Dear AMEP Alumni, Students and Friends,

Here is the third edition of the AMEP newsletter! It has been a little late in coming this year given that I was coordinating AMEP “long distance”: I spent a research sabbatical year in Paris, France. A bit more about that later.

There is again quite a bit of news to pass on to you this year: in the continuing string of “famous people with an AMEP degree” we profile Stephen Turner, founder and chief technology officer of a startup developing fast DNA sequencing technology and we have heard from John Holzrichter, president of the Hertz Foundation. As usual, the newsletter drew a number of alumni emails, and I have included news from some of you in the “Alumni news” section. It is always a pleasure for me to hear from alumni, so please drop me a line! If you are missing an issue you can download one from our webpage. Li Jiang, who has been the student editor of the first three newsletters has graduated. There is a profile of him inside. I will miss his help, I thank him, and I wish him the best of luck!

Returning, now, to my year in France. It has been an “anthropological” experience: although I have never before lived in France, I am actually half French and speak French fluently, which allowed me to blend in and observe the locals. I could go on about this for pages, but I’ll describe briefly my observations that relate to education and the AMEP program. France is rightfully proud of its “K-12” schools: there are uniformly high standards nationwide, teachers are very knowledgeable on the subject matter, and, as my children will attest, students have to work very hard. University level studies are much more of a mixed bag: “normal” universities are almost free, understaffed, and the idea of mentoring undergraduates in their educational choices and undergraduate research is nonexistent. The elite “grandes écoles” get the cream of the crop of students, and their very few graduates have a guaranteed lifelong career in a society that values highly educational accomplishments. (When I tell the random acquaintance in France that I am a mathematics professor and researcher, I get instant respect, whereas in the US I either get “math was my worst subject” or, in a skeptical tone, “what is there left to research in math?”)
One thing that is sorely lacking in the French system, though, is flexibility. This is true at all levels. School age children are quickly labeled and put into tracks: you sink or swim, and the lanes are straight and narrow. At university, it is unthinkable for a student to take courses from several majors, let alone different colleges. As far as I can tell, the words “late-bloomer”, “interdisciplinary”, and “breadth” have no real translation in the French educational system.

Educational flexibility is, however, a hallmark of AMEP. In my opinion, flexibility, together with its high standards, has made AMEP disproportionately successful compared to its size. I would venture to say that AMEP has in fact an ideal blend of thoroughness (which the French are good at) and pragmatism and flexibility (which the US is famous for).

So much for philosophy. Enjoy the newsletter and see you next year!

Paul Milewski,
AMEP Coordinator

Faculty Profile

Professor Chris Hegna is a professor in the department of Engineering Physics at UW-Madison. He received his BS in AMEP in 1986 with a focus in Electrical and Computer Engineering. Professor Hegna had an early interest in solid state physics and its overlap with microelectronic devices, but later found appeal in plasma physics. As an undergraduate, he took a number of math and physics courses and learned about the AMEP program through Professor Connor, who was its coordinator at the time. He received his PhD in Applied Physics from Columbia University following that. Professor Hegna then worked as a post-doc at both Princeton and UW-Madison before becoming a faculty member here in 2001.
As a theoretical plasma physicist, Professor Hegna’s main research involves the magnetic confinement of plasmas. The goal of the research is to confine and sustain high temperature plasmas for use in nuclear fusion as a commercial source of electricity. His current research includes developing theoretical models to understand macroscopic instabilities in high temperature plasmas, turbulence and transport properties, self-organization of plasmas, and many other aspects of plasma physics. He is the Director for the Center for Plasma Theory and Computation, a multi-departmental center that coordinates plasma research activities for professors, scientists and graduate students on campus.

Professor Hegna would like to remind undergraduate students that UW-Madison has a very rich and diverse set of activities and research opportunities and that students should try to expose themselves to as many opportunities as possible. He emphasizes that academics is only a small portion of the education process. To take full advantage of what Madison has to offer beyond the classroom, students must expose themselves to research. Professor Hegna says he was “lucky to get exposed to them early in [his] career.”

The infamous tattoo question makes its return. When asked what equation he would have tattooed on his body, Professor Hegna believes “J x B”, which represents the force density that a magnetic field puts on a plasma, would be appropriate for a plasma researcher. For those of you who don’t remember, J is the current density, B is the magnetic field and x is the cross product.

Recent Graduates

Zac Labby graduated from the AMEP program in 2007 and also received the AMEP Leadership Award that year. He is currently a graduate student at the University of Chicago in the department of Medical Physics. While there is plenty of math in studying Medical Physics, Zac was surprised to find that there is also a large amount of statistics that he needs to learn. Though he did not learn much statistics at Madison, Zac believes that the mathematical skills he learned through the AMEP program have made learning statistics easier. After gaining this new experience, Zac
would like to suggest for students to take some statistics courses during their undergraduate career, saying, “a lot of the ‘applied math’ that gets done in practice is ‘applied stats,’ and any thesis level work has to have legitimate statistics for validity.”

Nikos Savva graduated from the AMEP program in 2001. He was sponsored by the Cyprus-America scholarship program to study mathematics at UW-Madison. While searching through the course catalog to find appropriate classes, Nikos learned of the AMEP major and immediately switched to it, choosing electrical engineering has his engineering focus.

Nikos believes that the diverse background in science and engineering he obtained as an undergraduate has shaped the way he thinks as an applied mathematician. He realized the “importance of interactions among researchers from diverse backgrounds coming together to tackle problems encountered in different fields.”

While at UW-Madison, Nikos was fascinated by plasma physics and was involved in various plasma research groups. His work ranged from aiding graduate students with their work in experiments or data analysis to building electronic circuits that exhibit chaotic behavior. Though he is more inclined towards theoretical work, Nikos gained a deep appreciation for experimental research.
After graduation, Nikos remained in Madison as a research intern at the Waisman Center, working on a project on brain fiber tracking. During his stay there, he was fascinated by “the way medical doctors, neuroscientists, physicists, and psychologists all came together to look into issues of brain development.” Nikos was awarded a Presidential Fellowship in 2002 to pursue doctorate studies in applied mathematics at MIT. During his studies, he became interested in theoretical fluid mechanics, which led to thesis work on the subject of surface tension phenomena related to viscous fluid sheets. After receiving his PhD in 2007, Nikos moved back to Europe. Since then, he has been working as a postdoc in the Chemical Engineering Department of Imperial College, London. His current work focuses on wetting phenomena, particularly on drop spreading over spatially heterogeneous substrates.

At UW-Madison, Nikos most enjoyed the courses on analytical methods of applied mathematics. He states that, “Mastery of these tools is essential, since these are usually the first tools one utilizes to tackle problems in applied sciences.” Nikos recalls a funny memory about a midterm test for an abstract algebra class:

“The professor was willing to arrange a time for the test that was most convenient for everybody. We could not however reach a consensus on the time...In the end the professor suggested a time that no schedule conflicts were possible. We found ourselves taking the test around 6am, but he was kind enough to bring coffee and cookies in class to help us stay awake through the test!”

Nikos believes the level of education received through an AMEP degree is a great asset for a successful career in a wide variety of fields. He advises that students “should not hesitate to try different paths to discover their true career aspirations.”

Hi, I’m Li Jiang and I’ve been the editor of the AMEP newsletter for three years now. I have graduated and will be leaving Madison at the end of summer. I will be attending Cornell University in the fall to pursue a PhD in Mechanical Engineering. I plan to do research in microfluidics for biological applications.

I have always enjoyed math and physics in high school. When it came time to find a major, my parents and I separately circled all the majors that we thought would suit me. AMEP turned out to be one of the few majors that we all selected. Reading more about the program only piqued my interest more. It took me another year to decide on my engineering focus. Finally, I found the field of nanotechnology tucked in the Engineering Physics department’s website. When I first told my advisor, Paul Milewski about my
decision to focus on Engineering Physics, he jokingly said, “So you’re trying to learn as little engineering as possible!”

I began doing research for Professor Kevin Turner in Mechanical Engineering in the summer after my junior year. My project focused on measuring the stiffness of water droplets. As microelectromechanical systems (MEMS) continue to shrink, precision in positioning tiny parts must increase to achieve high performance. Traditional tools based on optical or mechanical approaches fall short of what is necessary and research has turned to using surface tension effects to achieve operations such as alignment, rotation, and bonding. Water has high surface tension compared to common liquids but few have closely examined the resistive forces that can be generated by water droplets, which is crucial if water is to be used in MEMS. My work was to analyze the lateral stiffness of water droplets wedged between flat parallel plates as one is displaced.

Like many alumni who have been profiled in the AMEP newsletters, my advice is for students to start research early. You will not only learn theory and techniques that you can’t find in textbooks, it will also give you an entirely different way of approaching a problem. Unlike in other engineering majors, research is not integrated into the AMEP curriculum in the form of a capstone course or a senior thesis. Because of this, I found it particularly difficult to balance the time I spent on research with the time I needed to spend on all my classes. Another way to get exposed to different fields is to attend
research seminars and colloquiums. Many undergrads don’t attend because they assume that they won’t understand anything. Well…that’s mostly true, however, at the very least, you will see what issues are out there. And, if you go to the right ones, you’ll get some free pizza!

My favorite classes have been Intro to Quantum Physics with Professor Chun Lin, Applied Mathematical Analysis with Professor Fabian Waleffe, and Fracture Mechanics with Professor Walter Drugan. All three professors were engaging and demanding, which gave me a sense of satisfaction when I was finally able to understand a hard concept.

Among all the great times I’ve had at Madison in the past four years, one will always stand out: it was towards the end of the fall semester in my junior year. It was my toughest semester. Three friends and I went to Chamberlin Hall one night to study for an Electromagnetism exam. In a fine example of Wisconsin weather, it snowed the night before and rained the following afternoon. After studying for hours, we left the building around midnight, exhausted. It had gotten cold enough outside that a smooth layer of ice had formed over the snow. The ice was strong enough to support us and we were able to skate in our boots. We roamed around campus looking for the steepest slopes to slide down. The field in front of Ag Hall was my favorite (I have a scar on my left hand to prove it!). We must have been out there for another two hours just sliding down hills. It’s rare to find time to be carefree and completely forget about school (not to mention doing so the night before an exam) but, for those two hours, all of my stress disappeared.

Alumni News

**Dr. Stephen Turner**, one of the recipients of last year’s UW Distinguished Young Alumnus Award, graduated from AMEP in 1991. He chose the AMEP major because he did not feel at home in either the engineering program or the physics program. Dr. Turner sees AMEP as “a triple threat” and “ideal preparation for a future that involved innovation and entrepreneurship.”

During his undergrad years, Steve worked at the Center for X-ray Lithography. He stayed there as a full-time research specialist after graduation. After two years, his employer, Franco Cerrina, convinced him to pursue a PhD, and he entered Cornell University’s Applied Physics program. At Cornell, Steve founded Pacific Biosciences, originally called Nanofluidics. In 2004, the company won financing from a Silicon Valley venture firm and moved to California, where he has lived since.

Throughout his childhood, Dr. Turner had dreamed of becoming an innovating entrepreneur. He first focused on Electrical Engineering at Madison with the idea of
working for, or creating a startup as a career. However, he found that the program seemed geared more towards future professional engineers, and was not as helpful for those who wished to focus on entrepreneurship. For a while, he became interested in a career as a professor (his father is a mathematics professor). His original dreams came true with the founding with of Pacific Biosciences.

Pacific Biosciences is at the forefront of the race to the “$1,000 genome.” It is developing “third generation DNA sequencing technology,” different from current methods in that “it harnesses the real-time power of DNA polymerase enzymes”- enzymes that are responsible for DNA replication in cells. The enzymes sequence DNA every time they replicate a genome. The company has created technology that “eavesdrops on the enzyme during replication.” Dr. Turner is inventor on 22 issued U.S. patents and in 2003 he was listed in the MIT Technology Review’s 100 top innovators.

Although AMEP gives students a reprieve on the number of breadth courses, Steve advises students not to be satisfied with the bare minimum of social sciences and humanities classes required. Since he left Wisconsin, there have been many instances where the humanities courses he took have been just as important as courses in the sciences. He also found computer science courses he took in Madison to be extremely valuable and recommends students to not only take superficial courses, but to “get in to the nitty gritty” and understand as much as they can.
Steve’s answer to reminiscing on his fondest memories of the Madison years: “There are too many to mention, and I’m sure some of them wouldn’t be appropriate to mention anyway! I’d have to look into the statute of limitations on certain things.” He enjoyed learning from Professors Barney Webb, Lou Brookes, and Franco Cerrina, who was also his advisor. He also took “the most entertaining calculus class” from Professor Steve Wainger and greatly enjoyed his time in the UW choir. Considering his career path, it’s not surprising that his one regret is that he never took a class in organic chemistry: “It’s the kind of experience that you can only do as a full time student.”

This year we have again been contacted by some of the first graduates of the AMEP program: Dr. Edward Cottrell, who graduated in 1949 and Dr. Richard Black, who graduated in 1947.

Dr. Edward Cottrell graduated from UW-Madison in 1944 after completing the UW Army Air Force pre-Meteorology Training Program. He completed math studies through Solid Geometry and Integral and Differential Calculus (then taught by Professors Rudolph Langer and Burt Colvin prior to his leaving for work on the Manhattan Project). Dr. Cottrell was apparently a very good sketch artist: he was invited by Prof. Langer to dinner after giving him a pencil portrait he drew of him during lecture. The Langers even performed a short musical program after dinner, with Mrs. Langer on the piano and Prof. Langer on the violin. Perhaps this story will give ideas to future students who may have missed a homework assignment here and there.

After discharge from the Air Force in 1946, Dr. Cottrell returned to Madison and entered a then new program called Applied Mathematics and Mechanics (later AMEP). He took courses in Complex Variables, Civil, Mechanical and Electrical Engineering, and Mechanical Drawing before graduating with a BS in 1949. After this, Dr. Cottrell applied to MIT’s architecture program. Though he was accepted, he had to delay his studies due to the expenses involved. To save money, Dr. Cottrell moved to Florida and taught public school for two years. During this time, he met his future wife, who was also a new teacher. It turns out that he would never leave Florida.

Dr. Cottrell earned his Master’s Degree in Education Administration from the University of Florida in 1954 and taught and did administrative work before finishing his PhD at University of Florida’s College of Education in 1962. Dr. Cottrell then worked as Assistant Dean of Instruction and Director of Institutional Research at St. Petersburg Junior College, a position he held for thirty years. Dr. Cottrell is 84 years young and enjoying his retirement in Clearwater, Florida.
Dr. Richard Black is one of the two graduates of AMM in 1947, the other being Dr. Hirsh Cohen, who was featured in last year’s newsletter. In addition to Dr. Cohen’s recollections, Dr. Black remembers that they both served as undergraduate teaching assistants under Mrs. Sokolnikoff.

After graduation, Dr. Black went to work for General Electric Co, calculating stress in suspension springs of refrigerator compressors. He later returned to Madison to earn his MSc and PhD in Applied Math, before becoming the first director of the UW-Milwaukee computer center.

AMEP Leadership Prize

Matt Harrington is the recipient of this year’s AMEP Leadership Prize, and will also become the new student editor for the newsletter next year. Like many AMEP students, Matt developed a strong interest in math, physics, and engineering during high school. When he saw the AMEP major at the UW-Madison website, his exact thought was, “That sounds like me.” After he learned more about the program in the summer before and during his freshman year, his mind was set. Matt signed up for the AMEP program with Mechanical Engineering as his focus and hasn’t looked back.

During the summer after his sophomore year, Matt worked at Prism Computational Sciences performing research on laser produced plasmas. The goal was to develop short wavelength technology for applications in areas such as lithography and medical imaging. Specifically, Matt worked on designing and utilizing an extreme ultraviolet (EUV) pinhole camera. On campus, Matt recently joined Professor Jean-Luc Thiffeault’s research group in the Department of Mathematics. His work focuses on understanding the complexity of mathematical braids and their application to the stirring of a very viscous fluid. Matt explains his work on braids in the following manner:
“Basically, you imagine you have a circular vat of fluid with however many rods inserted vertically. Mixing the fluid involves switching the positions of the rods over and over, and a braid is a way of graphically depicting this mixing process...the flow is the motion of the fluid as it is mixed; the braid itself represents the motion of these rods.”

Matt believes that it is important to know as soon as possible everything that is out there in terms of research opportunities. He regrets not looking into research earlier in his undergraduate career. Understandably, this is a common issue with AMEP students who have a broad range of interests making it hard to narrow down to one project.

Along with beginning research early, Matt would also advise younger students who are interested in AMEP to contact advisors early, even before they arrive on campus. This is the best way to find out whether the program suits one’s interests or not. Also, for those who find the AMEP curriculum daunting, Matt says, “Just go for it!” He has found the courses to be complementary, stating that “the physics courses often provide the theoretical concepts while the engineering courses show how these concepts are applied to real life. Meanwhile, the math courses provide the analytical tools needed for both theoretical and applied views.”

So far, Matt’s favorite courses have been Math 415, Applied Dynamical Systems, Chaos and Modeling with Professor Thiffeault and Physics 311, Mechanics with Professor Eriksson. Both classes have helped to develop his interests for graduate study, and both professors have conveyed passion and pride in teaching their students.

Though Matt still has one more year, he already has many fond memories here. His most cherished memory is the time that he has spent as a trumpeter in the marching band. As it turns out, many of the band members are engineers, and Matt quickly found students who shared similar interests with him. On a personal level, he says the hard work that is demanded of the members elicits “a tremendous sense of pride in performing at Camp Randall and on [their] numerous road and bowl trips.”

Matt has plans to pursue a physics PhD program to study nonlinear dynamics after graduation. He is currently beginning the application process and looking at universities all over the nation.

Congratulations also to Lyubov Chumakova, a past AMEP prize winner who was awarded a National Science Foundation post-doctoral fellowship to pursue research at the Massachusetts Institute of Technology after receiving her PhD at New York University. The list of prior winners of the AMEP leadership Prize, endowed by Dan Koellen, can be found on the website.
Contact Information

For any information regarding the AMEP program, please contact the AMEP coordinator:

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The AMEP website is www.math.wisc.edu/~amep

Giving to the AMEP Program

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