transport and signaling. Our goal is to understand the molecular basis of allostery. This has important implications in medicine and biotechnology. Allosteric proteins such as nuclear receptors, kinases, and G-protein coupled receptors are prime drug targets. Mutations in these proteins can lead to a systemic loss of regulation, resulting in cancer, as well as developmental, hormonal and metabolic disorders.

Understanding the molecular underpinnings of how a mutation disrupts allostery has important implications for precision medicine. Biosensors that can detect small molecule ligands (metabolites) are a highly valuable tool with applications in synthetic biology, medical diagnosis, environmental monitoring, bioremediation, and bioenergy. Our laboratory combines computational protein design and high-throughput experimentation to design allosteric biosensors for new molecules.

The research interests of my laboratory reflect my own diverse training as a chemical engineer, a computational structural biologist and a synthetic biologist. As most chemical engineers do, I worked in the industry after college; first, in a petroleum refinery, and then selling industrial pumps and control valves.

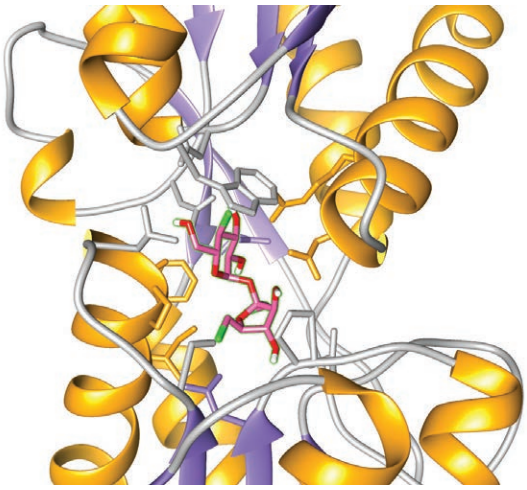
However, I did not find industry intellectually rewarding and decided to pursue a masters in chemical engineering in Missouri. My first inspiration to pursue my current research occurred in a Statistical Thermodynamics course. I was amazed that a macroscopic property of matter, such as freezing point or boiling point of water, could be accurately computed from interactions occurring at the molecular level by applying principles of probability and statistics. This led to my masters thesis on a computational model of molecular nucleation in atmospheric cloud.

As I was pondering my next career step, I was bitten by the biology bug! I was blown away when I saw the three-dimensional structure of a protein for the first time. It was the structure of bacteriorhodopsin, a light-driven proton pump. I was in awe of the complexity of the structure, the intricate molecular connections, and the beautiful parallel-antiparallel alignment of the transmembrane alpha helices. I knew right away that I wanted to work on understanding protein structures and protein folding.

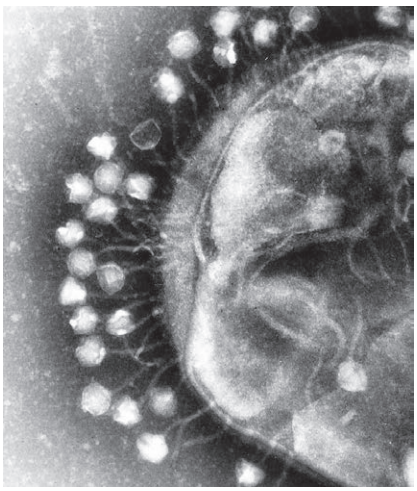
My second inspiration was the idea that the complex three-dimensional shape of a protein structure is uniquely determined by the primary amino acid sequence, and hence could be computed without the need for experiments. I joined the laboratory of Dr. David Baker at the University of Washington, Seattle for my Ph.D., where I developed computational tools to predict three-dimensional structure of proteins at atomic-level accuracy.

My third inspiration was as a postdoctoral fellow in Dr. George Church's laboratory at Harvard Medical School, where I learned the power of "multiplexing." Multiplexing is the experimental approach to make millions of measurements of a system in a single assay. In the Church lab, I saw multiplexing applied firsthand in contexts as diverse as next-generation sequencing, metabolic engineering and the brain connectome.

I am excited to continue pursuing my research at the University of Wisconsin–Madison Department of Biochemistry. I enjoy the time I spend in our lab with talented biochemists, microbiologists, and engineers. My experiences here have been great so far and I look forward to many more.



Left: Crystal structure of the lac repressor redesigned to bind to sucralose.



Right: TEM image of bacteriophages attached to a bacterial cell surface.

Right: image by Dr Graham Beards - en:Image:Phage.jpg, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=5035798

Professor Philip Romero

Developing high-throughput approaches to understand principles of protein structure and design new functions

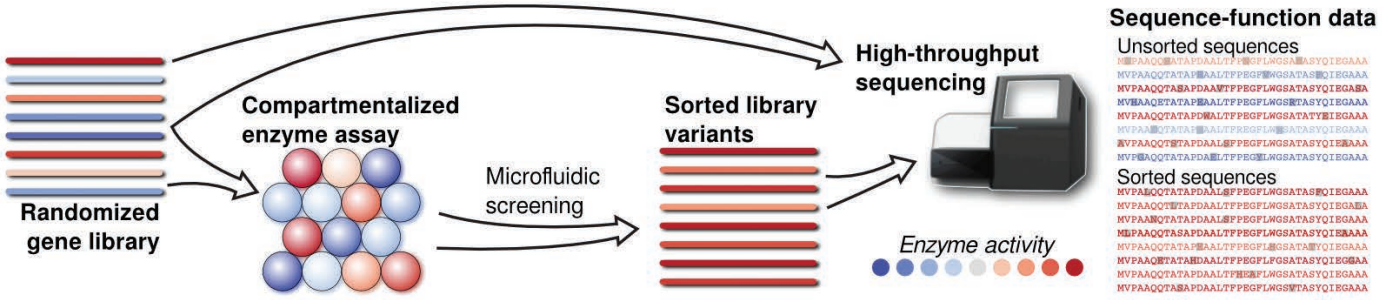
I joined the UW–Madison Department of Biochemistry in the summer of 2016. I was previously an assistant professor in the Department of Chemical Engineering at UCLA. My research group works on protein engineering, using a combination of theory, computation, and experimental methods.

Proteins are amazingly diverse molecules that are capable of performing a wide variety of complex molecular functions. You can take 20 amino acids and string them together in different combinations to generate the molecules that drive biological processes such as metabolism, cellular communication, and DNA replication. We're interested in stringing together new combinations of amino acids to generate new and useful protein functions. The applications of protein engineering are endless. As a graduate student in Frances Arnold's lab at Caltech, I engineered proteins as MRI contrast agents for brain imaging, enzymes to degrade biomass into fermentable sugars for bioenergy, and anti-cancer protein therapeutics.

A key challenge in protein engineering is our limited understanding of the complex relationships between protein sequence, structure, and function. This mapping involves thousands of atoms, a practically infinite number of conformational states, and poorly understood physical interactions. My lab at UW-Madison leverages new high-throughput experimental technologies to obtain a comprehensive and unbiased view of the mapping between sequence and function. We're able to obtain functional data from millions of protein sequence variants. We combine these massive data sets with recent advances in large-scale machine learning to extract detailed and quantitative knowledge of how proteins work.

A longer-term goal for my research program is the ability to rationally design proteins with custom molecular/biological functions. This capability would have a tremendous impact across all areas of biology, medicine, and biotechnology. You could identify an emerging infectious disease and then use a computer to rapidly design a therapeutic protein to treat it. You could design custom biocatalysts to interconvert different types of chemicals for industry. The possibilities are really endless once we learn the principles of protein design.

I'm really excited about UW-Madison's cutting-edge research environment, excellent colleagues, and its core strengths in biochemistry and chemical engineering. The University really fosters interdisciplinary and collaborative research. I've been interacting closely with faculty in statistics, electrical engineering, and chemical engineering. I've also been struck by the many opportunities to participate in larger-scale, team science projects. For example, the Great Lakes Bioenergy Research Center, which is a large multidisciplinary group of researchers working to solve problems in energy. There is also the Wisconsin Institutes for Discovery, which has six research themes to tackle big problems that are outside the scope of single-investigator projects. I'm looking forward to building my interdisciplinary research program in this highly stimulating and collaborative environment.



Large-scale analysis of protein sequence-function relationships provides a comprehensive and unbiased view of the molecular basis of protein function.

Professor Ophelia Venturelli

Revealing evolutionary principles of microbial ecologies and networks through experiment, computation and theory

In natural environments, microbes don't appear in isolation but are instead embedded in diverse communities composed of self and non-self. In such communities, microbes interact via competition, cooperation and cell-to-cell communication. For example, microbes compete over limited resources, wage antibiotic warfare by producing toxic chemicals, communicate via signaling, engage in metabolic interchange or detoxify their environment.

For example, specific microbes can secrete metabolites that are utilized by different members of the community, forming a positive interaction. A multitude of diverse mechanisms of interaction impacts community-level functions by altering the fitness and activities of constituent members.

It has become increasingly evident that microbial processes provide diverse functions to influence plants, oceans, soil, and even human health. A detailed and quantitative understanding of the principles of microbiomes can enable scientists and engineers to recreate them to harness their benefits. I joined the Department of Biochemistry in July 2016, and I am fascinated by these processes. Before joining the department, I was a postdoc at the University of California, Berkeley and earned my Ph.D. at the California Institute of Technology and bachelor's degree from Stanford. I am interested in elucidating the molecular and ecological principles that drive microbial communities and developing mathematical models to predict and analyze microbial behaviors. We also aim to exploit biological and engineering design rules to engineer microbial systems to perform novel functions.

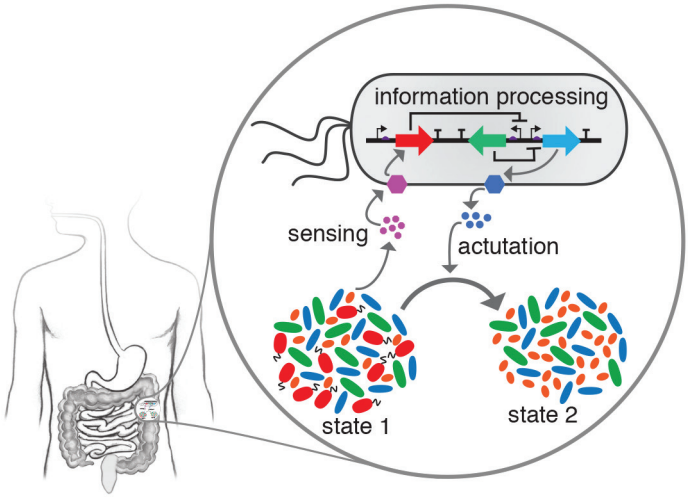
For example, microbes exist on and inside the human body, which constitutes the human microbiome, significantly contribute to human health. I'm interested in understanding how human-associated microbial communities function and how to design microbes to monitor human health, deliver drugs on demand or enhance resistance to invasion by intestinal pathogens. I am also interested in studying microbial communities in broad applications including agriculture and bioenergy.

During my undergraduate years, I became fascinated with the dynamics of biological networks and how these networks can enable cellular information processing. I realized that it was not possible to reason about the quantitative behavior of complex networks without mathematical frameworks. I became very interested in how you can capture those networks using computational models and spent several years in undergrad and grad school taking computer science, engineering and math classes. At UW–Madison, my work focuses on systems biology, synthetic biology, and microbial communities.

A recent project has focused on developing a generalizable framework to reverse engineer microbial interactions in multi-species communities. Leveraging these methods, we are interested in understanding the dynamic response of the gut microbiota to external pressures such as antibiotics and invasion by the pathogen *C. difficile*. We are also developing microfluidic platforms to interrogate inter-species interactions and designing genetic circuits in probiotic organisms to shape the structure and function of the gut microbiota.

I am looking forward to working with students from diverse backgrounds in combining engineering principles, microbiology, biochemistry, and mathematical modeling. As an assistant professor in Biochemistry, I am also affiliated with the Department of Bacteriology and the Department of Chemical and Biological Engineering.

UW-Madison is a supportive and collaborative environment, the students are highly motivated and the research areas are incredibly diverse across campus. I'm excited to interact with faculty across many departments at UW-Madison.



The Venturelli lab aims to dissect the molecular and ecological basis of microbial communities using model-guided methods. These principles will be exploited to engineer microbes to perform novel functions that benefit human health.

Alumnus: Michael Green

A creative leader in understanding how gene control contributes to cancer and new modes of therapeutic intervention

When he finished his undergraduate degree in the Department of Biochemistry at the University of Wisconsin–Madison in 1974, Michael Green had little idea that in 2015 he would become the director of the University of Massachusetts Medical School Cancer Center. He did, however, leave the department with a base of knowledge he still uses in his current studies of cancer biology.

After receiving his undergraduate degree, Green attended Washington University for a Ph.D. and medical degree. He was a postdoctoral scholar and then professor at Harvard until 1990, before moving to U Mass Medical School. He held a variety of positions there before becoming director of the cancer center. At U Mass, Green is also currently chair of the Department of Molecular, Cell, and Cancer Biology.

"I would say that my experiences studying biology, chemistry and biochemistry at UW helped shape my career because they provided an initial exposure to fundamental scientific concepts that remain integral to my current research," he says. "I also feel that UW provided a great overall undergraduate education, and courses I took for example in mathematics and the humanities were also very important to me."

Broadly, Green researches the regulation of gene expression and how that expression affects disease. He seeks to understand how normal cells become cancer cells and also reveal new possibilities for treatment. He says the primary reason he carries out his research is to have a potential positive impact on human disease.

His many honors include election to the National Academy of Sciences, National Academy of Medicine, and European Molecular Biology Organization. He has also earned a Searle Scholar Award, the Presidential Young Investigators Award, and the McKnight Neuroscience Award.

During his time in the Department, Green worked in the lab of professor Tom Record. One of his undergrad classmates was Alan Attie and the two are still good friends. Attie is now a professor in the UW–Madison Department of Biochemistry. Green also received a Babcock Fellowship in Biochemistry from the department in 1973.

"What always strikes me when I return to Madison is the remarkable amount of growth and how much larger and how many more research buildings there are now here compared to when I was an undergraduate," Green says. "It's always enjoyable to come back to visit or give seminars."

Alan Attie (left) and Michael Green circa 1975

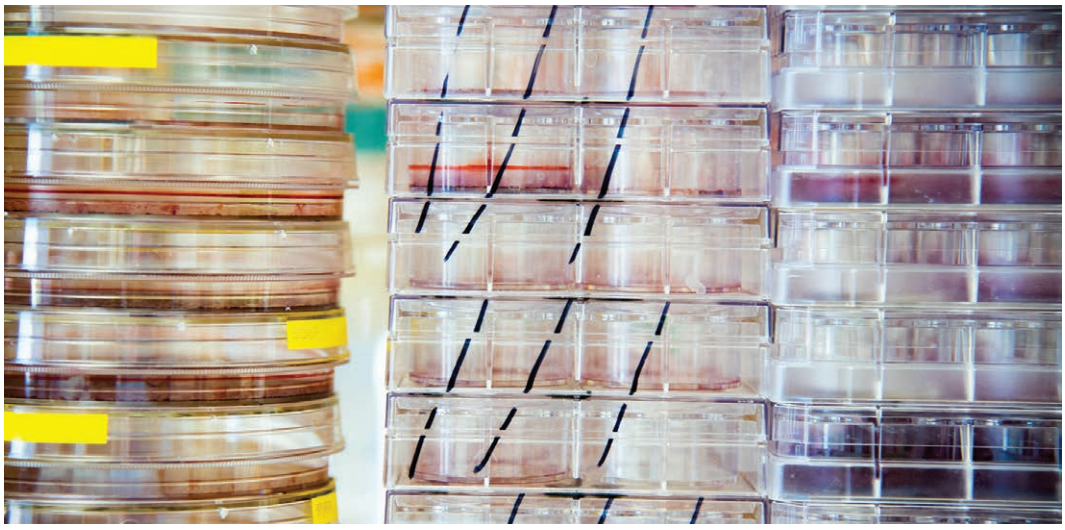


Photo by Robin Davies

Alumnus: William Rutter

An innovative pioneer in biochemistry and genetic engineering and founder of biotechnology receives an Honorary Degree

The Department of Biochemistry was proud to nominate William J. Rutter for a 2016 honorary degree. He received the award during university commencement on Friday, May 13 at the Kohl Center.

Rutter's relationship with the department goes back to the time he spent as a postdoctoral researcher in the lab of professor Henry Lardy. A pioneering biochemist, Rutter helped lay the foundation for the then-emerging field of biotechnology.

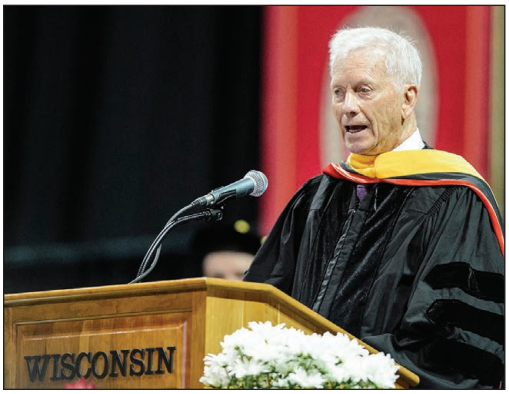
Honorary degrees from UW–Madison recognize individuals with careers of extraordinary accomplishment. The Committee on Honorary Degrees looks to sustained and characteristic activity as its warrant: uncommonly meritorious activity exhibiting values that are esteemed by a great university.

Research breakthroughs under Rutter's leadership include the first cloning of genes for insulin and growth hormone, at the University of California, San Francisco. He became part of UCSF as the head of their Department of Biochemistry and Biophysics in 1968. In 1981, he helped found Chiron Corporation. There he discovered a recombinant DNA vaccine for hepatitis B and decoded genomes for HIV and hepatitis C viruses.

Rutter is currently chairman and founder of Synergenics, LLC, which has a portfolio of biotechnology companies. The group provides services, such as financing, legal and business advice, and scientific and operational resources, to companies at different stages of development.

"Bill Rutter, a founder of the field of biotechnology, has made seminal contributions in both academia and industry," says nominator Ronald T. Raines, the Henry Lardy Professor of Biochemistry, Linus Pauling Professor of Chemical Biology and Professor of Chemistry at UW–Madison. "Our campus played an important role at the inception of his career; in turn, the biotechnology industry has had an enormous impact on both our campus and the city of Madison. The faculty of the Department of Biochemistry voted unanimously, and with great enthusiasm, to endorse this nomination."

Rutter has published more than 380 scientific articles and holds over 25 patents. Additionally, he is a member of the National Academy of Sciences and the American Academy of Arts and Sciences.

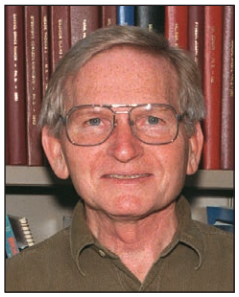


William Rutter giving his commencement address. Photo by Bryce Richter

Photo by Robin Davies

Emeritus Profile: Professor Perry Frey

Recollections of a life in chemical mechanistic enzymology and 27 years in Madison



In response to a request for a profile of my development as a chemical mechanistic enzymologist, I offer the following. My parents were John and Inez Frey, who were happily married for 68 years in Plain City, Ohio. This was a small, rural community of ~1500 at the time I was born in 1935. My twin sister and I started school in first grade at the local public school in September of 1941, and three months later we learned about the attack at Pearl Harbor and the start for America in World War II. About two years later, I began carrying and delivering a newspaper to neighbors, and I read about the war. It was very hard to learn about local soldiers who lost their lives or returned with life-long injuries.

Early Education

By the time I reached high school I had learned how fortunate I was. My parents were intelligent people who had been prevented by cultural pressures from obtaining higher education. My father grew up in an Amish family and was prevented by that culture at the time from attending high school. He was allowed an eighth-grade education, after which he worked on the family farm until he turned 21 in 1930, the depth of the Great Depression. He could have been any kind of professional man if he had been able to obtain a higher education. GEDs did not exist then, but he read widely and became socially and politically mature; and he taught himself music on the violin, guitar, and organ. He worked as a farm laborer for a couple of years and then acquired skills in seasonally complementary trades as a sheep shearer and painting contractor. My mother grew up a Mennonite, which did not restrict her education. However, she had to leave high school in the 10th grade to help support her younger siblings after the departure of their father. She worked at her own job after we children entered grade school, and she became manager of the local office of the General Telephone Company. My parents impressed on me the importance of a high school diploma, which they regarded as a key to success. My father employed me in his contracting business through junior and senior high school, and later in college. I graduated from high school in 1953.

College at Ohio State

In high school I became interested in science, especially chemistry. I have often been asked by students and colleagues if I intended to have an academic research career. My answer was always that I had no specific intention other than to be a chemist. I was fortunate to live within 19 miles of The Ohio State University, where tuition was $50.00 per quarter at the time, and the Chemistry Department was excellent. I spent the year after high school commuting daily to and from Ohio State. The commute was inconvenient, but I could not afford to live on campus, and there were other pressures. At the time, federal law required all healthy young men to complete 8 years of military service. Three main paths were available. One could enlist in the Army, Navy or Air Force and serve for eight years or as a career. Alternatively, one could join an Active Reserve or National Guard unit for eight years. This involved limited training on active duty, followed by regular training as a "weekend warrior" for the balance of the eight years. A third option was to volunteer for military conscription and serve on active duty for two years. For the balance of the eight years you were in the Ready Reserve, which did not require meetings or other training. College deferments were possible to avoid active duty, but I did not know anyone who had one. Religious objectors were given alternative options. I chose the third option because it would satisfy my military requirement in essentially two years and qualify me for college support under the GI Bill of Rights. I entered the U. S. Army in 1954. After training in basics and tank weapons mechanics, I was transferred to Germany for the balance of my active duty.

I have been told that my military service was a waste. I do not agree. I met people from the streets of New York, the mountains of Appalachia, the forests and cotton fields of the deep South, the deserts of the Southwest, and the mountains and forests of the Northwest. And I spent more than a year in Germany. It was a social education.

I returned to Ohio State in 1956 and completed the curriculum for a Bachelor of Science degree in chemistry. The chemistry courses were generally excellent. As I made progress I became increasingly comfortable with my choice of major, while placing a high and appropriate value on all of my other courses, including philosophy, English composition, German, comparative literature, economics, political science, and of course physics and mathematics.

Chemistry at the USPHS

After graduating in 1959, I took additional higher level courses and worked as a teaching assistant. I was at loose ends, was not doing well, and was uncertain about my future. I was certain about one thing. I had met Carolyn Mae Scott on a date to see Madam Butterfly at the Cincinnati Summer Opera. Carolyn lived and worked in the Cincinnati area, and I thought it was important to see her every day. Therefore, I moved to Cincinnati and found a position as a food chemist at the Sanitary Engineering Center in Cincinnati. This center was operated by the United States Public Health Service (USPHS), and it was concerned with air and water pollution and food safety. The Center later became part of the Environmental Protection Agency. Carolyn and I were married in February 1961, and our first daughter Suzanne was born in February 1962.

As a food chemist in the USPHS, I worked under contract with the U. S. Army to neutralize the paralytic toxin from the red tide organism *Gonyaulax catenella*. This became known as saxitoxin. I purified it from Alaskan mussels and studied methods to chemically bind it to bovine serum albumin. I succeeded in chemically linking it to the protein, and in collaboration with microbiologists tested the conjugate for immunogenicity in rabbits. The conjugate elicited antibodies in rabbits, and some of the antibodies neutralized the paralytic effects of saxitoxin. Thus, saxitoxin linked to serum albumin served as a hapten in immunized rabbits. This work introduced me to immunology and toxicology.

Pursuit of the Ph.D.

During 1960-63 I furthered my chemical education by taking graduate courses in analytical, inorganic, organic, and physical chemistry in the Evening School at the University of Cincinnati. I decided to pursue a Ph.D. degree and applied to the National Institute of General Medical Sciences for a Predoctoral Fellowship. Based on my academic record the Institute awarded me a fellowship. I was drawn to the research of Professor Robert H. Abeles, then at the University of Michigan, whom I had met when he was an Assistant Professor of Chemistry at Ohio State. I called him, told him about my fellowship, and asked if he would accept me as a graduate student. He agreed. Our family moved to Ann Arbor in January 1964.

Upon arrival in Ann Arbor I learned that Professor Abeles had accepted a position in the Department of Biochemistry at Brandeis University in Massachusetts. He asked if I would be willing to move there the following August. I agreed and spent January to August at Michigan taking courses in biological chemistry, the chemical synthesis of natural products and starting my Ph.D. research. Abeles introduced me to the biochemistry of the Vitamin B_{12} coenzyme adenosylcobalamin, which he had found to be required in the bacterial dehydration of propane-1,2-diol to propionaldehyde. Abeles and his associates had purified dioldehdrase, the enzymatic catalyst. I synthesized 2*R*- and 2*S*-[1-^{2}H]propane-1,2-diols with identical configuration at C1 by chemical and enzymatic methods and showed that dioldehydrase transferred the 1-pro-*R* hydrogen from C1 of one stereoisomer and the 1-pro-*S* hydrogen from C1 of the other stereoisomer to C2 of propionaldehyde. We published this unusual stereochemistry and moved to Brandeis University.

At Brandeis I continued classroom studies in biochemistry, enzymology, and physical organic chemistry and moved forward with research on the role of adenosylcobalamin in the action of dioldehydrase. Abeles and associates had discovered that glycolaldehyde inactivated dioldehdrase in the presence of adenosylcobalamin, producing cob(II) alamin. This form of vitamin B_{12} lacked the adenosyl-moiety, and the cobalt was Co^{2+}, the one-electron reduced form the more common cob(III)alamin. I was charged with finding out what had happened to the adenosyl-moiety. I synthesized 5'-deoxyadenosine and identified it as the product derived from adenosylcobalamin in the inactivation. I also showed that inactivation by [2-^{3}H]glycolaldehyde led to the incorporation of tritium into 5'-deoxyadenosine. This keyed me to the idea that adenosyl-C5' might participate in hydrogen transfer in adenosylcobalamin-dependent reactions. In February 1965, Carolyn and I welcomed our younger daughter Cynthia into the world.

Next, I found that reaction of [1-^{3}H] propane-1,2-diol as substrate with the complex of adenosylcobalamin and dioldehydrase produced [^{3}H] adenosylcobalamin, with all of the tritium bonded to C5' of the adenosyl-moiety. Reaction of unlabeled propane-1,2-diol with [^{3}H]adenosylcobalamin and dioldehydrase produced [^{3}H] propionaldehyde. Therefore the adenosyl-moiety of adenosylcobalamin mediated hydrogen transfer. This function of adenosylcobalamin was subsequently found in all other adenosylcobalamin-dependent enzymatic reactions known at the time. I completed my Ph.D. research in 1967.

Postdoctoral Research

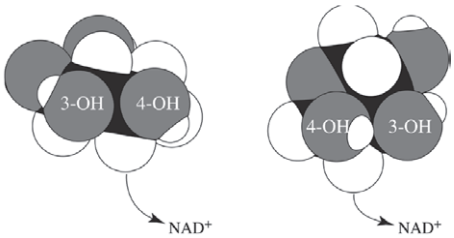
Near the end of my time at Brandeis, Professor Abeles suggested that I do postdoctoral work with F. H. Westheimer at Harvard. Knowing that Abeles had done postdoctoral work with Westheimer, a leading mechanistic enzymologist, I agreed. Abeles called Westheimer and informed me on the same day that I had a postdoctoral commitment. I interviewed with Westheimer, was awarded an NIH postdoctoral fellowship, and joined his group in November 1967. Westheimer had led research on bacterial acetoacetate decarboxylase and showed the role of the lysyl-6-amine in iminium-formation with the Beta-keto-group of acetoacetate, thereby promoting decarboxylation. Researchers preceding me had found that the pH-rate profile in acylation of this lysyl-amino group displayed a p*K*a of 6, 4.5-p*K*a units below that of lysine in water. Westheimer was concerned about kinetic ambiguities and asked me to look into this. I conducted reporter group spectrophotometric studies and found the active site microenvironment to lower the thermodynamically measured p*K*a-values of both neutral and positively charged acidic groups in the active site by 4 p*K*a-units. This could happen only in a positive electrostatic field.

University Faculty Career

Three weeks after starting my postdoctoral research, I received a letter from the Department of Chemistry at Ohio State requesting my application for an Assistant Professorship. I had been recommended by my mentors. I responded by submitting my *Curriculum Vitae* and application. I was interviewed and offered the position. I accepted the appointment and started my own laboratory in January 1969. In April 1969 I was awarded my first individual research grant from the NIH and accepted my first graduate students at Ohio State.

During my career at Ohio State from 1969-81 and at UW-Madison 1981-2008, more than 90 graduate and postdoctoral researchers collaborated with me in work on the chemical mechanisms of action of enzymes. These students were excellent in their own ways and produced research with me in the refereed literature. The students became friends and went on to their own careers in academia, research institutes, the biotechnology, pharmaceutical, and agricultural chemical industries in the U. S. and around the world. I cannot name them all in this space, but their names appear in our group website.

At Ohio State, our group pursued three main lines of research. We started with the Leloir Pathway, UDP-galactose 4-epimerase (GalE) and galactose-1-P uridylytransferase (GalT), which had been sparingly studied and presented significant mechanistic issues. We found that the interconversion of UDP-galactose and UDP-glucose by the GalE-NAD^+ complex involved the intermediate UDP-4-ketoglucose. Experiments on substrate selectivity and binding, kinetics, and isotope tracing suggested that nonstereospecific hydride transfer at glycosyl-C4 could be explained by substrates presenting different glycosyl rotamers to NAD^+, as illustrated (*next page*).



Hydride transfer rotamers of Gal E substrates UDP-xylose and UDP-arabinose.

This proved to be consistent with the crystal structure subsequently determined at UW-Madison in collaboration with Professor Hazel M. Holden. The structure also keyed us to finer points of the hydride transfer mechanism.

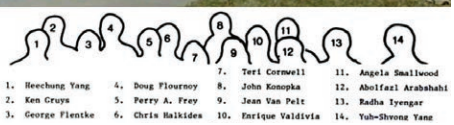
GalT catalyzes the reaction of galactose-1-P (Gal-1P) with UDP-glucose to produce UDP-galactose and glucose-1-P (Glc-1-P). I thought that Gal-1P and Glc-1-P should bind to the same site, so that the overall kinetics should be Ping Pong Bi Bi, in the Cleland nomenclature, and the intermediate should be a covalent UMP–X-GalT. Our group showed this to be correct kinetically and by isolation and characterization of the kinetically competent covalent intermediate. The gene and amino acid sequences, site-directed mutagenesis, and chemical rescue experiments pointed to His166 as the active site nucleophile X linked to UMP. The crystal structure later determined in collaboration with Professors Ivan Rayment and Hazel Holden at UW-Madison verified this assessment.

Our work on GalT inspired us to look more broadly into the mechanisms of phospho- and nucleotidyltransferases. Most were controversial regarding the involvement of covalent (E—P) intermediates. I thought that stereochemistry at the transferred phosphorus could resolve controversies. We devised syntheses of substrates with chiral P, using ^{18}O, ^{17}O, ^{16}O and/or S as substituents on P to generate chirality. And we developed spectroscopic and chemical methods to assign configurations.

We found the GalT reaction to proceed with overall retention at P, presumably by way of inversion in two transfer steps. We confirmed inversion in the first transfer step to form the E-His166—UMP. We subsequently completed stereochemical analyses on 13 other transferases. All studies indicated inversion at each transfer and retention whenever a covalent E—P was an intermediate. The results supported the rule that whenever both forward and reverse acceptors were similar structurally and electrostatically, the mechanism was two-step phosphotransfer with retention, like GalT. Whenever the two acceptors were unlike, the mechanism was a single phosphotransfer with inversion at P.

Beginning at Ohio State, we also undertook studies of a central enzyme in energy metabolism, the pyruvate dehydrogenase (PDH) complex. We simplified and improved the purification from E. coli. Other labs had shown it to consist of three enzymes – pyruvate dehydrogenase, dihydrolipoyl transacetylase, and dihydrolipoyl dehydrogenase – but its subunit composition was controversial. We managed to provide strong evidence for 24:24:12 as the subunit composition, using chemical and molecular mass analysis.

In 1981, we moved to UW-Madison and continued with research on GalE, GalT and other phosphotransferases, and we focused attention on the chemical mechanism of the PDH complex. The cofactors thiamine diphosphate (ThDP) and lipoamide were involved, as well as the substrates pyruvate, NAD^+/NADH, and CoA/acetyl-CoA. Various chemical mechanisms could be considered. We were able to prove the intermediacy of S^8-acetyldihydrolipoamide. We also generated indirect evidence for the participation of 2-acetyl-ThDP. Finally, we synthesized 2-acetyl-ThDP, determined its


1. Heechung Yang 2. Ken Gruys 3. George Flentke 4. Doug Flournoy 5. Perry A. Frey 6. Chris Halkides 7. Teri Cornwell 8. John Konopka 9. Jean Van Pelt 10. Enrique Valdivia 11. Angela Smallwood 12. Abolfazl Arabshahi 13. Radha Iyengar 14. Yuh-Shyong Yang

Frey Group December 1984

chemical properties, and proved it to be an intermediate in the reaction of PDH complex.

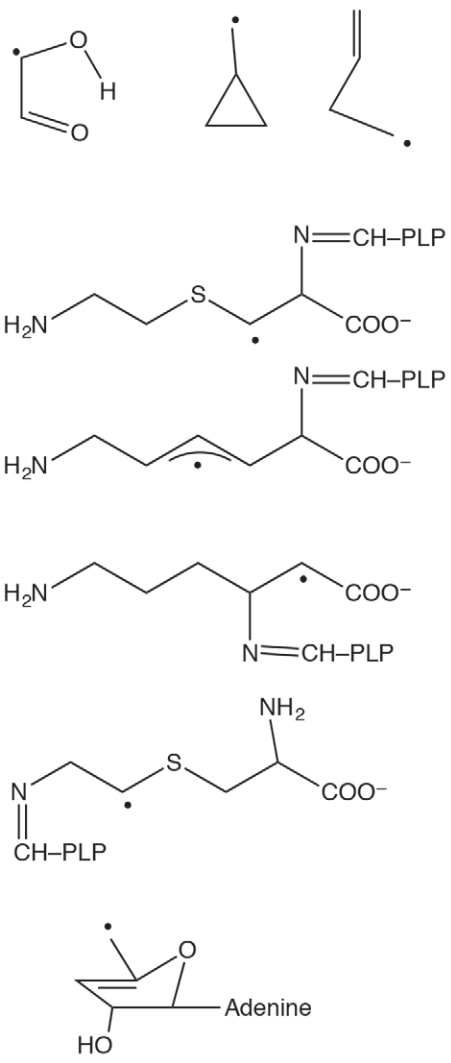
As a graduate student, I was taught that carbon-centered radicals could play no role in enzymatic reactions. They were too reactive and hard to control and would create havoc in an active site. By the 1970s, radicals began to appear in active sites, even in the active sites of dioldehydrase and other B_{12} enzymes.

By 1985 I began to take an interest in the role of S-adenosylmethionine (SAM) in reactions that, at the time, seemed unusual for this molecule. I was particularly interested in the role of SAM in the reaction of lysine 2,3-aminomutase (LAM), which had been discovered at UC-Berkeley by H. A. Barker and associates 15 years earlier. It catalyzed the interconversion of lysine and 3,6-diamininohexanoate, that is, migration of the alpha-amino group from C2 to C3. This reaction followed the pattern that had been established for adenosylcobalamin-dependent enzymes, but it did not require a vitamin B_{12} coenzyme. I wondered whether the adenosyl in SAM (Ado-CH_2—S^+-Met) could be made to function in the same way as the adenosyl group in adenosylcobalamin (Ado-CH_2—Co^{3+}-cobalamin). On its face, this did not seem reasonable. The Co—C bond in adenosylcobalamin was known to be weak (31 kcal/mol) and could undergo homolytic scission to the 5'-deoxyadenosyl radical and Co^{2+}, whereas the homolytic bond dissociation energy for a C—S^+ bond was >62 kcal/mol. However, the reaction of LAM was stimulated by Fe^{2+}, suggesting to me that complex chemistry might be at work.

Our group found that the adenosyl group in SAM mediated hydrogen transfer by LAM in exactly the same way as it did in adenosylcobalamin-dependent enzymes. We wrote a radical isomerization mechanism for the aminomutase reaction. We also discovered that the role of Fe^{2+} was in the assembly of a [4Fe-4S] cluster that ligated SAM through the carboxyl and amino groups. And we discovered that the iron-sulfur cluster mediated homolytic cleavage of the S+—CH_2 bond in SAM by inner sphere electron transfer.

Concurrently with the work on LAM, we undertook to examine the reaction of methane monooxygenase,

with support from the Amoco Research Foundation. I thought this reaction should proceed through a carbon-centered radical mechanism, and we succeeded in demonstrating this by chemical methods. We also extended the LAM research to an adenosylcobalamin-dependent lysine 5,6-aminomutase. We ultimately observed and characterized more than 15 carbon-centered radical intermediates by chemical and spectroscopic methods, mainly in collaboration with my colleague Professor George H. Reed and his associates, who specialized in characterizing carbon-centered radicals by isotope-edited electron paramagnetic resonance spectroscopy. Typical radicals found in active sites are shown below, where PLP is pyidoxal phosphate.



Typical carbon-centered radicals identified at enzymatic active sites.

Low-Barrier Hydrogen Bond (LBHB)

My colleague W. W. Cleland postulated in 1992 that certain enzymatic processes might be potentiated by the transient formation of LBHBs. This keyed me to recall a paper by G. Robillard and R. Shulman in 1972, in which they observed a downfield 1H-NMR signal at 18 ppm in chymotrypsin at low pH (pH < 7) and assigned it to the proton bridging His57 and Asp102 in the active site. It was unusual to observe such an exchangeable proton in aqueous solution by ^{1}H-NMR, and even more unusual to observe one so far downfield. I thought this should be a property of an LBHB.

Examination of the literature on such hydrogen bonds in small molecules supported my thoughts. The literature characterized three classes of hydrogen bonds according to their strengths, conventional, 2-10 kcal/mol; intermediate strong (LBHB), 10-20 kcal, mol; and very strong, >24 kcal/mol. The LBHBs were regarded as asymmetric, short hydrogen bonds intermediate in strength, displaying ^{1}H-NMR signals at 18-20 ppm, low deuterium fractionation factors, and deuterium and tritium isotope effects on chemical shifts. In very strong hydrogen bonds the proton was shared equally and centered between heteroatoms and displayed ^{1}H-NMR signals >20 ppm. I thought that the downfield proton in chymotrypsin fit the bill for an LBHB, and we assigned this. My colleague Professor John Markley and his associates concurred and published extensive properties, including deuterium fractionation and enthalpy of exchange with medium protons.

It was recognized that His57 would be protonated in the tetrahedral intermediate of the chemical mechanism at neutral pH. I thought that it should be engaged in an LBHB at that step. It was known that the peptidyl trifluoromethylketone (TFK) inhibitors, introduced by my former mentor R. H. Abeles, formed tetrahedral adducts with Ser195 analogous to tetrahedral intermediates. I called Abeles and asked if he could forward one of them to me. He agreed. Then I read his paper published in 1987, in which he and his associate observed the downfield signal at 18.7 ppm in one of these adducts, and the signal persisted at pH 9, exactly the behavior I expected. I called Abeles again and pointed out that he had already done the experiment that I envisioned. He agreed, although I had the impression that he might not have been convinced of the LBHB. He forwarded the inhibitor.

Our group synthesized the series of peptidyl TFKs that Abeles and associates had introduced, and we studied the properties of the corresponding chymotrypsin adducts. In collaborations with John Markley, we found downfield ^{1}H-NMR signals between 18.6 and 18.9 ppm, very low deuterium fractionation factors, very high enthalpies for exchange, and deuterium and tritium isotope effects on chemical shifts. We also constructed linear free energy correlations of the 1H-NMR chemical shifts with the published inhibition constants for the inhibitors, the p*K*a-values for His57 in the adducts, and the enzymatic reactivity of corresponding methyl ester substrates. In short, the evidence for LBHB was very strong, as was the correlation between strength of the LBHB with enzymatic reactivity.

Collaborators

Collaboration in science is very important to progress. I have enjoyed the pleasures and advantages of collaborating with more than 30 senior colleagues in Asia, Europe, and the Americas during my career. Ten of my collaborators have been colleagues in the Biochemistry Department of UW-Madison. I have mentioned my collaborations with graduate and postdoctoral students. They were no less valuable to and appreciated by me. My research was generously supported by the NIH for 44 consecutive years. This work could not have been done without the support of all my collaborators and financial supporters.

Conclusion

My professional life has been made possible by the support and understanding of my family. Carolyn and I have been joined by daughters Suzanne Frey and Cynthia Chapek; grandchildren Samantha and Ian Smith, Carrie and Bonnie Chapek; and great granddaughter Alice Smith. Their constant affection for us and for one another has been our sustaining force.

Emeritus Perspective: Dave Nelson

Celebrate UW's groundbreaking and far-reaching contributions to science

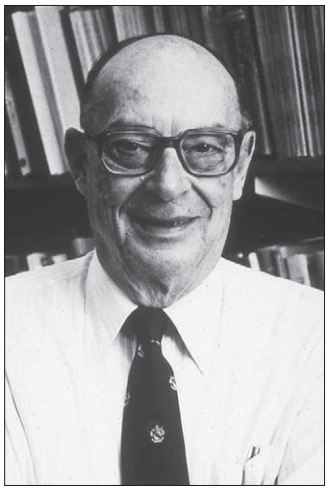
Dave Nelson (I) retired at the end of 2012, and started a second career as an old guy and science museum developer. It has always concerned me that the many remarkable contributions in science and engineering in Wisconsin are not celebrated here in the ways that we celebrate accomplishments in sports (Kohl Center and Stadium), art (Chazen), and music, dance and drama (Overture). These homegrown historical discoveries in science and engineering should be a source of pride and inspiration to the young scientists, engineers, and entrepreneurs who are building on the foundations of earlier work. For the taxpayers who foot the bill for much current research, scientific history provides clear evidence for the positive impact that such research has on our daily lives.

The result of our not celebrating research accomplishments publicly is easy to illustrate. Who can identify, for example, the man who grew up in Madison, went to high school and college here, then went on to win two Nobel prizes in physics? Who was the UW graduate student who developed the technology that made artificial insemination of dairy cattle practical, leading to genetically improved dairy herds all over the world, fewer farmers gored by bulls, and the development of a billion dollar Wisconsin industry? John Bardeen (1908-1991), born and educated in Madison, shared the 1956 Nobel Prize in Physics for the discovery of the transistor (which allowed miniaturization of electronic devices), and the 1972 Prize in Physics for his work on superconductivity at low temperatures. He remains the only person ever to have won two Nobel Prizes in Physics. (The Bardeen Laboratories are not named for him, but for his father, the first dean of the UW Medical School.) Henry Lardy (1917-2010), in his first year of graduate work at the UW, found a simple way to preserve bull sperm so that cows all over the world could be artificially inseminated with semen from genetically outstanding bulls. These are but two of many examples of world-renowned Wisconsin scientists not widely recognized in their own back yards.

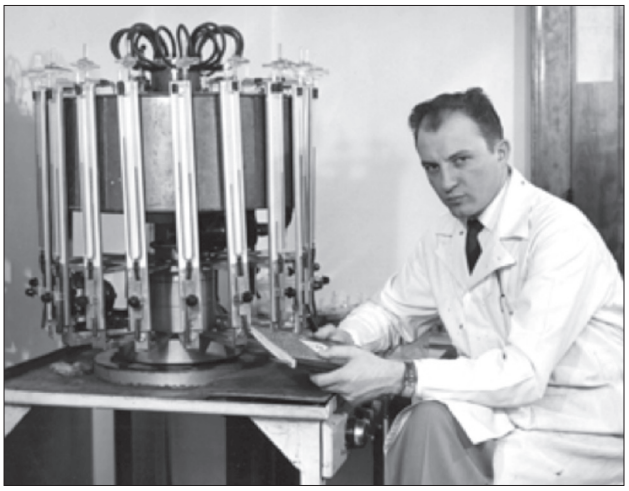
The Wisconsin Science Museum opened in October of 2015 in space shared with MATC just off the Capitol Square. All of the exhibits have a connection with Wisconsin universities or industries. Most of the exhibits trace an historical development from initial discovery to eventual application. Many of the exhibits are hands-on, and comprehensible to a seven year-old. There is a Hall of Fame, with 60 historical figures and their accomplishments. Several of the exhibits combine art and science—Wisconsin landscape photographers who work with infrared cameras, a Wisconsin physicist (Robert Wood) who pioneered UV and IR photography.

In its current state, the Museum is a "first draft", which will be improved and expanded as we have time and acquire more funding. We would be delighted to have you visit the Museum, and to hear your suggestions about people or developments that should be included in the Museum. If you have historically interesting things in your attic, we would be very pleased to hear about them. And it goes without saying that financial contributions would be very helpful. See our website:

www.WisconsinScienceMuseum.org



John Bardeen



Henry Lardy

IPiB Update – *A major driving force for excellence*

By Professor Ivan Rayment, Chair, IPiB Steering Committee

The Integrated Program in Biochemistry (IPiB) continues to thrive thanks to the joint contributions of its home departments – Biochemistry in the College and Agricultural and Life Sciences (CALS) and Biomolecular Chemistry in the School of Medicine and Public Health (SMPH) – and the stream of high-caliber graduate students who apply to and join our program every year. This marks the tenth year since its first entering class so it is appropriate to look back at what has been accomplished since the inception of IPiB and look forward to new challenges.

IPiB is currently the graduate school home to 106 talented students from across the U.S. and several international locations including Bangladesh, China, Germany, India, Republic of Korea, Russia, South Africa, and the United Kingdom. Since its launch in 2006, IPiB has granted 99 Ph.D. and 14 MS degrees. At the time of graduation, these students collectively had published over 450 scientific articles, half of which were first-author publications.

In 2016, the University of Wisconsin-Madison ranked 22nd by U.S. News & World Report among the best global universities for biology and biochemistry, and 29th among best global universities overall. In 2014, UW-Madison's graduate program in biochemistry tied for second in the U.S. So we can certainly strive to do better.

Following the encouragement from the Graduate School and the Office of the Provost at UW-Madison, and in response to our students' interests in career exploration while in graduate school, IPiB has undertaken several new initiatives to help our students discover and develop their professional interests. The majority of our graduates still go on to postdoctoral positions, but this is gradually changing as professional development opportunities for graduate students continue to increase in areas such as patent law, life science communications, and science policy. We encourage our students to explore these and other areas through graduate coursework outside of biochemistry and biomolecular chemistry.

As part of the University's accreditation process, IPiB has developed ten specific higher learning goals that we expect our students to achieve in order to be successful in their chosen professions. To help measure achievement of these goals, the Program is preparing to change how students are evaluated at their annual progress report meetings. Each student will be assessed by her or his thesis committee on how well they are making progress on each of the higher learning goals, and receive feedback on how to continue to make good progress. The cumulative results will be examined to see how well IPiB as a whole is helping its students make the most of their graduate education.

IPiB is also part of a multi-disciplinary effort – led by the Department of Biomedical Engineering with additional support from the Departments of Genetics, Biostatistics and Medical Informatics, Mathematics, and Bacteriology – to add quantitative biology (QBio) as a minor option. Admissions data point to an increased interest in this area among prospective students, and current students are also taking additional coursework in this area. We hope to offer this minor area formally by the Fall of 2017.

In addition to developing and launching two new required courses for its first-year students, IPiB has initiated a review of its graduate curriculum for the first time since its launch in 2006. Over the years, faculty members have retired or moved to other institutions and their courses have been put on hold. While we are proud of the course offerings available to our students, both inside and outside the IPiB curriculum, we recognize that as science advances so should the answer to the question "What do we want our students to know?" I expect that we will have a consort of new courses to talk about in future newsletters.

Finally, our Program would not be as successful and robust as it is without the tireless volunteer efforts of our Student-Faculty Liaison Committee (SFLC), IPiB's student governance body. Each year, this team of students functions to create professional development and networking opportunities, and community outreach and academic support events. The SFLC also provides feedback and perspective to the IPiB Steering Committee, which helps the Program achieve its goals to:

- Create a preeminent doctoral program in biochemistry with broad opportunities for research training
- Offer a coordinated and high quality program of coursework in biochemistry
- Promote cross-fertilization across departmental and college/school boundaries among faculty and students
- Vigorously recruit outstanding graduate students nationally and internationally

Let the SFLC tell you for themselves what they have accomplished in the past year (page 35).

Finally, we cordially invite all IPiB, Biochemistry, and Biomolecular Chemistry alumni and friends to stay in touch, follow our news via social media, and serve as professional development resources for our graduate students.

Keep in touch!

Like the IPiB Program on Facebook
facebook.com/UWMadisonIPiB

Connect with IPiB on LinkedIn
linkedin.com/groups/8422773

IPiB Degree Listings May 2013 - December 2016

Degree	Name (Major Professor)	Thesis Title	Currently
PhD Aug 2015	**Claudia P. Sanabria** (Amasino)	Studies in biomass traits in the model grass *Brachypodium distachyon*	Scientist with Corpoica, Bogotá, Columbia
PhD Dec 2014	**Juan B. Rodriguez-Molina** (Ansari)	Discovering unexpected connections and developing tools to define the CTD code of Pol II	Postdoc, University of Cambridge, UK
PhD Dec 2016	**Graham Erwin** (Ansari)	The design and development of polyamide-based artificial transcription factors	Postdoc with P. Kim, Stanford University, CA
PhD Dec 2016	**Cory Nemec** (Ansari)	Non-canonical kinases expand the RNA polymerase II CTD code	Postdoc with A. Ansari, UW-Madison
PhD Aug 2014	**Mufaddal S. Soni** (Attie)	Role of Cellular Acyl-carnitines and Glucose-mediated Regulation of Tomosyn on Insulin Secretion	Senior Consultant at Deloitte, Inc, Chicago, IL
PhD Dec 2013	**Amber Schuh** (Audhya)	Regulatory Mechanisms that Govern Membrane Deformation and Scission in the ESCRT-Mediated Endocytic Pathway	Senior Scientist at PPD, Madison, WI
PhD May 2014	**Mandy Burnham** (Audhya)	Altered Interleukin-5 Family Cytokine Induced Signaling in Primary Human Eosinophils	Pharmacy Business & Data Analysis Specialist at Security Health Plan, Madison, WI
PhD May 2016	**Adam Johnson** (Audhya)	Trk-fused gene clusters COPII-coated transport carriers and promotes early secretory pathway organization	Postdoc with S. Harrison, Harvard University, Boston, MA
PhD Aug 2015	**Xin Chen** (Brow)	Mechanism and targets of Sen1 helicase in termination of non-coding RNA synthesis in yeast	Postdoc with X. Bao, Northwestern University, Evanston, IL
PhD May 2013	**Kathryn D. Mouzakis** (Butcher)	The structure and function of the HIV-1 frameshift site stem-loop	Assistant Professor of Chemistry, Fort Lewis College, Durango, CO
PhD Dec 2013	**Alex Hebert** (Coon)	Improvements to stable isotope and label-free quantitative proteomic methods	Assistant Scientist, Coon Group
PhD Aug 2014	**Angela J. Gruber** (Cox)	The many faces of RecA: Characterization of unique RecA functions	Scientist, PreventionGenetics, Marshfield, WI
PhD May 2015	**Erin A. Ronayne** (Cox)	Enzymology and genetic studies of bacteriophage P1 Ref, a RecA-dependent endonuclease	Scientist, Thermo Fisher Scientific, Carlsbad, CA
PhD Dec 2015	**TaeJin Kim** (Cox)	Unlocking the recombinational potential of the RecA protein, and its cellular cost	Scientist, Provivi, Inc., Santa Monica, CA
PhD May 2013	**Elise Wagner** (Denu)	Identifying small molecule inhibitors of chromatin-binding proteins	Principal Scientist for Chemistry, Covance, Indianapolis, IN
PhD Aug 2014	**Kristin Dittenhafer-Reed** (Denu)	Reversible Protein Acetylation in the Mitochondria: Cellular and Molecular Function of the NAD+ Dependent Deacetylase Sirtuin 3	Assistant Professor of Chemistry, Hope College, Holland, MI
PhD Dec 2014	**Jessica L. Feldman** (Denu)	Molecular mechanisms of the NAD+-dependent deacylase SIRT6: metabolic links to reversible histone acetylation	Postdoc with C. Peterson, U Mass Medical School, Worcester, MA
PhD May 2015	**Justin F. Acheson** (B. Fox)	Structural investigation of complex formation in Class II diiron enzymes	Research Associate, Zimmer Lab, Charlottesville, VA
PhD Aug 2013	**Jonathan K. Mitchell** (Friesen)	Baculovirus AcMNPV manipulates the host DNA damage response via a novel F-box protein to promote virus multiplication	Imanis Life Sciences, Rochester, MN

Degree	Name (Major Professor)	Thesis Title	Currently
PhD Dec 2016	**Nathaniel M. Byers** (Friesen)	Baculoviruses manipulate the host DNA damage response and apoptosis to aid virus multiplication	Postdoc, Center for Disease Control, Ft. Collins, CO
PhD May 2013	**Rachel L. Kubiak** (Holden)	Structural and functional studies of enzymes involved in the biosynthesis of unusual sugars	Merck Research Labs, Boston, MA
PhD Dec 2016	**Ari Salinger** (Holden)	A Structural and Biochemical Investigation of the Biosynthesis of Deoxysugars from Pathogenic Bacteri	Postdoc with P. Thompson, U Mass Medical School, Worcester, MA
PhD Aug 2015	**Matthew Mead** (Hull)	Unraveling the Transcription Network Regulating Sexual Development in the Human Fungal Pathogen *Cryptococcus neoformans*	Postdoc with A. Rokas, Vanderbilt University, Nashville, TN
PhD Aug 2015	**Mingwei Huang** (Hull)	Determination of Factors Critical for Sexual Development and Spore Germination in *Cryptococcus neoformans*	Postdoc with C. Hull, UW-Madison
PhD Aug 2016	**Naomi Walsh** (Hull)	Phagocytosis and Dissemination of *Cryptococcus neoformans*	Postdoc with C. Hull, UW-Madison
PhD May 2013	**Kelly Manthei** (Keck)	Structural studies of eukaryotic and bacterial RecQ complexes	Postdoc, University of Michigan, Ann Arbor, MI
PhD May 2014	**Basudeb Bhattacharyya** (Keck)	Biochemical Mechanisms of PriA-Mediated DNA Replication Restart	Lecturer, University of WI-La Crosse, La Crosse, WI
PhD Aug 2015	**Sarah Wessel** (Keck)	Molecular interactions in PriC-mediated DNA replication restart	Postdoc, Vanderbilt University, Nashville, TN
PhD May 2016	**Christine Wolak** (Keck)	Structure and Function of the *Escherichia coli* Ribonuclease HI/Single-stranded DNA-binding protein complex	Scientist at 23andMe, San Francisco, CA
PhD May 2015	**Paul J. Wrighton** (Kiessling)	Synthetic surfaces to probe human pluripotent stem cell fate decisions	Postdoc with W. Goessling, Boston, MA
PhD May 2015	**Daniel Zwick** (Kiessling)	Synthetic antigens as probes of B and T cell activation	Postdoc with A. Valujskikh, Lerner Research Institute, Cleveland, OH
PhD Aug 2016	**Darryl Wesener** (Kiessling)	Biosynthesis of Microbial Glycans and Their Recognition by the Human Immune System	Postdoc with J. Gordon, Washington University, St. Louis
PhD Aug 2013	**Dan Park** (Kiley)	The response regulator ArcA uses a diverse binding site architecture to globally regulate carbon oxidation in *Escherichia coli*	Postdoc, Lawrence Livermore National Laboratory, Livermore, CA
PhD Aug 2013	**Sarah Teter** (Kiley)	Fe-S cofactor mediated recognition of two classes of binding sites by the *Escherichia coli* transcription factor IscR	Applications Scientist, Promega Corporation, Madison, WI
PhD Dec 2013	**Nicole Beauchene** (Kiley)	Influence of O2 on the Ferric Uptake Regulator (Fur) Regulon in *Escherichia coli* K12	Postdoc, NIH, Bethesda, MD
PhD Dec 2015	**Daniel C. Noble** (Kimble)	*C. elegans* FOG-1/CPEB and FOG-3/Tob work together to control the oogenesis program	Postdoc, Molecular analytics department., Bristol Myers Squibb, Bloomsbury, NJ.
PhD Dec 2013	**Pyae P. Hein** (Landick)	Regulation of RNA Transcript Elongation: Mechanisms of RNA Polymerase Pausing and Translocation	Scientist, Juno Therapeutics, Inc., Watham, MA

IPiB Degree Listings May 2013 - December 2016

Degree	Name (Major Professor)	Thesis Title	Currently
PhD May 2013	**Woonghee Lee** (Markley)	Computational development towards high-throughput NMR-based protein structure determination	Assistant Scientist, with NMRFAM, UW-Madison
PhD Aug 2016	**Kai Cai** (Markley)	Structural and Functional Studies on Human Mitochondrial Iron-Sulfur Cluster Biosynthesis	Postdoc with J. Markley, UW-Madison
PhD May 2016	**Shravan Sukumar** (Mitchell)	Markers of Specificity in Protein-DNA Interactions	Dow Agrosciences, Gibson City, IL
PhD Dec 2014	**Wenjiang Ma** (Mosher)	Binding of intrinsically disordered sequences to structured proteins: Lessons from bacterial adhesins and fibronectin	Postdoc, Harvard Medical School, Boston, MA
PhD May 2015	**Brendan J. Floyd** (Pagliarini)	Characterization of orphan mitochondrial proteins via quantitative interaction mapping	Finishing medical degree part of MD/PhD at UW-Madison
PhD May 2015	**Amelia Nestler** (Pagliarini)	Impact of Dynamic Post-Translational Modifications on the Activities of Mitochondrial Proteins	Manager, Northwest Green Chemistry, Oregon
PhD Aug 2015	**Jonathan A. Stefely** (Pagliarini)	Biochemical Functions of ADCK3 and Other Coenzyme Q Biosynthesis Proteins	Postdoc in Pagliarini lab before finishing medical degree part of MD/PhD at UW-Madison
PhD May 2014	**Kelly Watters** (Palmenberg)	Comparative Analysis of Rhinovirus 2A Protease Cleavage of the Nuclear Pore Complex	Postdoc with A. Palmenberg, UW-Madison
PhD Dec 2014	**Ryan V. Petty** (Palmenberg)	Studies on the Encephalomyocarditis Virus Leader and 2A Proteins' Cooperative Interactions for Host Cell Control	Harvard Law School, Boston, MA
PhD Aug 2015	**Hillary C. St John** (Pike)	The Osteoblast to Osteocyte Transition: Epigenetic Changes and Response to Mineralotropic Hormones	Researcher, Cystic Fibrosis Foundation, Boston, MA
PhD Aug 2016	**Md. Sohel Shamsuzzaman** (Pike)	Roles of Vitamin D and Its Target Gene RANKL in Atherosclerosis	Faculty position, Biochemistry Department, University of Bangladesh, Dhaka, Bangladesh
PhD Dec 2014	**Chelcie H. Eller** (Raines)	Interactions of Ribonuclease 1 with the Cell Surface	Scientist, PPD, Middleton, WI
PhD May 2015	**Sean B. Johnston** (Raines)	PTEN *in Vitro* and *in Silico*: Implications in Cancer and Autism	Programmer, Google, Mountain View, CA
PhD Dec 2015	**James D. Vasta** (Raines)	Development of Selective Inhibitors and Modulators of Human Collagen Prolyl 4-Hydroxylase	Scientist, Promega, Fitchburg, WI
PhD May 2016	**Trish T. Hoang** (Raines)	Molecular Basis of Angiogenesis and Neuroprotection by Angiogenin	Postdoc with R. Raines, UW-Madison
PhD Dec 2015	**Kate E. Helmich** (Ralph)	Structural biology of enzymes involved in the biosynthesis and biodegradation of lignin	Legal specialist, Quarles & Brady, Madison, Wisconsin
PhD May 2013	**Katherine C. Rank** (Rayment)	The Role of Asymmetry within Kinesin Motors	Scientist, PPD, Middleton, WI
PhD Dec 2014	**Keenan Taylor** (Rayment)	The Application of Fusion Proteins in Structural Studies of Coiled Coil Containing Proteins within Macromolecular Complexes	Postdoc, Vanderbilt University, Nashville, TN
PhD Dec 2016	**Rebecca Phillips** (Rayment)	The Structural Basis of Kinesin Processivity	Scientist, PPD, Middleton, WI
PhD May 2013	**D. Benjamin Knowles** (Record)	Effects of polyethylene glycols and polyols on protein and nucleic acid processes	Postdoc with V. Sperandio, UTSW Med. Center, Dallas, TX

Degree	Name (Major Professor)	Thesis Title	Currently
PhD May 2015	**Loren M. LaPointe** (Senes)	Structural organization of the FtsB/FtsL transmembrane subcomplex of the bacterial divisome	Postdoc with C. Sanders, Vanderbilt Univ., Nashville, TN
PhD May 2015	**Ambalika S. Khadria** (Senes)	FRET-based biophysical characterization of bacterial divisome transmembrane proteins	Postdoc with M. Ramsey U of North Carolina at Chapel Hill
PhD Aug 2015	**Benjamin K. Mueller** (Senes)	The GASright Motif in Membrane Protein Dimerization and Structural Prediction	Postdoc with J. Meiler, Vanderbilt Univ., Nashville TN
PhD Aug 2013	**Rachel B. Rodrigues** (Sussman)	Investigating the function and regulation of the Arabidopsis plasma membrane proton pump AHA1 using reverse genetics and mass spectrometry	Postdoc with S. Gygilab, Harvard University, Boston, MA
PhD May 2014	**Melanie M. Ivancic** (Sussman)	Identification of serum protein biomarkers for the early detection of colon cancer via quantitative proteomics	Postdoc with M. Sussman, UW-Madison
PhD May 2016	**Kelly Stecker** (Sussman)	Investigation of early signaling mechanisms in plant osmotic stress response	Postdoc with Heck lab, Univ. of Utricht, Netherlands
PhD Aug 2016	**Benjamin B. Minkoff** (Sussman)	Mass spectrometric based analysis of receptor mediated hormone signaling in Arabidopsis	Postdoc with M. Sussman, UW-Madison
PhD Dec 2015	**Manohary Rajendram** (Weibel)	Uncovering specialized roles for membrane phospholipids in protein localization and function in *Escherichia coli*	Postdoc, Stanford University, CA
PhD Dec 2015	**Douglas Porter** (Wickens)	Target selection by natural and redesigned PUF proteins	Postdoc with Khavari Lab, Stanford University, CA
PhD Dec 2015	**Shruti Waghray** (Wickens)	Control of translation by the CCR4-NOT complex during *Xenopus* early development	Postdoctoral Scientist, Ionis Pharmaceuticals, Carlsbad, CA
PhD Dec 2016	**Christopher Lapointe** (Wickens)	New strategies reveal key features of protein-RNA networks	Postdoc, Stanford School of Medicine, Stanford, CA

Degree	Name (Major Professor)	Currently
MS May 2015	**Clay Williams** (Coon)	Covance, Madison, WI
MS Dec 2013	**Matthew W. Zmudka** (Holden)	Epic, Verona, WI
MS May 2016	**Alexander DeHaven** (Hoskins)	Project Coordinator, Center for Open Science, Charlottesville, VA
MS May 2014	**Mark DeCanio** (Kiessling)	
MS Dec 2013	**Kaitlin R. Marquardt** (Mitchell)	Programmer Analyst, Forward Health Group, Inc., Madison, WI
MS Aug 2015	**Lucas O'Neill** (Ntambi)	Teaching chemistry & biology & coaching baseball at Polytechnic High School in Fort Worth, TX
MS Dec 2013	**Robert G. Presler** (Raines)	Scientist, Influenza Research Institute, Madison, WI
MS Dec 2016	**Christine N. Bradford** (Raines)	Administrator, UW-Madison
MS May 2013	**Rachel Barkley** (Rayment)	Senior Research Associate, Kemin Industries, Animal Nutrition and Health, Des Moines, IA

Biochemistry Advisor Degree Listings May 2013 - December 2016

Degree	Name (Major Professor)	Program	Thesis Title	Currently
PhD Dec 2015	**Daniel Woods** (Amasino)	Genetics	Genetics of flowering time in the temperate grass, *Brachypodium distachyon*	Postdoc with R. Amasino, UW-Madison
PhD Aug 2016	**Asuka Eguchi** (Ansari)	CMB	Control of Cell Fate with Artificial Transcription Factors	Postdoc with A. Ansari, UW-Madison
PhD Dec 2016	**Devesh Bhimsaria** (Ansari)	ECE	Computational Methods for Detailing Protein–DNA Binding Affinities	Postdoc with A. Ansari, UW-Madison
PhD Aug 2015	**Lyndsay Wrighton** (Attie)	CMP	The role of synaptotagmin-11 in the formation of the dense core insulin granule and regulated insulin secretion	Pathology Specialist, Roche, Inc., Boston, MA
PhD Aug 2013	**Rose T. Byrne** (Cox)	Microbiology	Defining the Genetic Basis of Ionizing Radiation Resistance	Scientist, InDevR, Inc., Boulder, CO
PhD Dec 2014	**Lindsey Kaschner** (Craig)	CMB	A Conserved Domain Important for Ribosome Association of the Eukaryotic J-protein Co-chaperones Jjj1 and Zuo1	Program Coordinator, Student Success Initiatives, University of Texas at Austin, Austin, TX
PhD Dec 2015	**Johnnie A. Walker** (B. Fox)	Biophysics	The Potential of Multifunctional Glycoside Hydrolases in Biocommodities Production	Postdoctoral Research Fellow, Emory University, Atlanta, GA
PhD Dec 2016	**Margaret Rodgers** (Hoskins)	Biophysics	Conformational Dynamics of the snRNAs during Spliceosome Assembly and Activation	Postdoc with Sarah Woodson, Johns Hopkins, Baltimore, MD
PhD May 2013	**Rachael T. C. Sheridan** (Kiessling)	Biochemistry	Directing the immune system through targeted multivalent interactions	Flow cytometry core manager, Van Andel Institute, Grand Rapids, MI
PhD Aug 2013	**Christopher D. Brown** (Kiessling)	Chemistry	Design, Synthesis and Biological Utility of Polysaccharide Chain-Terminating Glycosides	Medical Resident, Cornell University, Ithaca, NY
PhD Aug 2014	**Joseph C. Grim** (Kiessling)	Chemistry	Chemical probes of dendritic cell C-type lectin receptors	Postdoc, with K. Anseth, Univ. of Colorado Boulder, CO
PhD Aug 2014	**Mario A. Martinez Farias** (Kiessling)	Chemistry	Acceptor Surrogates for Mycobacterial Glycosyltransferases	Research Investigator, Dupont, Wilmington, DE
PhD Aug 2015	**Joshua M. Fishman** (Kiessling)	Chemistry	Polyoxazinones from ROMP	Research Scientist at 3M, Minneapolis, MN
PhD May 2016	**Kittikhun Wangkanont** (Kiessling)	Chemistry	Structural Analysis of Galactofuranose-Binding Lectins and Biosynthetic Enzymes	Lecturer, Chulalongkorn University in Bangkok, Thailand
PhD Aug 2014	**Elena P. Sorokin** (Kimble)	CMB	Genomic Perspectives on Cell Fate Reprogramming in the *C. elegans* Germline	Postdoc, Bustamante lab, Stanford Univ., Stanford, CA
PhD May 2016	**Aman Prasad** (Kimble)	CMP	RNA binding landscapes in germ cells: Insights on stem cell regulation	Finishing medical degree part of MD/PhD at UW-Madison
PhD Dec 2015	**Hesamaddin T. Dashti** (Markley)	Biophysics	Computational aspects of protein NMR	Postdoc with NMRFAM, UW-Madison
PhD Dec 2013	**Neil J. Daily** (Martin)	MCP	CAPS interacts with SNARE proteins to enable vesicle membrane fusion	Biotechnology Research Scientist, University Research Park, Madison, WI
PhD Dec 2014	**Sang Su Woo** (Martin)	CMB	Calcium-induced vacuole formation in RBL-2H3 basophils requires Munc13-4	Research Associate with T. Martin, UW-Madison
PhD Aug 2015	**Joseph M. Esquibel** (Martin)	MCP	CAPS Clusters t-SNAREs prior to SNARE Complex Assembly	Instructor, Madison College, Madison, WI

Degree	Name (Major Professor)	Program	Thesis Title	Currently
PhD Dec 2013	**Maggie Burhans** (Ntambi)	Nutritional Sciences	Role of monounsaturated fatty acids in metabolic regulation	Postdoc, University of Washington, Seattle, WA
PhD May 2015	**Joshua J. Carson** (Pagliarini)	CMB	Regulation of Mitochondria by Reversible Protein Phosphorylation	Licensing Associate, WARF, UW-Madison
PhD Dec 2015	**Jarred W. Rensvold** (Pagliarini)	CMB	Identification and characterization of an adaptive mitochondrial biogenesis response to iron deprivation	Assistant Scientist, Pagliarini lab, UW-Madison
PhD May 2014	**Holly A. Basta** (Palmenberg)	CMB	Phosphorylation by distinct kinases regulates cardiovirus Leader protein function at the nuclear pore complex	Faculty, Montana State University, Bozeman, MT
PhD Aug 2014	**Valjean R. Bacot-Davis** (Palmenberg)	Microbiology	Structure and Dynamics of the Encephalomyocarditis virus Leader Protein in Deregulation of Host Nucleocytoplasmic Transport	Postdoc, McGill University, Montreal, Canada
PhD Aug 2015	**Jessica J. Ciomperlik** (Palmenberg)	CMB	Identification of EMCV Leader protein's cellular partners for inhibition of nucleocytoplasmic trafficking	CDC intern, Atlanta GA
PhD Dec 2016	**Alex H. Carlson** (Pike)	MCP	Transcriptional Regulation of and by Components of the Vitamin D Endocrine Axis	Epic, Verona, WI
PhD May 2014	**Jo Ellen Lomax** (Raines)	CMB	Ribonucleases and Ribonuclease Inhibitors: Structure, Function, and Evolution	Program Director, Harvard Medical School, Boston, MA
PhD Dec 2014	**Amit Choudhary** (Raines)	Biophysics	n-to-pi* Interactions in the Molecules of Life	Assistant Professor, Harvard Medical School, Boston, MA
PhD Dec 2014	**John C. Lukesh III** (Raines)	Chemistry	Thiol–Disulfide Interchange: Design, Synthesis, and Evaluation of Reagents and Organocatalysts for Chemical Biology	Postdoc, Scripps Research Institute, La Jolla, CA
PhD Dec 2015	**Kristen A. Andersen** (Raines)	MCP	Bioorthogonal Reactions for Protein Chemistry and Chemical Biology	Scientist, Catalant Pharma Solutions, Madison, WI
PhD Dec 2015	**Matthew R. Aronoff** (Raines)	Chemistry	New Tools for Chemical Biology from Main Group Elements	Postdoc, ETH - Zürich, Zürich, Switzerland
PhD May 2016	**Robert W. Newberry** (Raines)	Chemistry	Backbone Carbonyl Interactions in Proteins	Postdoc, UCSF, San Francisco, CA
PhD Dec 2016	**Thomas P. Smith** (Raines)	Chemistry	Biomedical Applications and Strategies using Boronic Acids	Postdoc with R. Raines, UW-Madison
PhD Aug 2016	**Wu Lan** (Ralph)	BSE	Investigation of the Structure and Biosynthesis of the Flavonolignin Polymers in Monocots	Postdoc, École Polytechnique Fédérale de Lausanne, Switzerland
PhD May 2013	**Emily J. Guinn** (Record)	Chemistry	Developing Solutes as Quantitative Probes of Protein and Nucleic Acid Processes	NIH Postdoc with S. Marqusee, UC Berkeley, Berkeley, CA
PhD Aug 2014	**Emily F. Ruff** (Record)	Chemistry	Studies of Key Regions of *Escherichia coli* RNA Polymerase and Promoter DNA in Transcription Initiation	Postdoc with Levinson lab, University of Minnesota, Minneapolis, MN
PhD Dec 2015	**Raashi Sreenivasan** (Record)	Biophysics	Characterizing DNA bending, wrapping and opening in *E. coli* RNA Polymerase during transcription initiation	Postdoc with M. Whorton, Oregon Health & Science University, Portland, OR

Biochemistry Advisor Degree Listings May 2013 - December 2016

Degree	Name (Major Professor)	Program	Thesis Title	Currently
PhD May 2016	**Rituparna Sengupta** (Record)	Biophysics	Developing Solutes as Probes of Conformational Changes in Steps and Transition States of Protein Processes	Postdoc with T. Record, UW-Madison
PhD May 2014	**Sabareesh Subramaniam** (Senes)	CB	Conformational sampling in protein structure prediction	VMware, Palo Alto, CA
PhD May 2016	**George K. Auer** (Weibel)	Biomedical Engineering	Developing new tools to identify novel factors that contribute to bacterial cell mechanics	Scientist, Emerald Cloud Lab, South San Francisco, CA
PhD Aug 2016	**Katherine A. Hurley** (Weibel)	Pharmaceutical Sciences	Discovery and characterization of the antibacterial activity of small molecules	
PhD May 2015	**Cary T. Valley** (Wickens)	CMB	Specificity and manipulation of PUF-RNA interactions	Senior Scientist, PPD, Middleton, WI
PhD Aug 2015	**Daniel J. Wilinski Jr.** (Wickens)	CMB	Evolution of RNA-PUF protein networks	Postdoc, University of Michigan, Ann Arbor, MI

Degree	Name (Major Professor)	Program	Currently
MS Aug 2016	**Anna Kropornicka** (Ansari)	Genetics	Epic, Verona, WI
MS Aug 2014	**Kelly Werner** (Pagliarini)	CMB	Middle & High School Tutor, Califon, NJ
MS May 2014	**Kaylee A. Underkofler** (Raines)	Chemistry	Medical Student, Tufts Medical School, Boston, MA

BSE: Biological Systems Engineering
CB: Computational Biology
CMB: Cellular and Molecular Biology
CMP: Cellular and Molecular Pathology
ECE: Electrical & Computer Engineering
MCP: Molecular and Cellular Pharmacology

SFLC IPiB Student Faculty Liaison Committee – *Students foster interaction and collaboration*

By Kimberly Haupt, 2015-2016 IPiB SFLC Chair

The Student Faculty Liaison Committee (**SFLC**) is the IPiB graduate student organization. We work to organize events and programs that serve IPiB graduate students, the Biochemistry and Biomolecular Chemistry departments, and our local community.

A central tenant of SFLC's mission is to facilitate interaction and collaboration within the IPiB program. Twice monthly, SFLC invites everyone to enjoy coffee, tea, cookies and conversation at Tea Time. The event is beloved and well attended, and offers a venue for networking between students, postdocs, faculty, staff and undergrads of the Biochemistry and Biomolecular Chemistry departments. In the fall, to welcome new first year IPiB students to campus, SFLC hosts the New Student Welcome Picnic. The annual "new students vs. current students" kickball game is always a lot of fun, and in August 2016, the current students continued their winning streak.

SFLC also works to recognize and celebrate the achievements of IPiB researchers at several annual events. In September each year, more than 200 people attend the annual IPiB Retreat. The 2016 Retreat was held at the Wisconsin Institutes for Discovery and featured 12 research talks and 57 poster presentations. At the IPiB Winter Reception, we recognize the achievements of IPiB faculty, students and staff, both scientific and otherwise, over the past year. A slideshow of accomplishments from the IPiB community is looped during the event as we celebrate work well done, alongside the traditional lab supplies ornament making contest. In the spring, the annual Awards in Research and Teaching (A.R.T.) Reception honors the recipients of the Leirmo and Denton awards and the creative talents of our IPiB colleagues.

To prepare IPiB students for their next steps after leaving UW-Madison, the SFLC works to provide professional development opportunities. The Student Lunch Symposia, an SFLC sponsored lunchtime seminar series, has traditionally been an excellent venue for IPiB students to give practice talks for conferences, preliminary exams, and thesis defenses. In addition, over the past two years, we have expanded the Student Lunch Symposia to include discussion of professional development topics; IPiB affiliates have presented on science policy experiences, industry internship experiences, how to find a postdoc, and money management during grad school. In May 2015, IPiB students had a chance to participate in Mock Interviews with scientific professionals from the Madison community. Participants received valuable interviewing experience and resume advice. IPiB students also have an opportunity to network with renowned scientists through the Student Invited Speaker Seminar. In October 2016, Professor Carolyn Bertozzi from UC Berkley visited to meet with IPiB students and share her work on cancer immunotherapy. This coming year, we look forward to hosting several career panels for jobs outside of academia.

IPiB colleagues enjoying a Tea Time event in February 2015.

Finally, SFLC strives to give back to the University of Wisconsin and the city of Madison by sponsoring numerous outreach events, including Family Science Nights at local schools and community centers, Exploration Stations at the Wisconsin Science Festival and service at the Second Harvest Food Bank. Fun science activities led by IPiB students at these events include DNA extraction from bananas and testing the acidity of different kinds of candy using baking soda. Additionally, in Winter 2015, we held a very successful Food and Clothing Drive to collect donations for the Community Action Center of South Central Wisconsin. The IPiB community donated everyday clothes and canned goods, as well as high-need items such as children's clothing, business wear (including men's ties), toiletries, new socks and undergarments.

All of the Food and Clothing Drive donations prior to drop-off at CACSCW.

The events and programs organized by SFLC would not be possible without the hard work of our committee members. We encourage students and faculty to support the SFLC by volunteering to serve on the committee itself and participating in our programming. We also ask that you consider supporting SFLC through our annual Apparel Sale – look for more information on the IPiB Facebook Page (***facebook.com/UWMadisonIPiB***) each Fall semester. Please reach out to let us know if you have any questions, event ideas or would be willing to serve as a career resource for current students by contacting our Graduate Student Services Coordinator Kate Ryan (*cryan7@wisc.edu*).

Postdoctoral Training – *Developing researchers and teaching and planning for the future*

By Professor Robert Landick

Postdoctoral training in the Department of Biochemistry continues to grow in importance in the Department's research, teaching, and outreach missions. Currently, over 40 postdoctoral trainees work on research projects in collaboration with our 36 research-active faculty, including at least five trainees supported by individual postdoctoral research fellowships from diverse sources, including the National Institutes of Health and the Beckman Foundation. Postdoctoral trainees play vital roles in the Department and University. Several of the more prominent roles are highlighted here.

Training in the successful conduct of high-impact research is the principal focus of postdocs in the Department. Their scientific accomplishments are too numerous to list, but are a cornerstone in the Department's success. Each year, faculty nominate outstanding trainees for the Department's Boyer Award for Postdoctoral Excellence, endowed by Nobel Laureate Paul D. Boyer (see "Boyer Award" essay page 46).

Each year, postdoctoral trainees in the Department select and invite a seminar speaker to present research in an area of their choice, and to meet with postdocs to discuss strategies for success in a research career. The 2017 speaker was Jackie Barton from CalTech, who presented a seminar on "DNA Signaling." Last year's speaker was Andrew Camilli from Tufts University. The postdoc-invited seminar is a great opportunity for postdocs to interact as an academic community, as well as to explore themes of career development.

Teaching also is a focus of training for some of our postdocs and the Department offers several opportunities for postdocs to gain teaching experience. Trainees have collaborated with faculty to develop lectures in the lab course, Biochemistry 651. Here, postdocs gain experience by developing topics for discussion and leading seminar sections on a biochemical theme. In Biochemistry 660, postdoc trainees work with Professor Marv Wickens to develop lectures on biochemical methods for the incoming graduate students. This approach provides the experience of teaching a course – as many of the postdocs ultimately will do as faculty – but in a microcosm, enabling their research to continue unabated. Some of our postdocs also participate in the University of Wisconsin Delta program (***www.delta.wisc.edu***), which offers a year-long Certification in Research, Teaching, and Learning and provides outstanding preparation for those wishing to pursue a teaching career.

Postdoctoral training also has become an increasingly important focus for UW-Madison generally. The Department has been happy to see the University's postdoctoral training mission formalized by the creation of the Office of Postdoctoral Studies (***www.postdoc.wisc.edu***). The Office of Postdoctoral Studies provides a wealth of useful career information to prospective and current postdocs in Biochemistry, ranging from information on benefits, funding sources, and University policies – to Career Planning Workshops in topics like Negotiating Effectively, Starting a Company, and Research Mentor Training – to individual counseling sessions and peer-editing grant writing groups. The Office of Postdoctoral Studies participated in a Postdoc Forum hosted by the Department of Biochemistry on Dec. 11, 2016, at which many new ideas were generated and the level of enthusiasm for additional activities was exceptional. If you know anyone considering a postdoc at UW-Madison Biochemistry, please refer them to the Office of Postdoctoral Studies website for more information on campus-wide postdoctoral training programs.

Our postdoctoral trainees are a special group of colleagues who join the Department at a crucial stage in their careers. They help the Department develop new scientific expertise and drive the Department's productivity. They also are key members of the Biochemistry community who help train and mentor our graduate and undergraduate students and foster unexpected advances through new collaborations. If you have ideas or suggestions for postdoc training in Biochemistry or want to help support our efforts, please contact Bob Landick (***landick@ biochem.wisc.edu***).

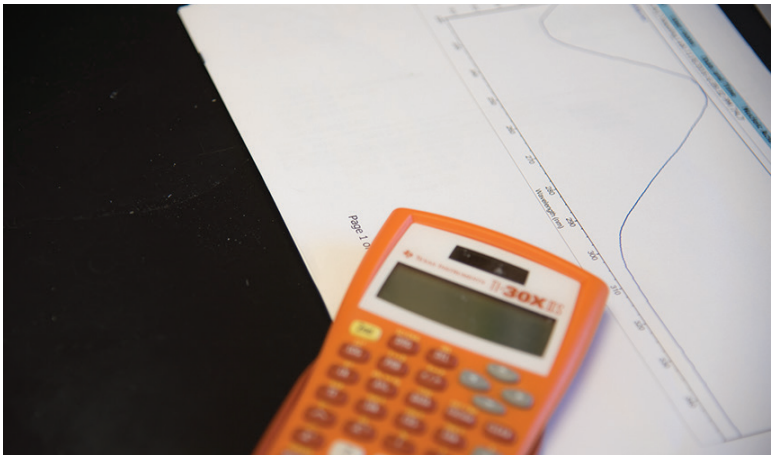


Photo by Robin Davies

Undergraduate Program – *Training the leaders of the future through innovative programs*

By Professor Mike Cox

The Biochemistry undergraduate major continues to grow, challenging Department resources but inspiring some of our best activities. In Fall 2016 Biochemistry had 585 declared undergraduate majors, and is the 13th largest major at UW. The two semester Biochemistry 507-508 sequence designed for our majors serves about 200 of those students each year. The one semester Biochemistry 501 now has over 750 students in the fall, over 500 in the spring, and 45-50 in the new summer version. The undergraduate experience in the Department includes the Biochemistry Scholars program, which places our top declared majors into labs no later than the fall of sophomore year, and initiates a lab commitment that usually extends over 3+ years. That experience often includes summer internships abroad in the SCORE, SuperG, or Khorana programs described later in this newsletter. James Ntambi takes another large group of students, many of them pre-med, to Uganda each winter break, also described below. The department keeps a list of summer internship opportunities at other U.S. universities on the department's undergraduate webpage, and students unable to go abroad often take advantage of these opportunities to expand their research experience. The capstone for the Scholars program is a trip to the ASBMB meeting in April of their senior year to compete in the undergraduate research poster competition. The April 2016 contingent is pictured (below) in San Diego. Mike Cox accompanies this group each year and will be taking 16 students to the Chicago ASBMB meeting in April, 2017. The department supports these undergraduate travel opportunities in part with scholarship funds that never grow as fast as the demands placed on them. Finally, our undergraduate student organization is now linked to the ASBMB. Our goal is to provide both a science education and a research experience at UW that will be transformative.

From left to right: Matt Stefely (Pagliarini), Brexton Turner (Hoskins), Alina Zdechlik (Ntambi), Sara Bugliosi (Landick), Lindsey Felth, Mary Menhart (Cox), Bowon Joung (Cox), George Luo (Hoskins), Matt Lammers (Weibel), Serena Wan (Cox), and Willey Lin (Eisenstein)

Undergraduate Student Organization – *The evolution of a group driven by enthusiasm for research*

By Collin McFadden

This year, our undergraduate major student organization (Undergraduate Biochemistry Student Organization or UBSO) officially changed its name and status to represent UW–Madison as a local chapter for the American Society for Biochemistry and Molecular Biology (ASBMB). With the resources from the national organization, our chapter offers an environment for undergraduates to learn about future opportunities, meet students taking similar classes, and share their excitement about science with their community.

Our ASBMB chapter provides a space for students to grow academically, connect with campus opportunities, and meet others with a shared interest in biochemistry. The chapter is committed to finding engaging speakers and exploring a broad range of topics to help its students prosper in Madison.

Meetings are often twice a month on Thursdays at 6PM. Most members are biochemistry or molecular biology majors, but all interested students are encouraged to join. If you wish to join our mailing list or are interested in sharing your insights at one of our meetings, contact us at teamasbmb@gmail.com.

Outreach:

ASBMB hosts a DNA extraction booth at the Wisconsin Science Festival and CALS Day for Kids to offer younger students a hands-on opportunity to experience science. Members lead children through the experiment and explain the science behind each step of the process.

Professional Development:

Many events help students develop skills and connect to global and campus opportunities with individual meetings dedicated to helping students find research labs, learn to effectively communicate on a scientific poster, and discover study abroad opportunities that match their interests.

Advising:

Each semester, ASBMB hosts a meeting to explore ways to satisfy course requirements and arrange time to work in research labs. Students enroll with greater confidence after discussions with other students and with Kendra Gurnee, the biochemistry advisor, about class offerings and previous experiences in each section.

Career Planning:

Guests from academia and industry speak at meetings each year to show students potential career options after graduation. ASBMB also invites graduate and medical students to talk at an event each fall to offer advice for undergraduate students who are interested in pursuing similar paths.

International Programs: *England, Germany, India and Uganda*

Science is international. It is not merely that facts are facts, but also that great work is being done all around the world, and is communicated instantaneously. World-wide research collaborations and consortia now permeate science, and regularly reach the headlines. Each culture builds on its own strengths, perspectives and history. The more our students understand other cultures, the more effective they will be in the future. Scientists, companies and policy makers all benefit from having a first-hand international perspective.

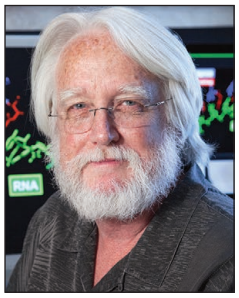
The Biochemistry Department has created four innovative programs that provide opportunity for study abroad. These are run by their founders -- Professors Aseem Ansari, James Ntambi, and Marv Wickens. Students do research or fieldwork in India, Uganda, England, and Europe. Each program provides a different experience, but they all are designed to enrich the students' training, experience and international perspective.

The Khorana Program (Prof. Ansari) sends students from UW to India to do research, and brings students from India to UW (and now other institutions). Associated programs are designed to enhance agriculture and Tech Transfer in India, and draw on the expertise of the Department, UW, and WARF. The SCORE and SUPER-G Programs (Prof. Wickens) are described in some detail below. The Uganda Program (Prof. Ntambi) sends students to that African nation to learn first-hand how biochemistry and nutrition impact Uganda's health care.

These experiences come at an exceptionally formative time in an undergraduate's life, and so ripple into the student's future. We are honored to work with so many gifted and stimulating young men and women, and provide them with these exceptional opportunities to learn more about themselves, science, and the world.

SCORE and SUPER-G Programs: Research in Cambridge, Oxford and Heidelberg

By Marv Wickens



These programs give students the opportunity to do research in cutting-edge laboratories in one of the world's leading institutions of scientific enquiry and scholarship. The SCORE program sends students to Cambridge or Oxford, and the SUPER-G program to the European Molecular Biology Lab (EMBO) in Heidelberg, Germany.

"This trip was honestly one of the most meaningful experiences of my life so far."

SCORE student, 2016

"I worked hard, I played hard, but I also relaxed hard… It felt like a lifestyle, one that I truly embraced."

SUPER-G student, 2016

The students do research intensively in a host lab, using a broad range of approaches, including biochemistry, neurobiology, development and structural biology. The problems they have studied vary each year, and range very broadly – from cancer, to how the ribosome works, to neurodegeneration. The mentors are outstanding scientists, and include Fellows of the Royal Society and EMBO, as well as recipients of the Nobel Prize.

The experience blends committed research with fascinating locales and cultures. It enables students to see themselves, their work and their future through an international lens. In some cases, students have gone on to receive prestigious international fellowships, including the Rhodes, Marshall and Wellcome scholarships, and to do their post-graduate work in Cambridge or Oxford.

Students often find that the experience enriches their interest in science, and virtually all of them see the world as a richer and more inviting place.

"…a fantastic, once-in-a-lifetime experience that I will be forever grateful for. I learned more about myself as a person, proved to myself that I am capable of moving away from home independently, gained a clearer idea of what type of research I would like to do, and did some unforgettable traveling."

SCORE student, 2015

From left: Hannah Mast, Alex Koo, Jaffna Mathiaparanam, Tim Krueger, Cai Cimperman and Matt Ritger on the Cambridge "backs" behind King's College.

Andy Delaitsch brings UW to the Jungfrau during a break from EMBL.

Matt Ritger, Cai Cimperman and Alex Koo in front of Blenheim Palace, overjoyed with their data.

For more information visit:
www.biochem.wisc.edu/score or *www.biochem.wisc.edu/super/superg*

The Khorana & Bose Programs - India

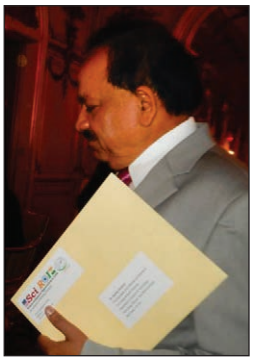
By Professor Aseem Ansari

2017 will mark a decade since the "Khorana Scholars" pilot program brought in three students to the Department of Biochemistry from the best schools in India. The program aims to give wings to talent and nurture future "Khoranas." For those who may be unfamiliar with this avatar of the **Wisconsin Idea**, it might help to restate that the program is named in honor of Dr. Har Gobind Khorana, a pioneer in the field of chemical biology and synthetic biology, who won the 1968 Nobel Prize as a member of our department. With the financial backing of the Government of India (DBT), 50 talented Indian students identified through a meritocratic nation-wide search are offered summer research internships in leading laboratories across the U.S. Over the past decade, the Khorana program has grown in numbers and prestige and is often considered the "undergraduate Fulbright" program in India. Dr. Khorana himself was pleased with the students who bore his name and expressed his joy in meeting and hearing of new batches until he passed away in November 2011.

Since the Newsletter in 2012, the Khorana Program was "cloned" by the Science and Engineering Research Board (SERB), the Indian counterpart to the U.S. National Science Foundation (NSF). While based on the Khorana program template, the SERB supported program is designed to support undergraduates who are interested in science, mathematics and engineering disciplines that are not connected to biology. Thus, it complements the Khorana program that is focused on supporting undergraduates who are engaged in life sciences. To honor the scientist who imagined the particle that was to bear his name (Boson), the program was named **S. N. Bose Scholars Program**. The Bose program was launched in early 2013 and by the end of the year Higgs-Boson was awarded the Nobel Prize for Physics. The S. N. Bose program not only funds an additional 50 Indian students but also provides Indian Government funds for 25 U.S. students (at all stages of their academic career) who are interested in a summer research internship in India. There is a possibility that NSF will support an additional 25 American students so that there is parity between the number of U.S. and Indian Bose scholars exchanged every year.

Together, the Khorana and Bose programs are now second in size and scope only to the U.S. State Department's Fulbright program in India. And, there are serious discussions of expanding the programs further to include industrial internships and entrepreneurial programs. Over the past decade, as the programs grew from 15 students per summer at UW (2007 – 2010), to 30 Khorana scholars per year across the Big 10 Midwestern Universities (CIC 2011-2013), to 100 Indian and 25 U.S. scholars at all leading U.S. and Indian institutions (2014 - onwards), the administrative burden associated with handling the unique requirements of nearly 50 U.S. and Indian institutions led us to create a U.S. 501(c)3 non-profit called Wisconsin-India Science & Technology Education Program (**WINStep Forward**) to manage the multi-institutional engagements. WINStep has since been contacted by leadership at Yale, University of Chicago, Cold Spring Harbor Labs, UT-Southwestern, Rice, Baylor and Brown University to set up institution-specific programs that are templated on the Khorana and Bose Programs. At UW, the non-profit now works closely with the Visiting International Scholars Program (VISP) to place scholars across different colleges. Not surprisingly, placements at Harvard, Stanford, MIT, and Caltech have not mitigated the cohort size at UW, we have continued to attract about 15 Khorana and Bose scholars every year.

Another example of "organic" growth was the creation of a new initiative for scholars that had obtained the Ph.D.s and were engaged in postdoctoral training. In 2015, Khorana alumni and their friends worked with WINStep to launch **Sci-ROI** (Science and Research Opportunities in India). Sci-ROI, a postdoc-run initiative, is building a network of graduate students, postdocs, professionals and entrepreneurs in the U.S. and identifying and creating new and mutually beneficial research and entrepreneurial ventures in U.S. and India. Sci-ROI was launched by *Dr. Ausaf Sayeed, the Consul-General of India* at the Consulate in 2015, and within a year this vibrant postdoc-run organization partnered with WINStep to put together the very first Young Investigators Meeting at Chicago (**YIMC 2016**). The event brought together the heads of top Indian academic institutions, leading science policymakers from the U.S. and India, multinational Pharma companies, Water management groups, Chicago-based Tech Incubator CEOs, and senior U.S. Commerce Department representatives in India. The event was launched at the Indian Consulate in Chicago on October 23rd and continued at the University of Chicago over the next two days. The participation was capped at 150 because of space restrictions at the Consulate but the groundswell of interest in the event was so encouraging that the next event is scheduled in September 2017 with the Indian Minister of Science and Technology and a senior representative of the U.S. State Department as the key speakers and sponsors of the event. The focus will be on the creation of mutually beneficial research and entrepreneurial partnerships between the U.S. and India. The future of Khorana and Bose Programs, Sci-ROI and WINStep Forward, looks promising and together we hope to make a positive impact and carry proudly the banner of UW and the Wisconsin Idea.



Dr. Harsh Vardhan, Minister
Science & Technology, Government of India

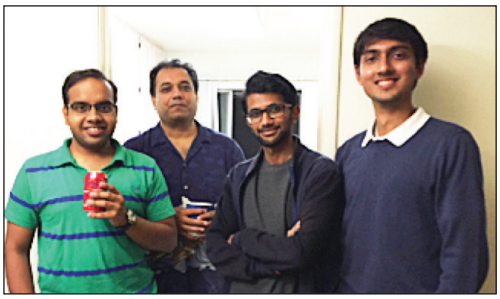
Over the years, we have received invaluable advice and support from UW alumni that have helped these programs grow and thrive. As always, we seek your advice on areas that might benefit from further engagement and we invite you help create new and exciting opportunities for the next generation of transformative U.S. and Indian Khorana and Bose Scholars.

For more information visit:
www.winstepforward.org.

University of Wisconsin-Madison students Hannah Lider, Daniel Howard, Tenzin Paljor in India.

"Madison has been highly motivating for me both professionally and personally. It provided me with the opportunity to work and interact with Dr. Kevin Eliceiri, Dr. Yuming Liu, and Dr. Aseem Ansari, the pioneers of my field who will continue to inspire me throughout my life. This program helped me to understand the scientific quest of 'light delivery modeling and simulations.' The work culture in the U.S. was something that not only inspired me, but also all the young fellow Indian scholars who had been awarded Khorana Scholarships. This experience, inspiration and exposure is something that I believe will motivate all of us for the advancement of research in India and its application to solve the current challenges in the life sciences."

Vaibhav Phad



Left to Right: Aadithya Kannan (2014 Bose Scholar and Grad Student at Stanford) Dr. Aseem Ansari, Amir Faraz (2016 Khorana Scholar), and Alap Kshirsagar (2016 Bose Scholar), meet up in California, 2016.

University of Wisconsin-Madison physics student Daniel Howard Trying his hand at an alternative career in India.

"Accepting this scholarship is doubtlessly the best decision I have ever made. I learned more about myself, my career goals, and what is important to me than I even knew was possible. The experiences I had and the connections I made this summer will be with me for a lifetime. After returning home I decided to pursue a certificate in International Engineering with a focus on Southeast Asia. I have been looking forward to my return to India since the moment I boarded the plane home."

Hannah Lider

2016 Indian Khorana Students at Camp Randal, UW-Madison

University of Wisconsin-Madison students Anna Barker and Kelli Verhoeven in India.

"The S.N. Bose program was a great experience to conduct research and learn how it is done in another country The experience was both scientifically and culturally enriching. I can truly say I met a lot of great people in and out of the lab."

Tenzin Paljor

The Uganda Program

By James Ntambi, with past participants Ryan Berns, Anna (Marsicek) King and Trista Cushman

The Uganda Health and Nutrition Program combines what students learn in the classroom with real world experiences in the East African country of Uganda. To prepare for the international experience, students enroll in a semester course where they interact with UW faculty, staff and other students to learn about the myriad of factors that impact people's abilities to make informed health and nutrition decisions for themselves, their families and their communities. Topics covered include: agriculture, child malnutrition, communicable and non-communicable diseases, economics, education, politics, prenatal care, women's health, and many more. The end of the fall semester culminates with a three-week learning experience in Uganda.

The journey begins when students land in the city of Entebbe and then take a 2-hour drive to their home for the next 3-weeks, the village of Lweza. In Lweza, students become a part of a place-based approach to community development that focuses on collaborative efforts to help address needs as identified by the community. During their time in Uganda, the group departs also has an opportunity to see the beauty of the country by visiting one of two national parks, either Queen Elizabeth National Park or Murchison Falls National Park. During these trips, they visit health clinics and villages in those areas so that they also have perspectives on healthcare in other regions of the country.

While in Uganda, students come face-to-face with the reality of subsistence farming and the impacts this has on health, they see HIV/AIDS first hand, and they are able to see how important women's health and nutrition are to the overall health of their families and communities. While much of the success of the program lies in the strong relationships built over the years with members of the Lweza community, this directly is related to Prof. Ntambi's connections both with Lweza, but also with the experts who add to the program which include community experts along with faculty and staff from Uganda's Makerere University. Through these relationships, students gain a truly unique exposure to the intersection of politics, economics, culture, and education as it relates to public health.

The formal program is a collaboration between the Biochemistry and Nutrition Departments, and the CALS Office of International Programs. The students gain a profound understanding of the realities faced by so many in the world. Students collaborate intimately with villagers, who in fact identify the projects that are needed. The program needs financial support to continue. With that in mind, the student alumni themselves created The Village Health Project (VHP). This program raises funds, applies for grants and fellowships and seeks donations. To donate, please send a check to: Village Health Project, 333 East Campus Mall, Room 3207, Madison, WI 53715-1380 (***http://www.villagehealthproject.org/***).

For more details concerning the international health and nutrition program in Uganda please contact John Ferrick (***john.ferrick@wisc.edu***) Associate Director of International Programs at UW-Madison/ College of Agricultural & Life Sciences and co-director of the Uganda program.

"Throughout my undergraduate education I was involved in a variety of medical/health programs both locally and abroad, but my experiences with Village Health Project and the Uganda Field Experience stand out distinctly. Students who sign up to complete their Undergraduate Certificate in Global Health Field Experience in Uganda are required to carry out a project. These projects allow students to explore the links between agriculture, nutrition, sanitation, and health. My project helped me gain real-world experience in the field of global-public health while I was still a student. After having lived in Uganda for three weeks, working with the community in order to create sustainable solutions, I saw first-hand the impact that a small, motivated group of students can have on the lives of others. I found out that working with and through the community allowed us to build relationships and lay the groundwork for changes that continue even when we are not there. Additionally, we had the unique opportunity to live and work in the Mukono (Lweza) community while we were there, which was such an amazing way to contribute to Dr. Ntambi's hometown and certainly adds to what makes this Field Experience so memorable, rewarding, and fun."

Ryan Berns, 2013

Students involved in setting up a community garden in the agriculture and nutrition arm of the program.

Students participating in running a mobile clinic in a rural community in Uganda.

"Participating in the Uganda Program during my junior year at UW-Madison was the highlight of my undergraduate career. I had done very little international travel prior to traveling to Uganda, and the Uganda Program was my first glimpse of the poverty, healthcare, and resource depletion in another part of the world. The trip was truly eye opening, and it fostered my passions for public health, global citizenship, and civic participation. Following the trip to Uganda, I felt empowered to help find solutions to some of the problems I had observed in Uganda. I became a part of the Village Health Project (VHP), a 501(c)(3) non-profit student organization that was created by alumni of the Uganda Program. Through VHP I have met amazing people and learned about the joys and challenges of working on global health issues abroad. My trip to Uganda and my work with VHP encouraged my desire to become a healthcare professional. As a graduate of UW-Madison, I am currently pursuing my goal of becoming a Physician Assistant. The Uganda program shaped my perspectives on public health, healthcare, and social justice. It has also influenced how I plan to practice medicine in the future. I would absolutely recommend this trip to any student who wants to learn more about global health and expand their view of global citizenship."

Anna (Marsicek) King, 2014

"Last summer I moved back to Wisconsin after one of the most difficult experiences of my life. If you had told me then in one year I'd be experiencing Uganda, I would've said you were crazy. Fast forward one year and I walked on the reddest sands and the greenest grasses. I held the hands of the young and old. I saw some of the worst living conditions, but the happiest of faces. I learned that a country struggling to provide a healthcare system to its citizens could see the importance of preventative healthcare that a 'civilized' country such as ours cannot. I saw the effects of malnutrition like I could never imagine, but found more similarities in our two countries than I would have guessed. I saw elephants and cried. I could almost touch giraffes and lions and hippos and alligators. I rode a boat on the Nile. I learned more this summer than I ever could have imagined possible, but perhaps the most important lesson I learned was the power of love.

Uganda is, as most developing countries, struggling in its ability to provide healthcare. Their system consists of the expected doctors, nurses, clinics, and hospitals, but lacks the funds, medicine, and personnel that are necessary to reach the masses. In our country, doctors and nurses are far overworked, but imagine their workload if only a fraction of them existed. To combat this, Uganda's healthcare system implements a level of healthcare called the Village Health Team (VHTs.) These members are ordinary community members selected by the village to volunteer their time to help. VHTs receive some training and supplies of basic care so they can understand if someone is ill and needs to see a doctor. They devote themselves to spreading the word of healthcare opportunities, such as our mobile health clinics, to their community and help keep things organized when we provide such care. A level of healthcare based solely on volunteers to care for the initial wellbeing of its citizens exhibits an aspect of healthcare not mirrored in our society.

Big pharmaceutical companies drive most healthcare systems in developed countries, particularly in the United States. Because it is more profitable to treat chronic illnesses, especially non-communicable illnesses, than to prevent them, funding is allocated to medications rather than prevention education. Uganda does not follow this trend. The importance of prevention and fixing the problem before it occurs is valued in Uganda's healthcare system. Though mostly affected by communicable diseases, the rates of non-communicable illnesses and deaths are rising in Uganda. This is indicative of the importance of proper nutrition. Along with illnesses, malnutrition is an epidemic in Uganda. Whether caused by lack of education or the inability to access proper nutrients, it can lead to stunting, edema, increased risk of disease, and even death. Uganda's fight to reduce malnutrition is an excellent example of their strategies to prevent illnesses rather than treat them. Uganda treats many children suffering from poor nutrition but focuses even more on properly educating mothers, communities, and even the children on how they must eat to remain healthy. Nutrients are explained in relatable terms and families are taught to prepare foods properly in the right ratios. This preventative approach to healthcare is mirrored in all facets of the system. Nutritionists, doctors, and nurses aim to teach their patients how to remain healthy to avoid illness, but they can only help once people have sought help. Because of this glitch, they reach less of the population than necessary. This weakness is strengthened by the VHTs, caring members of the community who visit their peers and urge them to seek medical attention. Without the knowledge spread by these volunteers, fighting for the improvement of Uganda's health would be futile.

I have always believed in science. Biochemistry makes the bodywork. Proper nutrition feeds a body so it can properly grow. Medicine cures illnesses. Science can be proven. But some things in life are intangible. Sometimes your soul needs more than proteins, carbohydrates, lipids, vitamins, and minerals to grow. Medicine is instrumental to healthcare and the wellbeing of a country, but it can only go so far. Medicine can only treat; it can do nothing to prevent illnesses. The care and love that is put into the healthcare system in Uganda is something we could all learn from. We all need medicine to aid our health, but perhaps we often overlook the strongest medicine of all."

Trista Cushman, 2016

In Memoriam: Mo Cleland

By Professor Perry Frey

William Wallace Cleland, Professor of Biochemistry, passed away on March 6, 2013 of injuries sustained in an accident.

Professor Cleland preferred to be addressed as "Mo", and all of his friends knew him by this name. Mo was born to Elizabeth and Ralph E. Cleland in Baltimore, MD on January 6, 1930. His mother was a chemist and his father a botanist. His father was elected to the National Academy of Sciences and as a Fellow of the American Academy of Arts and Sciences. Mo took pride in following his father into these honorary academies.

Mo's family moved to Bloomington, IN, where his father served on the faculty and administration of Indiana University. Mo graduated from Oberlin College, A.B. 1950, and from the University of Wisconsin, M.S. 1953 and Ph.D. 1955. He served in the Medical Corps of the U.S. Army for two years, and he carried out postdoctoral research under Eugene P. Kennedy at the University of Chicago. He returned to the University of Wisconsin-Madison as an Assistant Professor of Biochemistry in 1959 and advanced to Professor of Biochemistry in 1966. He served as the Marvin. J. Johnson Professor of Biochemistry in 1978 and Steenbock Professor of Chemical Sciences in 1982-2003.

Mo made many influential contributions to enzymology. He brought order into the field of multi-substrate steady-state enzyme kinetics. In 1963, he published a series of three papers on this topic in *Biochimica et Biophysica Acta;* paper I. Nomenclature and rate equations; II. Inhibition: nomenclature and theory; III. Prediction of initial velocity and inhibition patterns by inspection. In this work, Mo derived the basis for Cleland's rules, which allow one to write the rate equation for a multi-substrate enzyme by inspection of kinetic patterns. In connection with this work, Mo coined the term "ping pong kinetics" for a kinetic pattern implicating a covalently modified enzyme-substrate intermediate. These papers have been widely cited and led to his inclusion among the 300 most cited scientists in 1978.

Prior to Mo's report in the early 1960s, proteins were often purified in the presence of mercaptoethanol, which countered the detrimental effects of oxygen. Mercaptoethanol had an unpleasant odor, and two equivalents were required to reduce a disulfide. Mo studied the reducing properties of a number of dithiol compounds and found that dithiothreitol, also known as DTT or Cleland's Reagent, fitted the bill perfectly. He found DTT to be a water-soluble solid with little odor and a strong reducing agent. Cleland's Reagent or DTT has been on the shelf in most biochemical laboratories for nearly half a century.

The analyses of bond changes in nonenzymatic chemical reactions often employ kinetic isotope effects (KIEs) because heavy isotopes alter reaction rates, usually with minimal effects on chemical properties. In enzyme studies, such analyses are complicated by noncovalent steps, such as the binding of reactants and release of products, plus conformation changes of the protein. In early collaborations with University of Wisconsin-Madison colleagues Dexter Northrop and Marion O'Leary, Mo undertook to overcome the problems and apply KIEs to analyze chemical mechanisms in enzymes. In the process, Mo invented the equilibrium perturbation method for measuring KIEs. This method was brilliantly conceived and enabled a KIE to be measured at chemical equilibrium in a single experiment.

Mo continued with this work and became a master of enzymatic kinetic isotope effects. He worked to neutralize the masking of chemical steps by the use of alternative substrates to increase ligand dissociation rates, by determining pH-effects in search of conditions where chemical steps limit rates, and by site-directed mutagenesis to decrease rates of chemical steps. When any of these methods worked, KIEs on maximum turnover velocity could be measured.

Mo extended these methods by employing multiple KIEs to refine structures of transition states and even to distinguish between step-wise and concerted chemical mechanisms.

Mo was elected to the American Academy of Arts and Sciences in 1977 and to the National Academy of Sciences in 1985. He received the Merck Award from the American Society for Biochemistry and Molecular Biology, the Alfred Bader Award in Bioinorganic or Bioorganic Chemistry from the American Chemical Society (ACS), the Repligen Award In The Chemistry of Biological Processes from the Division of Biological Chemistry of the ACS, the Stein and Moore Award from the Protein Society, and the Hilldale Award in the Physical Sciences from the University of Wisconsin-Madison.

Mo enjoyed sailing on Lake Mendota and was the Commodore of the Mendota Yacht Club in 1966. Mo also enjoyed ice boating and crewed on a Class A ice boat on Lake Winnebego. Mo once commented: "I do remember sailing on the Mary B at Oshkosh in a real blow. That was the race where we made one downwind leg (2 miles) in one minute flat. Quite a thrill!". He was a patron of the arts and was honored recently as one of a handful of 50-year subscribers to the Madison Symphony Orchestra concert series. He loved the opera and supported Madison Opera as well as opera companies across the United States.

Mo was a world-class philatelist. Known to his philatelic colleagues as Wallace Cleland, he began collecting stamps in childhood. He became active as a philatelic researcher in the late 1960s, and was recognized as one of the leading experts on plate numbers on U.S. stamps. He was a member of the United States Stamp Society (U.S.S.S.), formerly called the Bureau Issues Association, since 1966, and served on its Board of Governors from 1989-91, as Chairman of the Board from 1992-97, and as Acting President in 1992.

In recognition of his many contributions to philately, he received the B.I.A. (U.S.S.S.) Hopkinson Memorial Literature Award for best article or series of articles in a single year in 1986, 2002, and 2006. He received the prestigious George W. Brett Century of Service Award from the U.S.S.S. in 2006, and the Lifetime Achievement Award in Philately from the Smithsonian Institution in 2008. In 2009, he was inducted into the U.S. Stamp Society Hall of Fame and the Wisconsin Federation of Stamp Clubs Philatelic Hall of Fame. He published more than 320 articles in the *United States Specialist* and the *Canal Zone Philatelist*.

continued, bottom page 45

In Memoriam: John Garver

By Professor Dave Nelson

We lost our friend and colleague John Garver in 2015. John was born Oct. 16, 1925 and died on April 16, 2015 at Longboat Key, Florida, where he and his wife Fanny spent their winters after retirement.

John grew up on a dairy farm near Rockford, and came to the University of Wisconsin to earn his B.S. and M.S. degrees in Chemical Engineering in 1947. In 1955 he finished his Ph.D. work at the UW, also in Chemical Engineering. After several years at the University of Illinois, in 1957 he joined the UW faculty in the Department of Biochemistry, where he continued the long tradition (E.L. Tatum, W.H. Peterson, E.B. Fred, Marvin Johnson, for example) of Wisconsin excellence in the field of fermentation biochemistry.

With Johnson's retirement, John took on the operation and management of the 2000 liter fermentation pilot plant in Biochemistry, and began a long series of collaborations with researchers throughout the UW and in industry, in which John's expertise in fermentation allowed the production of large quantities of bacterial and yeast cells and the valuable proteins contained in them. For example, he collaborated with Frank Strong in isolating pigments from *Physarum,* with Bob Burris in the production of large amounts of cytochrome c from wheat germ, and with several UW researchers in the production of restriction enzymes before they were commercially available.

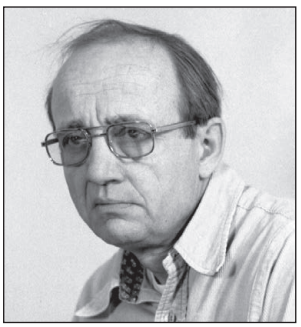
John's own research interest was in testing mathematical models of microorganisms' growth under conditions of limiting substrate or oxygen. He studied the growth kinetics of ciliated protozoans, and of mixed bacterial cultures that metabolized methane. Many of us profited from his gift for quantitative reasoning, applied to problems as diverse as the kinetics of sugar mutarotation and beta-galactosidase activity in milk.

Much of John's informal consulting took place over coffee at the Rennebohm's drug store where the Wisconsin Institutes for Discovery now stand. There was also a certain amount of political discussion at Rennebohm's; it was common to find John and Mo Cleland there, generally representing opposite ends of the political spectrum. When John retired in 1981, his friends in Biochemistry acquired a booth from Rennebohm's and presented it to him, with an appropriately inscribed brass plate. That booth stood for years in the Fanny Garver Gallery.

During his student years, John met Fanny over a bridge game one night in the Memorial Union. They were married in 1948. In 1972, they bought an art gallery on State Street, renamed the Fanny Garver Gallery, in which he became deeply involved. In 1981 John retired from his position in Biochemistry to give more time to the gallery, which John and Fanny ran together for many years. To find promising artists and their art, they traveled widely in the U.S. and abroad; London was a favorite destination. John continued to work at the gallery until his death.

John loved to play bridge, and was very good at it; it apparently appealed to his analytical side. John's friends in Biochemistry enjoyed his no-nonsense, can-do attitude about both science and politics, his wry sense of humor, and his complete lack of ego. He was a very good man and a very good friend.

Fanny Garver has retired, but their son Jack continues to run the downsized Garver Gallery in Madison.



In Memoriam

W.W. (Mo) Cleland
Professor 1959-2013
March 2013

William W. Cravens
PhD 1940 - Hart
October 2008

Erna Ellestad
Lab technician
April 2015

John C. Garver
Professor 1957-1981,
Emeritus 1981-2015
April 2015

Alfred E. Harper
Professor 1956-1990,
Emeritus 1990-2017
March 2017

Charles F. Huebner
MS 1941, PhD 1943 - Link
November 2012

Roy Kanemoro
MS 1982 - Adler,
PhD 1986 - Ludden
January 2011

George O. Kohler
MS 1936, PhD 1938 - Hart
2006

Nancy F. Millis
PhD - Johnson
September 2012

David D. Nehls
Lab Tech Support
Supervisor 2003-2015
August 2016

Sambhorao T. Rao
1969-1990 with Sundaralingam
Asst Prof 1970-1977
February 2011

Larry D. Satter
PhD 1965 - Suttie
2006

Vinod K. Shah
Senior Scientist 1986-1998 - Ludden
December 2015

In Memoriam: Vinod K. Shah

Adapted from Dhavan V. Shah, Winston J. Brill, Gary P. Roberts, & Paul W. Ludden memorial article

Dr. Vinod K. Shah, Senior Scientist Emeritus in the Department of Biochemistry passed away from complications following a heart attack on December 21, 2015.

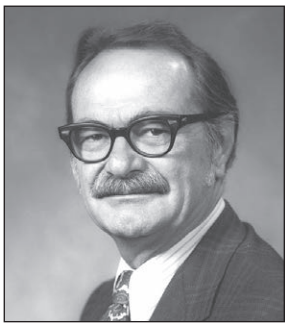
Born in Vadondara, India to Kasturchand and Savitaben Shah, Vinod studied biochemistry at the Maharaja Sayajirao University in Baroda where he received his Ph.D. for a dissertation on fungal metabolism. Immigrating to the United States in 1965, Vinod joined the Department of Bacteriology at UW–Madison in 1966 where he began an incredibly productive research career, most prominently in the area of biological nitrogen fixation. He discovered, isolated and characterized the Iron-Molybdenum cofactor (FeMo-co) of the enzyme nitrogenase.

Vinod sought out important research questions, no matter how difficult and pursued them with tenacity. He retired in 1998 as a senior scientist in the Department of Biochemistry. He received the Chancellor's Award for Excellence in Research in 1992.

An extraordinarily generous man, Vinod was a caring mentor to many younger scientists who sought his advice on science and life. On numerous occasions, he deferred first authorship on important manuscripts in order to promote the careers of students working with him on the projects. In his retirement, Vinod remained active in scientific circles and within the Madison Indian community. He was an enthusiastic card player and he became an accomplished chef.

Vinod was a first-rate scholar who contributed significantly to one of the most challenging research areas of his time, as well as a generous and caring mentor, devoted patriarch to his family, and civic-minded citizen of the university and the broader society.

As we go to press: Alfred (Alf) E. Harper passes away



Professor Emeritus Alfred "Alf" E. Harper passed away in late March of 2017. Harper was affiliated with the Department of Biochemistry and also the Department of Nutritional Sciences.

Born in 1922, the native of Lethbridge, Alberta began studying under biochemist Conrad Elvehjem in 1949 and received his Ph.D. in 1953. Following a four-year stint at the Massachusetts Institute of Technology, Harper spent his entire career at UW–Madison, retiring in 1990 to the state of Washington.

In 1968, he was instrumental, along with others, in establishing the Department of Nutritional Sciences. He served as its first chair for almost 20 years. His research focused on amino acids and the control of metabolism, and he mentored more than 50 graduate students in his lab and published more than 400 research articles.

Harper had a strong interest in national nutrition policy and served on and chaired the Food and Nutrition Board of the National Academy of Sciences for many years. He was also part of many other scientific organizations and government groups.

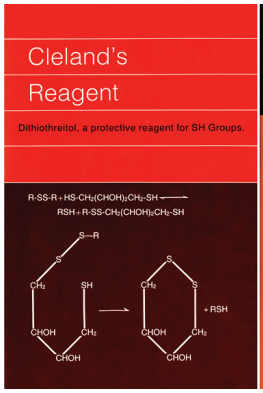
Working with the Food and Nutrition Board, he played a large role in setting recommended dietary allowances (RDA). These guidelines served as an example of a healthy diet. He authored several reports on these topics, including one on the role of cholesterol in heart disease.

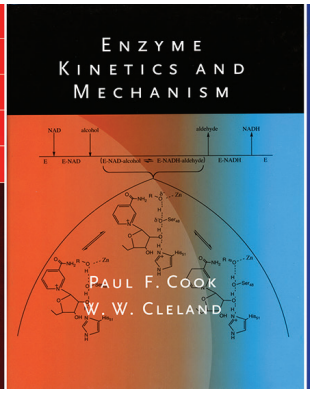
During his life, he received many recognitions and awards, including the Borden Award from the American Institute of Nutrition in 1965 and the Atwater Award from the USDA in 1990. He also received the Conrad Elvehjem Award for Public Service in Nutrition from the American Institute of Nutrition and the Distinguished Service Award from CALS.

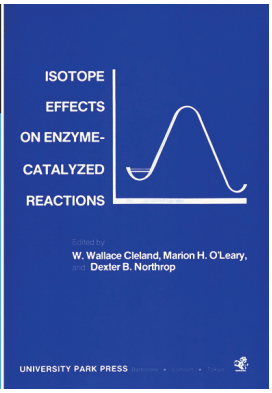
Cleland continued from page 43

Mo was a proud and devoted parent, with his former wife Joan Cleland, to daughters Elsa and Erica and grandparent to Max, Finn, and Griffin. He was generous to colleagues everywhere who consulted him on enzyme kinetics, often insisting that he be given no attribution. Postdoctoral students and young faculty members commented on their pleasant experiences with Mo's quick answers to their questions. He was a kind and generous friend to colleagues and collaborators, and a dominant force in mechanistic enzymology.

Mo was a large man in both physical stature and spirit. He was very kind and generous to colleagues he regarded as kindred spirits. Professor Louis B. Hersh of the University of Kentucky, whom Mo advised as a consultant in Lou's research, commented as follows: "I can't think of a kinder gentle giant."







Boyer Awardees Build on Postdoctoral Successes

By Professor Robert Landick

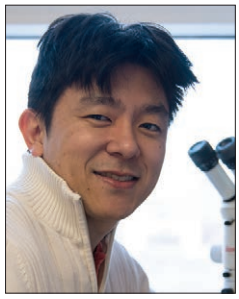
One of the most visible demonstrations of the vitality of research in the Department is the exceptional success of the young scientists selected for the Paul Boyer Postdoctoral Research Award. The Boyer Award for Postdoctoral Excellence was endowed by Paul D. Boyer, after his receipt of the 1997 Nobel Prize in Chemistry, to recognize the exceptional achievements of postdoctoral researchers in our department and the crucial roles they play in so many of the research projects underway here. Paul Boyer is an alumnus of the UW-Madison Biochemistry Department, having earned a Ph.D. degree here in 1943 after completing landmark research on vitamin C and potassium as enzymatic co-factors under the guidance of Prof. Paul Phillips. Dr. Boyer went on to conduct postdoctoral research at Stanford on stabilization of bovine serum albumin for transfusions during the war effort then underway. After WWII, Dr. Boyer became a faculty member at the University of Minnesota where he developed new methods for investigating enzyme mechanisms, and then moved to UCLA in 1963 where he became the founding director of its Molecular Biology Institute. Dr. Boyer was awarded the 1997 Nobel Prize in Chemistry for his research on the enzymatic mechanism underlying the biosynthesis of ATP (along with co-awardees John E. Walker and Jens C. Skou), and is also widely known for editing the classic series "The Enzymes."

Our recent Boyer Awardees are off to a great start following in Paul Boyer's footsteps. Our 2013 Boyer Awardee, Zak Campbell, was recognized for his breakthrough research with Marv Wickens on mechanisms that control recognition specificity in RNA-binding proteins and for the development of a new method to determine protein affinities to large libraries of protein sequences. Zak is now building his own research group after starting as an Assistant Professor of Biological Sciences at the University of Texas-Dallas in August 2015. Zak's group has launched research efforts on synthetic biology, biochemical genomics, and stem-cell biology while continuing his strong interest in protein-RNA recognition.

Our 2014 Boyer Awardee, Eric Montemayor, was recognized for elucidation and characterization of a stunning co-crystal structure of U6 RNA bound to its protein chaperone Prp24 at 1.7 Å resolution. This was the first structure of a protein with multiple (four) RNA recognition motif (RRM) domains bound to an RNA and the first example of a protein domain threaded through an RNA loop. Eric's postdoctoral achievement spanned the research programs of Sam Butcher (Biochemistry) and David Brow (Biomolecular Chemistry), and is an excellent example of the way postdoctoral researchers in the Department can leverage efforts across research groups to both strengthen their training and empower their research. Eric has now assumed a staff scientist position in the Department of Biochemistry and is continuing his award-winning research on RNA splicing mechanisms.

In 2015, the pool of nominees was so strong that the Boyer Award was split between two highly successful postdoctoral researchers: Kevin Desai, working with Ron Raines, and Melkam Kebede, working with Alan Attie. Kevin was recognized for his novel research on mechanisms that repair RNA molecules by ligating nucleolytic fragments, mediated by a noncanonical RNA ligase called RtcB. After completing his highly successful postdoctoral research with Raines, during which he first-authored five high-impact papers describing his findings on this interesting repair enzyme, Kevin has assumed a position with Aeon Global Health in Gainesville, GA. At Aeon, Kevin is applying his considerable research prowess to develop new clinical applications.

Melkam Kebede was recognized for her ground-breaking discovery that a gene of unknown function associated with diabetes encodes a key player in the formation of insulin secretory granules. Melkam came to UW Madison from an unusual background, having earned a B.S. degree at the University of Melbourne at the age of 18 after a childhood in Nigeria. Melkam has now returned to Australia to assume a position as laboratory lead in the Charles Perkins Centre at the University of Sydney, where she is pursuing a high-profile research program on type 2 diabetes.



Our 2016 Boyer Awardee is Scott Aoki, a postdoctoral researcher with Judith Kimble. Scott was recognized for his discovery that the PGL germ granule assembly protein is a base-specific, single-stranded RNase. As our most recent awardee after less that two years in the Kimble group, Scott is, not surprisingly, still finishing his postdoctoral studies in the Kimble group prior to heading out on the job market.

We celebrate the successes of all the outstanding postdoctoral researchers in the UW-Madison Dept. of Biochemistry, and are especially proud of this outstanding group of recent Boyer awardees. It is a mark of his humble foresightedness that Paul Boyer chose to invest a portion of his Nobel Prize winnings to promote the development of their careers, and we look forward with eagerness to the many great things they too will accomplish.

Faculty

Rick Amasino	2013 Hilldale Professorship
Alan Attie	2015 Fellow of the American Association for the Advancement of Science
Sebastian Bednarek	2013 "Thousand Talents Plan" Award, Zhejiang Province Government, China 2013 National "High-end Foreign Expert" Award, China Central Government 2015 "Thousand Talents Plan" Award, Zhejiang Province Government, China 2015 National "High-end Foreign Expert" Award, China Central Government
Sam Butcher	2016 Spitzer Teaching Excellence Award
Mike Cox	2013 Evelyn M. Mercer Professorship
Hazel Holden	2016 Prolific Author Award by the journal *Biochemistry*
Aaron Hoskins	2014 Beckman Young Investigator, Arnold and Mabel Beckman Foundation 2014 Shaw Scientist, Greater Milwaukee Foundation
Laura Kiessling	2014 Alfred Bader Award in Bioorganic or Bioinorganic Chemistry 2014 Hamilton Award, University of Nebraska 2015 Alexander M. Cruickshank Award, Gordon Research Conferences 2016 Vilas Distinguished Teaching Award 2016 Gibbs Medal, Chicago Chapter of the ACS 2016 Vilas Distinguished Faculty Award, UW-Madison
Judith Kimble	2013-2014 Chair, ASCB International Affairs Committee 2014-2015 Member, President's Committee on National Medal of Science 2014-present Vilas Board of Trustees 2015-2017 Chair, President's Committee on National Medal of Science committee 2016-2018 Member, National Research Committee on Next Generation Researchers
James Ntambi	2013 ASBMB Award for Exemplary Contributions to Education 2016 Wisconsin Without Borders Peter Bosscher Award
Dave Pagliarini	2014 Vilas Associates Award, UW-Madison 2015 Promoted to Associate Professor with tenure 2015 Lead Investigator and Neilsen Chair of the Morgridge Metabolism Theme 2016 Presidential Early Career Award for Scientists and Engineers (PECASE) 2016 Pound Research Award, CALS 2016 Co-lead for one of the 14 inaugural UW2020 awards
Ann Palmenberg	2014 International Data Corp. (IDC) High Performance Computing Innovation Excellence Award 2015 WARF named Professorship 2016 Fellow American Academy for the Advancement of Science
Ron Raines	2013 RSC Jeremy Knowles Award (UK) 2014 WARF named Professorship 2014 Givaudan–Karrer Lectureship (Universität Zürich) 2014 Robert W. Taft Memorial Lectureship (UC Irvine) 2015 Humboldt Research Award (Germany) 2016 ACS Ralph F. Hirschmann Award 2016 Elected to National Academy of Inventors
John Ralph	2013 Bruker Award 2014 Thompson Reuters as a Highly Cited Researcher 2014 Anselme Payen Award, American Chemical Society 2014 CSIRO, Australia, McMaster Fellowship 2015 ASPB Highly Cited Author (2009-2013 papers) 2015 Thompson Reuters as a Highly Cited Researcher 2016 Awarded Distinguished Professor status at Tokyo U. of Agriculture and Technology 2016 Thompson Reuters as a Highly Cited Researcher
Vatsan Raman	2016 Shaw Scientist, Greater Milwaukee Foundation
Tom Record	2013 Hilldale Professorship

Honors & Awards

Faculty

Michael Sussman	2015 WARF Innovation Award
Doug Weibel	2013 Vilas Associate Award, UW-Madison 2013 ASCB Early Career Life Scientist Award 2014 CALS Class of 1955 Distinguished Teaching Award 2014 Pound Research Award 2015 Scialog Fellow, Research Corporation and Gordon & Betty Moore Foundation

Emeritus

Roland Rueckert	2014 Forest Steward of the Year. Awarded by the Lumberjack Resource Conservation & Development Council.

Staff

Jorge Rencoret	Ralph	2013 Bruker Award
Yuki Tobimatsu	Ralph	2013 Best poster award, Stanford's GCEP National Conference
Laura Vanderploeg	Dept. Media Lab	2013 CALS Excellence in Service Award
Xueming Zhang	Ralph	2014 China Scholarship Council fellowship
Jenelle Gierhart-Sutter	Dept. Office	2015 CALS Classified Staff Award
Mathish Nambiar-Veetil	Ralph	2015 Fulbright Fellowship
Kallee Radtke	Dept. Office	2015 Rose M. Klein Special Events Award
Charlie Lor	Dept. IT	2016 Administrative Improvement Award
Cathy Michael	Dept. Office	2016 Administrative Improvement Award
Dave Parker	Dept. Office	2016 Administrative Improvement Award
Kerry Tobin	Dept. IT	2016 Administrative Improvement Award

Postdoctoral Staff

Eric Montemayor	Butcher/Brow	2014 Boyer Award for Postdoctoral Excellence in Biochemistry
Melkam Kebede	Attie	2015 Boyer Award for Postdoctoral Excellence in Biochemistry
Kevin Desai	Raines	2015 Boyer Award for Postdoctoral Excellence in Biochemistry
Scott Aoki	Kimble	2016 Boyer Award for Postdoctoral Excellence in Biochemistry
Justin Mobley	Ralph	2016 WARF Ambassador

Postdoctoral Fellowships

2013

J. Kyle Friend	Kimble	American Cancer Society
Melkam Kebede	Attie	American Diabetes Association Mentor Based Fellowship
Katie Brenner	Weibel	Hartwell Postdoctoral Fellowship
Thomas Ream	Amasino	Life Science Research Foundation
Hannah Seidel	Kimble	Life Science Research Foundation
Scott Aoki	Kimble	NIH Ruth L. Kirschstein National Research Service Award
Zachary Campbell	Wickens	NIH Ruth L. Kirschstein National Research Service Award
Kevin Desai	Raines	NIH Ruth L. Kirschstein National Research Service Award
Paul Grimsrud	Pagliarini	NIH Ruth L. Kirschstein National Research Service Award
Matthew Kotlajich	Landick	NIH Ruth L. Kirschstein National Research Service Award
Matthew Kraft	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Nicholas McGrath	Raines	NIH Ruth L. Kirschstein National Research Service Award
Melanie Preston	Wickens	NIH Ruth L. Kirschstein National Research Service Award
Matthew Bruss	Attie	Trainee on the Molecular and Applied Nutrition Training Grant
Natalie Niemi	Pagliarini	United Mitochondrial Disease Foundation

2014

Erika Sorensen-Kamakian	Kimble	American Cancer Society
Melkam Kebede	Attie	American Diabetes Association Mentor Based Fellowship
Katie Brenner	Weibel	Hartwell Postdoctoral Fellowship

Postdoctoral Fellowships

2014 *continued*

Pradyut Paul	Attie	Juvenile Diabetes Research Foundation
Katie Brenner	Weibel	L'Oreal USA for Women in Science Fellow
Hannah Seidel	Kimble	Life Science Research Foundation
Scott Aoki	Kimble	NIH Ruth L. Kirschstein National Research Service Award
Jameson Bothe	Markley	NIH Ruth L. Kirschstein National Research Service Award
Kevin Desai	Raines	NIH Ruth L. Kirschstein National Research Service Award
Paul Grimsrud	Pagliarini	NIH Ruth L. Kirschstein National Research Service Award
Matthew Kotlajich	Landick	NIH Ruth L. Kirschstein National Research Service Award
Sayaka Masuko	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Melanie Preston	Wickens	NIH Ruth L. Kirschstein National Research Service Award
Scott Messenger	Martin	Trainee on the Molecular and Applied Nutrition T.G.
Natalie Niemi	Pagliarini	United Mitochondrial Disease Foundation

2015

Erika Sorensen-Kamakian	Kimble	American Cancer Society
Melkam Kebede	Attie	American Diabetes Association Mentor Based Fellowship
Pradyut Paul	Attie	Juvenile Diabetes Research Foundation
Hannah Seidel	Kimble	Life Science Research Foundation
Katie Brenner	Weibel	L'Oreal USA for Women in Science Fellow
Katie Brenner	Weibel	Wisconsin Governor's Business Plan Contest
Scott Aoki	Kimble	NIH Career Transition Award
Scott Aoki	Kimble	NIH Ruth L. Kirschstein National Research Service Award
Katie Brenner	Weibel	NIH Ruth L. Kirschstein National Research Service Award
Robert Brown	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Kevin Desai	Raines	NIH Ruth L. Kirschstein National Research Service Award
Sayaka Masuko	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Jonathan Mayers	Bednarek	NIH Ruth L. Kirschstein National Research Service Award
Scott Messenger	Martin	NIH Ruth L. Kirschstein National Research Service Award
Scott Messenger	Martin	Trainee on the Molecular and Applied Nutrition T.G.
Natalie Niemi	Pagliarini	United Mitochondrial Disease Foundation

2016

Erika Sorensen-Kamakian	Kimble	American Cancer Society
Brian Gold	Raines	Beckman (Arnold and Mabel) Foundation
Pradyut Paul	Attie	Juvenile Diabetes Research Foundation
Katie Brenner	Weibel	L'Oreal USA for Women in Science Fellow
Mateusz Manicki	Pagliarini	Morgridge Postdoctoral Fellowship
Scott Aoki	Kimble	NIH Career Transition Award
Katie Brenner	Weibel	NIH Ruth L. Kirschstein National Research Service Award
Robert Brown	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Sayaka Masuko	Kiessling	NIH Ruth L. Kirschstein National Research Service Award
Jonathan Mayers	Bednarek	NIH Ruth L. Kirschstein National Research Service Award
Scott Messenger	Martin	NIH Ruth L. Kirschstein National Research Service Award

Graduate Students

2013

Rachel Kubiak	Holden	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Amber Schuh	Audhya	Sigrid Leirmo Memorial Award in Biochemistry
Paulo Castro	Ralph	Chilean International student exchange researcher award
Fabio Carvajal	Ralph	Chilean International student exchange researcher award
Ambalika (Rika) Khadria	Senes	Dance Your Ph.D. Competition Top Honors
John Lukesh	Raines	Harry and Helen Cohen Graduate Research Award
Heather Free	Ralph	International student exchange researcher award from U. Auckland, NZ
Judith Schaefer	Ralph	International student exchange researcher award from U. Hamburg, Germany
Rebecca Smith	Ralph	International student exchange researcher award from UBC, Canada
John Lukesh	Raines	Sigma–Aldrich Graduate Student Innovation Award
Yang Lin	Ralph	Student exchange researcher award from UCSB

Graduate Students *continued*

2014

Angela Gruber	Cox	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Kristen Dittenhafer-Reed	Denu	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Emily Ruff	Record	Sigrid Leirmo Memorial Award in Biochemistry
Laura Bond	Ntambi	Best Poster at ASBMB, lipids section
Robert Newberry	Raines	Eastman Chemical Summer Research Award
Kalie Mix	Raines	Great Lakes National STEM Scholarship
Anders Jensen	Ralph	International student exchange researcher award from Copenhagen U., Denmark
Tucker Carrocci	Hoskins	RNA Society Meeting Biochemistry Journal Poster Award
Brett Diehl	Ralph	Student exchange researcher award from Penn State U.

2015

Brendan Floyd	Pagliarini	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Tucker Carrocci	Hoskins	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Raashi Sreenivasan	Record	Sigrid Leirmo Memorial Award in Biochemistry
Matthew Stilwell	Weibel	Discovery Challenge Award
Darryl Wesener	Kiessling	Discovery Challenge Research Competition
Robert Newberry	Raines	Ralph F. Hirschmann–Daniel H. Rich Graduate Award in Bioorganic Chemistry
Kate Helmich	Ralph	Selected to represent GLBRC at the DOE Contractors meeting

2016

Rebecca Phillips	Rayment	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Ian Windsor	Raines	Denton Award for Graduate Student Excellence in Teaching & Mentoring
Kim Haupt	Kimble	Sigrid Leirmo Memorial Award in Biochemistry
Tina Lynch	Kimble	Biological Scholars Award
Robert Newberry	Raines	Charles and Martha Casey Research Excellence Award in Chemical Biology
Jinze Dou	Ralph	International student exchange researcher award from U. Helsinki, VTT, Finland
Robert Newberry	Raines	WISL Award for Communicating Research to the Public

Graduate Fellowships

2013

Brandon Taylor	Kimble	Advanced Opportunity Fellowship
Angela Gruber	Cox	Burris Predoctoral Fellowship
Christopher Lapointe	Wickens	Biochemistry Scholar Research Assistant Award
Loren LaPointe	Senes	Biochemistry Scholar Research Assistant Award
Gregory Reynolds	Bednarek	Biochemistry Scholar Research Assistant Award
Douglas Porter	Wickens	Biochemistry Scholar Research Assistant Award
Manohary Rajendram	Weibel	Biochemistry Scholar Research Assistant Award
Matthew Zmudka	Holden	Biochemistry Scholar Research Assistant Award
Sandra Tseng	Ansari	Biochemistry WARF Research Assistant Award
John Crooks	Weibel	Biochemistry WARF Research Assistant Award
Jonathan Stefely	Pagliarini	NIH NRSA Fellowship
Kristen Andersen	Raines	PhRMA Foundation Pre-Doctoral Fellowship
Jarred Rensvold	Pagliarini	Louis and Elsa Thomsen Distinguished Graduate Fellowship
Kate Helmich	Ralph	WARF Research Assistant Graduate Fellow
Ryan Petty	Palmenberg	Wharton Predoctoral Fellowship
Mufaddal Soni	Attie	Wharton Predoctoral Fellowship

2014

Gregory Reynolds	Bednarek	Stephen Babcock Agricultural Chemistry Research Fellowship
Danielle Lohman	Pagliarini	NSF Graduate Research Fellowship
Wen Chyan	Raines	NSF Graduate Research Fellowship
Sarah Robinson	Kimble	NSF Graduate Research Fellowship
Sandra Tseng	Ansari	NSF Graduate Research Fellowship
Jonathan Stefely	Pagliarini	NIH NRSA Fellow
Tucker Carrocci	Hoskins	William H Peterson Fellowship in Biochemistry

Graduate Fellowships

2014 *continued*

John Crooks	Weibel	William H Peterson Fellowship in Biochemistry
Graham Erwin	Ansari	William H Peterson Fellowship in Biochemistry
Ti-Yu Lin	Weibel	William H Peterson Fellowship in Biochemistry
Ananya Ray	Landick	William H Peterson Fellowship in Biochemistry
Shravan Sukumar	Mitchell	Steenbock Predoctoral Fellowship in Biochemistry
See-Yeun Ting	Craig	Steenbock Predoctoral Fellowship in Biochemistry
Brendan Floyd	Pagliarini	Louis and Elsa Thomsen Distinguished Graduate Fellowship
James Vasta	Raines	Wharton Fellowship in Biochemistry
Kate Helmich	Ralph	WARF Research Assistant Graduate Fellow

2015

Robert Newberry	Raines	ACS Nelson J. Leonard Graduate Fellowship
See-Yeun Ting	Craig	Denton Fellowship in Biochemistry
Ian Windsor	Raines	Genentech Predoctoral Fellowship
Kanghyun Lee	Craig	Hopkins Fellowship in Biochemistry
Zack Kemmerer	Pagliarini	NIH Molecular and Applied Nutrition (MANTP) fellowship
Jonathan Stefely	Pagliarini	NIH NRSA fellow
Jessica Cardenas	Bednarek	NSF Graduate Research Fellowship
Wen Chyan	Raines	NSF Graduate Research Fellowship
Michael Veling	Pagliarini	NSF Graduate Research Fellowship
Ellen Crummy	Martin	Dr. James Chieh-Hsia Mao Wisconsin Distinguished Graduate Fellowship
Ti-Yu Lin	Weibel	Dr. James Chieh-Hsia Mao Wisconsin Distinguished Graduate Fellowship
Samuel Craven	Senes	William H Peterson Fellowship in Biochemistry
Emily Garnett	Raines	William H Peterson Fellowship in Biochemistry
Thi Thao Nguyen	Sussman	William H Peterson Fellowship in Biochemistry
Valerie Tripp	Raines	William H Peterson Fellowship in Biochemistry
Mohammad Murshid Alam	Kiessling	Mary Shine-Peterson Fellowship
John Crooks	Weibel	William R & Dorothy E Sullivan WI Distinguished Graduate Fellowship
Laura Bond	Ntambi	William R & Dorothy E Sullivan WI Distinguished Graduate Fellowship
Gregory Reynolds	Bednarek	William R & Dorothy E. Sullivan WI Distinguished Graduate Fellowship
Molly McDevitt	Pagliarini	Stefaniak Fellowship in Biochemistry
Fima Zaltsman	Kiessling	Stefaniak Fellowship in Biochemistry
Andrew Reidenbach	Pagliarini	Louis and Elsa Thomsen Distinguished Graduate Fellowship
Tyler Stanage	Cox	Wharton Fellowship in Biochemistry

2016

Kalie Mix	Raines	CALS Senator Robert Caldwell Distinguished Graduate Fellowship
Allison Didychuk	Butcher	CALS Wisconsin Distinguished Graduate Fellowship
Ari Salinger	Holden	Genentech Predoctoral Fellowship
Samantha Anderson	Senes	Dr. James Chieh-Hsia Mao Wisconsin Distinguished Graduate Fellowship
Kyle Robinson	Pagliarini	NIH Biology of Aging and Aging-Related Diseases (BAARD) Fellowship
Wen Chyan	Raines	NSF Graduate Research Fellowship
Tina Lynch	Kimble	NSF Graduate Research Fellowship
Beth Boudreau	Landick	William H Peterson Fellowship in Biochemistry
Tina Lynch	Kimble	William H Peterson Fellowship in Biochemistry
Ti-Yu Lin	Weibel	Dorothy Sullivan Wisconsin Distinguished Graduate Fellowship
Kelly Mitok	Attie	Dorothy Sullivan Wisconsin Distinguished Graduate Fellowship
Thi Thao Nguyen	Sussman	Dorothy Sullivan Wisconsin Distinguished Graduate Fellowship
Thiago Santos	Weibel	Louis and Elsa Thomsen Distinguished Graduate Fellowship
Sabrina Dumas	Ntambi	Science and Medicine Graduate Research Scholar
Michael Andreas	Rayment	Steenbock Predoctoral Fellowship in Biochemistry
Deena-Al Mahbuba	Senes	Steenbock Predoctoral Fellowship in Biochemistry
Tyler Stanage	Cox	Steenbock Predoctoral Fellowship in Biochemistry

Graduate Students *continued*

Training Grant Awards

2013

Tucker Carrocci	Hoskins	Biotechnology Training Program
Kristen Dittenhafer-Reed	Denu	Biotechnology Training Program
Megan Dowdle	Sheets	Biotechnology Training Program
Alexander Justen	Kiessling	Biotechnology Training Program
Danielle Lohman	Pagliarini	Biotechnology Training Program
Robert Presler	Raines	Biotechnology Training Program
Elena Sorokin	Kimble	Biotechnology Training Program
Christine Bradford	Raines	Chemistry Biology Interface Training Program
Aubrey Ellison	Raines	Chemistry Biology Interface Training Program
Heather Hodges	Kiessling	Chemistry Biology Interface Training Program
Andrew Reidenbach	Pagliarini	Chemistry Biology Interface Training Program
Kaitlin Marquardt	Mitchell	Computation and Informatics in Biology and Medicine
Rachel Barkley	Rayment	Graduate Training in Molecular Biosciences
Michael Bellecourt	Landick	Graduate Training in Molecular Biosciences
Shane Bernard	Wildonger	Graduate Training in Molecular Biosciences
Laura Bond	Ntambi	Graduate Training in Molecular Biosciences
Roger Diehl	Kiessling	Graduate Training in Molecular Biosciences
Graham Erwin	Ansari	Graduate Training in Molecular Biosciences
Elisa Frankel	Audhya	Graduate Training in Molecular Biosciences
Angela Gruber	Cox	Graduate Training in Molecular Biosciences
Trish Hoang	Raines	Graduate Training in Molecular Biosciences
Sean Johnston	Raines	Graduate Training in Molecular Biosciences
Anastasia Lindahl	Denu	Graduate Training in Molecular Biosciences
Molly McDevitt	Pagliarini	Graduate Training in Molecular Biosciences
Kalie Mix	Raines	Graduate Training in Molecular Biosciences
Amelia Nestler	Pagliarini	Graduate Training in Molecular Biosciences
Lucas O'Neill	Ntambi	Graduate Training in Molecular Biosciences
Jarred Rensvold	Pagliarini	Graduate Training in Molecular Biosciences
Katharine Schulz	Harrison	Graduate Training in Molecular Biosciences
Sandra Tseng	Ansari	Graduate Training in Molecular Biosciences
James Vasta	Raines	Graduate Training in Molecular Biosciences
Michael Veling	Pagliarini	Graduate Training in Molecular Biosciences
Naomi Walsh	Hull	Graduate Training in Molecular Biosciences
Sarah Wessel	Keck	Graduate Training in Molecular Biosciences
Anna Kropornicka	Ansari	Institutional Training Grant in the Genomic Sciences
Benjamin Minkoff	Sussman	Institutional Training Grant in the Genomic Sciences
Matthew Mead	Hull	Microbes in Health and Disease Training Program
Brendan Floyd	Pagliarini	Molecular and Applied Nutrition Training Program
Emily Garnett	Raines	Molecular and Cellular Pharmacology Training Program
Anna Kropornicka	Ansari	Predoctoral Training Program in Genetics
Sarah Robinson	Kimble	Predoctoral Training Program in Genetics
Daniel Woods	Amasino	Predoctoral Training Program in Genetics
Brandon Hoover	Weibel	Predoctoral Training in Molecular Biophysics
Margaret Rodgers	Hoskins	Predoctoral Training in Molecular Biophysics
Matthew Stilwell	Weibel	Predoctoral Training in Molecular Biophysics
Funita Phan	Mosher	Training In Cancer Biology
Nathaniel Byers	Friesen	Virology Training Program

2014

Tucker Carrocci	Hoskins	Biotechnology Training Program
Kristen Dittenhafer-Reed	Denu	Biotechnology Training Program
Megan Dowdle	Sheets	Biotechnology Training Program
Alexander Justen	Kiessling	Biotechnology Training Program
Danielle Lohman	Pagliarini	Biotechnology Training Program
Ian Windsor	Raines	Biotechnology Training Program

Training Grant Awards

2014 *continued*

Aubrey Ellison	Raines	Chemistry Biology Interface Training Program
Sarah Hansen	Hoskins	Chemistry Biology Interface Training Program
Andrew Reidenbach	Pagliarini	Chemistry Biology Interface Training Program
Samson Condon	Senes	Computation and Informatics in Biology and Medicine
Michael Bellecourt	Landick	Graduate Training in Molecular Biosciences
Laura Bond	Ntambi	Graduate Training in Molecular Biosciences
Roger Diehl	Kiessling	Graduate Training in Molecular Biosciences
Graham Erwin	Ansari	Graduate Training in Molecular Biosciences
Sean Johnston	Raines	Graduate Training in Molecular Biosciences
Anastasia Lindahl	Denu	Graduate Training in Molecular Biosciences
Molly McDevitt	Pagliarini	Graduate Training in Molecular Biosciences
Kalie Mix	Raines	Graduate Training in Molecular Biosciences
Amelia Nestler	Pagliarini	Graduate Training in Molecular Biosciences
Lucas O'Neill	Ntambi	Graduate Training in Molecular Biosciences
Katharine Schulz	Harrison	Graduate Training in Molecular Biosciences
Brandon Taylor	Kimble	Graduate Training in Molecular Biosciences
James Vasta	Raines	Graduate Training in Molecular Biosciences
Michael Veling	Pagliarini	Graduate Training in Molecular Biosciences
Johnnie Walker	B. Fox	Graduate Training in Molecular Biosciences
Naomi Walsh	Hull	Graduate Training in Molecular Biosciences
Sarah Wessel	Keck	Graduate Training in Molecular Biosciences
Anna Kropornicka	Ansari	Institutional Training Grant in the Genomic Sciences
Benjamin Minkoff	Sussman	Institutional Training Grant in the Genomic Sciences
Brendan Floyd	Pagliarini	Molecular and Applied Nutrition Training Program
Kimberly Krautkramer	Denu	Molecular and Applied Nutrition Training Program
Erik Jessen	Landick	Predoctoral Training Program in Genetics
Sarah Robinson	Kimble	Predoctoral Training Program in Genetics
Funita Phan	Mosher	Training in Cancer Biology

2015

Megan Dowdle	Sheets	Biotechnology Training Program
Alexander Justen	Kiessling	Biotechnology Training Program
Sarah Hansen	Hoskins	Chemistry Biology Interface Training Program
Andrew Reidenbach	Pagliarini	Chemistry Biology Interface Training Program
Samson Condon	Senes	Computation and Informatics in Biology and Medicine
Zachary Kemmerer	Pagliarini	Molecular and Applied Nutrition Training Program
Kimberly Krautkramer	Denu	Molecular and Applied Nutrition Training Program
Josue Baeza	Denu	Graduate Training in Molecular Biosciences
Michael Bellecourt	Landick	Graduate Training in Molecular Biosciences
Laura Bond	Ntambi	Graduate Training in Molecular Biosciences
Roger Diehl	Kiessling	Graduate Training in Molecular Biosciences
Elisa Frankel	Audhya	Graduate Training in Molecular Biosciences
Evan Glasgow	B. Fox	Graduate Training in Molecular Biosciences
Trish Hoang	Raines	Graduate Training in Molecular Biosciences
Sean Johnston	Raines	Graduate Training in Molecular Biosciences
Anastasia Lindahl	Denu	Graduate Training in Molecular Biosciences
Molly McDevitt	Pagliarini	Graduate Training in Molecular Biosciences
Kalie Mix	Raines	Graduate Training in Molecular Biosciences
Amelia Nestler	Pagliarini	Graduate Training in Molecular Biosciences
Kyle Nishikawa	Raman	Graduate Training in Molecular Biosciences
Lucas O'Neill	Ntambi	Graduate Training in Molecular Biosciences
Katharine Schulz	Harrison	Graduate Training in Molecular Biosciences
Brandon Taylor	Kimble	Graduate Training in Molecular Biosciences
Nathan Thomas	Henzler-Wildman	Graduate Training in Molecular Biosciences
Naomi Walsh	Hull	Graduate Training in Molecular Biosciences

Graduate Students

Training Grant Awards

2015 *continued*

Sarah Wessel	Keck	Graduate Training in Molecular Biosciences
Alejandra Canales	Attie	Institutional Training Grant in the Genomic Sciences
Anna Kropornicka	Ansari	Institutional Training Grant in the Genomic Sciences
Benjamin Minkoff	Sussman	Institutional Training Grant in the Genomic Sciences
Erik Jessen	Landick	Predoctoral Training Program in Genetics
Alex Murphy	Kimble	Predoctoral Training Program in Genetics
Margaret Rodgers	Hoskins	Predoctoral Training in Molecular Biophysics
Christopher Brandon	Attie	Training Program in Translational Cardiovascular Science

2016

Kyle Robinson	Pagliarini	Biology of Aging and Age-Related Diseases Training Grant
Megan Dowdle	Sheets	Biotechnology Training Program
Evan Glasgow	B. Fox	Biotechnology Training Program
Alexander Justen	Kiessling	Biotechnology Training Program
Dylan Plaskon	Raman	Biotechnology Training Program
Sarah Hansen	Hoskins	Chemistry Biology Interface Training Program
Mark Klein	Denu	Chemistry Biology Interface Training Program
Samson Condon	Senes	Computation and Informatics in Biology and Medicine
Josue Baeza	Denu	Graduate Training in Molecular Biosciences
Roger Diehl	Kiessling	Graduate Training in Molecular Biosciences
Elisa Frankel	Audhya	Graduate Training in Molecular Biosciences
Alexis Lawton	Denu	Graduate Training in Molecular Biosciences
Anastasia Lindahl	Denu	Graduate Training in Molecular Biosciences
Kalie Mix	Raines	Graduate Training in Molecular Biosciences
Kyle Nishikawa	Raman	Graduate Training in Molecular Biosciences
Hridindu Roychowdhury	Romero	Graduate Training in Molecular Biosciences
Katharine Schulz	Harrison	Graduate Training in Molecular Biosciences
Brandon Taylor	Kimble	Graduate Training in Molecular Biosciences
Nathan Thomas	Henzler-Wildman	Graduate Training in Molecular Biosciences
Alejandra Canales	Attie	Institutional Training Grant in the Genomic Sciences
Zachary Kemmerer	Pagliarini	Molecular and Applied Nutrition Training Program
Kimberly Krautkramer	Denu	Molecular and Applied Nutrition Training Program
Anna Kropornicka	Ansari	Predoctoral Training Program in Genetics
Megan Leander	Raman	Predoctoral Training in Molecular Biophysics
Margaret Rodgers	Hoskins	Predoctoral Training in Molecular Biophysics
Christopher Brandon	Attie	Training Program in Translational Cardiovascular Science

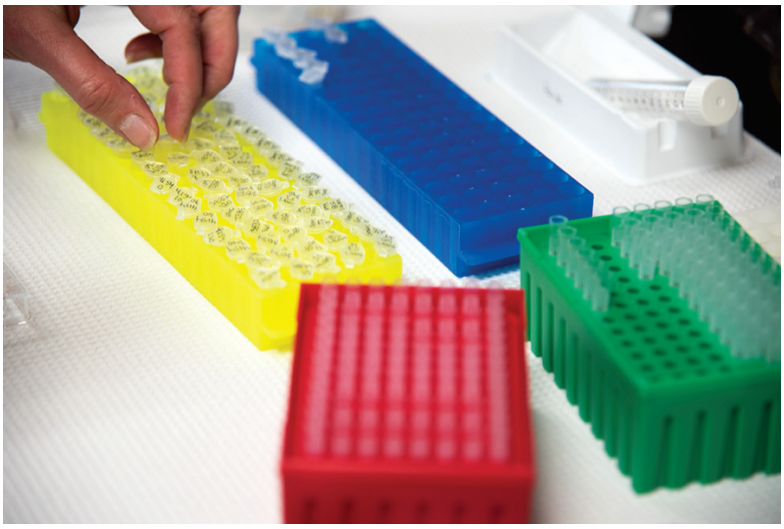


Photo by Robin Davies

Undergraduates

Biochemistry Undergraduate Summer Research Award

2013 **Thomas Alderson** (Markley)
Chin Leng Cheng (Raines)
Kellie Kolb (Landick)
Hong Hong Liao (Butcher)
Jack Vidani (Kiessling)
Kevin Walters (Raines)
Lucas Zarling (Kiessling)

2014 **Allison Abellaneda** (Wildonger)
Ibrahim Ali (Markley)
Claire Armstrong (Senes)
Emily Baumann
Evan Buechel (Record)
Lixue Cheng (Record)
Victoria Heinrich (Weibel)
Daniel Hron (Landick)
Matthew Lammers (Weibel)
Bradley Maerz (Weibel)
William Mulligan
John Nielsen (Wickens)
Madhusudan Rajendran (Weibel)
Meghan Turner
Benjamin Weber (Kiessling)

2015 **Claudia Aldrich** (Kiessling)
Aaron Anderson
Adam Awe
Amanda Beltrame (Raines)
Katherine Faulkner (Weibel)
Matthew Grieshop (Ansari)
Katherine Jiang
Matthew Lammers (Weibel)
George Luo (Hoskins)
Hannah Mast (Hoskins)
Bradley Reynolds (Weibel)
Un Shin Schmidt
Praisten Tiano (Senes)
Brexton Turner (Hoskins)
Lucas Zarling (Kiessling)
Alina Zdechlik (Ntambi)

2016 **Samuel Block**
Jonathan Doenier (Kimble)
Brandon Dopkins (Holden)
Wen Fu (Kiessling)
Jack Gellerman (Mitchell)
Austin Gluth
Collin Goebel
Timothy Guthrie (Kimble)
Lucy Jiang (Senes)
Lili Kim (Kiessling)
Joseph Kraft (Record)
Hannah Poe (Hoskins)
Ryan Rebernick
Joseph Trimarco (Cox)
Ke Xu (Kiessling)
Nicholas Yan (Craig)
Trevor Zachman-Brockmeyer (Holden)

Hilldale Undergraduate Research Fellowship

2013 **Chin Leng Cheng** (Raines)
Drew Gunderson (Pagliarini)
Kristin Harrington (Ntambi)
Emily Lingeman (Martin)
Kayla McKaveney (Craig)
Hannah Meddaugh (Fox)
Tayla Olsen (Cox)
Madhusudan Rajendran (Weibel)
Matthew Sternke (Record)
Kevin Walters (Raines)
Si Wang (Record)
Lucas Zarling (Kiessling)
Yurun Zhang (Record)
Drew Birrenkott
Emily Gasteyer
Bridget Mais
Sarah Nordeen
Enio Perez
Jyothiprashanth Prabakaran
Nicholas Sanchez
Alexander Sliwicki
Jack Vidani
Clara Ye

2014 **Allison Abellaneda** (Wildonger)
Matthew Ashton (Hoskins)
Daniel Chantigian (Holden)
Sherry Cheng (Record)
Rachel Dvorak (Cox)
Victoria Heinrich (Weibel)
Isabel Johnson (Pagliarini)
Hong Hong Liao (Butcher)
Jiayue Liu (Ansari)
Victoria Martino (DeLuca)
Jennifer Nguyen (Wildonger)
Emily Baumann
Sin Chan
Eric Madsen
Daniel Magyar
Bill Mulligan
Mengyao Niu
Nicholas Rettko
Meghan Turner
Matthew Wolf

2015 **Claudia Aldrich** (Kiessling)
Amanda Beltrame (Raines)
Nathan Delvaux (Holden)
Emma Doenier (Kimble)
Matthew Grieshop (Ansari)
Matthew Lammers (Weibel)
Evan Lange (Senes)
Adam Lauko (Craig)
George Luo (Hoskins)
Kevin O'Connor (Record)
Alexander Peterson (Raines)
Matthew Stefely (Pagliarini)
Brexton Turner (Hoskins)
Benjamin Weber (Kiessling)
Adam Awe
Carol Coutinho
Richard Giza
Amal Javaid
Katherine Jiang
Tej Mehta
Yiming Qin
Kelsey Rayment
Jane Ryu

2016 **Joshua Bensen** (Kiessling)
Clare Kai Cimperman (Record)
Arthur Clark (Hoskins)
Andrew Delaitsch (Butcher)
Jonathan Doenier (Kimble)
Michael Drahnak (Pagliarini)
Wen Fu (Kiessling)
Evan Heiderscheit (Ansari)
Hannah Mast (Hoskins)
Helena Record (Wildonger)
Nicholas Yan (Craig)
Jennifer Bird
Sloane Bratton
Aditya Dewanjee
Austin Gluth
Runyu Hong
Laurel Kelnhofer
Jorgo Lika
Brady Lundin
Matthew Schneider
Sarah Wang
William Xiang

Undergraduates

Nationally Competitive

Goldwater Scholarship

- 2013 **Drew Birrenkott**
  Emily Lingeman (Honorable Mention)
- 2014 **Rachel Dvorak** (Cox)
- 2015 **Bill Mulligan**
  Meghan Turner
- 2016 **Hannah Mast** (Hoskins)

Marshall Scholarship

- 2015 **Rachel Dvorak** (Cox) (Finalist)
- 2016 **Bill Mulligan** (Finalist)

Rhodes Scholarship

- 2014 **Drew Birrenkott**
- 2016 **Bill Mulligan** (Finalist)

Other National

ASM Undergraduate Research Capstone Award

- 2015 **Madhusudan Rajendran** (Weibel)

RIKEN Summer Internship in Japan

- 2013 **Drew Gunderson** (Pagliarini)

Meetings

ASBMB Meeting Best Undergraduate Poster Prize (Cell Biology)

- 2015 **Allison Abellaneda** (Wildonger)

ASBMB Meeting Undergraduate Poster - Honorable Mention

- 2015 **Doug Zoerner** (Hoskins)
- 2016 **Brexton Turner** (Hoskins)
  Alina Zdechlik (Ntambi)

Campus-Wide

Holstrom Environmental Scholarship

- 2013 **Heather Smaby**

Sophomore Research Fellowship

- 2015 **Jaime Brown** (Friesen)
  Ryan Rebernick
  Sarah Wang
  William Xiang
  Annie Yao
- 2016 **Stefani Lucarelli** (Butcher)

Named a "Top 15 of 2015"

- 2015 **Emily Baumann**

University Book Store Award

- 2014 **Chin Leng Cheng** (Raines)
- 2015 **Victoria Heinrich** (Weibel)
  Kevin O'Connor (Record)
- 2016 **Lucas Zarling** (Kiessling)

Wisconsin Idea Fellowships

- 2016 **Stephen Early** (Kiessling)
- 2015 **Victoria Heinrich** (Weibel)
  Kevin O'Connor (Record)
- 2016 **Lucas Zarling** (Kiessling)

Other Campus

Adult Student Scholarship Award

- 2014 **Emily Zytkiewicz** (Record)

Alpha-Helix Scholar

- 2014 **Amanda Belltrame**

CALS Outstanding Senior Award

- 2015 **Rachel Dvorak** (Cox)

Ann M. Durra Scholarship

- 2016 **Ashley Ng** (Wildonger)

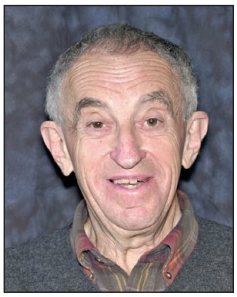
Trewartha Undergraduate Honors Research Grant

- 2015 **Matthew Lammers** (Weibel)

University League General Scholarship

- 2016 **Ashley Ng** (Wildonger)

From the Emeritus Faculty



Julius Adler

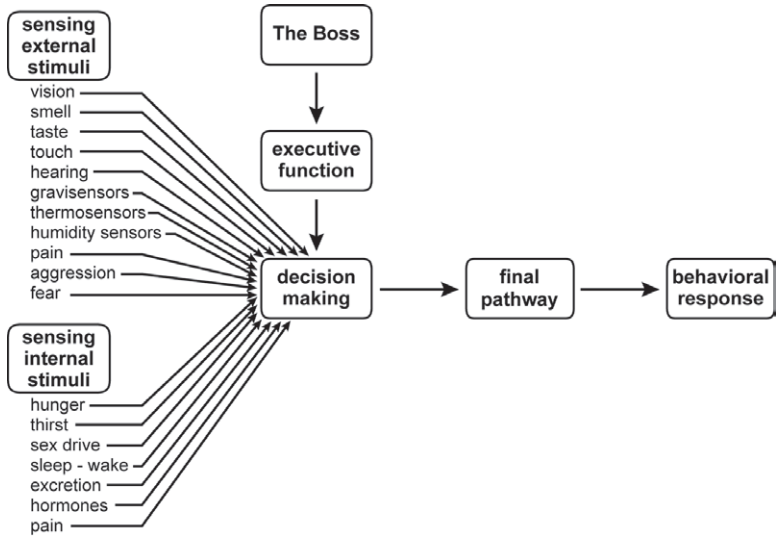
It has been wonderful to have eight super undergraduates this past year, and seven super undergraduates the year before, to do research with me. As a result of their excellent work, we have published these papers just now:

1. "Decision Making by *Drosophila* Flies", Julius Adler and Lar Vang, 2016, bioRxiv. Here we isolated mutants that can't decide what to do when presented with attractant plus overpowering repellent, they move only randomly.

2. "*Drosophila* Mutants that Are Motile but Respond Poorly to All Stimuli Tested", Lar Vang and Julius Adler, 2016, bioRxiv. Here we isolated mutants that fail to respond to any stimulus, whether attractant or repellent. The mutants are defective in a gene needed for sending information from sensory receptors to response.

3. "A Search for The Boss: The Thing Inside Each Organism That Is in Charge", Julius Adler, 2016, Anatomy, Physiology, and Biochemistry. This is a hypothetical paper (allowed most rarely!). In all organisms, whether microorganisms or plants or animals, there is a mechanism that controls everything (figure below).

I will be very happy to see any of you, please come. Recently, I saw one of my recent undergraduates, Joe Sanfilippo. The highlight there is a beautiful baby girl, Rose! Joe and Madelyn have just graduated with a Ph.D. from Indiana University and are now doing postdoctoral work out east, Joe at Princeton. Ran Tao has visited me, he is very excited about being a first-year student at the University of Wisconsin Medical School here. I enjoyed meeting Ran's parents from China a year ago in Madison.



Where decision making, final pathway, and behavioral response are thought to act in organisms in general

Paul Ludden

It is wonderful to be back "Home" in Biochem after an absence of 15 years. After five years at Cal Berkeley and just finishing 10 years at SMU in Dallas, Linda and I are relishing the opportunity to spend part of each year in Madison. My time away has given me a perspective of UW and its Biochemistry Department, and I am confident that there is no greater university and certainly no better Biochemistry Department. It has been gratifying to hear unsolicited praise of UW Biochemistry over the years from university leaders around the world as well as from former students of the Department spanning the decades. On returning, it is reassuring to see that the graduate program remains strong and that the young faculty of the department are inspiring.

I have enjoyed hearing from quite a few former students and postdocs over the past year and the range of their careers amazes me. Haian Fu is now the holder of an endowed chair at Emory. Sandy Grunwald is currently serving as interim associate vice chancellor for academic affairs at UW LaCrosse. Scott Ensign continues to receive every teaching accolade at Utah State. Tim Hoover is embarking on his second term as department chair at UGA and Diana Downs is "living the dream," also at UGA. Steve Singer is now Director, Microbial Communities Group at Livermore Labs, and Dan Wacks continues as Dept. Chair at Redlands University. Luis Rubio runs a large group at the Centro de Biotechnologica in Madrid and recently had his funding from the Gates Foundation renewed. I had dinner with Ranjini Chatterjee, Yan Ma and Dehua Zhao in SF this past year and was amazed at how they have moved into the CRISPR world! Two former labmates now work in the art world – Chris Staples as an artist and environmentalist in Florida and Ken Dick is now the business manager for the very successful art enterprise of his wife Michelle. After stepping out as Dean of Faculties at Stockholm University, Stefan Nordlund keeps finding things to do – most recently he served as chair of a

humanities department as they reorganized. Bob Lowery is setting new directions in his company, BellBrook Labs and occasionally gets together with Len Saari to play some bluegrass. Len and his wife Brenda, hosted Linda and I at their Northern Minnesota retreat last summer. Len is now enjoying retirement after many years and many roles at DuPont. Priya Rangaraj is now a market segment manager at Thermofisher Scientific in Rockford and Yaoping Zhang is now a Senior Scientist and Project leader in the GLBRC at UW. Juan Imperial from Madrid visited this past summer and he continues to explore the rhizobial genome. Gail Stirr is now the Administrative Director at McPherson Eye Research Institute at UW. Connie Williams and her husband, Jeff, are also back in Madison. Jeff was an undergrad with Bob Burris and is now President of Lucigen. I have lost touch with some former labmates and I hope this note will prompt them to drop me a line at ***pludden@gmail.com***. Apologies if I overlooked anyone who had sent a note to me this year.

Brian Fox has made my return to the Department easy by making an office (Rm 141D) available to me and giving me a space in his lab where I am playing around developing experiments for future scientists who are currently in third grade. Thanks, Brian. I especially enjoy sitting in on the Fox lab meeting when I can. Of course, I continue my collaboration with Gary Roberts – now as a Frisbee golf partner; we routinely crush the opposition team of retired UW mathematicians against whom we play regularly. CALS Dean Kate Vandenbosch also asked me to serve on the CALS Board of Visitors and I am enjoying that experience. Best wishes to all. – Paul

George Reed

Greetings from 4404A HFD BSB. In the short four years post retirement I have been frequently quizzed about how I am taking to retirement. My stock answer is that I haven't yet found anything that I do not like about it. I have been fairly successful in avoiding tasks that I do not enjoy or at least minimizing their consumption of my time and energy. I have enjoyed very much attending the Biochemistry Club lunches and Departmental seminars and colloquia. Participation in the 909 seminar has provided opportunities to pass along axioms such as the now legendary "1 kcal rule" and quips about too many significant figures in published data!

Perry Frey and I collaborated on an invited chapter on Biological Catalysis for *The Encyclopedia of Cell Biology*. Russ Poyner assisted with a chapter on Fourier methods of resolution enhancement in EPR for *Methods in Enzymology*.

I have appreciated hearing from many former students and postdocs in the Department and Institute.

Bill Reznikoff

A Decade of Retirement

The UW-Madison Biochemistry Department – although some things change slowly (same drive for excellence in research and education) and quickly (imagine trying to find my way in the "old" Henry Mall Biochem building [a great venue for undergrad education] or checking the faculty list and wondering who a third of the faculty are [they are new, Bill! a sign of the continued excellence in research]). In ten years, a lot can happen. Our (Cathy's and my) lives have also included both continuation with the previous 37 years and new exciting happenings.

The decade started off with our building a new home (Cathy's design) coupled with our moving to Cape Cod, MA, near to the research/teaching laboratories at the Marine Biological Laboratory (MBL) in Woods Hole.

My goal was to have a hobby lab at the MBL meaning that I would have a desk and a bit of bench space in someone's lab. From that territory I collaborated with other scientists and did some of my own research. I knew that it would work because I had recently completed a 6-month sabbatical in a microbial genomics lab and had a blast (and a BLAST) and published two papers.

My idyllic situation changed when the new director of the MBL (Gary Borisy, an old friend from UW Madison days) decided that he could twist my arm to perform administrative duties. This lead to a 6-year appointment as Director of Education. In MBL terms this means supervising the great advanced research courses for grad students and postdocs. To get a flavor of these courses, see Doug Weibel's description of his experiences as a Physiology Course student (***https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3814159/***). I totally loved the job although it sometimes involved a degree of multi-tasking that is not my customary way of working.

My appointment ended and following an unprogrammed heart attack, and recovery, I moved back into my hobby lab. I have been using high throughput DNA sequencing to study mixed bacterial populations and sometimes the mobile elements found in some of the genomes. Again it has been great with wonderful science and colleagues. Best of all, I have NO official responsibilities.

Cathy and I enjoy being with our grandchildren, having friends visiting us, and traveling. Before I retired, James Ntambi introduced us to Uganda and Cathy, in particular, has continued our connections supporting K-12 education initiatives.

Yes, you can visit but please give us at least a week's notice.

From the Labs

Calling all Past Members of the Department of Biochemistry
We want to hear from you!!!! Let us know what you have been up to.
Please remind us of the faculty or facility you worked with and approximately when.
Keep in touch!! Send updates to:
E-mail: ***alumninews@biochem.wisc.edu*** or regular mail in care of the department.

Like the Department on Facebook
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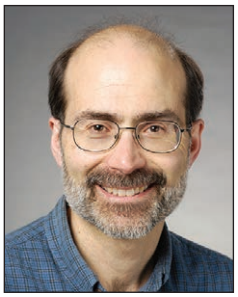


Amasino lab

We continue to study how plants perceive seasonal cues and translate that perception into the initiation of flowering. For many years, we have studied this in the model plant Arabidopsis, but since the last newsletter, our focus has shifted to a model grass, *Brachypodium distachyon*. Some of the reasons for this shift include: 1) grasses are an important group of plants in many native ecosystems as well as for food (corn, wheat, and rice are grasses), 2) grasses are also a potential bioenergy crop and delaying flowering can increase biomass yields, so our work is relevant to our Great Lakes Bioenergy Research Center, and 3) much of what my lab and others have learned about flowering in Arabidopsis is not likely to apply to grasses (see below); thus, flowering in grasses is a new frontier to explore.

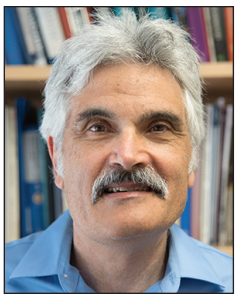
One seasonal cue we have studied is exposure to winter cold. Many plants that are adapted to temperate climates require exposure to winter cold in order to flower in the spring. The changes brought about by exposure to cold are known as vernalization. When we began to study vernalization in Arabidopsis, nothing at all was known about how this process operated at a molecular level. Over the years, we and others worked out many of the molecular details of how exposure to winter cold leads to flowering in the spring. However, what we have learned about vernalization in Arabidopsis does not apply to grasses because the grass and Arabidopsis vernalization systems evolved independently – 150 million years ago, when the grass and Arabidopsis lineages split, the continents were in different locations, the earth's climate was much warmer, and vernalization systems had not yet evolved!

Daniel Woods and **Tom Ream**, starting "from scratch," investigated flowering at a molecular level in Brachypodium. Starting with 1) screens for mutants with altered flowering behavior and 2) studies of the genetic basis of natural variation in flowering behavior, Daniel and Tom identified many novel genes that are critical for the initiation of flowering in Brachypodium. Tom moved on to a position at Monsanto, and Daniel has continued to piece together grass flowering pathways starting with identified genes and using various biochemical techniques to flesh out the molecular details of the role of the gene products. We have found that a unique phytochrome photoreceptor is involved in day-length sensing in grasses (see Highlights section of this newsletter), and several other exciting projects are in the pipeline. Daniel has been recently joined in this effort by graduate student **Aaron Lomax** and postdoctoral fellow **Frédéric Bouché** who joined us after completing his thesis at the University of Liège.

Associate scientist **Scott Woody** continues to develop innovate tools for bringing classical and molecular genetics to high school and undergraduate classrooms; these tools use a collection of rapid-cycling *Brassica rapa* mutants that he developed (***see http://fpsc.wisc.edu***).

In addition to our flowering studies, I have been involved in a few educational endeavors beyond teaching in our large-enrollment course, Biochemistry 501. One is a project entitled "POSOH—Place-based Opportunities for Sustainable Outcomes and High-hopes" which is a partnership with the Sustainable Development Institute of the College of Menominee Nation funded by the USDA. The goal of the project is to develop a cross-cultural community of educators, basic researchers, and First Nation members to foster, in a culturally integrated manner, science education in energy and sustainability at the middle school, high-school, and undergraduate levels. A major driving force in this project is my colleague Hedi Baxter-Lauffer who has a Ph.D. in education. I am also the faculty director of the Great Lakes Bioenergy Research Center's Education and Outreach program; a major goal of this effort is to broaden the understanding of current issues in bioenergy at the K-16 levels through the development of curriculum modules, teacher-training workshops, and supporting summer research for K-12 teachers in Energy Center labs. I also co-authored a National Academy of Sciences report on 'Developing Assessments for the Next Generation Science Standards' about methods to evaluate K-12 students' understanding of scientific concepts.

News of lab members who have become alumni since the last newsletter: As noted above, former postdoc **Tom Ream** is now at Monsanto. Graduate student **Claudia Sanabria**, who did her thesis work on biomass traits in Brachypodium, has joined a research organization, Corpoica, in her native Colombia. Her web page (in Spanish) is ***http://www.corpoica.org.co/menu/ninv/nuevos-investigadores/claudia-patricia-sanabria-galindo/***. **Joohyun Lee**, who did postdoctoral work on the mechanism by which the duration of exposure to cold is measured during vernalization, is now a Research Assistant Professor at the University of Massachusetts at Amherst. **Ryland Bednarek**, who did an internship in the lab after completing his undergraduate degree, is now a graduate student in the Department of Plant Pathology at Cornell.



Attie lab

Our lab mobilized over the past two years to carry out an ambitious genetic screen for genes that affect insulin secretion. The heavy lifting was done by our wonderful core team: **Mary Rabaglia**, **Kiki Schueler**, **Donnie Stapleton**, and **Shane Simonnett**. The effort paid off; we have mapped ~20 loci and are now drilling in to study individual genes and their function. Our genetic studies have also been a hub for collaborations with other labs. With Josh Coon's lab, we are mapping genes that control metabolites and proteins. With Federico Rey, we are mapping genes that determine which organisms in the microbiome take up residence in the intestine. With Wes Pike, we have identified a gene that affects bone mineral density. We are excited by all of the leads and the many exciting projects that will emerge from our genetics pipeline. Joining this effort is a new graduate student from the Nutritional Sciences program, **Laura Borth**. In addition, **Jieun Lee**, a graduate of Michael Wolfgang's lab at Johns Hopkins, will soon join the lab as a postdoctoral scholar.

Butcher lab

Greetings from the Butcher lab! The past several years have been busy and exciting. We continue to enjoy our productive collaborations with the groups of **Dave Brow** and **Aaron Hoskins**. Our collaboration with Dave Brow led to the first high resolution structure of the U6 snRNP core, solved by **Eric Montemayor**. In collaboration with **Nate Sherer's** lab (Molecular Virology and Oncology, McArdle Laboratory), **Pablo Garcia-Miranda** described how RNA stability determines the efficiency of frameshifting in HIV. Pablo is now a professor in Seville, Spain. Sam continues to be an active co-PI of NMRFAM, along with **John Markley** and **Katie Henzler-Wildman**. **Allison Didychuk** is a senior biophysics Ph.D. student and published an outstanding paper describing the mechanism of protein-catalyzed annealing of U4/U6 RNAs.

In 2016, the laboratory welcomed new biophysics Ph.D. student **Gurnimrat "Nimu" Sidhu** and a new postdoctoral scientist, **Yuichiro Nomura**. Our strong team of undergraduate researchers includes **Andrew Delaitsch**, **Matt Larson**, **Stefani Lucarelli** and **Johanna Virta**. Our NIH-funded efforts to understand how proteins and RNA associate during spliceosome assembly continues to produce exciting new structures, so stayed tuned!

Cox lab

Current Lab News:

We're very pleased to welcome two graduate students into the lab this year.

Miguel Osorio Garcia from the University of California, Berkeley. While at UC, Berkeley, Miguel worked in the lab of Seth Rubin identifying the activating partners of the E2F family of transcription factors.

Zachary Romero from New Mexico State University. While at New Mexico State University, Zachary worked in the lab of our Cox lab alumna **Shelley Lusetti** (Ph.D. UW-Madison 2002), who's an Associate Professor at that institution. While in Shelley's lab, Zachary studied the various mechanisms that bacteria use to repair their DNA after being exposed to stress.

Steven Bruckbauer received a Wisconsin Distinguished Graduate Fellowship award, The Morgridge Biotechnology Fellowship in December 2016. Congratulations, Steven!

Bragging rights for the lab go to Mike who scored the plane seat next to Steven Van Zandt in May 2016. Little Steven and Mike had such a great conversation that Mike was given a free ticket to see Bruce Springsteen and the E Street Band's first concert of their European tour in Barcelona. Way to go Mike!

Goings:

Stefanie Chen joined the Cox lab as a postdoctoral fellow in 2012. She came from the Tao-shih Hsieh lab at Duke University where she explored the need for topoisomerase activity in the Blm-Top3a "dissolvasome" DNA repair complex. In the Cox lab, Stefanie took over the analysis of two proteins that turned up in an earlier screen, the products of the genes yejH and uup. Her studies of yejH demonstrated a substantial role of the gene in DNA double strand break repair. Stefanie was also involved in a wide range of teaching programs at UW-Madison. In summer 2016, Stefanie accepted a position as Teaching Postdoctoral Fellow, Biotechnology Center, North Carolina State University, Raleigh, NC.

Since the last newsletter the following Cox lab graduate students received their Ph.D.s:

2013 – **Rose Byrne Nash**: Scientist, InDevR, Inc., Boulder, CO.

2014 – **Angela Manlick Gruber**: Scientist, PreventionGenetics, Marshfield, WI.

2015 – **Tae Jin Kim**: Scientist, Provivi, Inc., Santa Monica, CA.

2015 – **Erin Ronayne**: Scientist, Thermo Fisher Scientific, Carlsbad, CA.

Cox Lab Visitors:

Susan T. Lovett, Professor, Department of Biology and Rosenstiel Medical Sciences Center, Brandeis University. Fall 2016, Susan spent a month in the lab while on sabbatical working on RadA.

Camille Henry, graduate student, Aix Marseille University (UMR AMU CNRS) LBC Barras. Spring 2016, Camille spent two months in the lab working to test other biochemistry properties of RecA like DNA binding and DNA exchange for the different oxidation states of RecA.

Emiko Sano, postdoctoral fellow, University of Montana in the lab of Scott Miller. Spring 2016, Emiko spent one month in the lab to learn how to purify RecA proteins from the bacterium *Acaryochloris marina*.

A. Brindhi Hyacinth, Khorana Program for Scholars. Summer 2016, Brindhi spent 10 weeks in the lab studying the effect of methyl methanesulfonate in the expression of DNA polymerase V subunits in *E. coli*.

Wellington Claiton Leite, graduate student, Ponta Grossa State University, Brazil. From 2014-2015, Wellington working in the lab carrying out experiments related to the RecA and RecX proteins of the bacterium *Herbaspirillum seropedicae*.

Shelley Lusetti, Associate Professor, Department of Chemistry and Biochemistry, New Mexico State University. August - September 2014 and March - May 2015, Shelley worked in the lab while on sabbatical.

Other lab alumni who dropped by while in town were **Qun Shan**, **Dennis Harris** and **Yeajin Song**, **Rachel Dvorak**, **Reece Goiffon**, **Tayla Olsen**, **Mary Menhart**, **Kevin Rice** and his wife, **Angela Gruber** and **Khanh Ngo**. If any other alumni are in the Madison area, make sure you stop by to say hi and let us know how you're doing. **Liz** and **Carol** are still around so you'll be remembered well.

Mike Cox and Steven Van Zandt May 2016

Craig lab

Greetings from the Craig lab. Much has happened since the last dispatch from the lab – many comings and goings.

Some folks have both come and gone: **Tommer Ravid** from the Hebrew University of Jerusalem recently left the lab after spending a sabbatical year here. We got immersed in ubiquitin system/proteolysis and he in molecular chaperones. We both learned a lot, including HOW COMPLICATED both systems are! And **Jarek Marszalek** has come and gone several times, spending a few months a year here as a visiting professor from his permanent home at the University of Gdansk. It is hard to believe that the recent visit was his 18th – and as productive as ever. Two grad students from Jarek's lab, **Julia Majewska** and **Michal Rogaczewski**, worked in the lab for a year on their Fe-S cluster biogenesis projects, as well.

Lindsey Kauschner (nee Hoover) graduated. After an extended trip to Central America, she moved back to her beloved Austin, TX, with a job at UT Austin working in the office of "Student Success Initiatives." Her work on ribosome associated chaperones, Jjj1 and Zuo1, was picked up by a postdoc who joined the lab, **Ruchika Sharma**. Ruchika comes to Madison from the Indian Institute of Science, Bangalore - via Bethesda, Maryland where she had a short, but productive, stint in the Masison lab.

Two other graduate students are close to graduating – almost there! **Kanghyun Lee** has made progress in figuring out Zuo1 and its interaction with both the ribosome and that pesky atypical Hsp70 Ssz1. **See-Yeun Ting** has been picking apart Tim44, that amazingly complex scaffold protein of the mitochondrial import motor. **Nick Yan**, an undergrad in the lab, has been working with him on the Tim44 project. All three have made very productive use of the Bpa site specific crosslinking approach.

Szymon Ciesielski, **Brenda Schilke** and **Tom Ziegelhoffer** have been tackling a question that we have been working on for years – and just what is the difference between the J-protein that can maintain yeast prions and the similar one that can't? Combining yeast genetics and NMR, we may be getting there.

Both **Hyun Young Yu** and **Om Shrestha** have moved on to new positions. **Hyun Young** is happily employed at Catalent Pharma Solutions here in the Madison. **Om** moved (and got married!) to a position at Cold Spring Harbor Labs – where, not surprisingly, he continues structural biology.

Last, but not least, **Betty** is no longer chair. She is spending much more time on the 4th floor, thinking about science in ways she had not before (e.g. what exactly is an NOE?).

Fox lab

Hello from 141B Biochemistry Laboratories. This updates comings and goings from 2013 to present.

In the Biochemistry Laboratories, the current people, sorted by their lab bay from south to north are **Nathan Kuch** (IPiB graduate student, BTP trainee), **Evan Glasgow** (IPiB graduate student, BTP trainee), **Kirk Vander Meulen** (staff scientist) and **Emily Beebe** (staff scientist). **Jenna Amro** is our current Dane County Youth Apprenticeship intern, following in the footsteps of **Edward Cao**, our most prolific ever "bard of the white board."

In 2014, we had a remarkable year, as **Chris Bianchetti** took a job as an Assistant Professor of Chemistry and Biochemistry at UW Oshkosh, **Shishir Chundawat** became an Assistant Professor of Chemical Engineering at Rutgers University, and **Taichi Takasuka** became an Assistant Professor of Biochemistry at Hokkaido University in Sapporo, Japan. All three are doing well in their new positions, and I am happy to see them learning how to do even more things at once, as is required by their chosen profession.

Our two most recent Ph.D. graduates are **Justin Acheson** (Summer 2015) and **Johnnie Walker** (Fall 2015).

Justin made a final flash in his Ph.D. thesis, after figuring out how to get toluene into the active site of toluene 4-monooxygenase crystals. He was able to carry out catalysis in the crystal and trapped a reactive intermediate in the active site that is best described as an Fe^{2+}/Fe^{3+}-peroxo bound at the C-4 position to a delocalized toluene radical. We worked with Prof. Thomas Brunold from the Department of Chemistry on this project, and the result is now in press in a respectable science magazine. Justin is now a postdoctoral fellow at the University of Virginia.

Johnnie finished his dissertation work with two notable publications on how enzymes react with plant biomass. His first major contribution was on the fusion of carbohydrate binding modules (CBMs) to a broad specificity catalytic domain. He showed different CBMs could promote activity by guiding the catalytic domain to different substrates. Johnnie also worked with **Lai Bergeman** and collaborators from California and Georgia on another study where he demonstrated the reactions of single, pure enzymes with various polysaccharides in plant cell walls. Johnnie is now a postdoctoral fellow at Emory University.

Kirk ended a multi-year project with Elanco this year, and quickly transitioned to work with Evan, Nathan and Emily on various aspects of bioenergy-related enzymology. We continue to use cell-free translation as a platform for gene discovery from many different species, bioinformatics, biochemical assays, and structural biology in our research. Emily has been using cell-free translation to provide functional fingerprints to phylogenetic trees. This is a great way to improve on the uncertainties of in silico genome annotation.

Mike Mbughuni became a Clinical Chemistry Fellow at Mayo Clinic in Rochester, MN and **Lai Bergeman** became the Administrator for NMRFAM.

You can read elsewhere in this newsletter my comments on being Chair of the Department (***page 3***). This is a great honor and challenge. I look forward to every day because of the outstanding people I get to work with from my research lab, from the department, and the entire university.

To you, the reader of these brief comments, best wishes for the future. Please let us know if you are in Madison for a visit. We would be happy to see you.

Friesen lab

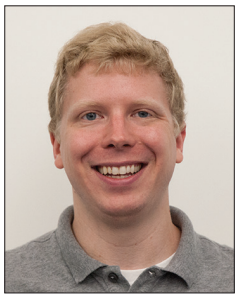
A hearty greeting from the Friesen lab. I hope that this newsletter finds everyone happy and in good health. Located on the 7th Floor of R.M. Bock Laboratories, the PDF lab is one of five research groups that comprise the Institute for Molecular Virology (IMV). Both Ann Palmenberg and myself are Biochemistry faculty members within the IMV - I currently serve as IMV Chair. Our lab continues to research the biochemistry of host-virus interactions by using insect-specific baculoviruses as our model. Our main interest is the hot topic of how the host cell's DNA damage response (DDR) is manipulated by DNA viruses to expedite viral DNA replication, a project initiated by **Jonathan Mitchell** (Ph.D., 2013) and continued by **Nate Byers** (Ph.D., 2016), both of whom were IPiB grad students in the lab. Jonathan and Nate found that a baculovirus-encoded protein has the ability to alter the DDR of mammalian cells and thus we are looking into the mechanistic details of this exciting discovery and probing other large DNA viruses for similar effects. So for the first time, we have lots of mammalian cells plus other DNA viruses in the lab. Something new happens every day! A second-year Ph.D. student **Jared Erickson** is continuing this interesting project.

Both Nate and Jonathan are the most recent lab members to graduate. Nate is a postdoctoral fellow at the Centers for Disease Control (Fort Collins, CO) and Jonathan is a new staff scientist at Imanis Life Sciences (Rochester, MN), where he works with **Rianna Vandergaast** (Ph.D., 2011) who has been an Imanis scientist for nearly two years – they both don't seem to want to get away from cold weather. I have heard much from many PDF lab alumni this past year. During the holidays, I love the cards and letters that keep me up-to-date with the families, new jobs, and travels. New positions and jobs have overflowed recently. Special congratulations to **Nadine Dalrymple** (Rutgers University Foundation), **Kim Schultz** (FDA Fellow), **Mike Guy** (Northern Kentucky University), **Dave Taggart** (MorNuCo, Inc.), **Erik Settles** (Northern Arizona University), **Becky Cerio** (Nat. Institute of Diabetes & Digestive & Kidney Diseases), and **Jen Cartier** (Unity College, Maine) on their new positions over the past couple of years. Also, congrats to **Gulam Manji**, who is now on the medical faculty at Columbia University Medical

Center. **Erica Lannan** (Prairie State College) was awarded tenure this year, too – hurrah! **Kathy Zuehlke** (Hajek) continues her award-winning science classes at Chamblee in Atlanta. Traveling from Indiana, **Doug LaCount** and **Susan Mendrysa**, along with their boys, stop by often in Madison on their way to visit family up north – both Susan and Doug are tenured faculty at Purdue. Proving that it's a small world, Tamara Rodems, daughter of **Steve Rodems**, is working on her Ph.D. here in the Cancer Biology Program (McArdle)! The Rodems family stopped to say hello when they dropped Tamara off to begin her studies. **Steve Zoog** (BioMarin Pharmaceutical Inc.) says all is well in California and still follows Badger athletics. **Steve Pullen** and his wife Sue (Steve is a research director at Boehringer Ingelheim, CT) have sent me a holiday photo card for more than 20 years in a row, thereby documenting their family history – it's one of my favorite Christmas gifts each year. Lastly, **Diccon Fiore** continues to work in virology as he runs the Kalejta Lab on the 6th floor here in the IMV.

Anna and I, plus our four Brittany spaniels, are doing well. Just this summer we finished repairs and renovations on our home on Friar Lane due to a direct hit by an F3 tornado. We were lucky as neither our family nor anybody else in the neighborhood was hurt by that June twister – nonetheless, three houses right next to us were destroyed. We were home at the time that the warning sirens sounded off at midnight and barely had time to duck for cover in the basement! To this day, the dogs hide under the bed whenever the wind picks up! Our britts continue to provide welcomed entertainment and a good reason for us to get outdoors for long runs and canoeing. I continue my hobby of skeet shooting at a local club. I shoot well enough that I have been traveling to high-end competitions here in the Midwest on the weekends. However, this summer (2017) there will be less fun and more work as I once again will serve as the local organizer for the American Society for Virology meeting to be held at Monona Terrace in late June. We expect a record-breaking attendance (>1,500) of virologists simply because Madison is such a great place to have the ASV conference (really it's all about the quality of beer served!). This year's meeting will be my third Madison meeting in a row working as the local host. Fortunately, the virology community here is very strong and we have lots of excellent help, including my co-host Kristen Bernard, a professor in Veterinary Medicine who studies West Nile virus. Some of you may remember when our lab would present more than five workshop talks at the Madison ASV meeting because we all volunteered to help with the meeting anyway!

My duties as Chair of the Institute keep me plenty busy writing, budgeting, organizing, reporting, and listening to faculty and the Vice-Chancellor. It couldn't be done without help from our Bock Labs Director, Kim Voss, who keeps the virologists and molecular biologists here in the building working together. Nonetheless, one of my favorite jobs is teaching within the Biochemistry Department – I continue to instruct upper-level undergrads in my virology course (Biochem 575) with my co-instructor Andrew Mehle, a faculty member and influenza expert in the Dept. of Medical Microbiology & Immunology. This spring semester, we have almost 70 students enrolled, mostly seniors. These students inspire me to come into the lab early to work on and update my lectures. The advantage to me is that the sunrises from my east-facing office window have been spectacular (see photo) as seen from the 7th floor. Often, I also can also view the Bock Labs' family of red-tail hawks then. These majestic aviators have nested and raised two broods on the window ledge on the 8th floor of our building – pretty cool! It looks to be another successful year as they are already building their nest for the coming season. Similarly, I wish success to all of you, too. God bless!



Hoskins lab

Greetings from the Hoskins Lab! A lot has changed since the last newsletter when I was just starting up the lab. The lab is up and running and the first graduate students are already beginning to leave the lab! We have set up very nice lab space next to the Wildonger lab (the -donger in Hodonger) and all the microscopes are up and running, collecting data, and being used by a number of scientists across campus. This relieved Aaron immensely... Our tri-lab collaboration with Dave Brow and Sam Butcher continues to be strong and rewarding, while the lab cat and dog (Louise and Agatha) keep Aaron busy.

The biggest news is that Hoskins Lab graduate students have been set loose upon the world! **Alex DeHaven** received his Masters' degree in May 2016 and has since moved on to the Center for Open Science. **Maggie Rodgers** is the first of the "tri-snRNPs" to earn her Ph.D. in December 2016 and will soon begin a postdoc with Sarah Woodson at Johns Hopkins. Maggie thinks she may be U6, but if she's the first to leave does that mean she's U4?

The other tri-snRNPs (**Tucker Carrocci** and **Josh Larson**) are busy at the moment finishing up experiments and writing papers in preparation for graduating in early 2017. Tucker has done a tremendous amount of work exploring the functions of the U2

proteins SF3b1 and Prp5 in splicing, while Josh's detailed single molecule experiments on U1 have provided new insights into how splicing factors work together to promote spliceosome assembly. Expect to hear about their further adventures in the next update. **Sarah Hansen** and **Ian Norden** are each making great strides with their graduate work. Sarah is finishing up her biophysical characterization of U1/RNA interactions while Ian recently installed a microinjection system on the departmental STORM microscope and is pioneering single molecule imaging of snRNAs in human cells.

On the undergraduate front, current lab members **David Beier**, **Arthur Clark**, **Nikolai Grabowski**, **Hannah Mast**, **Jack McCann**, and **Hannah Poe** are keeping us all busy. Former undergrad **Nate Jakowski** is now working in Florida as a pharmacist, and **Megan Waibel** is currently in pharmacy school. **Ross Laurent** will soon be Dr. Ross and is currently at UW's School of Medicine. **Brexton Turner** and **Matt Ashton** are both taking some time off before medical school, while **Leon Sun** and **George Luo** have both entered MD/Ph.D. programs at Boston University and Case Western, respectively. **Doug Zoerner** is in medical school at U. Kentucky, and both **Sean Rodgers** and **Zaw Htet** have gone on into graduate school in biophysics at UT Southwestern and Harvard, respectively. **Josh Paulson** is back in the Hoskins Lab as our lab manager (or Mr. Manager) and is pretty much essential for keeping us up and running.

Former postdocs **Sandy Tretbar** and **Jiacui Xu** have each secured positions in their home countries. Sandy is now a postdoc on a habilitation track at Martin Luther University Halle-Wittenberg while Jiacui is now in the Department of Biotechnology at Jilin University. **Xin Chen** joined the lab briefly as a postdoc after earning his Ph.D. from Dave Brow's lab. Xin worked on some Mango-RNA related projects in collaboration with **Peter Unrau** before leaving for a postdoc at Northwestern University in the Bao lab. Earlier this year, **Dr. Clarisse van der Feltz** joined the Hoskins lab from Brandeis as a postdoc and is finishing up some work on U2 snRNA dynamics that was begun by Alex before moving on to other projects.

In addition to Josh Paulson, **Dr. Chris DeCiantis** joined the Hoskins Lab as a staff scientist and is in charge of the microscopes in the post tri-snRNPs era. Chris, his wife, and two children came to Wisconsin from North Carolina, but luckily Chris is originally from upstate New York and is familiar with cold weather.

That's all for this dispatch. If you are in the neighborhood, stop by, say hello, let's catch up.

Kimble lab

The Kimble lab has seen its usual flux over the past few years.

Three IPiB students completed their Ph.D.s and moved on to postdoctoral positions: **Elena Sorokin** is now at Stanford University; **Dan Noble** is at Bristol Squibb; and **Douglas Porter**, a joint student with Prof. Wickens, is at Stanford. In addition, two MD/Ph.D. students finished the Ph.D. part of their program: **Clint Morgan** was an IPiB student, has finished his medical training and moved on to a residency in General Surgery at UW-Madison; **Aman Prasad** was in the Cellular and Molecular Pathology Graduate Program and has now returned to complete the MD portion of his MD/Ph.D. program. And finally, **Aaron Kershner**, a CMB student who finished his Ph.D. in 2011 but stayed in the lab for a few years as a Research Specialist, has now moved on to a postdoctoral position at Stanford University.

Several postdocs completed their training and moved on to faculty positions: **Dr. Kyle Friend** is now an Assistant Professor at Washington and Lee University; **Dr. Amy Groth** is an Assistant Professor at Eastern Connecticut State University; **Dr. Hannah Seidel** is an Assistant Professor at Eastern Michigan University; **Dr. Erika Sorensen-Kamakian** is an Assistant Professor at Wabash University IN.

And others have both joined and gone from the lab in this interval, including post-baccaulearate researchers **Marco Ortiz** and **Anne Ryan**, research specialist **Ipsita Mohantey** and several undergraduates **Emma Doenier**, **Drew Fenlason**, **Tyler Hansen**, **Allie Hentschell**, **Hannah Karp**, **Andy Krawczyk**, **Sarah Jayawardene** and **Cecilia Lei**.

Despite this efflux, the lab is still a lively place. Some are still with us, including postdoc **Scott Aoki**; IPiB students **Heaji Shin** and **Kim Haupt** and our amazing permanent staff **Sarah Crittenden**, **Jadwiga Forster**, **Anne Helsley-Marchbanks** and **Peggy Kroll Connor**. And others have joined, including three IPiB students **Brandon Taylor**, **Tina Lynch** and **Brian Carrick**, a joint student with Professor Wickens; two Genetics students **Sarah Robinson** and **Alex Murphy**; and a postdoctoral fellow **ChangHwan Lee**. Undergraduates currently in the lab include **Sindhu Battula**, **Jon Doenier**, **Tim Guthrie** and **Kim Law**.

Please stop by to say hello and get caught up if you are in the neighborhood!!

Markley lab

Greetings from the Markley laboratory. Many changes have transpired since the last Newsletter message. We survived the cliffhanger competitive grant renewals for both the National Magnetic Resonance Facility at Madison (NMRFAM) and BioMagResBank (BMRB). And over the past year, we have been winding down two large projects with John as the PI and **John Primm** as Project Manager: the *Mitochondrial Proteome Project* (part of the NIH Protein Structure Initiative), which partnered our group and that of **Dave Pagliarini** with the large protein structural genomics facility led by Guy Montelione at Rutgers, and the *Accelerated Renewable Energy Project* (funded by USDA Biomass Research and Development Initiative), which has involved UW groups from Ag & Applied Economics, Computer Science, Biological Systems Engineering, Space Science & Engineering, UW-Extension, along with two Wisconsin companies and a dairy farm in northern Wisconsin. The goal of the first project was to determine structures of mitochondrial proteins and discover their functions. The second project is aimed at sustainable solutions to dairy manure management and optimal use of its agricultural nutritive components. Our investigations of the bits of biochemical machinery and their mechanisms in the steps leading to the biosynthesis of iron-sulfur proteins in mitochondria continue to yield surprising results from the efforts of **Kai Cai**, **Ronnie Frederick**, and **Marco Tonelli**. We have submitted an NIH R01 application that we hope will enable us to ramp this project back up next summer.

Goings and comings.

Rita Hannah, our wonderful Project Assistant for many years, retired at the end of 2015. We were fortunate in recruiting **Lai Bergeman** as Rita's replacement; Lai worked with John in the Center for Eukaryotic Structural Genomics and more recently was with the Great Lakes Bioenergy Research Center. Another retiree was **Eldon Ulrich**. John and Eldon first published together in 1975 when Eldon was a graduate student at Purdue. They collaborated together continuously thereafter, except for the few years when Eldon worked in industry. Eldon with John was co-founder of BMRB, and Eldon served as BMRB's director for many years until his retirement. **Pedro Romero** has ably taken over as BMRB director, but, fortunately, Eldon still comes around as an invaluable asset to the project. Three postdocs have moved on to new pursuits: **Jameson Bothe** to Merck, **Jaime Stark** to law school and patent law, and **Vincent Chen** back to Duke University. **Reid Alderson**, who was a very productive undergrad, received a fellowship for a year at Oxford University followed by graduate studies with Ad Bax at the NIH. A new postdoc, **Fariba Fathi**, joined the lab bringing experience in metabolomics. **Paulo Cobra**, who spent a year in the lab on a graduate student fellowship from the Brazilian government, has returned as a postdoc. **Hesam Dashti**, who completed his Ph.D. in the Biophysics Program, is staying on as a very creative postdoc. Finally, **Hamid Eghbania** is back as an Associate Scientist in charge of software development.

NMRFAM

We are delighted with the successful recruitment of Associate Prof. **Katie Henzler-Wildman** to the Biochemistry Department as a co-investigator of NMRFAM along with co-PIs **Sam Butcher** and John. Katie is helping us transition NMRFAM into the areas of membrane proteins and solid-state NMR. Her start-up funds enabled the upgrades of a Varian 600 and the Varian 900 MHz spectrometer to Bruker consoles and probes offering new capabilities, including higher sensitivity solution NMR (including ^{19}F) and state-of-the-art solid-state NMR. The wide-bore 400 MHz NMR spectrometer, the first one John purchased upon moving to UW-Madison, reached the end of its operational lifetime and was ceremoniously decommissioned. We have secured funding for a helium recovery, purification, and liquefaction system for NMRFAM that is being ordered and will be installed in 2017. This system will conserve this non-renewable resource and lower NMRFAM's operating expenses considerably. Many familiar faces are still at NMRFAM pursuing their special skills and planning publications: **Milo Westler** on spin ideographs, **Gabriel Cornilescu** on oriented molecules large and small for structure determinations from RDC measurements, **Dave Aceti** on ligand screening, **Marco Tonelli** on virtuoso NMR applications to collaborative projects, **Maria Nesterova** on expanding the NMRFAM-BMRB small molecule database, **Woonghee Lee** on NMR software development, and **Ronnie Frederick** on protein production and labeling par excellence. **Mark Anderson** keeps NMRFAM instrumentation going and **Dmitri Maziuk** straddles NMRFAM and BMRB, keeping our computer systems operational. **Zsolt Zolnai** is the PI on an NIH grant that funds his Sesame LIMS project; he continues to work from his apartment in Brooklyn, NY.

BMRB

Pedro Romero's staff at BMRB includes an able new addition, Assistant Scientist **Kumaran Baskaran**, senior programmer **Honggao Yan**, and **Jon Wedell**, who started with BMRB as an undergraduate, continued working for BMRB part-time while traveling the world, and is back full-time. BMRB, which, along with RCSB PDB, PDBe, and PDBj, is a branch of the Worldwide Protein Data Bank (wwPDB), hosted the annual meeting of the Advisory Committee of the wwPDB in Madison, on October 12, 2016. This meeting brought together structural biologists from the US, UK, Japan, India, and New Zealand.

NMRbox

Staff members of BMRB and NMRFAM (**Hamid Eghbalnia**, **Hesam Dashti**, **Jon Wedell**) are involved with this new NIH-funded project, whose PI is Jeff Hoch from UConn. The goals of NMRbox are to make software packages used in NMR spectroscopy more available, more interoperable, and more persistent.

News from former lab members

Jin Hae Kim, following a postdoc in Germany, has moved to a position at Samsung Labs in Korea.

Ntambi lab

Greetings from the Ntambi lab. Since our last letter, we have said goodbye to several great lab members. Three graduate students and two undergraduates are still carrying on the Ntambi lab tradition and delving further into the regulation and physiological functions of fatty acid desaturation.

Maggie Burhans defended in December 2013. Her research elucidated the differential metabolic effects of the hepatic monounsaturated fatty acids, oleate and palmitoleate. She is now a postdoctoral fellow at Fred Hutchinson Cancer Research Center in Seattle, WA. In her position in Mario Kratz' research group, she studies adipose tissue inflammation in humans. Maggie's undergraduate students have also left the lab and are both pursuing careers in healthcare. **Nick Friedlander** is a first year pharmacy student at UW–Madison, and **Kristin Harrington** is a first-year MD/Ph.D. student at Emory University.

Lucas O'Neill graduated with a master's degree in May 2015, wrapping up his work on the role of stearoyl-CoA desaturase-2 in adipose tissue biology. He is now teaching chemistry and biology at Polytechnic High School in Fort Worth, TX. His mentorship extends beyond the classroom, as he is also coaching the high school baseball team.

Visiting graduate student **Fang Ding** joined our lab for a year and characterized primary adipocyte cell lines derived from SCD mouse models. She is now a research assistant at the Suzhou Institute of Systems Medicine in Suzhou, China.

Postdoctoral fellow **Chang-An Guo** joined our group in 2013 and worked with visiting scientist **Linjie Wang** and undergraduate **Eva Shelton** to determine the different roles of SCD1 and SCD2 in adipocyte differentiation. Chang is now a Scientist at Omniox in San Carlos, CA. Linjie has returned to his home institution, Sichuan Agricultural University, in Chengdu, Sichuan, China, where he is a professor of animal genetics and breeding.

Sabrina Dumas is a fifth year nutritional sciences graduate student studying the mysterious skin-specific SCD1 knockout mice. Sabrina is interested in how bile acid metabolism and immune cell infiltration help protect the skin-SCD1-/- mice from weight gain on an obesogenic diet. Sabrina worked with undergraduate student **Robbie Boehmer**, who graduated in December 2015. Robbie is now working as a live-in aide in Madison, and plans to complete an accelerated master's program in nursing in the fall of 2017.

Ahmed Aljohani is a fifth year graduate student in endocrinology and reproductive physiology. Ahmed's research focuses on the effects of hepatic SCD1 deficiency on systemic glucose metabolism. Last year, Ahmed was joined by Biochemistry undergraduate student, **Abe Bonneville**.

Laura Bond is a sixth year biochemistry graduate student. She is investigating how heat production in brown adipose tissue regulates fatty acid metabolism in liver and white adipose tissue. Laura also worked with undergraduate **Alina Zdechlik** to determine that brain-specific deletion of SCD1 influences lipid homeostasis in the liver. Alina graduated in May 2016 and is now a first year biochemistry graduate student at the University of Minnesota.

Dr. Ntambi is still actively involved in the Uganda Program and the Village Health Project. Through these programs, UW students work alongside community members to support sustainable nutrition and agricultural programs in Lweza, Uganda. He was awarded the Wisconsin Without Borders Peter Bosscher Award for his commitment to the Village Health Project.

Please stop by our lab in the 4th floor of Biochemistry Laboratories to say hello.

Pagliarini lab

Hello again from the Pagliarini Lab, which is now located in the Morgridge Institute for Research just down the street from the DeLuca Biochemistry Complex. We have had a busy and productive few years building upon Madison's rich history in metabolic biochemistry and mitochondrial biology. In particular, our group has continued to focus on three general areas:

1. Defining functions for orphan mitochondrial proteins. Mitochondria are tiny metabolic "machines" inside our cells responsible for converting the food we eat into a common energy currency for use throughout our bodies. When mitochondria fail to function properly, some ~250 diseases can result. A major bottleneck in understanding – and ultimately in treating – these diseases is defining functions for the hundreds of mitochondrial "parts" (proteins) that malfunction in each disease. Recently, we have published articles that make use of leading edge technologies to systematically define these functions. **Brendan Floyd** and **Mike Veling**, along with collaborators from Josh Coon's group, led a *Molecular Cell* study that identified functions for proteins by identifying other proteins that they interact with physically. **Jon Stefely**, also in collaboration with the Coon group, led a *Nature Biotechnology* study that likewise defined protein functions by virtue of the metabolic signatures that result when they are genetically ablated.

2. Establishing how Coenzyme Q is made. Coenzyme Q (CoQ) is an essential component of mitochondria's main engine—oxidative phosphorylation. CoQ was discovered right here in Madison in the late 1950s in the laboratory of David Green; however, many steps of its biosynthesis remain unclear. **Danielle Lohman**, **Andrew Reidenbach**, and **Jon Stefely** led recent papers published in *PNAS* and *Molecular Cell (x2)* that highlight new functions of proteins in the CoQ biosynthesis pathway, thereby building on this UW-Madison legacy.

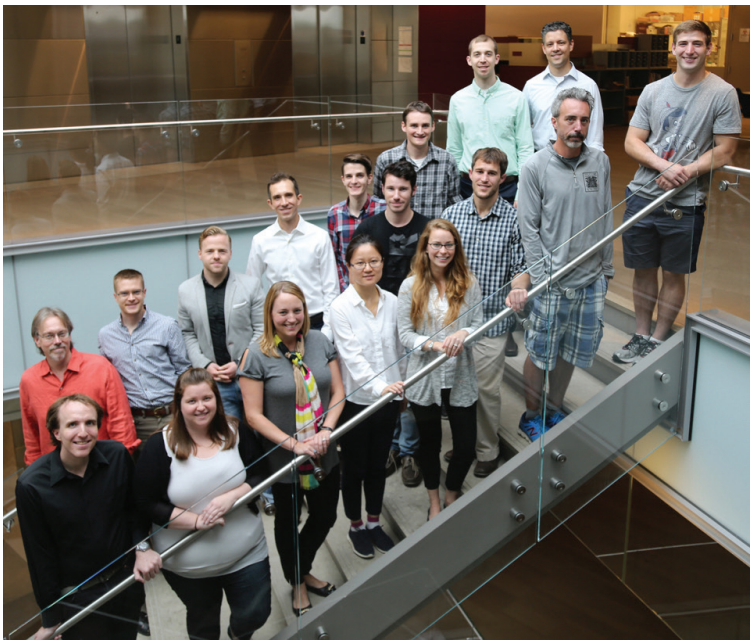
3. Determining how mitochondria are made and regulated. Most mitochondrial diseases are extremely difficult to treat because there is no effective way to repair the disrupted processes. Our group is

exploring new therapeutic angles by defining the pathways and processes that regulate mitochondrial function and biogenesis. **Jarred Rensvold**, in collaboration with John Denu's group, led a study on the transcriptional and epigenetic regulation of mitochondrial production published in *JBC*. **Xiao Guo** and **Natalie Niemi** led a *Cell Reports* study that identified new functions of a phosphatase that regulated mitochondrial metabolism by dephosphorylation select proteins in the matrix.

We are fortunate that our work has been recognized by a number of honors and awards. These include three new Hilldale awardees (**Isabel Johnson**, **Matt Stefely**, and **Mike Drahnak**), two new NSF graduate fellowships (for **Danielle Lohman** and **Mike Veling**), and three UW Distinguished Graduate Fellowships (for **Jarred Rensvold**, **Andrew Reidenbach**, and **Brendan Floyd**), among others. I (**Dave**) was fortunate to be recognized by a UW-Madison Vilas Associates Award, a CALS Pound Research award, and a Presidential Early Career Award for Scientists and Engineers (PECASE), which included a visit to the White House to meet President Obama! Finally, in a notable non-science competition, graduate student **Zack "Science Ninja" Kemmerer** led a three-person UW-Madison team that won the inaugural Team Ninja Warrior: College Madness tournament, beating out Georgia, UCLA, and MIT in the finals!

Coming and Goings: The lab has changed quite a bit in the past few years, with many people coming and going. Five graduate students successfully defended their Ph.D. theses: **Amelia Nestler** (**nee Still**) moved to Oregon to become a Consulting Project Manager at Northwest Green Chemistry; **Josh Carson** is now a Licensing Associate at WARF; **Jarred Rensvold** remained with the laboratory as an Assistant Scientist, and **Brendan Floyd** & **Jon Stefely** are continuing the MD portions of their MD/Ph.D. program. On the other side, no fewer than **12** new postdocs (**Mateusz Manicki**), graduate students (**Mike Veling**, **Zack Kemmerer**, **Kyle Robinson**, **Nate Murray**, **Edrees Rashan**, and **Jon Schmitz**), staff (**Rahul Gupta**), and undergraduates (**Jessica Bowden**, **Mike Drahnak**, **Katie Jeddeloh**, **Jacob Sokol**, and **Lainy von Bank**) have joined the laboratory since the last newsletter! I look forward to featuring their awards and accomplishments next time around. Finally, in September of 2015, our entire group recently moved to the Morgridge Institute for Research where I also direct the new Morgridge Metabolism Theme.

We hope to continue reporting exciting new stories from each of our research themes in the next Newsletters. In the meantime, check out our lab website (***www.pagliarinilab.org***) for the latest news and publications!



Palmenberg lab

Palmenberg is chugging on! Last year, having accomplished most of what was ever worth doing with this virus, we put to bed the final EMCV projects after **Holly Basta**, **Valjean Bacot-Davis**, **Ryan Perry** and **Jessica Ciomperlik** finished their theses. **Ann**, **Marchel Hill** and **Kelly Watters** are now working full-time on rhinovirus C, (collaborating with Jim Gern and Yury Bochkov) comparing and contrasting these isolates with the deep knowledgebase from the rhinovirus A&B. It took us two years to learn to grow RV-C in the lab, but last fall, Marchel delivered the first small batch to Michael Rossmann at Purdue, and his structure wizards achieved 10 Å resolution by cryoEM tomography, in just 36 hrs! The full structure was published this spring (2.8 Å), and it's eye-popping in its beauty and unique new features. There is so much new biology in this arena that we are sure to be working here for a while. Ann's health is currently OK (been in remission for 5 years, yeah!) so it's likely the lab will continue for perhaps the next 4-5 years before wrapping it all up. This past fall, Ann's autobiography was (solicited) and published in the Annual Reviews of Virology. The article has a lot of history from the early years, science stories and name dropping. Those of you from the olden days (especially Biochemies) might find it amusing to learn how much the graduate program and the Department have changed... all for the better! Marchel and Kelly are fine, and send warm wishes to our alumni around the world, as does **Roland Rueckert** who still stops in occasionally when he isn't tending his forests in Rhinelander. The ASV meeting will return to Madison in June of 2017, and it would be a great opportunity for an informal reunion.

Please keep in touch.

Pike lab

Members of the Pike Lab have been active during the past few years. Given our interest in gene regulation, which is an integral component of our efforts to understand the molecular actions of the vitamin D hormone, the emergence of new genome-wide techniques to study this process that is central to cellular function has been nothing short of revolutionary. In brief, we adopted the techniques of ChIP-seq analysis in cell culture, and subsequently in tissues derived from mice and other organisms to explore the genome-wide principles of vitamin D action both in vitro and in vivo. These techniques have allowed us to confirm previous findings, redefine the nature of emerging principles and to discover new features essential to the regulation of gene expression by the vitamin D hormone. Perhaps the most interesting of these findings is the observation that the bulk of the regulatory regions of genes for not only vitamin D action but of other transcription factor mediated actions are located within introns and within intergenic regions frequently many kilobases from gene promoters. The implications of this discovery are many. Another observation is the dynamic nature of the regulatory sites that mediate the activity of genes. These regions are highlighted epigenetically, and their presence or absence is controlled during development, differentiation, and disease. Thus, target genes for vitamin D and the vitamin D receptor (VDR) are not only cell-type specific but cell-state specific as well. These findings have revealed that genes represent a dynamic and temporally dependent moving target for regulation by hormones that include $1,25(OH)_2D_3$.

Embedded within the genome-wide data sets, however, have been multiple genes that have been of primary interest to us for many years. Importantly, with the advent of the above techniques we have been able to explore many of these genes including those involved in the vitamin D system such as the *VDR* and more recently the vitamin D metabolic genes *Cyp27b1* and *Cyp24a1*. In addition, we have also explored the regulation of the genes for *RANKL, Mmp13, Opg,* as well as the gene for fibroblast growth factor 23 (*Fgf23*). It has been surprising to discover how increasingly complex the regulation of these genes has turned out to be. An extremely important facet of our work has been the application of CRISPR/Cas9 gene editing methods to the study of not only gene regulation in cells but of genomic sites in the mouse in vivo. This technique has rapidly decreased the time required to delete an enhancer in the mouse genome and as such has enabled the direct study of regulatory function of specific genes in vivo. This approach has revealed details of gene regulation that are unique to specific genes such as the *Vdr, Rankl,* and others, and has provided new insight into the tissue-specific regulation of genes not available in vitro. Perhaps the most profound outcome of the application of techniques described above is that the molecular mechanisms of gene regulation can now be explored entirely in vivo at a level of detail that was once limited only to that in cell culture. We look forward to further technological advancements that will not only provide new insights, but further illuminate our understanding of vitamin D action.

Key Individuals in the Pike Lab

Mark B. Meyer, Ph.D. Mark Meyer is an Associate Scientist in the laboratory, and represents a central player in not only the laboratory infrastructure, but in the conductance of scientific projects of strong relevance to our overall research objectives. Dr. Meyer has formed the basis for our genome-wide efforts using ChIP-seq analysis and was instrumental in the application of CRISPR/Cas9 methods to our overall research. His past efforts have focused on the impact of bone cell differentiation on the cistromes for the master bone cell regulators RUNX2 and C/EBPβ and on the molecular consequence of this cellular process on gene regulation by vitamin D. Mark has also focused on the regulation of *Mmp13*, a gene that is regulated by multiple hormones including the vitamin D hormone. Using ChIP-seq, CRISPR/Cas9 and other techniques in cells in culture, he has uncovered unique mechanisms through which this gene is regulated by these hormones. Indeed, deletion of one of these regulatory regions in the mouse at the University Biotechnology Center using our CRISPR/Cas9 methods and target RNAs fully recapitulated in vivo the activities governing this gene's regulation in vitro. His current research efforts are directed towards understanding the mechanisms that govern the regulation of key renal genes involved in the metabolism of vitamin D. Significantly, Mark has also been invited to speak at several key scientific meeting in both the bone and vitamin D fields.

Nancy A. Benkusky. Nancy is an Assistant Researcher, and has provided key technical support for Dr. Meyer as well as for all other members of the Pike Lab. Nancy has provided the technical skills that have been crucial for the creation of virtually all of our ChIP methods as well as for the preparation of all ChIP-seq libraries that continue to be sequenced at the Biotechnology Center. Nancy is also fully versed in the isolation and qPCR analysis of RNAs from mouse tissues, and it is safe to say that she as well as others have performed literally thousands of analyses of gene expression by these methods. Nancy has collaborated most recently with Mark Meyer in our efforts to understand the mechanisms through which the renal genes responsible for producing and then degrading the vitamin D hormone are regulated in vivo. Surprisingly, despite key efforts in the 1970's, the mechanisms through which these regulatory events occur have remained unknown until now.

Seong Min Lee, Ph.D. Seong Min Lee is an Assistant Scientist in the laboratory, and has focused his work of several years on understanding the regulation of the VDR gene. This work makes use of both the genome-wide techniques we have employed as well as those involving genome editing. Using these techniques, Seong Min has been able to define key regulatory elements within the VDR gene that mediates its regulation by hormones such as PTH and its autoregulation by $1,25(OH)_2D_3$. Identification of these regulatory regions emerged only as a result of the application of ChIP-seq analysis. Having identified the transcriptional and regulatory domains of the mouse VDR gene, Seong Min has been able to rescue the biological phenotype of the *Vdr*-null mouse with large DNA segments containing either the mouse or human VDR genes, thus humanizing the mouse. In so doing, he has been able to explore mutant forms of the human VDR and to create a

mouse model of the human syndrome of hereditary vitamin D resistant rickets. Seong Min has been also involved in developing in vivo ChIP analysis of mouse tissues including those from the intestine and kidney to explore mechanisms linked to the tissue-specific expression of genes; these analyses have been extended to the application of in vivo ChIP-seq analysis. Current efforts are focused on understanding of the regulation of specific genes in unique vitamin D target tissues such as the parathyroid gland. Seong Min received a Trainee Travel Award for the 18th Workshop on Vitamin D held in 2015 in the city of Delft in Belgium.

Melda Onal, Ph.D. Melda is currently a Research Associate in the Pike Lab. She has focused on understanding the regulation of the RANKL gene in the in vivo setting of the mouse. RANKL is a highly complex gene whose product serves multiple biological roles and its regulation is equally complex as well. Melda created a series of mouse strains that contain individual deletions of each of the key enhancers that were identified by ChIP-seq and other methods, and has focused over the last few years in characterizing the regulatory and biological consequence of these deletions on the mouse phenotype. The effects of these deletions confirmed virtually all of the observations that we had made through in vitro studies, but extended our understanding of RANKL gene regulation at the tissue level enormously. In short, these studies have revealed developmental, age-related, cell-type specific and hormone-specific features of the individual enhancers that govern RANKL expression in vivo. These results could only be obtained through in vivo studies. Melda is currently focused on understanding the regulation of the new phosphaturic hormone FGF23, whose physiological and pathophysiological actions may well eclipse those of the parathyroid hormone.

Mitchell Ritzinger is currently an undergraduate Biochemistry student in the laboratory who plans to conduct Honor Student Thesis studies in 2017.

Former Members of the Pike Laboratory

Since the last newsletter, several members of the laboratory have completed their studies and moved to new positions to advance their careers. **Hillary St. John** completed her studies on the impact of osteoblast differentiation to the terminally differentiated osteocyte, earning her Ph.D. in 2015, and has taken a research position at the Cystic Fibrosis Foundation in Boston, MA. She is using her CRISPR/Cas9 skills to explore the role of mutations in the syndrome of Cystic fibrosis. **Sohel Shamsuzzaman, B.S., M.S.**, received his Ph.D. in 2016 from the Department of Biochemistry and has returned to a faculty position in the Biochemistry Department at the University of Bangladesh in Dhaka, Bangladesh. Sohel explored the role of vitamin D in a mouse model of atherosclerosis and discovered a new role of RANKL in the calcification of this diseased tissue. **Alex Carlson** received his Ph.D. in 2016 from the Program in Molecular and Cellular Pharmacology here on campus. Alex evaluated the mechanisms through which the gene *Cyp24a1* was regulated by the vitamin D hormone in vitro and in vivo. Alex also discovered a novel enhancer that controls the expression of *Fgf23*. He is currently employed at Epic here in Madison. Finally, **Erin Riley** has moved to a technical position at Northwestern University in Chicago where she is current employed as a Research Assistant to further her skills as an animal researcher.

Several Biochemistry undergraduate students have competed their degrees and have moved on. **Tori Osinski** was accepted in the Department of Biochemistry at the University of Virginia in 2015 in pursuit of her Ph.D. **Allison Danielson** was accepted into the College of Osteopathy in Minneapolis, MN in 2015. She obtained several co-authorships with Melda Onal on papers that were published during her stay. **Jon Markert** was an honors student in the Pike lab and was accepted into the Department of Biochemistry at the University of Colorado at Boulder in the fall of 2016 in pursuit of his Ph.D. He will also be a coauthor on several papers with Melda Onal and Mark Meyer for his contributions to their work.

Summary

As a laboratory leader, I consider it a privilege to have worked or to continue to work with the talented individuals named above, who have made this laboratory a powerhouse for quality vitamin D research. As a complete "data junkie," their collegiality with each other and with me and their hard work and efforts have made it a joy for me to come to work every single day. The University of Wisconsin-Madison and the Department of Biochemistry here in Madison are to be commended for the quality institutions that they represent.

In a May 2016 ceremony at the Kohl Center, **Jim Vasta**, **Trish Hoang**, **Robert Newberry**, and **Kristen Andersen** of the **Raines lab** received their Ph.D. degrees alongside **Bill Rutter**, who received an honorary doctor of science degree (see story on page 21). Bill was a postdoctorate with Henry Lardy at the Institute for Enzyme Research. In turn, Ron was a postdoctorate with Bill and now serves as the Henry Lardy Professor of Biochemistry.

Ralph lab

Research

The last few years have been pretty exciting (and maybe just a little out of control) in the Ralph lab, where students, postdocs, and researchers are involved in a range of often collaborative studies on plant cell wall biochemistry. Although work devoted to developing new methods, discovering genes and elucidating pathways, and just plain old good science, gets sidelined by such an exercise, we suspect that among the most exciting and impactful are the following, in no particular order...

- ***Zip-lignins.*** We finally succeeded in implementing, with collaborators at MSU and UBC, in Arabidopsis and Poplar, and published in ***Science***, an idea from the group (originally at the U.S. Dairy Forage Research Center) to use an exotic gene, *FMT*, to engineer the biosynthesis of monolignol ferulate conjugates xylem-specifically into the plant. This ultimately results in inserting readily cleavable ester bonds into the backbone of the lignin polymer ('Zip-lignins'), making lignin's removal in processing for pulp and paper or for saccharification to sugars and liquid fuels, considerably more facile and less energy demanding. With sensitive new methods developed to unambiguously determine that monolignol ferulates had been used in lignification, we then discovered, and published in ***Science Advances***, that Nature was already doing this in some natural plants! Engineering a related *PMT* gene from grasses into dicots also improved their processability (as published in ***Plant Physiology*** and the ***Plant Journal)***.
- ***Gene discovery.*** Discovered and authenticated new genes in a pathway that was already thought to be fully understood. With collaborators in Belgium, we reported in ***Science*** on the new lignin monomer pathway gene *CSE* (which was also featured on the cover of that issue), and followed it up with collaborations with the University of North Texas (UNT) and a ***Plant Journal*** article showing its essential role in *Medicago truncatula* – in some plant species, it appears to be less crucial.
- ***Lignins from novel hydroxycinnamyl alcohols.*** Discovered, with collaborators again from UNT, lignins entirely derived from non-canonical new monomers caffeyl alcohol or 5-hydroxyconiferyl alcohol. Both result in almost homogeneous linear unbranched polymers in the usually 'messy' combinatorial radical coupling process – papers in the ***Plant Journal*** and ***Plant Cell***.
- ***Novelhydroxycinnamaldehydes-derived lignins.*** Discovered, with collaborators at Purdue U., ways to make lignins entirely from hydroxycinnamaldehydes (instead of the monolignols – hydroxycinnamyl alcohols), published in ***Plant Cell***. This followed the discovery, with collaborators at UNT, of a healthy Medicago *CAD* mutant that had a lignin 95%-derived from hydroxycinnamaldehydes!
- ***New lignin monomers.*** Discovered, with collaborators in Spain, that various plants utilize the flavone tricin in their lignification – a series of 4 papers in ***Plant Physiology*** and the ***Plant Journal***. Tricin is the first phenolic from outside the lignin pathway to be shown to be incorporated into the polymer; we are on the trail of more – stay tuned!
- ***Rescuing dwarfing.*** Discovered, in a study led by collaborators at Purdue and published in ***Nature***, a new way, disruption of certain 'mediator' genes, to recover the growth and viability of transgenic plants containing lignin derived solely from the usually minor *p*-coumaryl alcohol.
- ***High-yield conversion of lignin to monomers.*** Developed, with collaborators in Switzerland and published in ***Science***, a way to stabilize lignin structures during acid hydrolysis such that near-theoretical yields of lignin monomers were obtained upon hydrogenolysis; a record 78% monomer yield was obtained from special transgenic poplars.
- ***New antifungal.*** Discovered and published in ***PNAS*** a rather potent new natural antifungal compound derived from grass cell wall components that is now undergoing scaled-up agricultural testing due to its novel mechanism of action.
- ***Visualizing lignification in plants.*** Developed both fluorescent and click-based monolignol derivatives for providing insight into lignification in plants (and stunning pictures).
- ***New paradigm.*** Ushered in a new era of 'designer lignins' with a review on the topic in ***Current Opinion in Biotechnology.***

Yes, all these and more were in just the last 3 years! We have also been lucky enough to have 5 of our articles featured as cover articles – see the graphic.

Departures

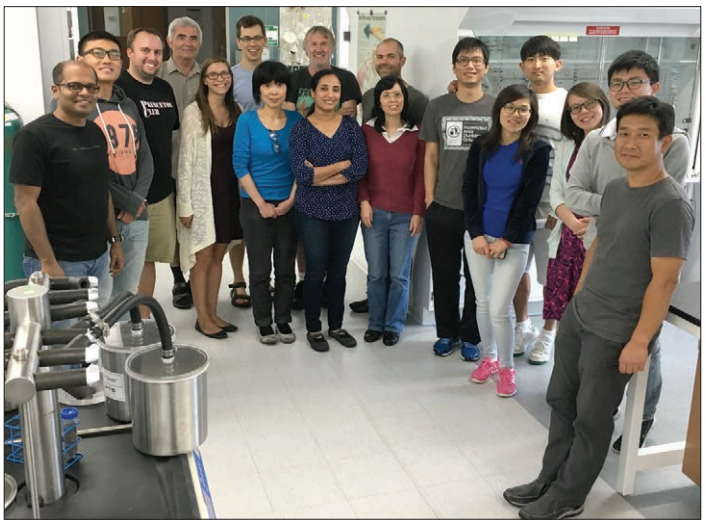
Fachuang Lu, who has been in the group for nearly a quarter of a century (!!) now has a Director's position at Guangzhou University, in China. We miss him, but he continues to collaborate and visits twice a year to work in the lab and keep his hand in with synthesis and method development. **Liping Wei** (known to us as **Lily Summer**) completed her MSc. **Wu Lan** and **Kate Helmich** graduated with their Ph.D. degrees and moved on to bigger and better things. Postdocs/scientists: **Alden Volker** got a nice job after not being with us for so long, **Ali Azarpira** moved to a position in California, **Yuki Tobimatsu** is now a Professor at Kyoto University, Japan where his career is rocketing off, and **Jorge Rencoret** is back at INRAS in Seville, Spain – we sure miss these wonderful researchers/colleagues/friends.

Arrivals

We've been fortunate to have been joined by scientists **Steve Karlen** and **Yukiko Tsuji**, postdocs **Rebecca Smith**, **Fengxia Yue**, and **Justin Mobley** (and, briefly, **Li Shuai**), and Ph.D. student **Yanding Li**, and **Matt Regner** is back with us. A host of wonderful undergrads help liven up the lab – **Eric**, **Allison**, **Joshua**, **Justin**, **Minty**, **RJ**, **Evan**, and **Stephanie**. We've also been honored to host Fulbright Fellow **Mathish Nambiar-Veetil** from India, and Professor **Xueming Zhang** (China). Visiting Ph.D. students included **Jinze Dou** (Finland), **Fabio Carvajal** and **Paulo Castro** (Chile), **Brett Diehl** (Penn. State), **Anders Jensen** (Denmark), **Yang Lin** (UCSB), **Rebecca Smith** (UBC), and **Heather Free** (NZ).

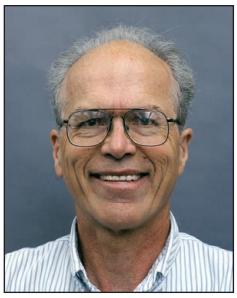
Social news

There have been babies galore to members of the group – we were starting to worry about the water in the building's bubblers! No, seriously, it is so great when such wonderful people have kids.



Most of the Sept 2016 group in our lab at the Wisconsin Energy Institute.

Journal cover articles from 2013-2016 (below).



Record lab

Tom and the group are thriving in wonderful space in the almost-new Biochemical Sciences Building, and research is going well. We hope that all of you reading this are thriving also, and hope to hear from you.

Graduate Students and Postdoctoral Researchers

Since 2012, five graduate students from our lab have earned Ph.D. degrees. **D. Benjamin Knowles** (IPiB) is a postdoc at University of Texas Southwestern Medical Center. **Emily Guinn** (Chem) is a NIH postdoctoral fellow at the California Institute for Quantitative Biosciences, University of California-Berkeley. **Emily Ruff** (Chem) is a postdoc at the University of Minnesota-Twin Cities. **Raashi Sreenivasan** (Biophys) is a postdoc in the Department of Physiology and Pharmacology at the Oregon Health & Science University. **Rituparna Sengupta** (Biophys) completed her Ph.D. followed by a short postdoc here, and is currently with her husband in Saint Paul, MN, exploring non-academic research opportunities.

Dr. Kate Henderson joined our lab in 2015 after obtaining a Ph.D. in bio-inorganic chemistry from Mississippi State University. She was recently awarded a Ruth Kirschstein National Research Service Award (NIH postdoctoral fellowship) for her research in transcription initiation.

Current graduate students are **Xian Cheng** (Biophys), **Munish Chhabra** (Biophys) and **Kevin Lauterjung** (Biophys). Xian, in her fourth year and with a thesis to write, is working on the thermodynamic analysis of small solute interactions with biopolymer functional groups in water. Her initial first-author paper was recently published in ***Biophysical Journal***, and more are on the way. Munish, in his third year, is studying initial interaction between *E. coli* RNAP and promoter DNA fragment in the transcription initiation process using fluorescent techniques. Both are successfully mentoring many undergraduates in their research. Kevin recently joined our laboratory to do research on transcription initiation in vitro and in vivo, including a collaborative project with the Raman laboratory.

Our lab hosted two CAPES Postdoctoral Fellows from Brazil. **Rogério C. Sassonia** from Universidade Federal de Tocantins, Palmas, visited in 2012-13 to study Hofmeister salt effects on DNA helix formation. **André Luiz Galo** from São Paulo State University, São Paulo, visited in 2015-16 to study effects of sugars on DNA stability by isothermal titration calorimetry.

Undergraduates

One of the major goals of our lab is the training of undergrads to become the next generation of scientists. In any given semester we have about 15 to 20 undergrads doing research with us. Congratulations to all of our graduating seniors going on to

graduate school, medical school, or starting careers!

In 2015 we hosted undergrad ***Khorana Scholar*** **Priya Chittur** from Anna University in India, now in grad school at Cal Tech. This summer (2017) ***Khorana Scholar*** **Rahul Vivek** from Bharathidasan University will visit our laboratory.

Three laboratory undergraduates were honored by their selection for overseas internships in 2016. Through the ***S.N. Bose*** program, **Cristen Molzahn** did a semester of research on prion proteins in Bangalore, India. **Kai Cimperman** did summer research at Oxford University in England through the UW ***SCORE Program***, and **Runyu Hong** did summer research at EMBL in Heidelburg, Germany through the UW ***Super-G Program***. Kai and Runyu both received Hilldale Research Fellowships for this academic year for their senior thesis research, **Lulu Callies** and **Yao Yao** received Chemistry awards for summer research, and **Joe Kraft** was awarded a Biochemistry scholarship for summer research. High school student **Austin Frings** (*Tom's grandson*) joined us over the summer to do research.

Research Scientists, Associates, Specialists and Interns

Mike Capp, long-time researcher and laboratory manager, retired in 2015. Mike's many very significant contributions included his development and application of methods to quantify solute-solute interactions in water, and dissect these interactions into free energy contributions from individual functional groups. He is greatly missed!

Irina Shkel's exceptional skills in computational analysis continue to be invaluable for our research team, and she has co-authored several of the dozen papers our lab has published since 2012. After completing her undergrad degree in 2014, **Mikaela Poulos** became a research intern and lab manager, in addition to performing RNAP research. After a year with us, Mikaela moved to New York to begin her career at Electro Fiber Technologies. Completing her undergrad degree in 2015, **Emily Zytkiewicz** then became lab manager as well as continuing her solutes research. Previous undergraduate researcher and intern **Si (Cece) Wang** is now a medical student at Northwestern.

Three recent graduates who did undergraduate research in our laboratory stayed on for a gap year in 2016-17 as research interns while applying to graduate programs. **Cristen Molzahn** and **Lindsey Felth** are working with Kate Henderson to determine how the stability of the RNA polymerase-promoter DNA complex affects transcription initiation. **Sherry Cheng** is leading the effort to characterize solute-solute interactions by solubility assays. All three interns are gaining valuable teaching experience mentoring undergraduates and serving as teaching assistants for Tom's biophysical chemistry course.

Meetings and Travel

Kate, Munish, Raashi, and Xian presented posters at the 2015 and 2016 annual Biophysical Society Conference in Los Angeles. Cristen, Lindsey, Munish, and Kate presented posters at the Phage Meeting here at UW-Madison. Kate and Munish presented posters, and Xian gave a talk in the 2016 Gibbs Conference in Illinois. Ritu presented a poster and gave short talks on her research at both the FASEB Protein Folding in the Cell Conference in Vermont (2016) and Proteins Gordon Research Conference in New Hampshire (2015). Ritu and Xian presented posters at the Gibbs Conference on Biothermodynamics in Illinois (2015). Ritu also presented a poster at the Annual Biophysical Society Conference in San Francisco (2014). Undergraduate Lindsey Felth participated in the international ASBMB conference as part of the group led by Mike Cox, and received an Honorable Mention award in the Undergraduate Poster Competition in DNA, RNA, chromosomes and gene regulation.

Grants and Equipment

The lab is supported by a recently-acquired NIH MIRA award, consolidating our previous separate grants. We've recently acquired a new Rapid Quench Flow apparatus (Kin-Tek) for fast kinetic studies of transcription initiation and a freezing point depression osmometer to complement the vapor pressure osmometers and allow us to study solute-solute interactions at different temperatures.

Check out our website at ***biochem.wisc.edu/labs/record*** for more information or to contact us.

Sussman lab

WHAT? Since it has been a number of years since my lab last contributed to the newsletter, I need to bring you up to date on quite a bit of new things and thus, please forgive the verbosity. Many organisms go through two stages of development, a juvenile phase and an adult stage. With respect to my lab, although I have been on campus for over three decades, it is only in the most recent decades, i.e., the lab's adult stage, that I have been in the Department of Biochemistry. Our most recent discoveries are in three areas: (1) identifying a growth factor receptor kinase and its peptide ligand that in plants is fundamental to how cells regulate their rates of cell expansion, (2) deciphering the molecular mechanism by which the primary active transport protein at the cell surface of plants and fungi, i.e., the 100,000 dalton plasma membrane proton pump (H+-ATPase), is regulated by growth factors and hormones, and (3) using a newly invented instrument that creates microsecond bursts of hydroxyl radicals in solution with an electronically generated plasma to study protein conformation. All of these experiments utilize tandem mass spectrometers, which have been the workhorse for my lab's studies over the past ten years. Two additional projects that aren't directly related to the above core work include (i) using our mass spectrometers to identify, out of 1000's of blood proteins, a handful that are diagnostic biomarkers to predict colon cancer and (ii) using next generation sequencers to sequence the genome of the strong voltage electric eel and other electric fish, as well as direct proteomic measurements with mass spectrometers, to identify the proteins that nature has used to

convert muscle cells into electrocytes, the unique cell type of electric organs. We were particularly fortunate to have two widely read papers published in the journal ***Science*** in 2014, one describing our discovery of the ligand for a plant growth factor receptor kinase and the role of the ligand/kinase pair in plant development, and the other on electric fish. You might ask what connection is there between plant plasma membrane bioenergetics and electric fish? In fact, there is a clear one since both use high voltages, although in different ways, to survive. Plants use a proton pump with a stoichiometry of one proton per ATP, while animals use a sodium pump that pumps three sodium ions per ATP. This means that the plant enzyme has a reversal potential of ca. 450 mv, while the animal one is only 150 mv, which in turn means that plants can generate much higher transmembrane potentials than animals (in excess of 250 mv with plants, less than 150 mv in animals). The electric eel's electrocyte plasma membrane is unique because it has an asymmetric distribution of sodium pumps and channels at the two ends of the cell, and, because of this, it generates a transient transcellular potential that has enough power to kill any predator or prey that it wishes. So on the one hand we have sessile plants with their huge ***transmembrane*** potential, and the strong voltage electric eel with its huge ***transcellular*** potential. Both are examples of nature's complexity as well as its commonalities on how the plasma membrane provides essential life functions. Projects in my lab span wide areas of biology, but one main theme is the development and utilization of new genomic technologies to make drill-down, basic mechanistic discoveries on key molecules in the plasma membrane that allow cells to thrive.

HOW? Through the gracious funding of several federal agencies, this past year has been an especially productive and enjoyable one for the Sussman lab since everyone can eat and be clothed because Mike was successful in renewing and/or procuring grants from NSF (two), DOE and DOD. While the lab has been successful with NSF and DOE for many decades, we recently received funding for a new five-year $1.9M grant with Mike Cox as Co-PI, from the Dept. of Defense, to perform research with tandem mass spectrometers to understand how radiation covalently modifies the proteome of *E. coli*. It is also pleasing to note, in this age of 'translational' emphasis, that we were able to obtain federal funding for completely basic research using the best possible model system (*E. coli*) rather than being forced to work in an organism that has greater translational benefit but poorer prospects for revealing basic mechanisms.

WHO? Now for information on who has been doing what. Sussman's Ph.D. students of late are all actively continuing their education after their Ph.D.s by performing their postdocs in top mass spectrometry labs. This includes **Ed Huttlin** and **Rachel Rodriguez** going to Steve Gygi's lab at Harvard for their postdoctoral work and **Kelly Stecker**, a more recent graduate, going to the mass spec lab of Al Heck at the University of Utrecht in the Netherlands. **Ben Minkoff**, another recent mass spec expert, is a glutton for punishment since he is staying in the Sussman lab as a postdoc for several more years pursuing some fascinating new mass spec based technologies for identifying changes in three dimensional structure/conformation of proteins even within a mixture containing a complex proteome. Current Sussmanites include **Heather Burch**, the chief technician and lab 'enforcer,' five postdoctoral scientists **Jamison Wolfer**, **Pei Liu**, **Benjamin Minkoff**, **Melanie Ivancic** and **Miyoshi Haruta** and two senior Ph.D. students, **Thao Nguyen** and **Jeremy Volkening**. Undergraduates include **Amanda Laseke**, doing general lab tasks as well as helping graduate student Thao use yeast as a heterologous expression system for producing the plant plasma membrane proton pump, **Shanthi Cambala** who is working with postdoc Miyoshi Haruta and technician Heather Burch in testing the effect of cell permeant synthetic peptides on root growth and **Vilas Gaddameedi**, who works closely with postdoc Miyoshi Haruta in genotyping and analyzing Arabidopsis plants with mutations in protein kinase growth factor receptors. **Jamison Wolfer** is a synthetic organic chemist who is using our maskless array synthesizer to perform combinatorial chemistry by making hundreds of thousands of different polymer sequences from monomeric units (e.g., glucosamine derivatives) rather than amino acids or nucleotides that has been done previously in my lab and others. The biological 'pull' for Jamison's work is the fact that all of the bacteria, fungi and plant cells in the rhizosphere (i.e., the soil where plant roots live) are communicating with short oligosaccharides of glucosamine. Plants secrete chitinases which degrade chitin found only in insect exoskeletons and fungal cell walls, and when they detect oligoglucosamine (using oligosaccharide binding plasma membrane receptor kinases), they know that a pathogen is around and they marshal their defenses to kill or outlive those pathogens. On the other hand, symbiotic relationships between plants and 'friendly' microbes and fungi (e.g., nitrogen fixing bacteria or mycorrhizal fungi) can occur only because these friendly cells secrete modified glucosamine oligosaccharides that the plant detects with specialized plasma membrane receptor kinases different from the pathogen ones and tell the plant that the microbe or fungus is a friend, not a foe. So, in essence, oligoglucosamine derivatives are the 'internet' of the soil, and our understanding of their specific roles and possible use to improve agriculture is sorely limited by our lack of understanding of the effect of chemical substitutions in the glucosamine moiety.

Postdoctoral scientist **Melanie Ivancic** is continuing work she began in the Sussman lab as an IPiB Ph.D. student on the discovery of a handful of proteins in the blood whose concentration predicts the onset of colon cancer. In collaboration with colorectal surgeons at UW we have demonstrated that in a human population six blood proteins, measured with our mass spectrometer, can predict the onset of early stage colon cancer, and, hopefully, may one day help eliminate colon cancer. Many of us have friends or relatives that have been afflicted by colon cancer. Remarkably, this disease is nearly completely curable if discovered early enough, and by replacing that scourge of mankind, the colonoscopy, with a more user-friendly and less invasive blood test, Melanie's approach may create a future in which adults may no longer dread reaching the age where colonic invasions by their doctor are required.

WHY? In general, to be creative and have fun. But more specifically, over the

past three years we have been turning more and more of our attention to developing a technology that would answer the question: which of the 30,000 proteins in a cell has had its conformation (three-dimensional structure) altered when the cell is perturbed, either chemically (e.g. adding a hormone) or genetically (e.g., expressing a transgene)? Current mass spec based methods usually study 'dead' proteins, and their covalent modifications. Thus, we use phosphorylation or ubiquitination studies as surrogate indicators of proteins that have had their conformation changed. Although many of these studies have been informative, we are beginning to realize that some covalent changes in proteins are not necessarily biologically important. Thus, we believe that a method that directly measures 3D structural changes *in vivo* is more likely to be biologically informative. The technique we have recently developed uses microsecond bursts of hydroxyl radicals generated in a solution via an electronically created plasma (the fourth state of matter). This method is called 'footprinting' and resembles a similar method used historically to elucidate the structure of nucleic acids. Thus, we are measuring 'solvent accessibility' of the side chains of proteins, which is caused by the three-dimensional structure making some amino acid side chains reactive to hydroxyls, while others are buried and unreactive. Prior to our work, there was no readily available method that could reliably measure conformational changes in a complex proteome, either *in vivo* or *in vitro*, and we believe this technology we are developing will have wide uses, spanning all aspects of biology.

Weibel lab

2016 has been an exciting year in the Weibel lab. Undergraduate students **Brice Blahnik**, **KC Faulkner**, **Victoria Heinrich**, **Matt Lammers**, **Brad Maerz**, **Bradley Reynolds**, and **Kristy Stevlingson** graduated and moved to positions in industry, medical school, and nursing school. Sophomore **Soren Rozema** migrated to Jennifer Golden's lab in Pharmaceutical Sciences to pursue synthetic chemistry research and **Crystal De Jesus** spent the summer in our lab and returned to the University of Puerto Rico where she is continuing her undergraduate studies. We are very proud of the achievements and scholarship of Brice, KC, Victoria, Matt, Brad, Bradley, Kristy, Soren, and Crystal and wish them success.

Several graduate students completed their degrees and moved to new positions. **George Auer** received a Ph.D. in Biomedical Engineering and joined a biotech startup (Emerald Cloud Lab) in San Francisco. **Katie Hurley** received a Ph.D. in Pharmaceutical Sciences, moved to Silicon Valley, and is currently interviewing for positions in pharma. **Manohary Rajendram** received a Ph.D. in Biochemistry, moved to Silicon Valley, and is a postdoctoral fellow at Stanford University working with KC Huang. [A tractor beam in Silicon Valley appears to be tugging on alumni from our lab.] Biophysics graduate student **Brandon Hoover** moved to Regina Murphy's lab in the Department of Chemical Engineering at UW-Madison. George, Katie, Mano, and Brandon made seminal discoveries in our lab and we are thrilled to see them continue on to the next stages in their careers.

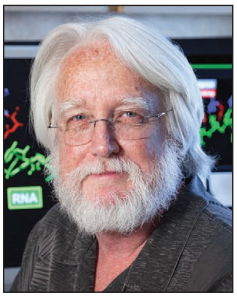
Several postdoctoral fellows moved on to new positions in 2016: **Dr. Linda Hu** (postdoc with Hank Seifert, Northwestern University), **Dr. Kelly Schwartz** (postdoc with Vatsan Raman, UW-Madison), **Dr. Jindong Zan** (postdoc with Mohamed Donia, Princeton). **Dr. Siseon Lee** finished a postdoc position and returned to South Korea to take a permanent position with the Korea Research Institute for Biotechnology and Bioengineering in Daejon. We wish them all the best in their new roles and research!

Our group's dairy mastitis diagnostics team moved on to bigger and better things in 2016. **Kelsey Veserat** (BS '16) joined Becton, Dickinson and Company (Chicago); **Dr. Mike Killoran** joined Promega (Madison); and **Daren Steuart** (exploring business markets) returned to focus on startup companies. The Gates Foundation continues to fund this area of research in our lab, now redirected at diagnosing crop viruses.

2016 brought several visiting scientists to our lab. **Dr. Robert Mitchell** (Professor, UNIST, South Korea) joined us for his sabbatical and introduced our lab to several new bacteria and areas of research. **Drs. Lili** and **Sen Hou** from the Polish Academy of Sciences spent several months in the lab working on a biophysical project studying the interface of bacterial membranes and peripheral proteins.

Katie Brenner's fertility startup company, bluDiagnostics received national attention by receiving several local and national awards and competitions. Another startup company — Agri Diagnostics — spun out of the lab to tackle agricultural testing.

We had several alumni, friends, and visitors drop by in 2016 and welcome you to visit us when you are back in Madison. Highlights included lab tours of K-12 students and a group of local boy scouts (Boy Scout Troop 101; Glacier's Edge) who visited to learn polymer chemistry. Onward and upward in 2017!



Wickens lab

It is a delight, on this terribly cold but crystalline white and blue morning, to give you an update on the Wickens lab. Whether you were in the lab yourself, or know it through collaboration, collusion, friendship, marriage, or the Ancient Gentleman's Luge competition, it is good to talk to you again and let you know that you always have a home here.

The comings and goings are many since the last newsletter. Let us begin with those inspired, energetic first year graduate students who joined the lab years ago and received their Ph.D.s in the last few years....

Chris Lapointe is the most recent Ph.D. graduate. The bulk of his work concerned RNA regulatory networks, and the development of new ways to identify them. Once we complete his manuscripts still in the hopper – or God forbid, slightly before – he will be off for a trip to South America. After hiking, relaxing and luxuriating in the carefree life, he'll be going to work at Stanford with Jodi Puglisi.

Douglas Porter, a joint student with Judith Kimble, embraced, absorbed and created computational methods that transformed the way we analyze RNA-protein interactions. At the same time, he figured out what happens to networks when you try to redesign the protein at their hub, and characterized key features of PUF-RNA networks in yeast and the worm germline. He now has gone off to Stanford – like Chris, and Aaron Kershner and Elena Sorokin and Sunnie Thompson before him. There, Douglas works with Paul Khavari. Clearly, Palo Alto has an alluring fragrance.

Daniel Wilinski developed a fascinating story on how RNA regulatory stories are rewired during evolution: one protein regulates a battery of RNAs in one species, but hands that role off to a different protein in another species. Daniel received his Ph.D. for that and other work in 2015 and then moved to the University of Michigan, where he now is a postdoctoral fellow.

Cary Valley received his Ph.D. in 2015 as well. He had studied the design and engineering of proteins based on the PUF protein scaffold, and generated a so-called "two-handed" model for how PUF proteins bind their RNA targets. After a stint at Pharmaceutical Product Development (PPD) in Middleton (essentially Madison), he has moved to Boston, where he now works at Sanofi.

Shruti (Waghray) Sasaki did remarkable work on how mRNAs are repressed during early development, pinpointing the key molecules involved and revealing the unexpected ways they work. Ph.D. in hand, she left for her much-loved California – which brought her close again to family – and there began a post-doc at Ionis Pharmaceuticals in San Diego.

Among the post-doctoral fellows, **Zak Cambell** left Madison for University of Texas at Dallas in 2015, where he assumed a faculty position and embraced the idea that he would no longer need a serious coat or winter boots, but would instead have Rick Perry and airborne moisture of quite a different, warmer kind than we usually deal with. While here, he made valuable contributions to analyzing RNA-protein interactions, and he and **Aaron Goldstrohm** have since collaborated as independent PI's on a project concerning mammalian Pumilio and Nanos – very cool!

Melanie Preston immersed herself in nucleotidyl transferases which led to several new enzyme activities we are pursuing, and was a great spirit in the group. She took a job at Promega in early 2016, a company just outside Madison, and is enjoying life there as a Scientific Instructional Designer. There she joins **Natascha Buter**, who had been a wonderful companion and technician in the lab for many years, and joined Promega in 2015, and **Brad Hook**, an alumnus of times long ago. Before she left, she and Daniel had a successful evolutionary foray into *Neurospora*.

Alana Doty Beadell, who worked on PUF proteins and their evolution while here, moved to the University of Chicago.

By a remarkable coincidence, **Shruti** (now in California) and **Chris** (then in my lab) were both at the same Gordon Conference at which **Melanie** (then at Promega) was an organizer – pretty amazing, and I am sorry I wasn't there myself!

Hugo Medina and **Brian Carrick**, a joint student with Judith Kimble, are the youngest folks in the lab, now doing their Ph.D. work. Hugo has hopped over the Prelim hurdle, and Brian is about to face it. Both are studying mRNA controls – which I know comes as an enormous surprise – and are doing well.

Carol Pfeffer continues in her infinite capacity to bear with me, laugh with me, keep me on track, recognize the things I really don't want to do and to only come in to my office with a sharp weapon when the deadline is tomorrow. Truly a delight and a gift to my sanity and perspective, and a wonderful symbiosis.

As for me, I think I am much the same, though of course things are always in flux.

δὶς ἐς τὸν αὐτὸν ποταμὸν οὐκ ἂν ἐμβαίη –
You cannot step into the same river twice (Heraclitus)

Everything moves, sometimes with gentle grace and sometimes with an abrupt jerk. Paint jobs, waistlines, governments, kidneys... Yet there is constancy. Judith and I are in the same house, now surrounded by Japanese maples and woodland flowers, and with a few more rooms than some of you will recall, but we live as ever – setting aside the massive variations as Zach was born, grew up, and then exited the scene. Judith and I have traveled a lot and seen fantastic, unforgettable things – most recently the unimaginably beautiful coral reefs of Raja Ampat in Indonesia. But the rush of great results and the thrill of solving a scientific problem is inimitable and remains, as does the joy of seeing students come of age and grab their project with both hands. In fact, that joy only increases with time. It has been a long and enduring joy to work with and get to know you, and I'd love to see you any time. A few of you have actually managed to come by and so I will close with my deep appreciation of your visits. All of you are forever welcome, here where our rivers once met.

Wildonger lab

Hello from the Wildonger lab! It's been a wonderful few years since our lab first started – as they say, time flies like an arrow, and fruit flies like a banana... We caught the CRISPR craze early on and, in collaboration with Drs. Melissa Harrison (Biomolecular Chemistry) and Kate O'Connor-Giles (Genetics), reported the first use of the CRISPR-Cas9 system to edit the fruit fly genome in May 2013 (it took a little over a week for the manuscript to be reviewed and accepted). Our original ***Genetics*** paper has garnered over 400 citations in the past three and a half years since its publication, and a review that we wrote on CRISPR for ***Genes and Development*** has been holding strong in the top five Most Read Articles list for over two years. We've been excited to receive some "popular" press as well: a front-page news story in the ***Wisconsin State Journal*** on CRISPR highlighted work done in the Wildonger lab. And we've been thrilled to be a part of the spread of this transformative new genome engineering technique on campus, which includes the establishment of a new genome engineering/translational genomics facility in the Biotechnology Center.

Our true loves, however, will always be neurons, microtubules, and molecular motors. To function properly, neurons rely on getting organelles, vesicles, and macromolecules to the right place at the right time. Not surprisingly, disrupting this neuronal transit system has been linked to a spectrum of human neurodevelopmental and degenerative diseases. Blending genetic, cell biology, and biochemical approaches, we've uncovered new mechanisms by which motors walking along microtubule "highways" deliver cargo to where it needs to be. **Ashley Arthur**, intrepid first member of the Wildonger lab and UW-Madison alum, authored our first paper on the regulation of dynein function during dendrite arborization. We look forward this year to publishing several exciting new stories on microtubule post-translational modifications, kinesin-mediated dendritic transport, and non-centrosomal nucleation of microtubules in neurons.

After writing up her paper, **Ashley Arthur** headed west to Minnesota to enter the Molecular, Cellular, and Developmental Biology & Genetics doctoral program at the University of Minnesota, Twin Cities, where she joined the laboratory of Dr. Margaret Titus. Ashley is now investigating how the actin cytoskeleton generates filopodia, and she is also pursuing a joint masters degree in Bioinformatics and Computational Biology. Back in Madison and the Wildonger lab, the first wave of graduate students to join the lab included **Sihui Yang** (CMB) and **Mike Kelliher** (IPiB). Sihui is delving into the who, what, when, where and how of generating microtubules in neurons that lack a centrosome, and Mike is motoring along to understand how kinesin activity is regulated to ensure that dendritic cargo is properly delivered to dendrites, not axons. Our first undergraduate students, **Jenny Nguyen** and **Allison Abellaneda**, have set a high bar: both were co-authors on papers, both were awarded Hilldale Fellowships, and Allison also won an impressive "Best Undergraduate Poster in Cell Biology" prize at the 2015 ASBMB meeting. After completing her masters degree in Biostatistics at UW-Madison this year Jenny will move to Virginia to join the University of Virginia Center of Public Health Genomics as a biostatistician. After graduating in 2014, Allison spent a year in Barcelona, Spain, before returning to her hometown, Minneapolis, where she is currently working as a medical scribe and yoga teacher, and is in the radiography program at St. Catherine University. Post-doctoral fellow **Brian Jenkins** joined our group in early 2013, moving from OHSU in Portland, OR, where he completed his Ph.D. with Dr. Gary Banker, one of the pioneers of the field of neuronal polarity. Brian has been looking into how the post-translational modification of microtubules regulates transport and neuronal morphogenesis. A founding member of Team "TMAc" (tubulin/microtubule acetylation), he has a couple great stories in the works. Undergraduate **Helena Record**, also a Hilldale Fellowship recipient (and daughter of Tom Record), has been working closely with Brian to investigate the role of microtubule acetylation in neurons. In the summers, in addition to working in the lab, Helena has also been participating in the Mobile Clinics and Healthcare in Uganda program organized by James Ntambi. Research scientist **Lindsay Mosher**, who joined the lab in 2014, pioneered a protocol for molecular screening for CRISPR-induced point mutations in flies and also made significant contributions to several projects in the lab before entering the School of Nursing here at UW. Our newest lab members are graduate student **Harriet Saunders** (IPiB) and research scientist **Dena Johnson-Schlitz**. Harriet is an alum of the Wickens lab, where she followed in the footsteps of her mother. In addition to new lab members, Jill and her husband David McCulley (Pediatrics/Neonatology at UW) also welcomed a new family member in May 2014. Their son Cal, now two-years old, has already started some "experiments" in the lab, putting cotton balls and water squirt bottles to good use. The past few years in the Wildonger lab have opened up exciting new avenues of research, and we look forward with enthusiasm to what the next few years have in store!

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