From the Chair:

The 2001-2002 academic year saw many changes in the Department of Biological Sciences. As many of you know, Dr. Leonard Beuving stepped down as Chair and I was appointed to serve as the one-year interim. I am happy to report that on July 01, 2002, I will become the permanent chair of the Department. I look forward to the opportunity of working with the Biological Sciences faculty and staff to further build the Department. During 2001-2002 Drs. David Rudge and Kamlesh Sharma joined the Department. Drs. Rudge and Sharma are both biology science educators and hold joint appointments in the Department of Biological Sciences and the newly formed Mallinson Institute for Science Education. In other personnel related news, we have successfully recruited a new microbiologist, Dr. Olga Maltseva, to replace Dr. Robert Eisenberg. Dr. Maltseva will join the Department this August as an assistant professor. She holds degrees from Ural State University and Russian Academy of Sciences in Russia and recently worked as research associate professor at the Stevens Institute of Technology (Hoboken, NJ). Dr. Maltseva’s specialty is the microbial degradation of PCBs. She will have the opportunity to collaborate with the WMU Environmental Institute’s investigation of PCBs in the Kalamazoo River watershed. Of further note, the WMU Board of Trustees approved the new High Throughput Screening (HTS) program and our first cadre of students has been admitted for the Fall ’02 semester. The HTS program is being directed by Dr. Brian Tripp (see page 9 for a profile of Dr. Tripp).

During 2001-2002 we unveiled our new departmental web site at www.wmich.edu/bios. The new site was intentionally organized to help alumni, friends and prospective students explore our department and view the new Wood and Haenicke Hall research facilities. At the present time, faculty, staff and graduate student information are all now available on the site – I urge you to “look-up” your former professors and find out what new research endeavors they have undertaken. Future improvements to the site will include a special Alumni section that will highlight the many contributions of Biological Sciences students and faculty to WMU since the Department’s inception in 1908.

The upcoming academic year is very special – in 2003 we will celebrate the one-hundredth anniversary of the founding of Western Michigan University. As part of these celebrations, the Department will be awarding the 2002-2003 Alumni Achievement Award. This fall’s recipient will be Dr. John Mulder (BS ’74). Dr. Mulder has a M.D. from Wayne State University and is the Clinical Director of the Vanderbilt-Ingram Cancer Center Pain and Symptom Management Program at Vanderbilt University. We extend our congratulations to Dr. Mulder.

Finally, be sure to mark your calendar for Homecoming Weekend this October 11-12, 2002. I would like to extend an invitation to all BIOS alumni to visit the Department and tour our wonderful facilities!

Sincerely,

Alexander Enyedi
Departmental Awards

The following twelve students were honored at the Departmental Spring Luncheon on Thursday, April 11, 2002.

★ Justin Knight
Distinguished Senior in Biomedical Sciences

★ Michael Ahrens
Distinguished Senior in Biology-Presidential Scholar in Biological Sciences

★ Holly Yettaw
Distinguished Pre-Professional in Biological Sciences

★ Jennifer Heyn
Merrill Wiseman Award in Microbiology

★ Sarah McDonald
Margaret Thomas DuMond Award

★ Bethany Huot
Hazel Wirick Scholarship

★ Jeffrey Muston
Collin J. Gould Memorial Scholarship

★ Elizabeth Weiss-DeBoer
Edwin B. Steen Book Award

★ Wendy Guat Hoon Tan
Distinguished Biomedical Sciences Graduate Student
Support the winning research plans so that the student may pursue his/her research under a faculty sponsorship.

- **Jennifer Heyn** ~ “The Biofilm Formation of *Pseudomonas aeruginosa*” {Dr. Silvia Rossbach} (Fall 2001 & Winter 2002)

- **Justin Knight** ~ “Phytoestrogen Levels Increase in Alfalfa Grown Under Elevated CO₂” {Dr. Dave Karowe} (Fall 2001)

- **Kory Johnson** ~ “GDNF is Localized to Fast Twitch Muscle Fibers in Rat Gastrocnemious Muscle” {Dr. John Spitsbergen} (Winter 2002)

- **Natalie Wallace** ~ “Increased Nerve Growth Factor Protein and Increased Innervation in Blood Vessels from Hypertensive Rats” {Dr. John Spitsbergen} (Spring/Summer 2002)

This year students were able to participate in the fourth annual “Arts and Sciences 2002: A Celebration of Research and Creative Activities”. Each year ten student posters are chosen in this college-wide event to be honored as an Outstanding Student Poster. The winning posters are chosen based on the quality of research, clarity of presentation and attractiveness of the poster. Justin Knight was one of this year’s winners with his poster entitled “Phytoestrogen...
Levels Increase in Alfalfa Grown Under Elevated CO2”. Dr. Dave Karowe is his mentor.

**Presentations**

**Erica Wehrwein** ~ “Neurotrophic Factor Expression in the Heart is Altered Following an Increase in Physical Activity” ⇝ Experimental Biology Conference- New Orleans, LA; Michigan Chapter of the Society for Neuroscience- Ann Arbor, MI {Dr. John Spitsbergen}

**Kory Johnson** ~ “GDNF is Localized to Fast Twitch Muscle Fibers in Rat Gastrocnemius Muscle” ⇝ 20th Annual Kalamazoo Community Medical and Health Sciences Research Conference, 2002 - Kalamazoo, MI {Dr. John Spitsbergen}

**Daryl Arkwright-Keeler** ~ “Characterization of the Glucose Responsiveness of the Rat Glucose-6-Phosphate Dehydrogenase Promoter” ⇝ 19th Annual Kalamazoo Community Medical and Health Sciences Research Conference, 2001 – Kalamazoo, MI {Dr. Susan Stapleton}

**Holly Yettaw** ~ “Characterization of Mitral Cells in the Olfactory Bulb of Adult Zebrafish” Association for Chemoreception Sciences - Sarasota, FL {Dr. Christine Byrd}

**Ukamaka Atueyi** ~ “The Role of Akt in Signaling Pathways in the Liver” 20th Annual Kalamazoo Community Medical and Health Sciences Research Day-Kalamazoo, MI {Dr. Susan Stapleton}

**Drs. Dave Cowan, Steve Kohler, DeWayne Shoemaker, Dave Karowe** ~ “Insect Ecology and Evolution at Western Michigan University” ⇝ North Central Branch of the Entomological Society-East Lansing, MI

**Awards Galore**

**Holly Yettaw** received a student travel award as well as a student housing award from the Association for Chemoreception Sciences to allow her to give a presentation at their annual meeting.

**Janet Lynn** received a $600 grant for her research entitled “Metal Dependent Gene Expression in Sinorhizobium meliloti”.

**Erica Wehrwein** received a Best Poster award at this year's Michigan Chapter of the Society for Neuroscience in Ann Arbor, MI. Her poster was entitled “Neurotrophic Factor Expression in the Heart is Altered Following an Increase in Physical Activity”. Erica’s research “GDNF is Regulated in an Activity Dependent Manner in Rat Skeletal Muscle” was also published in “Muscle and Nerve”.

**Natalie Wallace** was honored at the McNair Scholars luncheon for her research entitled “The Increase of Nerve Growth Factor and Change in Nerve Innervation Pattern in Hypertensive
Rats”. Dr. John Spitsbergen is her mentor.

☆ Takeshi Shimamura received a Dissertation Fellowship for 2001-2002 from the Graduate College. This award is to support the completion of his dissertation entitled “Elucidation of the Secondary Signaling Molecules Responsible for the Activation of NF-kB in Platelet Derived Growth Factor (PDGF) Transformed Mouse Fibroblast Cells”. The research provides insight to how PDGF modulates signaling cascades to make the cell cancerous.

☆ John Landosky was awarded a $10,000 NSF Doctoral Dissertation Improvement Grant for his dissertation entitled “The Effects of Elevated CO₂ on Plants, Pathogens, Herbivores and Natural Enemies: Ecological Consequences and Evolutionary Potentials.” Drs. Karowe, Enyedi and Ide were also listed on this award.

Serving Up Success

Ryan Maarschalk, a biomedical science junior, was named Western Michigan University’s Outstanding Male Scholar-Athlete for 2001-2002. Ryan has managed to be a successful member of Western’s Men’s Tennis team, while giving an exceptional performance in the classroom. He has maintained a 3.91 overall GPA and made the Dean’s list each semester at Western. At the No. 2 singles and No. 1 doubles positions, his court record boasts a 3-1 overall MAC record and the second highest amount of wins on the team with 40. Currently he is Western’s 26th most winning male tennis player with a total of 112 career wins. He was also recently named to the All-MAC second team.

In Other News

☆ Dr. David Karowe recently began a 4-year term as Subject Editor for the Journal of Environmental Entomology. With this position, he will make decisions on submitted manuscripts in the field of plant-insect interactions. Dr. Stephen Malcolm will be one of his Associate Editors.

☆ Dr. Susan Stapleton’s lab seems to have a monopoly on Best Presentation and Best Poster Presentation awards at the Annual Kalamazoo Community Medical and Health Sciences Research Day. A student from her lab has earned one of those awards for the past five years. This year’s winner for Best Presentation, Ukamaka Atueyi, is a former NIH Bridges and NSF REU recipient.

Research Ethics Fellowship

The WMU Research Ethics Fellows Program awarded Research Ethics Fellowships to Dr. Susan Stapleton and Daryl Arkwright-Keeler. A National Science Foundation Program on Ethics and Values in Science and Technology (EVIST) Grant entitled “Teaching Research Ethics-An Institutional Change Model” funds the Program. Twenty fellows (10 graduate students and 10 faculty) from different disciplines were chosen for the project. The fellows participated in a series of workshops
on research ethics, worked in study groups, developed presentations for their respective disciplines and participated in a Spring Research Ethics Conference in May. The goal of the program is to "build a community of researchers who will help create an institutional environment in which ethics is widely and explicitly embraced as an integral part of good research".

New Faculty

The Department of Biological Sciences would like to welcome our new microbiologist, Dr. Olga Maltseva. Dr. Maltseva will be joining us from the Stevens Institute of Technology in Hoboken, New Jersey where she has experience as a research associate professor of chemical biology. She received her BA in plant physiology and biochemistry in 1977 and an MS in microbiology in 1979, both from Ural State University, Sverdlovsk, Russia. She proceeded to the Institute of Biochemistry and Physiology of Microorganisms, Russian Academy of Sciences in Pushchino, Russia, where she earned her Ph.D.

Dr. Maltseva's current research primarily focuses on biodegradation and molecular microbiology, particularly in the application of molecular biology techniques for isolation and characterization of new bacterial strains, engineering new catabolic pathways and monitoring microbial populations, strains and genes in bioreactors and other environmental systems.

Research Experience for Undergraduates

This year 5 Department of Biological Sciences students participated in the Research Experience for Undergraduates (REU) in Ecology at the University of Michigan Biological Station. REU is a grant that allows undergraduates to gain research experience they would not normally have, not only by giving the students a research opportunity, but also by providing each student with a stipend and funding for supplies. Dr. David Karowe is the director and co-PI for this grant. Those that participated include:

DesDemonia Coleman ~ “Do Soybean Phytoestrogens Increase Response to Damage?” {Dr. David Karowe}

Donna Wright ~ “Phytoestrogen Content of Commonly Consumed Cruciferous Vegetables.” {Dr. David Karowe}

Talline Martens ~ “Evolution of Genes Controlling Floral Scent and Plant Defense.” {Dr. Todd Barkman}

Nabeel Hasan ~ “Using Molecular Markers to Help Control Invasive Species.” {Dr. DeWayne Shoemaker}

Awet Embiae ~ “The Effect of Cadmium Chloride and Cis-diaminedichloroplatinum on Salmonella typhimurium TA 1535 psk 1002.” {Dr. Gyula Ficsor}
New Master’s Program

This year was the first year for the Molecular Biotechnology-High Throughput Screening Master’s Program. An online description of the program curriculum is available at the website: http://www.wmich.edu/bios/hts.html. This program was approved in 2001 and started enrolling students in 2002. It involves 34 credit hours of courses taught in the Biology, Chemistry, and Statistics Departments and culminates in a 4-month industrial internship at one of several regional pharmaceutical companies. Pharmacia, Pfizer, Eli Lilly, and Proctor and Gamble Pharmaceuticals have all expressed support for this program. Dr. Brian Tripp is the coordinator of the Molecular Biotechnology HTS program and his duties include developing and maintaining interactions with pharmaceutical companies, mentoring students enrolled in this program, and coordinating industrial internships. Dr. Tripp is currently working with industrial pharmaceutical partners to develop a new HTS laboratory course to be offered through the Biology Department. It is envisioned that this course will involve screening a well-characterized enzyme for inhibition by a commercially available chemical compound library using modern high throughput plate reading spectrophotometers and sample handling robotics.

High School Scientists

Kalamazoo Area Math and Science Center’s Andrea Yancon and Kay Russo will be competing for gold at this year’s Intel International Science and Engineering Fair in Louisville, KY, with their research entitled “Gastric Eosinophilia in Ovine and Rodent Models Following Experimental Infection by the Gastrointestinal Nematode, *Ostertagia ostertagia*”. In order to qualify for the international competition, Andrea and Kay won the Southeastern Michigan Science Fair in Ann Arbor, MI. The research focused on using rodents as a more cost effective way to test treatments for a parasite that costs the cattle industry billions of dollars each year. Andrea and Kay performed a large part of this research in the Biological Imaging Center with Drs. Leonard Beuving, Rob Eversole and John Stout.

IGERT and BART

The Departments of Biological Sciences and Chemistry recently received approximately $450,000 as the third installment of a five-year $2.7 million Integrative Graduate Education Research Training (IGERT) grant from the National Science Foundation (NSF). IGERT is a flagship NSF program designed to train Ph.D. students in interdisciplinary approaches to major scientific issues. The IGERT program housed at WMU will provide 30-35 doctoral students with training in the emerging field of biosphere-atmosphere interactions, and is entitled Biosphere-Atmosphere Research Training (BART). The BART program is co-directed by Dr. David Karowe, an ecologist and evolutionary biologist in the Department of Biological Sciences, and Dr. Steven Bertman, an atmospheric chemist in the Department of Chemistry.
According to Dr. Karowe, "It is becoming clear that we must adopt an interdisciplinary approach if we are to understand, and eventually solve, many of the most pressing environmental issues facing us today". Students in the BART program have initiated dissertation projects addressing a range of topics, including how rising atmospheric carbon dioxide, CO₂ (due to the burning of fossil fuels) will affect amphibian development, mosquito-borne diseases and aquatic food chains. Also studied is forest succession and how increasing UV-B radiation (due to stratospheric ozone depletion) will affect food chains in lakes and rivers. Other BART students, whose previous training was primarily in atmospheric sciences, have initiated projects designed to determine the extent to which Michigan forests are sequestering CO₂ (a major issue in the current negotiations about whether the U.S. should adopt the Kyoto Protocol) and to understand how atmospheric pollution interacts with natural compounds emitted by trees to produce potentially harmful levels of ozone near the ground.

The goal of the BART program is to provide doctoral students with enhanced multidisciplinary training in the technical, professional and personal skills required for conducting research at the interface of the biospheric and atmospheric sciences. Scientists in other areas of biology and chemistry are successfully combining their expertise to elucidate fundamental life processes at the cellular and molecular scales. Ultimately it is essential that interdisciplinary studies be conducted at the scale of entire ecosystems and in the context of the entire global ecosystem. The BART program is designed to encourage doctoral students to adopt a multidisciplinary approach to understand the reciprocal interactions between the atmosphere and the biosphere. In so doing, BART hopes to facilitate the development of a new cadre of scientists prepared to address some of the most complex and important environmental issues of the 21st century. If you would like more information, please feel free to contact David Karowe or Steven Bertman, or visit our web site at www.bart-wmich.org.

Student participants receive a two-year fellowship that includes an annual stipend of $21,000 in addition to funds for travel to national conferences, summer living expenses and research supplies. Most students also receive full tuition and fees from their home institutions. During the summers, BART students reside at the University of Michigan Biological Station, where they conduct their interdisciplinary research and participate in a series of workshops, retreats and seminars. Doctoral students at any university in the country are eligible for support through BART.
specific area of investigation involves how the amino acid sequence in the well-defined Cam enzyme structure determines its catalytic function and how this function can be altered by mutations in the corresponding gene. A poorly understood functional feature of Cam is it has a high rate of catalysis for CO₂ hydration, but a very low rate of catalysis with model ester compounds, such as para nitrophenol acetate (PNPA). This is in contrast to some alpha-class carbonic anhydrases, such as human CA-II (Fig. 1C), which exhibits high rates of esterase activity with PNPA. The molecular determinants that result in low esterase function will be investigated using techniques of random mutagenesis and HTS activity assays of the resulting variants to identify versions that exhibit improved rates of esterase activity. The altered amino acid sequence of Cam variants will then be identified by DNA sequencing of the corresponding gene. It is envisioned that this research project will reveal fundamental information about the sequence and structural requirements for Cam and other carbonic anhydrases to function with non-physiological substrates. Results from this project should yield an understanding of the principles by which one enzyme evolves into another and what the “design rules” are for engineering an enzyme to perform a desired catalytic function.

Dr. Tripp’s second research project involves the study of bacterial flagellin proteins, both as a model self-assembling protein system and as a scaffold for the intracellular production, export and extracellular display of enzymes. An important problem in biotechnology is how to economically produce, purify and immobilize enzymes, so
they have high catalytic activity, are free of other enzymes and cellular contaminants and can be recovered from the chemicals they produce. Emerging nanotechnology research efforts may also benefit from the ability to engineer enzymes and other proteins into self-assembling structures for use as components in molecular devices. Many bacteria produce elongated, hollow protein fibers, flagella, that are rotated by membrane-bound molecular motors to achieve propulsion. Flagella are primarily composed of large amounts of the single protein flagellin. This self-assembling flagellin protein might be well suited for bacterial enzyme production and immobilization. The biological process which flagellin self-assembles is not fully understood and involves a variety of helper proteins, known as chaperonins. The amino and carboxy terminal sequences of bacterial flagellins are highly conserved across different species; these regions are critical for the self-assembly process. The middle region of the flagellin gene and corresponding protein varies greatly between species, suggesting it is non-essential for the self-assembly of flagella. This hypervariable middle region of flagellin has been successfully deleted without destroying the ability of the corresponding protein to self-assemble into filaments. The first flagellin x-ray crystal structure was published in 2001; it clearly shows how the N-and C-terminal alpha-helical peptide regions are in close proximity, while the hypervariable region protrudes away from the ends of the protein as a series of separate domains. A number of researchers have successfully inserted peptides into this region of flagellin for use in immunological studies. There are also several examples of entire enzymes and proteins inserted as genetic fusions in the variable middle region of bacterial flagellin. However, the catalytic activity of these inserted enzymes and efficient export and self-assembly of the fusion proteins into flagellar fibers has not been effectively demonstrated. The functional limits of the size, sequence, shape and location of inserted protein sequences inserted into flagellin are poorly defined. Thus, there is currently no rational method or database that describes the best locations for genetic insertion and deletion in flagellin proteins.

This research project will involve a thorough investigation of the minimal size of the flagellin protein that can be produced and exported to form functional flagella fibers in vivo. Both E. coli and Salmonella bacteria will be used as test organisms to screen for functional mutated flagellins. This project will also involve exploring the size limits and allowable sequences of foreign genes that can be genetically fused in the middle of flagella. The first foreign protein to be tested as an insertional target in flagellin is green fluorescent protein from a Pacific jellyfish, Aequoria victoria. This protein is easily detected by fluorescent assays, is highly tolerant of fusions to other proteins and is only fluorescent when properly folded. This
research will yield greater understanding of the physical limits of the chaperonin-assisted flagellin export and assembly process. The resulting information may also lead to the development of economically attractive methods of producing immobilized enzymes and other proteins for use in biocatalysis and nanotechnology applications.

Figure 1. X-ray crystal structures of gamma- and alpha-class carbonic anhydrase enzymes. Active site Zn$^{2+}$ ions are shown as spheres. Fig. 1A. Top view of trimeric gamma-carbonic anhydrase (Cam) metalloenzyme from the archaeal microorganism *Methanosarcina thermophila*. Each monomer subunit of Cam is depicted in a separate shade. Cam monomers are composed of left-handed beta-helix and alpha-helix secondary structures. The catalytic active sites are located between each pair of monomers. Fig. 1B. Side view of Cam showing location of active site Zn$^{2+}$ ion between beta-helical structures. Fig. 1C. View of structurally unrelated monomeric alpha-class carbonic anhydrase II from human red blood cells. This enzyme is composed primarily of beta-sheet structures, but also has the same active site Zn$^{2+}$ ion and catalyzes the same CO$_2$ hydration reaction.
Wood Hall in Fall

Photos courtesy of Takeshi Shimamura

Haenicke Hall in Late Summer

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