UNIVERSITY of WASHINGTON

CHEMLETTER

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LETTER FROM THE CHAIR

Dear Friend of Chemistry,

I have lots of exciting news to report. Our department is fortunate to have superb students, staff, and faculty who continue to do great science. Chemistry major Tim Welsh won the ThinkSwiss Research Scholarship and is spending the summer in Zürich. Biochemistry major Rachel Boccamazzo has been awarded the Bonderman Travel Fellowship and will spend eight months traveling to at least six different countries in two different regions of the world. Each year, the Husky 100 honors 100 UW students in all areas of study. We congratulate undergraduate students Kyle Curtis, Ernie Tao, Michelle Ann Wasan, Tim Welsh, and graduate student Nicholas Montoni for being named to the Husky 100.

Graduate student Sarah Vorpahl has been awarded the 2017-2018 Congressional Science and Engineering Fellowship on behalf of the Materials Research Society (MRS) and The Optical Society (OSA) (see page 8 for more about Sarah).

Our assistant professors have won several awards. Dan Fu received the Beckman Young Investigator Award (see page 4); Brandi Cossairt was named a Camille Dreyfus Teacher-Scholar. Ashleigh Theberge and her collaborator Erwin Berthier received the Kavli Microbiome Award, which will help them to develop new analytical chemistry methods to identify molecular signaling networks (see page 6).

Professor Michael Gelb will present the annual University Faculty Lecture at 7:00 pm on January 23, 2018. We encourage our friends to attend to learn about the wonderful work on infant screening for rare diseases (see pages 2–3).

Students in chemistry still learn the fundamentals of our discipline in ways familiar to earlier generations. However, we are continually introducing new courses to keep up with new developments and to improve the educational experience for our students. *Polymer Chemistry*, taught by AJ Boydston, will introduce students to the underlying chemistry that enables control over macromolecular structure, which in turn dictates property and function. Brandi Cossairt and David Ginger are developing a new hands-on lab course titled *Energy Materials, Devices and Systems*. This course provides project-based training for synthesis and characterization of new materials for energy generation and storage, and the integration of renewables

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IN THIS ISSUE

UW IN THE HIGH SCHOOL CHEM 110

In 2011, Professor Phil Reid, then Associate Chair for Undergraduate Education, was approached by Tim Stetter, the director of the UW in the High School (UWHS) program, about offering a college level chemistry course for high school students. For the past 36 years, the University of Washington has partnered with high schools across the state of Washington to provide official UW courses taught by each high school's teachers who have been approved and trained in the UW curriculum by UW faculty in the respective departments.

The UWHS program provides an alternative to Running Start (a program that allows 11th and 12th grade students to take college courses at a college campus) and Advanced Placement courses (college-level courses that prepare students to take the corresponding AP exam, for which the exam score may earn the student college credit), allowing students to earn UW credit for a college course offered at their own high school and without a single high-stakes exam as the only assessment tool. UWHS is fully accredited by the National Alliance of Concurrent Enrollment Partnerships, ensuring that "UWHS meets or exceeds rigorous national standards of quality, in the areas of curriculum, instructors, students, assessment, and program evaluation." (https://www.uwhs.uw.edu/about/).

Professor Reid and Senior Lecturer Colleen Craig worked, in collaboration with four high school teachers, to develop a curriculum to provide CHEM 110 (Preparation for General Chemistry) in the high schools. When the partnership began in the 2012-2013 academic year, UWHS CHEM 110 courses were offered by four teachers at three high schools in the Central Puget Sound region. As the Faculty Coordinator, Dr. Craig spearheaded the program, developed resources, provided discipline-specific teacher trainings, and made in-person visits for observations, all of which are required components for the UWHS program. The in-person observations are an opportunity for the Department of Chemistry team to provide feedback to the teachers about the content and format of the class period, engagement of the students, and the rigor of the content coverage as it compares to the expectations of the on-campus CHEM 110 course.

As the number of participating schools has grown and extended to the east side of the Cascades, several graduate students have served as liaisons, supporting the UWHS CHEM 110 course by visiting the schools for observations and participating in the annual training day for teachers. Senior Lecturer Kim Gunnerson (UW Bothell) served as a co-coordinator for a year and a half, helping to formalize the observation procedures to ensure continuity when observations are performed by different liaisons. Assistant Professor Alshakim Nelson joined the team as a faculty liaison in the 2016-2017 academic year, performing classroom observations and participating in the annual training day. Senior Lecturer Andrea Carroll will take over as Faculty Coordinator of the UW in the High School program for the Department of Chemistry at the start of the 2017-2018 school year.

Last year, 355 students at nine high schools earned credit for CHEM 110 through the UWHS program. As the UWHS CHEM 110 course enters its sixth year, the Department of Chemistry is thrilled to be expecting up to seventeen teachers offering the course in 2017-2018, more than tripling the number of participating schools since the inaugural year! In addition, we have expanded our reach to include several high schools from Eastern Washington, South Puget Sound, and the Olympic Peninsula. The UWHS CHEM 110 program is now truly a statewide endeavor.

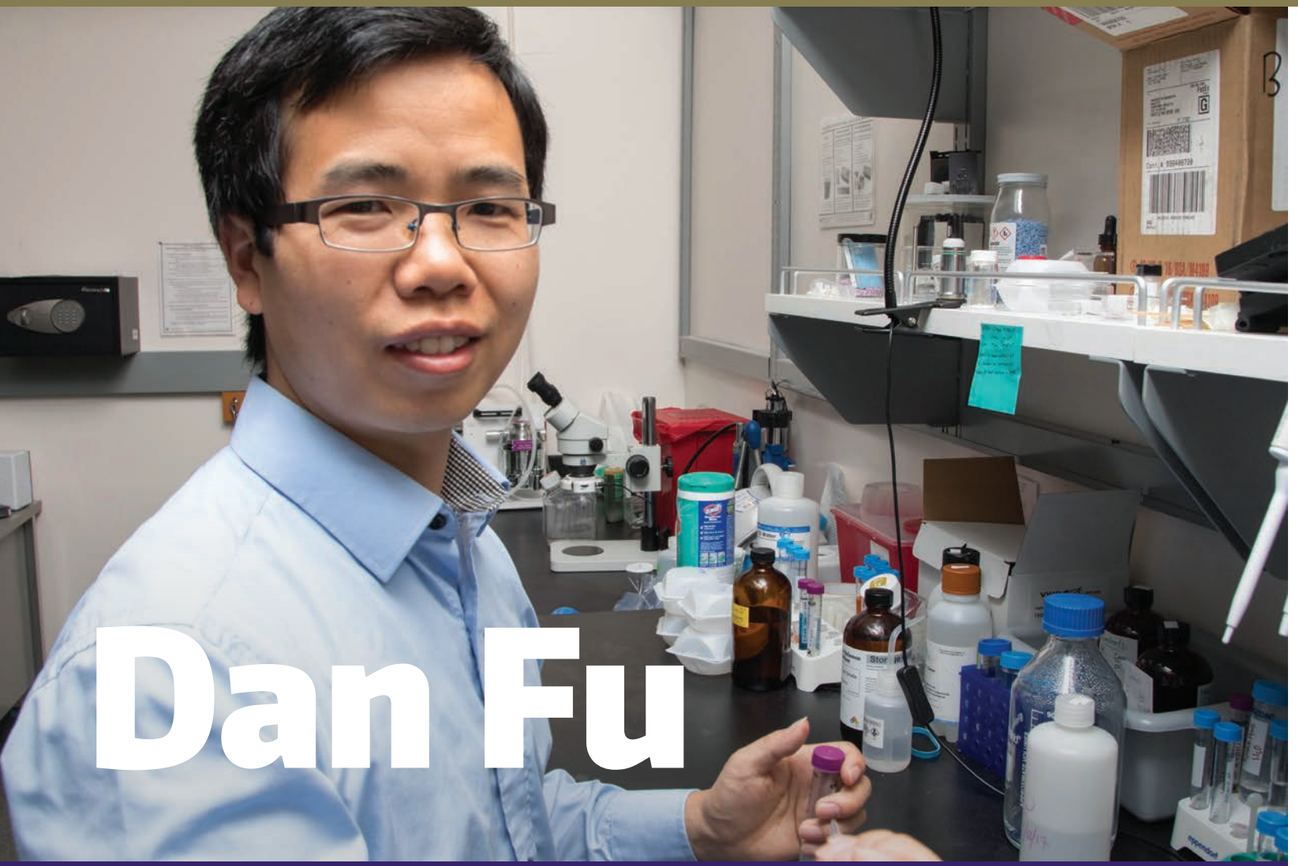
In preparation for the new school year, the Department of Chemistry team and eleven UWHS CHEM 110 teachers participated in the annual UWHS Training Day on campus. The morning plenary session, hosted by the UWHS staff, provided general information and program updates. The rest of the day was dedicated to discipline-specific training, discussing course expectations, best practices for the ALEKS® online learning system, and collaborative sharing of laboratory experiments and engaging in-class activities. After a tour of the renovated lecture hall and general chemistry laboratory spaces, Professor Nelson provided a tour of his research lab as well as an introduction to polymer chemistry and the polymers that surround us in our everyday lives. Everyone participated in a laboratory activity to make polymer hydrogels, demonstrating for the teachers a low-cost activity not requiring an extensive amount of preparation and one that that they can easily use to expose their students to polymer science. It was a wonderful day of networking, collaborating, and planning for the new year!

ABOVE: UWHS CHEMISTRY 110 TEACHERS PARTICIPATE IN A LOW-COST AND NON-TOXIC ACTIVITY THAT THEY CAN EASILY USE TO EXPOSE THEIR STUDENTS TO POLYMER SCIENCE.

SAVE THE DATE *for*
University Faculty Lecture

JANUARY 23, 2018

MICHAEL GELB, THE BORIS AND BARBARA L. WEINSTEIN ENDOWED CHAIR IN CHEMISTRY and Adjunct Professor of Biochemistry, will deliver the 2017-18 University Faculty Lecture. This prestigious annual event is scheduled for Tuesday, January 23, 2018 in Kane Hall; the lecture will start at 7:00 pm, with a reception immediately following the talk. **Save the date!**



Dan Fu

Dan Fu Receives Prestigious 2017 Beckman Young Investigator Award

Assistant Professor Dan Fu has been selected as one of eight recipients of the 2017 Beckman Young Investigator Award.

The Beckman Young Investigator Award is given by the Arnold and Mabel Beckman Foundation to promising young faculty members who are working to open areas of research in the chemical and life sciences. The recipients were selected from a pool of more than 300 applicants after a three-part review led by a panel of scientific experts.

"We are excited to support these amazing researchers," says Dr. Anne Hultgren, executive director of the Foundation. "The Foundation is committed to helping launch our next generation of talented scientists by giving them the funding and flexibility they need to pursue novel areas of study that have the potential for revolutionary breakthroughs."

Fu will use the funding provided by this award to develop an integrated optical imaging system, which will help researchers and doctors understand cancer cell growth and development to ultimately determine the best method of treatment and deliver a higher standard of personalized health care.

The last recipient of a Beckman Young Investigator Award at the University of Washington was Professor of Biochemistry David Baker in 1995.

The following story on Professor Fu and his research is reprinted from *Perspectives*, the College of Arts & Sciences newsletter.

To learn more about Professor Fu and his research, please visit his faculty page (http://depts.washington.edu/chem/people/faculty/fu.html) and research group website (http://depts.washington.edu/fudanlab/).

A NEW TOOL FOR STUDYING

Cancer Cells

by Nancy Joseph, July 17, 2017

Future cancer patients may have Dan Fu to thank for their individualized cancer treatment. Fu, assistant professor of chemistry, is developing tools that will identify the traits of cancer cells within a tumor with greater accuracy than ever before. For his ambitious work, he was recently named a 2017 Beckman Young Investigator, with a multi-year $750,000 award from the Arnold and Mabel Beckman Foundation.

One hallmark of cancer cells is that they grow and divide uncontrollably. Cancer treatments are designed to halt that growth and division. But cells within a tumor are often heterogeneous, with different mutation profiles and growth rates, complicating treatment. Even cells of the same type can grow at different rates depending on their location within a tumor. Cells close to a blood vessel, for example, may grow more quickly than cells further away from the vessel.

"It makes it hard to have a standardized treatment," says Fu. "Every person is unique, but also every cell is unique. So if we only treat the tumor as a whole, ignoring the difference between different cancer cells, the danger is that the drug kills only a fraction of the cells but leaves some behind. If one cell population in the tumor is growing really slowly and not responding to drugs, that could be a major factor in the tumor coming back."

Fu is developing an integrated optical imaging system that will allow researchers to more accurately measure the growth rates and other factors of each cancer cell in a tumor. The technology will also enable the study of tumors in a three-dimensional environment, which is crucial for understanding their behavior. Currently, most scientists study cells in a single layer in a Petri dish.

"It's important to study cell growth in its natural environment," says Fu. "Cells form spheroids, or clumps, and that cell-to-cell contact is really important, but you can't see that in a single layer in a Petri dish." The smooth, flat surfaces of the ubiquitous Petri dish are problematic as well. "Nowhere in your body do you have cells that attach to surfaces like that," Fu says. "When cells grow in that environment, the physiology of the cells changes because they have to attach to a surface that doesn't exist in the body. But that approach is what scientists are comfortable with, and what they have been using for many decades."

Fu's integrated optical imaging system uses invisible near-infrared light to explore whole tumor spheroids and more accurately measure not just individual cell growth within the tumor but also a range of other micro-environmental factors such as oxygen levels, pH, and metabolic activity, all of which influence cell behavior. At least that's the hope.

"We're at the very beginning," Fu says. "We know that we are able to image cell growth with the methods we're developing. Now the question is whether we have the accuracy to actually differentiate between two different cells. Our goal is to refine the tools and combine that with three-dimensional cell culture."

The implications for cancer treatment could be huge. "Once this is developed, we'll be able to actually see how individual cells in a tumor grow and respond to a cancer drug, allowing doctors to tailor treatment options rather than treating the cells as if they're all the same," says Fu. "That would be a key development."

PHOTO CREDIT: COLETTE COSNER

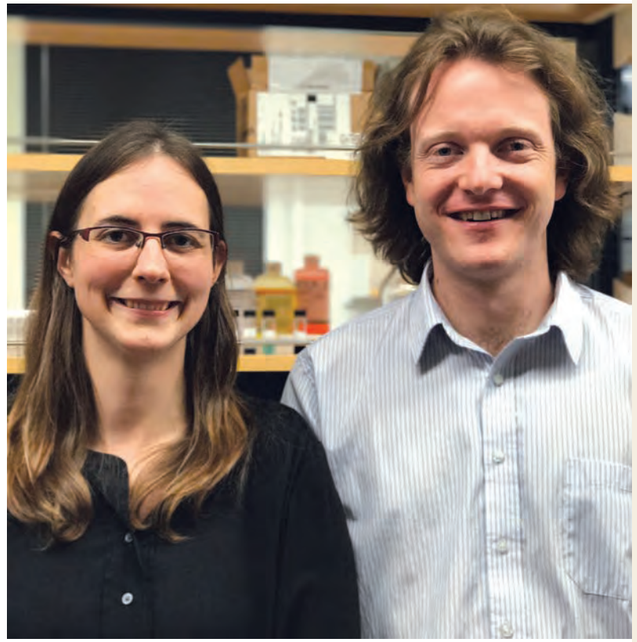
ASHLEIGH THEBERGE AND ERWIN BERTHIER RECEIVE THE KAVLI MICROBIOME AWARD

Assistant Professor Ashleigh Theberge and Affiliate Assistant Professor Erwin Berthier were selected to receive a Kavli Microbiome Ideas Challenge grant, which supports novel, cross-cutting tools and methods in the field of microbiome research. Approximately 100 applicants from around the world competed for a piece of this $1,000,000 grant, and Professor Theberge's collaborative project with Dr. Berthier was one of only three chosen for funding.

"The Kavli Microbiome Ideas Challenge is an exciting opportunity to support high risk, interdisciplinary research that does not normally receive traditional funding," said Tim Donohue, Chair of the Scientific Advisory board for the Kavli Challenge. "The grants selected for funding demonstrated great potential for the generation of novel tools and methods that will be broadly applicable across the many environments and move the field forward in the causal understanding of microbial and community function. The Kavli Foundation is to be commended for investing in this rapidly emerging field with this program."

The Theberge group, along with collaborator Nancy Keller at the University of Wisconsin–Madison, will use their $340,000 grant to develop a tool for deciphering multi-kingdom communication molecules using engineer cellular traps. The team will create new analytical chemistry and engineering tools that pull out key molecules from a mix of molecular noise in order to selectively "listen" to molecular signals produced by specific fungi, bacteria, or human cells.

To learn more about Professor Theberge and her research, please visit her faculty page (http://depts.washington.edu/chem/people/faculty/theberge.html) and research group website (http://depts.washington.edu/bcmelab/).



DR. GILES EPERON MAKES FORBES' "30 UNDER 30: ENERGY" LIST

by CEI

Though still completing a postdoctoral fellowship at the University of Washington, Dr. Giles Eperon has already made his mark in the field of energy, at least according to Forbes, which listed Eperon on "The 30 Under 30: Energy" list with other high-profile inventors and entrepreneurs this year. Eperon, who completed his Ph .D. at Oxford University, is currently working in the group of UW Chemistry Professor and MolES Faculty David Ginger.

Eperon is designing solar cells using hybrid halide perovskites, a class of mineral that holds great promise for cheap and efficient solar power. He has five patents and a long list of publications, including one that reported the perovskite formulations now widely used for record setting perovskite cells.

"Giles Eperon's Ph.D. work on earth-abundant perovskite semiconductors for low-cost, high-efficiency solar cells has already transformed how governments and industry worldwide are positioning hundreds of millions of dollars in investment in solar technologies, and he is arguably the most-cited, best-known scientist under 30 working in the field of solar energy," his postdoctoral advisor David Ginger observes.

In his recent publication in *Science*, Eperon and his collaborators showed that "by stacking multiple tailor-made perovskite modules we can exceed even the best solar panels of any type in the world, at much lower cost."

Eperon plans to commercialize technology related to his patents when he finishes his fellowship.

GILES EPERON DESIGNS THIN-FILM SOLAR CELLS MADE FROM HYBRID HALIDE PEROVSKITES. HE IS ONE OF THE MOST CITED YOUNG SCIENTIST WORKING IN THE SOLAR ENERGY FIELD.

Ms. Vorpahl
GOES TO WASHINGTON (D.C.)

by Jake Precht, May 1, 2017

Chemistry Ph.D. candidate Sarah Vorpahl will bring her passion for clean energy and policy to Washington, D.C. this September as a 2017-2018 Materials Research Society (MRS) and The Optical Society (OSA) Congressional Science and Engineering Fellow.

Her colleague in Clean Energy Institute (CEI) Chief Scientist David Ginger's group, Jake Precht, interviewed Sarah about her research, her experience as a CEI Graduate Fellow, and what's next in her career.

Jake Precht (JP): Tell me about your work investigating next-generation solar cells with CEI Chief Scientist David Ginger.

Sarah Vorpahl (SV): *My research in the Ginger Lab is broadly on a class of new solar cell materials that can be made into solution processible thin-films. This means that the solar cell absorber material is available as an ink that can be rolled out much the same way a newspaper is, via a roll-to-roll processor. Making solar cell materials in this way allows for a lot less material to be used, which both decreases the cost and increases the flexibility.*

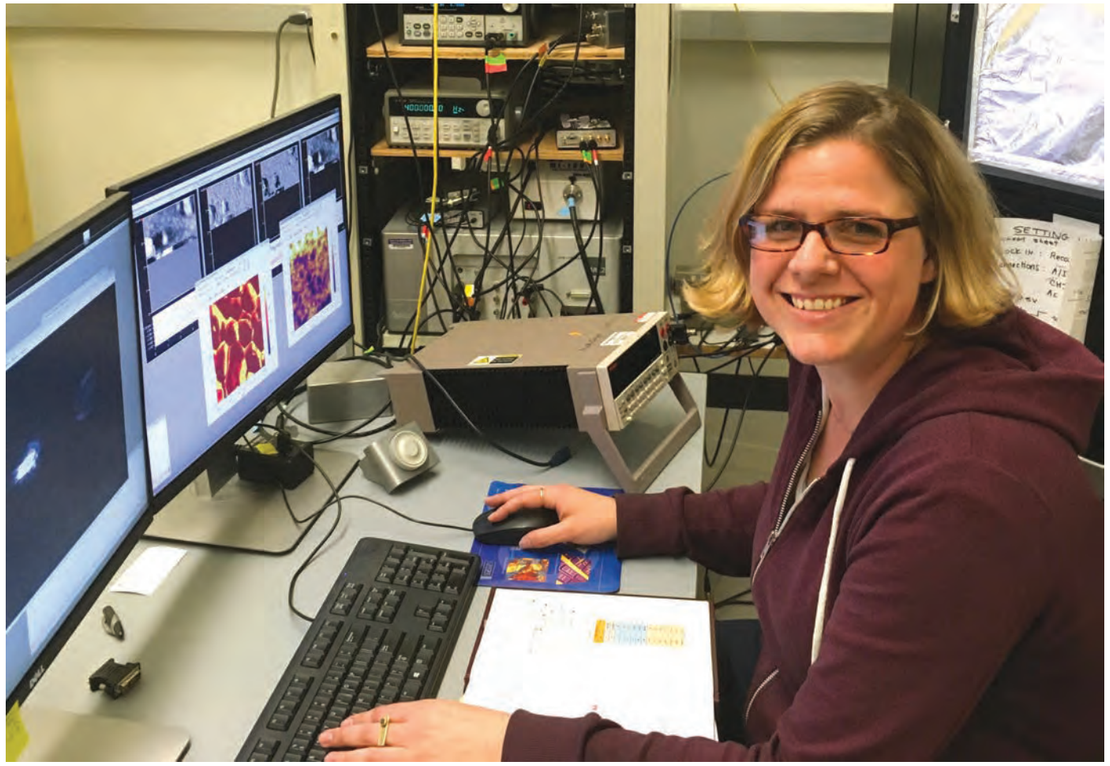
My most recent work focuses on an exciting new material called perovskite, which has gained attention for its swift rise in device efficiency within a relatively short period. Despite the impressive gains of these materials in the past 5 years, there are still many fundamental questions that remain open about perovskites. Our lab is interested in probing the fundamental electronic and material properties that underpin issues of device stability and other defects. I am particularly interested in understanding how the electromechanical properties of these materials, such as ferroelectric domain orientation, relate to their device performance as solar cells. I use atomic force microscopes to investigate these fundamental properties by creating maps with nanoscale spatial resolution that can then be correlated and compared with the overall performance at a bulk scale. Being able to ask fundamental questions about the local nanoscale properties under relevant operating conditions allows for a more dynamic understanding of how perovskites function as a solar cell.

JP: How has CEI helped you in these studies?

SV: *CEI has been a critical component to my graduate research. I have benefitted from the combination of having both world-class instrumentation as well as a vibrant community of graduate students and faculty in clean energy materials at my fingertips. I also think that because of CEI, the UW has been able to attract top-notch postdocs and new faculty, which has had a direct impact to my lab. I have taken advantage of the CEI Graduate Fellowship and academic meetings (such as the Orcas Conference) that have allowed me to interface with people about research related to my field.*

JP: How has CEI has helped you achieve your career goals?

SV: *CEI has provided me with incredible opportunities to interface with policy makers, industry, and entrepreneurs in the Washington state cleantech ecosystem. Since CEI is a member of the CleanTech Alliance, I have been able to take advantage of their events such as the CleanTech Breakfasts featuring important figures in the cleantech community as well as other networking events. Because I have made my interest in policy known within CEI, both my PI, David Ginger, and CEI Director Daniel Schwartz have given me amazing opportunities to represent CEI and discuss clean energy with local policy makers. For example, last October I served as a volunteer note taker at a Utilities and Transportation Commission workshop on innovation and the role of regulation. At this meeting, I learned about the challenges and unintended consequences of policy that seeks to satisfy the often-clashing interests between innovators, utilities, and regulators. CEI has been a hugely important institution during my graduate school career and has absolutely allowed me the space to grow and shape my policy understandings and beliefs.*



JP: What other organizations are you involved in at the University of Washington?

SV: *Four years ago, I founded Women in Chemical Sciences (WCS) to create a culture of inclusion in the UW Department of Chemistry and beyond. Under my guidance as president, WCS became a fully funded group in the Department of Chemistry, held dozens of workshops and career talks, and brought in world-famous speakers through competitive grants from within the University. I was also one of the founding members of Diversity in Clean Energy (DICE), a group within CEI that helps bring in diverse voices from the clean energy community. Last year, citing the need for further conversations across campus about diversity in STEM, I worked with CEI Graduate Fellow Nicholas Montoni to hold a one-day seminar called, "Strengthening STEM through Diversity." The event brought together more than a hundred students, faculty, and staff from across campus to help amplify the experience of minoritized students on campus.*

I have also been fortunate to spend some time working with other policy students on campus. Realizing my desire to translate my work to policy, I dedicated a year to advanced coursework in this field through the Evans School of Public Policy at the UW and earned a Ph.D. concentration in Public Policy and Management. I pursued this extracurricular research to understand the fundamental way to ask questions in this field and I have been able to apply these ideas directly in the arena of energy policy.

JP: Why do you think it's important to increase women's and other minority groups' participation in STEM?

SV: *Bringing a diverse voice to science makes it better. Not everyone is given equal access to the educational, emotional, or community resources necessary to achieve in STEM from an early age and especially later in college and beyond. Increasing representation and access to STEM means both increasing our early education in these subjects as well as having a faculty and student body that more closely mirror the demographics of this country. A major part of understanding the issues of diversity in STEM is talking about it! So creating safe places to share experiences, especially from those that have been successful, is critical to shining a light on the ways that minoritized students experience hardships as they go through their science careers.*

JP: I know that you're active in science policy advocacy here in Seattle. Tell me about your work for the Washington State Department of Commerce.

SV: *After the election, feeling a little dismayed and helpless, I contacted Brian Young, the Governor's clean technology sector lead at the Washington State Department of Commerce, whom I had met at a CleanTech Alliance event. I asked if I could intern at the Commerce Department to see how a technical person might have an impact on policy. I ended up working with the energy department on writing about the success stories from the Clean Energy Fund (CEF). CEF is an innovative program in the state of Washington that sets aside money from the capital budget for the development, testing, and deployment of new clean energy innovations to help reduce carbon emissions and increase the security and flexibility of the grid. I have been able to interface with all aspects of the clean energy world in Commerce, including the folks doing the daily policy work for clean energy in the state government, the big picture thinkers, the business development folks, as well the engineers who are working to make sure we can successfully transition to a new, shared energy economy. Seeing each of these roles has given me the opportunity to see how unique our energy landscape really is.*

JP: As long as we're talking science policy, now's a great time to say congratulations on your recent Congressional Fellowship! What are you going to be doing in Washington, D.C.?

SV: *I am honored to have this chance to work in D.C. I will be working in a congressional office staffing either a senator or representative on science-related issues. I am in a cohort of about 20 other fellows who will also be working on science issues. I hope to focus mainly on energy policy, but I am sure that I will have exposure to many different subjects as part of my work! I also get to take the same civics crash course as all freshmen congressional representatives. Hopefully I'll learn a little more about how a bill becomes a law than what I know from "Schoolhouse Rock!"*

JP: What is hindering widespread clean energy implementation in the United States?

SV: *I think the good news is that there are great advancements in technology on the way, especially at the academic research level! For example, we are seeing real potential in materials like perovskites for solar. Additionally, scientists are continuing to improve large-scale storage to help mitigate these distributed energy sources on the grid. I think that the biggest hurdle is an institutional one. Utilities in general are a very arcane business model and the institutions that regulate them create bureaucratic lag. Additionally, we have the very real hardware problem that comes with our aging and outdated electric grid. I believe that there are many progressive utilities that want to provide greater and cleaner options for energy consumers, but they also need to make money at the end of the day. Figuring out how to work with utilities and help mitigate cost and risk for modernizing the grid and bringing more distributed energy online is one of the greatest challenges moving forward for clean energy.*

I think that policy can step in to both incentivize renewable energy implementation as well as mitigate some of the risk involved with being an early adapter. Innovative policy like the Clean Energy Fund here in Washington state, and what's happening in New York, helps mitigate the risk to utilities and other institutions for being early adopters of clean technology.

JP: Thanks, Sarah! Good luck wrapping up your Ph.D. and starting your fellowship in D.C.!

Jake Precht is starting his third year of graduate studies in CEI Chief Scientist David Ginger's group.

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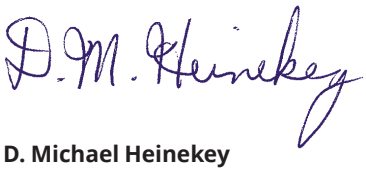
LETTER FROM THE CHAIR *contiuned from page 1*

into energy systems. Students will use instruments at the Clean Energy Institute's new Research Training Testbed located in the Nanoengineering and Sciences Building. The Research Training Testbed is part of CEI's Washington Clean Energy Testbeds.

As I write this, the UW administration is finalizing the budget for the coming biennium. As you may have heard, the legislature has significantly increased funding for K-12 education. The budget for higher education is less generous. The precise details of the UW budget are still being worked out, but we are looking at fairly lean times ahead.

I close with thanks to all of you for your generous contributions to the Department. Your gifts make possible many vital activities, including the recruiting of outstanding faculty and graduate students. We are very grateful for your generosity in giving back to today's students.

With best wishes,



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