UNIVERSITY of WASHINGTON

CHEMLETTER

AUTUMN 2019 / VOLUME XXXVII NO.2

LETTER FROM THE CHAIR

Dear Friend of Chemistry,

This year marks the 100th anniversary of the birth of Professor Emeritus B. Seymour Rabinovitch. Rab was a continual inspiration to his family and to all who knew him. He passed away in August 2014 after a long and illustrious career at the University of Washington. To celebrate Rab's centennial, this issue features a description of an experiment of historical importance by Rab and Jay Rynbrandt (Ph.D., 1970) as summarized by Professors Paul Hopkins and Charlie Campbell (pages 6-11). Rab's warm presence, charm, and kindness will be missed, but his legacy lives in the collegial environment we enjoy in this department thanks to his positive influence and commitment to diversity.

In my last letter, I announced the arrival of our newest assistant professors Dianne Xiao and Matt Golder. They have hit the ground running and you can learn more about them on pages 2-5.

As always, I am pleased to announce our students' recent accolades of highly competitive local, national, and even international awards. Jason Wien was named as the Freshman Medalist and Irika Sinha won the Goldwater Scholarship. Lauren Koulias was awarded the prestigious MOLSSI Software Investment Fellowship which supports software development efforts that will have a broader impact on the community. Jeffrey Buenaflor has been recognized with multiple university-wide awards including the Excellence in Teaching Award, the UWAA's Homecoming Scholarship, and being named to the Husky 100. Several students won travel grants and presented their research at conferences both throughout the United States and abroad, earning awards for their posters and presentations; eleven chemistry students are among the 2019-20 cohort of Clean Energy Institute Graduate Fellows; all of these and more are listed on pages 12-15 along with the departmental scholarships and awards that are made possible by the generosity of our friends and alumni.

Our faculty continue to gather recognition and awards for their achievements. Assistant Professor Dan Fu received an NSF CAREER Award and was named as an Eli Lilly Young Investigator. Assistant Professor Ashleigh Theberge was awarded a Packard Fellowship from the David and Lucile Packard Foundation. We are very proud to note that this is the *third* Packard Fellowship in recent times for our department: Munira Khalil won in 2008 and Brandi Cossairt in 2017. During this period, Packard Fellowships have been awarded to about 275 exceptional young scientists and engineers. Of these, 29 are chemists, and three of these chemists are members of our faculty! (Berkeley also had three, Harvard had two, and no other

Continued on back page

IN THIS ISSUE

FACULTY INTRODUCTIONS

By Seoyeon (Cece) Hong

Matthew Golder, Assistant Professor

Ph.D. Chemistry, 2015
UNIVERSITY OF OREGON

Dissertation: *Synthesis and Characterization of Small Molecule Carbon Nanotube Fragments*

Adviser: *Ramesh Jasti*

B.S. Chemistry, 2010
UNIVERSITY OF ROCHESTER

Thesis: *Studies of Carbodiimide Formation by a β-diketiminate Iron(I) Complex*

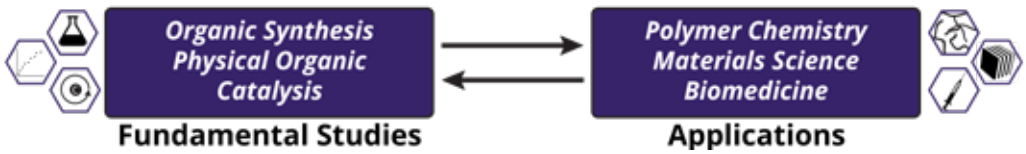
Adviser: *Patrick L. Holland*

Matthew Golder is a native of Massachusetts whose career in chemistry has taken him to New York and Oregon prior to landing in Seattle.

Matt's interest in organic chemistry and organometallics was cultivated at the University of Rochester where he earned a B.S. in chemistry. Matt first conducted research in organic materials as a DAAD-RISE Scholar at Humboldt University of Berlin under the guidance of Professor Stefan Hecht. As an undergraduate researcher at the University of Rochester, he studied the mechanisms of iron-catalyzed nitrene transfer with Professor Patrick Holland.

Matt began his doctoral work with Professor Ramesh Jasti at Boston University, and he earned his Ph.D. from the University of Oregon in 2015 after the Jasti research group relocated. As a graduate student, Matt studied the total synthesis and characterization of a class of carbon nanotube fragments. Carbon nanotubes exhibit properties that may improve challenges pertaining to energy storage, electronics, and biomaterials.

Upon completing his Ph.D., Matt returned to Massachusetts as an NIH F32 Postdoctoral Fellow at the Massachusetts Institute of Technology working with Associate Professor Jeremiah A. Johnson. Matt's postdoctoral research focused on the synthesis and applications of larger molecules, such as polymers. The properties of polymeric systems present various opportunities in biomedicine, sustainable energy, and electronics. Matt developed and characterized polymers that aim to control macromolecular sequence and structure for applications in self-assembly and drug delivery.



As a postdoctoral fellow, Matt mentored several junior scientists, participated in workshops for future faculty, and developed undergraduate courses at MIT.

In August 2019, Matt joined the faculty at the University of Washington as an assistant professor of Chemistry and a member of the Molecular Engineering & Sciences Institute. The current research efforts of his research team are to develop new strategies to synthesize novel and functional cyclic molecules, polymers with reconfigurable networks, and force-responsive soft materials. In order to build novel macromolecular architectures, the team is in an advantageous position to leverage the expertise from organic synthesis, physical organic chemistry, polymer chemistry, and materials science and is excited to take on interdisciplinary projects. The team hopes that the research will contribute to advancements in the fields of sustainability, biomedicine, and electronics using polymeric molecules.

The UW Department of Chemistry is delighted to welcome Matt. Several faculty members are impressed with Matt's research thus far and are excited to have him join the Department. Associate Professor Stefan Stoll, a member of the faculty search committee, says "Matt is really outstanding, and we are lucky that we were able to recruit him to the UW." Professor Bo Zhang, also on the faculty search committee, expressed the same sentiment as he says that he is "extremely delighted to have Matt as colleague in the Department". Bo believes that Matt's expertise "will significantly strengthen our research in organic materials chemistry." Associate Professor Brandi Cossairt concurs, exclaiming, "I am so excited that Matt decided to come to the UW."

Outside of research, Matt enjoys photography, cooking, and swinging kettlebells, and he has participated in two triathlons. Matt loves the outdoors and the good food scene in Seattle. He looks forward to exploring the Pacific Northwest on land and water.

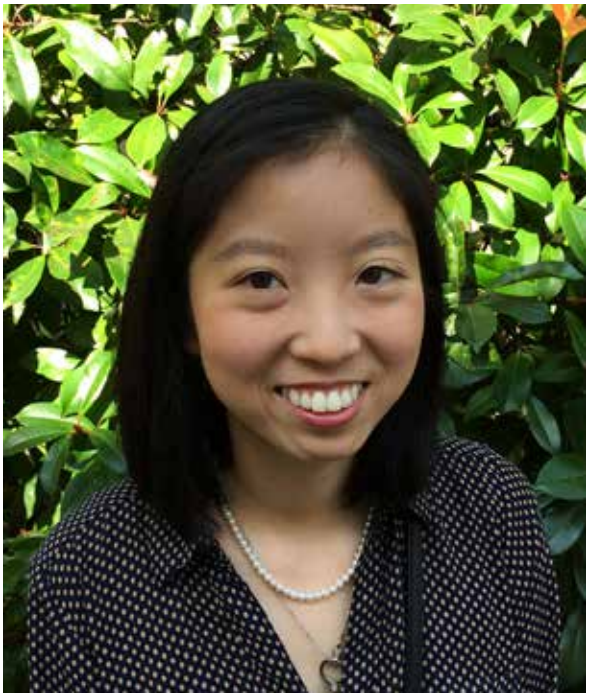
For more information about Professor Golder and his research, please visit his group page at golderresearchteam.org.

AN OUTFITTED FUME HOOD IN THE GOLDER LABORATORY WAITS FOR EAGER STUDENTS TO SYNTHESIZE NEW POLYMERS AND ORGANIC MATERIALS.

The current research efforts of his research team are to develop new strategies to synthesize novel and functional cyclic molecules, polymers with reconfigurable networks, and force-responsive soft materials.

FACULTY INTRODUCTIONS CONTINUED

Dianne Xiao, Assistant Professor



Ph.D. Chemistry, 2016
UNIVERSITY OF CALIFORNIA, BERKELEY

Dissertation: *Metal–Oxo and Dioxygen Chemistry in Metal–Organic Frameworks: Applications in Catalysis and Gas Separations*

Adviser: *Jeffrey R. Long*

B.A. Chemistry, 2011
HARVARD UNIVERSITY

Thesis: *Taming Manganese: Synthesis and Characterization of Trinuclear and Hexanuclear Manganese Clusters*

Adviser: *Theodore Betley*

Dianne Xiao was born in Ann Arbor, Michigan and lived in New Jersey, Massachusetts, and California before moving to Seattle to join the faculty at the University of Washington in July 2019.

Dianne graduated *summa cum laude* with a B.A. in chemistry from Harvard University in 2011. In her undergraduate research under the mentorship of Professor Theodore Betley, she investigated trinuclear metal complexes and studied how multiple metals can cooperatively bind and activate substrates.

Dianne earned her Ph.D. with Professor Jeffrey R. Long at the University of California, Berkeley. As an NSF Graduate Research Fellow, Dianne studied metal–organic frameworks (MOFs), which are organic-inorganic hybrid crystalline materials that exhibit high porosity and chemical tunability. MOF pores can be engineered to selectively trap certain molecules over others (e.g. carbon dioxide from flue gas), or to catalyze specific chemical reactions. Dianne's research focused on stabilizing reactive metal–oxo and dioxygen species in MOFs for applications in hydrocarbon oxidation catalysis. Her findings provided insights into how cheap and abundant materials such as gaseous alkanes can be converted into more valuable resources such as liquid fuels and commodity chemicals.

In addition to her research activities, Dianne is enthusiastic about teaching undergraduates. At Berkeley, she was recognized with an outstanding graduate student instructor award. She is looking forward to teaching undergraduate inorganic chemistry and general chemistry here at the University of Washington.

After graduating, Dianne conducted postdoctoral research at Stanford University as an Arnold O. Beckman Postdoctoral Fellow with Associate Professor Matthew W. Kanan. Dianne focused on developing new methods for carbon dioxide utilization. Her work uncovered a new route to carboxylic acids and other industrially useful products from low value starting materials such as carbon dioxide and hydrocarbons. Unlike her doctoral studies, which focused on MOF catalysts with very well-defined active sites, Dianne's postdoctoral studies utilized materials with amorphous structures but novel functions. This experience provided her with a new toolkit to characterize and understand catalysts with complex and ill-defined surfaces but exciting reactivity.

At the University of Washington, the Xiao group will develop new strategies to control the structure of porous materials across multiple length scales, from the molecular to the nano- and macroscale. By controlling both the local and long-range structure of porous molecules, the group hopes to uncover enhanced transport properties, new catalytic activity, and novel emergent behavior. Ultimately, the Xiao group hopes to address challenges in energy conversion, catalysis, and molecular separations, using expertise from inorganic, organic, materials, and physical chemistry.

After establishing the lab and setting up instrumentation over the first few months, the Xiao group is now focused on research. Dianne looks forward to recruiting students to her research group.

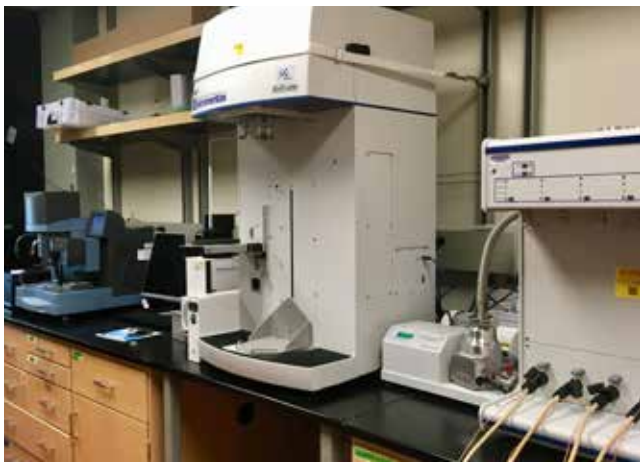
Dianne loved her first summer in Seattle and adores the view of the Seattle skyline and Mt. Rainier. She commutes to campus by foot and generally enjoys walking in Seattle. She is excited to be at the University of Washington, especially since she loves huskies and the color purple.

Likewise, the Department is excited to welcome Dianne. Stefan Stoll, associate professor and member of the faculty search committee, expressed his optimistic prospects of Dianne's expertise and the potential impacts to the Department: "Dianne is a powerhouse, and we are excited about her and the research program she is starting in our department." Several other faculty members shared similar excitement and delight about their new colleague. Professor Bo Zhang believes that "we are very lucky to have hired both [Dianne and Matt Golder] in the same year. Both Dianne and Matt have done outstanding work in their respective research areas. Having them on board will significantly strengthen our research in inorganic and organic materials chemistry."

Outside of the lab, Dianne enjoys watching Netflix and trying new restaurants.

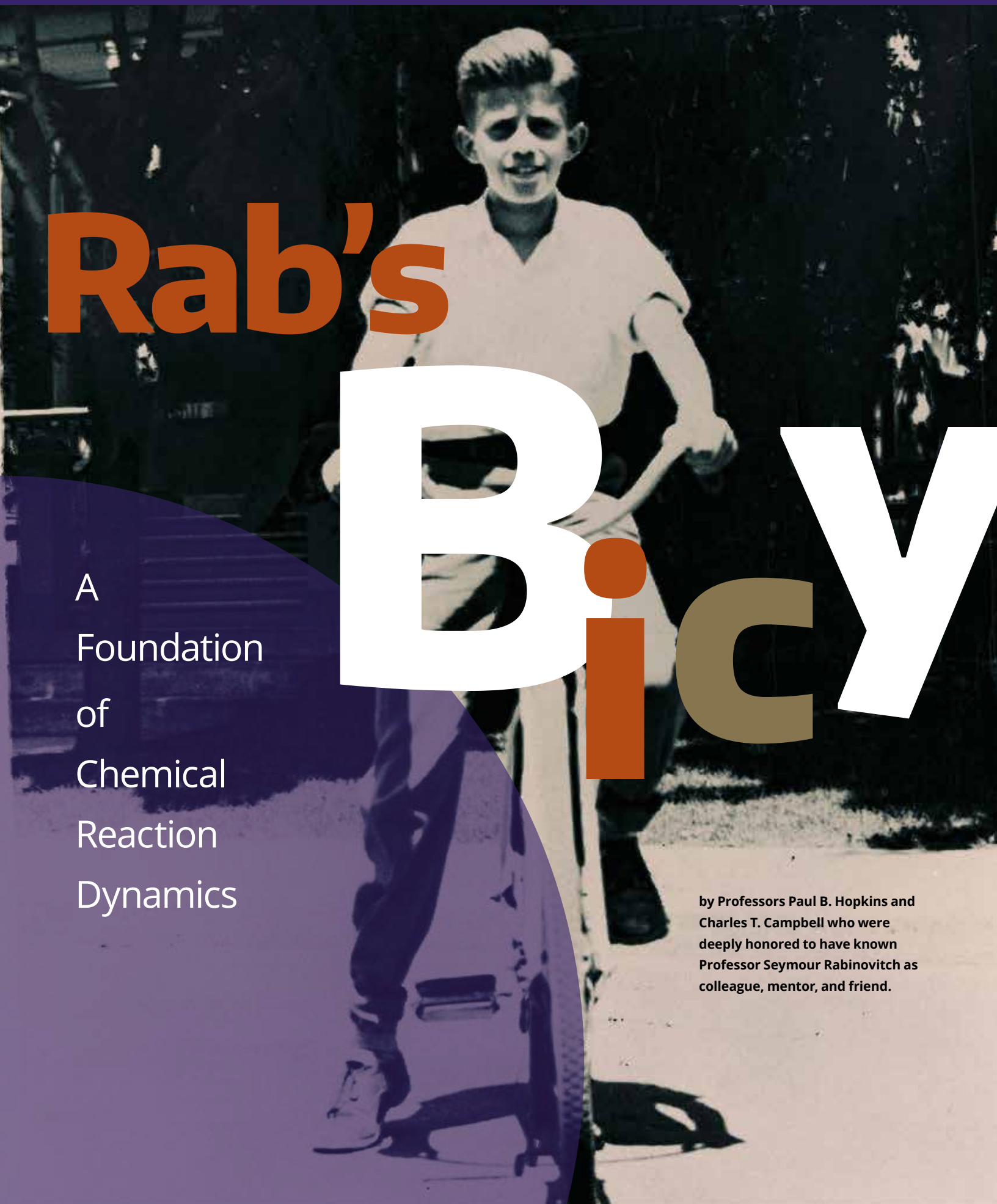
For more information about Professor Xiao and her research, please visit her group page at xiaolab.org.

FIRST-YEAR ROTATION STUDENTS IN THE XIAO GROUP GET TO KNOW EACH OTHER AND DIANNE OVER DINNER IN CAPITOL HILL.



STATE-OF-THE-ART GAS SORPTION EQUIPMENT HOUSED IN THE XIAO LAB WILL BE USED TO CHARACTERIZE THE SURFACE AREA AND GAS BINDING PROPERTIES OF NEW POROUS MATERIALS.

Seoyeon (Cece) Hong *is a doctoral candidate in the UW Department of Chemistry who studies protein mass spectrometry in the research group of Associate Professor Matt Bush. She enjoys writing about research, discoveries, and scientists' achievements for various audiences. Cece aspires to make an impact as a great science communicator.*



Rab's Bicy

A Foundation of Chemical Reaction Dynamics

by Professors Paul B. Hopkins and Charles T. Campbell who were deeply honored to have known Professor Seymour Rabinovitch as colleague, mentor, and friend.

Author's Note

Our dear colleague, mentor, and friend Professor Emeritus Seymour Rabinovitch passed away five years ago at the age of 95 after a long and illustrious career at the University of Washington. Thus, the year 2019 marks the 100th anniversary of Rab's birth in Montreal in 1919. Interested readers are directed to a retrospective of his life and academic career co-authored by one of us (Charles T. Campbell) at https://doi.org/10.1098/rsbm.2015.0021.

To celebrate Rab's centennial, we summarize here an experiment and its interpretation, his work with graduate student and UW alumnus Jay Rynbrandt (Ph.D., 1970). This work is of great historical importance in the field of chemical dynamics for reasons that should become clear in the article that follows. This experiment is celebrating its own anniversary, having been conducted and published in the time period from about 1969 to 1971, and is thus some 50 years old. This experiment continues to be cited today.

I. INTRODUCTION

Among many scientific accomplishments, Rabinovitch is particularly remembered for having clearly demonstrated that the energy of highly vibrationally excited polyatomic molecules in the gas phase is internally redistributed among all available modes at a rate that exceeds the typical rates at which such excited molecules can break bonds to form other species. The ratios of products of chemical reactions with different chemical structures (i.e., selectivities) are thus typically independent of the specific vibrational mode(s) into which the energy is originally deposited.

Interestingly, Rabinovitch also provided the first well-characterized example of a reaction which violates this rule, in which the product distribution *is* influenced by the site at which energy is deposited to form an excited reactant. One could argue that this experiment marks the birth of "chemical reaction dynamics" as we interpret that phrase today. The experimental design and analysis of the resulting data are brilliant and elegant. The experiment involved the creation of a symmetrical hexafluorobicyclopropyl that has come to be known as "Rab's bicycle" (Figure 1, at right). "At birth" this molecule contained a large excess of vibrational energy localized almost entirely to one of the two three-membered rings (depicted as **2*** in Figure 2 on page 9). Rab and his graduate student co-worker Jay Rynbrandt wondered whether it might be possible to detect preferential cleavage of the highly excited ring prior to redistribution of the vibrational energy throughout the entire molecule.

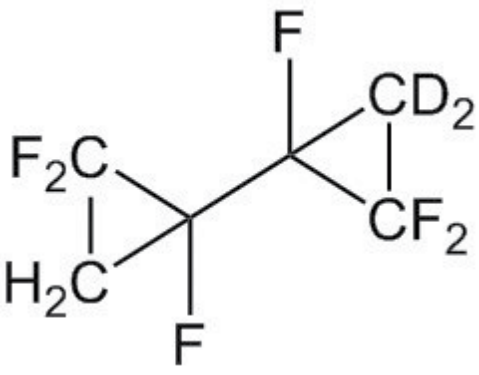


Figure 1. Rab's Bicycles. (above) Isotopically labeled "hexafluorobicyclopropyl", which has come to be known as "Rab's bicycle". (opposite) Seymour Rabinovitch in 1939 with a less famous bicycle.

II. THE EXPERIMENT

The experiment commenced with the addition in the gas phase of photochemically-generated singlet dideuteriomethylene ($^1CD_2$) to the hexfluorovinylcyclopropane **1**, to generate the excited bicyclopropyl **2*** (see Figure 2). On the basis of known standard heats of formation of similar starting materials, the addition reaction was calculated to be exothermic by about 110 kcal/mol. This excess energy was presumed to be non-randomly distributed, localized at the instant of reaction almost entirely in the newly formed ring, as depicted by the asterisk-labeled ring in **2***. Of great interest was how the species **2*** would partition among three possible channels: One possibility was for the highly excited, newly formed ring to fragment *selectively* by ejection of the comparatively stable difluorocarbene (CF_2), to afford **3** (Figure 2, left pathway). Alternatively, redistribution of the vibrational energy throughout the molecule would be expected to form randomly-excited **2***, which would in turn fragment by loss of difluorocarbene to yield a 1:1 mixture of **3** and **4** (Figure 2, center pathway). *Any amount of* **3** *formed in excess of* **4** *would be evidence of chemical reaction prior to internal energy redistribution.* The reason for and importance of the third possible channel, collisional deactivation of **2*** with the bath gas carbon monoxide (CO) (Figure 2, right pathway), to yield "stabilized" 2, is described in the next paragraph.

Reading between the lines we learn that Rabinovitch and his students were tenacious at overcoming adversity. At seemingly every step they encountered obstacles...

This was the first study ever to conclusively reveal a chemical reaction of sufficient speed to compete with internal energy redistribution.

An additional experimental variable, the ability to vary the pressure of an inert bath gas, in this case carbon monoxide, served two purposes. First, Rab and his co-workers, and others, had previously studied the deactivation of vibrationally-excited species by collisions with a bath gas. The rate of occurrence of such collisions as a function of pressure, and the ability of each collision to dissipate energy, were well understood. Collisional deactivation could thus serve as a clock against which to measure the rates of other competing reactions; it served in this case to provide the rate constant with which **2***, after vibrational energy redistribution, underwent fragmentation to form **3** and **4** in a 1:1 ratio (k_{random} in Figure 2). Second, at high pressures, collisional deactivation of **2*** to form the vibrationally-deactivated product **2** (lacking sufficient vibrational energy to fragment to **3** or **4** at any appreciable rate), was expected to reduce the "background" yield of **3** and **4** formed at longer time points in a 1:1 ratio, and enhancing the chances to detect even a few percent of excess of **3** formed selectively at early times.

In their first publication on this system, the reaction was conducted at carbon monoxide bath gas pressures ranging from 1 to 310 mm. The product mixtures were quantified using mass spectrometry, relying upon a fragment with m/e 95 that was diagnostic for **3**, and a fragment with m/e 97 (two units of mass higher due to the deuterium labels) for **4**. They observed a constant and nearly 1:1 ratio of products **3** and **4**. These results were consistent with many other chemical systems: internal redistribution of initially-localized vibrational energy is fast relative to bond-breaking chemical reactions that make new products.

Undeterred, Rab and Rynbrandt extended their study to even higher bath gas pressures, to increase the rate at which **2*** with vibrational energy redistributed would undergo collisional deactivation. One can imagine their delight as reactions at higher gas bath pressures at last resulted in a rising ratio of **3** to **4** (see Figure 3)! This was the evidence that a fraction of the chemical reaction was occurring prior to internal energy redistribution, yielding products whose structures were influenced by non-randomly distributed energy! At 3300 mm bath gas pressure, of the fragmentation products observed, 25% were from the non-random channel (yielding exclusively **3**), and the balance of 75% from the random cleavage channel (yielding a 1:1 mixture of **3** and **4**).

III. THE INTERPRETATION

The discussion that follows can be disorienting to the chemist accustomed to the concept of a rate constant. Rab and Rynbrandt chose to model their data by presuming that the rate constants $k_{non\text{-}random}$ and k_{random} in Figure 2 varied with time. At t = 0 sec, the instant of creation of **2***, the value of $k_{non\text{-}random}$ was presumed to be at its maximum ($k^{o}_{non\text{-}random}$). With time, as the excess energy in this newly formed ring dissipated across the entire molecule, $k_{non\text{-}random}$ was expected to drop in value, approaching zero. The value of k_{random}, initially zero at t = 0 sec, was presumed correspondingly to rise with time approaching some maximal value k^{∞}_{random}. The challenge they faced was to develop a quantitative model accounting for the rates of all these phenomena. Their model is described below.

As noted above, the rate constant k^{∞}_{random} for fragmentation of **2*** after the vibrational energy was fully distributed, was determined by competition with the pressure-dependent rate at which **2*** underwent collisional deactivation to yield **2**, and was found to be 2.3 X 10^{9} sec^{-1}. Using RRKM theory, they calculated an initial fragmentation rate for **2*** (with nearly all 110 kcal/mol of excess energy localized to one of the two cyclopropane rings, $k^{o}_{non\text{-}random}$) that was about 100-fold faster, 3.5 X 10^{11} sec^{-1}. These two values, the ratios of **2**, **3** and **4** produced as a function of pressure, and the assumption that the vibrational energy in the initially formed ring declines at a rate described by a simple exponential decay, were combined in a computer model to calculate a composite, effective rate of energy redistribution that best fit all of the experimental data: 1.1 X 10^{12} sec^{-1}.

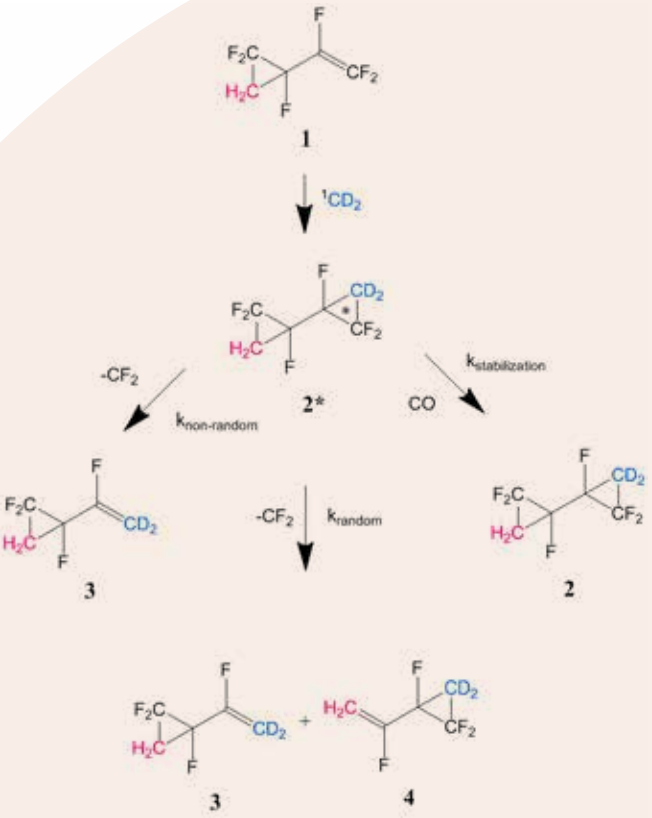


Figure 2. The Experiment. Rab's bicycle (**2***), formed initially with an excess of vibrational energy localized to the ring marked with an asterisk, reacted by three competing pathways: loss of difluorocarbene from the highly excited ring (to form **3**), loss of difluorocarbene equally from both rings (to form equal amounts of **3** and **4**), or relaxation by collisional deactivation with bath gas (to form stable **2**). CD_2 and CH_2 are depicted in blue and red, respectively, for clarity.

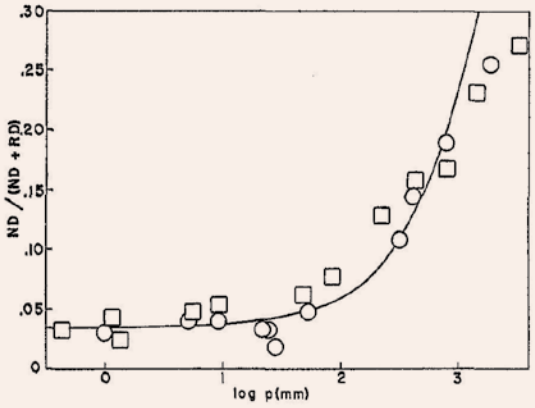


Figure 3. Excess Non-Random Fragmentation Enhanced at High Pressure. Ratio of non-random decomposition (ND) to form **3**, to total decomposition (non-random and random, ND + RD), ND/(ND+RD), as a function of log pressure (mm) of bath gas. Circles are data for system in Figure 2. Squares are data for an experiment in which the positions of protons and deuterons were interchanged. [Reprinted from J. Phys. Chem. 75, 1971, pp. 2164-2171.]

The consequences of the various reaction rates described above (some time-dependent, some pressure-dependent) on the rate of product formation as a function of time and pressure are depicted in Figure 4. It is helpful to think about these competing chemical reactions as occurring in two distinct stages. Stage one begins at t = 0 seconds with the birth of **2*** with excess energy localized to the newly formed ring. Stage one is a furious race between two ultra-rapid processes: fragmentation of the highly excited species to form predominantly **3** (in red), and redistribution of the vibrational energy throughout **2*** causing the rate of production of **3** to rapidly decline. The duration of stage one is so brief that collisions with carbon monoxide, deactivating **2*** (to form **2** that is too "cold" to react) are too infrequent to compete significantly. In stage one, just a few percent (they estimate 3.5%) of **2*** fragments selectively to form **3**. Stage one is effectively extinguished (compared to the rate of random cleavage) in less than a picosecond. In stage two, commencing after that first picosecond and lasting until **2*** is depleted (on the order of a nanosecond), fragmentation of **2***, now with energy nearly randomly distributed throughout the molecule (in black, expanded 50-fold on vertical axis; see Figure 4 legend) to form **3** and **4** in a 1:1 ratio, competes with collisions of **2*** with carbon monoxide at various pressures (rising from blue, to green, to purple), which lead to unreactive **2** as a final product. At the highest carbon monoxide pressures, the formation of **3** and **4** in 1:1 ratio is significantly suppressed, and **2** becomes the predominant product of stage two (slightly exceeding **3** and **4**). Thus, at the highest bath gas pressures, excess **3** (formed selectively in stage one) becomes more easily detected against a reduced background of the slowly-produced **3** and **4**.

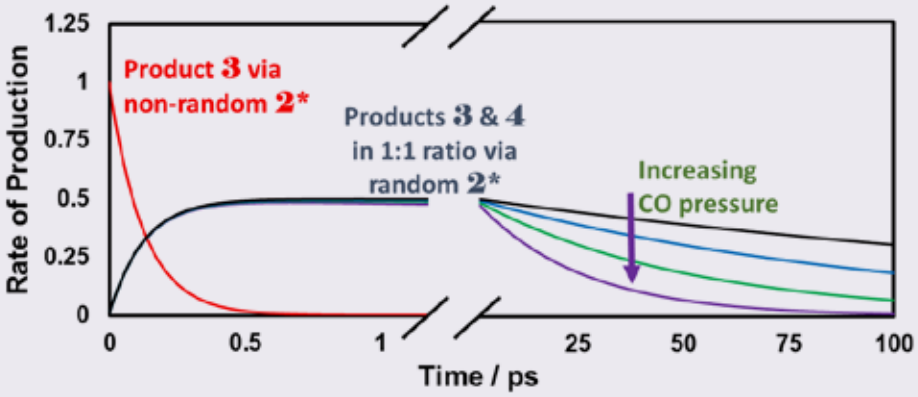


Figure 4. Time Evolution of Rates of Product Formation. This is an approximate representation of the kinetic model of Rabinovitch and Rynbrandt. In stage one, during the first picosecond, non-random fragmentation selectively to form **3** (red curve) predominates; the rate of this reaction declines rapidly as the excess vibrational energy in the newly formed ring is dissipated throughout the molecule. After the first picosecond, in stage two, the 100-fold slower random fragmentation to form **3** and **4** in equal amounts (black curve, expanded on vertical axis by 50X) can be suppressed by collisional deactivation (blue, green, purple curves representing results of rising CO bath pressure). As illustrated, the yield of **3** and **4** formed in stage two, proportional to the area under the curve, decreases with rising bath pressure, simplifying the detection of **3** formed in stage one. The exponential decay constant for the dissipation of localized vibrational energy, estimated by this experiment to be 1.1 X 10^{12} sec^{-1} (a ~1 picosecond time constant), is an important number in the history of our understanding of chemical reaction dynamics.

IV. EPILOGUE

Reading between the lines we learn that Rabinovitch and his students were tenacious at overcoming adversity. At seemingly every step they encountered obstacles. A few examples include complications that arose from the generation of the triplet state of methylene (rather than the desired singlet state) which were suppressed by incorporation of traces of the triplet scavenger oxygen in the bath gas; lack of reference samples of the products which were formed in only microscopic amounts, requiring the development of methods to characterize the products by mass spectrometry and gas chromatographic retention times rather than spectroscopy; and isotope-effects on mass spectrometric fragmentation reaction rates that necessitated the incorporation of isotope-effect correction factors in the quantitation of ratios of **3** to **4**.

This was the first study ever to conclusively reveal a chemical reaction of sufficient speed to compete with internal energy redistribution. This highly influential paper, now some fifty years old, has stood the test of time, and continues to be cited. This experiment remains today a textbook example of (1) how the dynamics of internal energy flow can effect chemical reactions, (2) the quantitation of rates at which vibrational energy is redistributed in molecules, and the (3) anomalous reactivity exhibited by molecules with localized high levels of vibrational excitation. Its sheer elegance and creativity have inspired many researchers, and will continue to do so.

V. REFERENCES

Rynbrandt, J.D. and Rabinovitch, B.S. J. Phys. Chem., **74**, 4175-4176 (1970)

Rynbrandt, J.D. and Rabinovitch, B.S. J. Chem. Phys. **54**, 2275-2276 (1971)

Rynbrandt, J.D. and Rabinovitch, B.S. J. Phys. Chem., **75**, 2164-2171 (1971)

FACULTY AWARDS & HONORS

Andrea Carroll

Finalist, Distinguished Teaching Award, University of Washington

Larry Dalton

Board of Directors, Washington State Academy of Sciences

Dan Fu

CAREER Award, National Science Foundation

Eli Lilly and Company Young Investigator Award in Analytical Chemistry

Sarah Keller

Cottrell STAR (Science Teaching and Research) Award, Research Corporation for Science Advancement

Lipidomics Excellence Award, Lipotype GmbH

Munira Khalil

Chemistry Faculty Lecturer, University of Washington Department of Chemistry

Anne McCoy

Elected Member, Washington State Academy of Sciences

William A. Chupka Lecturer in Physical Chemistry, Yale University

Cody Schlenker

CAREER Award, National Science Foundation

ACS Applied Energy Materials Young Investigator

Journal of the American Chemical Society Young Investigator

Ashleigh Theberge

Packard Fellow for Science and Engineering, David & Lucile Packard Foundation

František Tureček

INTER-EXCELLENCE Award for Czech-American Scientific Cooperation

POSTDOCTORAL SCHOLARS FELLOWSHIPS & AWARDS

Connor Bischak

Mistletoe Foundation Unfettered Research Grant

Daniel Kroupa

CoMotion Commercialization Postdoctoral Fellowship

Tristan Nicholson

Travel Award, American Society of Andrology Annual Meeting

Podium Presentation, American Society of Andrology Annual Meeting

Best Poster, American Urological Association Annual Meeting

Warren H. Chapman Resident Research Award, University of Washington

Housestaff Association Research Grant, University of Washington

Jian Wang

Mistletoe Foundation Unfettered Research Grant

GRADUATE FELLOWSHIPS & AWARDS

Casey Bisted

ARCS Foundation Fellowship

Jeffrey Buenaflor

Excellence in Teaching Award

Husky 100

Homecoming Scholarship, UW Alumni Association

Clean Energy Institute Travel Award

Oral Presentation, National Meeting of the American Chemical Society, Fall 2019

Caitlin Cain

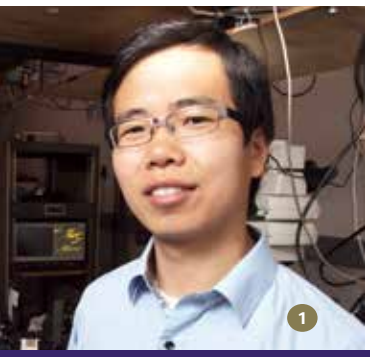
Mary K. Simeon and Goldie Simeon Read Chemistry Research Fellowship

Daniele Canzani

Mickey and Karen Schurr Endowed Graduate Support Fellowship

Theodore Cohen

Clean Energy Institute Graduate Fellowship



1 DAN FU **2** SARAH KELLER **3** ASHLEIGH THEBERGE **4** JEFFREY BUENAFLOR **5** ZACHARY COHEN

Zachary Cohen

Mickey and Karen Schurr Endowed Graduate Support Fellowship

Finalist, Student Research Achievement Award, Biophysical Society

Caitlin Cornell

21st Century Postdoctoral Fellowship Award in Understanding Dynamic and Multi-scale Systems, James S. McDonnell Foundation

Poster Prize, Biophysical Society of Canada

Travel Award, Biophysical Society of Canada

Peter Defnet

Irving and Mildred Shain Endowed Fellowship in Chemistry

Ryan DiRisio

Basil G. and Gretchen F. Anex Endowed Fellowship

Christopher Fellin

Lewis R. and Joan M. Honnen Endowed Fellowship in Chemistry

Lucas Flagg

NIST NRC Postdoctoral Research Associateship

Paige Gannon

Honorable Mention, National Science Foundation Graduate Research Fellowship Program

Jackson Geary

Lloyd E. and Florence M. West Endowed Fellowship in Chemistry

Atchuthan Gopalan

Clean Energy Institute Graduate Fellowship

Amanda Haack

Joanne & Bruce Montgomery ARCS Foundation Endowed Fellowship in honor of the American Lung Association

Joseph Heindel

Larry R. Dalton Graduate Fellowship

Best Student Talk, Northwest Theoretical and Computational Chemistry Conference

ExaLearn Project Fellowship, Office of Advanced Scientific Computing Research, Department of Energy

Quantum Molecular Design Summer School Scholarship, Stanford PULSE Institute

Symposium Presentation, National Meeting of the American Chemical Society, Fall 2019

Kristina Herman

Mickey and Karen Schurr Endowed Graduate Support Fellowship

Micaela Homer

Howard J. Ringold Endowed Fellowship

Xinying Hong

Raymond and Sally Paxton Endowed Fellowship in Chemistry

Hang Hu

Clean Energy Institute Graduate Fellowship

Laura Jacoby

Clean Energy Institute Graduate Fellowship

Joseph Kasper

Amy Scott and Stephen C. Alley Endowed Fellowship in Chemistry

Jonathan Kephart

David M. Ritter Endowed Scholarship

Clean Energy Institute Graduate Fellowship

Science Communication Fellowship, Pacific Science Center

Brianne King

Mary K. Simeon and Goldie Simeon Read Chemistry Research Fellowship

Lauren Koulias

Investment Fellowship, Molecular Sciences Software Institute

Honorable Mention, National Science Foundation Graduate Research Fellowship Program

Ulri Lee

Gary and Sue Christian Graduate Student Support Fellowship in Chemistry

Biosensors Travel Award

Calvin Leonen

Howard J. Ringold Endowed Fellowship in Chemistry

Chantelle Leveille

Lyle H. Jensen Graduate Fellowship

Student Research Achievement Award, Biophysical Society

Travel Award, Biophysical Society

Caroline Loe

Howard J. Ringold Endowed Fellowship in Chemistry

6 CAITLIN CORNELL **7** AMANDA HAACK **8** KRISTINA HERMAN **9** MICAELA HOMER **10** CHANTELLE LEVEILLE **11** CAROLINE LOE

Evan Long

Lewis R. and Joan M. Honnen Endowed Fellowship in Chemistry

Yongtian Luo

Brian R. Reid Endowed Fellowship in Chemistry

Zhongtian Mao

Benton Seymour Rabinovitch Endowed Fellowship

Morton M. Traum Surface Science Student Award, American Vacuum Society

Fundamental Discoveries in Heterogeneous Catalysis Award, American Vacuum Society

Alexis Mills

Clean Energy Institute Graduate Fellowship

Honorable Mention, National Science Foundation Graduate Research Fellowship Program

Benjamin Mitchell

National Science Foundation Graduate Research Fellowship

Nayon Park

Clean Energy Institute Graduate Fellowship

Marissa Parker

Molecular Biophysics Training Grant funded by the National Institutes of Health

Leo Porter-Zasada

Rowland Endowed Fellowship in Chemistry

Justin Pothoof

Clean Energy Institute Graduate Fellowship

Ben Poulter

National Science Foundation Graduate Research Fellowship

Kimo Pressler

David M. Ritter Endowed Scholarship

Andres Reyna

Howard J. Ringold Endowed Fellowship in Chemistry

Usha and S. Rao Varanasi Endowed Diversity Scholarship in Chemistry

Andrew Ritchhart

Chemistry Graduate Alumni Fund

Ricardo Rivera-Maldonado

ARCS Foundation Fellowship

Joo Yeon Diana Roh

David M. Ritter Endowed Scholarship

Austin Shaff

Amy Scott and Stephen C. Alley Endowed Fellowship in Chemistry

Heidi Spears

Molecular Biophysics Training Grant funded by the National Institutes of Health

Poster Award, UW Molecular Biophysics Training Program Retreat

Margherita Taddei

Howard J. Ringold Endowed Fellowship in Chemistry

Larry R. Dalton Graduate Fellowship

Fulbright Fellowship, Fulbright Foreign Student Program

Soo Nee Tan

Mary K. Simeon and Goldie Simeon Read Chemistry Research Fellowship

Anton Taraskin

George H. Hitchings Endowed Scholarship

Lindsey Ulmer

Eugene S. Mindlin Endowed Fellowship Fund

Tammi van Neel

NIH Diversity Administrative Supplement

Nicholas Vetterli

Benton Seymour Rabinovitch Endowed Fellowship

Kendahl Walz

Clean Energy Institute Graduate Fellowship

Sarah West

Clean Energy Institute Graduate Fellowship

Andrew Wildman

Paul H. and Karen S. Gudiksen Endowed Fellowship

Best Poster, Northwest Theoretical and Computational Chemistry Conference

Liam Wrigley

Clean Energy Institute Graduate Fellowship

Xi (Fiona) Xu

Tomas Hirschfeld Endowed Fellowship

Howard J. Ringold Endowed Fellowship in Chemistry

Muammer Yaman

Clean Energy Institute Graduate Fellowship

Tianzi Zhang

Gary and Sue Christian Graduate Student Support Fellowship in Chemistry

Travel Grant, Micro Total Analysis Systems (MicroTAS) International Conference on Miniaturized Systems for Chemistry and Life Sciences

1 EVAN LONG **2** KIMO PRESSLER **3** ANDRES REYNA **4** AUSTIN SHAFF **5** HEIDI SPEARS **6** MARGHERITA TADDEI

2018–19 *ALMA MATER* TRAVEL AWARDS

Recipients of these travel awards receive funds to present a seminar on their Ph.D. research at their undergraduate alma mater.

Jose Araujo
University of Southern California (Los Angeles, CA)

Amrita Basu
University of Calcutta (Kolkata, India)

Emily Dieter
Saint Michael's College (Colchester, VT)

Rae Eaton
Oberlin College (Oberlin, OH)

Michael Enright
Ripon College (Ripon, WI)

Jason Fontana
University of Trento (Trento, Italy)

Dylan Karis
University of Wisconsin–Eau Claire (Eau Claire, WI)

Joseph Kasper
Taylor University (Upland, IN)

Yang Liu
Sichuan University (Chengdu, China)

UNDERGRADUATE FELLOWSHIPS & AWARDS

Ziareena Al-Mualem
ACS Undergraduate Award in Physical Chemistry

Distinguished Research in Chemistry

Noah Baker
Earl W. Davie Endowed Scholarship in Chemistry or Biochemistry

Raveena Bhui
Ed F. and Clara M. Degering Tuition Scholarship

Andrew Boggiano
ACS Undergraduate Award in Inorganic Chemistry

Andrew Boggiano
Distinguished Research in Chemistry

Daniel Brock
Distinguished Research in Biochemistry

Lauren Cominsky
Ed F. and Clara M. Degering Tuition Scholarship

John Day
ACS Undergraduate Award in Analytical Chemistry

Gerald and Sheila Berkelhammer Book Award

Donya Derakshani
College of Arts & Sciences Gonfaloniere, University of Washington Commencement

Colette Felton
Distinguished Research in Biochemistry

Bri Fernandez
Distinguished Research in Chemistry

Zachariah Fincher
Honors General Chemistry Achievement Award

Anthony Garcia
Hyp Dauben Award

Marianna Gilbert
Hyp Dauben Award

David Hales
Student Service Award

Huayi Jiang
Distinguished Research in Biochemistry

Yaro Khimich
Boeing Scholarship

Thomas Khuu
Husky 100

Shohei Koshiro
Distinguished Research in Biochemistry

Kieran Lewis
Distinguished Research in Chemistry

H. K. Benson Undergraduate Tuition Scholarship

Matt Louie
Distinguished Research in Chemistry

Anika McManamen
Rex J. and Ruth C. Robinson Scholarship Fund in Chemistry

Brayden Miranda
P. C. Cross Award

Katie Mostoller
Husky 100

Brandon Mozzone
Distinguished Research in Chemistry

Samantha Paskvan
Zalia Jencks Rowe Undergraduate Tuition Scholarship

Angelo Ramos
Distinguished Research in Biochemistry

7 JOHN DAY **8** DONYA DERAKSHANI **9** YARO KHIMICH **10** THOMAS KHUU **11** KATIE MOSTOLLER

Hannah Redden

Donald J. Hanahan Endowed Scholarship in Chemistry or Biochemistry

Shareef Shaheen

Rex J. and Ruth C. Robinson Scholarship Fund in Chemistry

Irika Sinha

Goldwater Scholarship

Hyp Dauben Award

Usha and S. Rao Varanasi Endowed Diversity Scholarship in Chemistry

Dong Hyeok Song

Distinguished Research in Chemistry

Ethan Vo

Student Service Award

Grace Wang

Friends of Chemistry Award

Jason Wien

Freshman Medalist (2017-18)

Hyp Dauben Award

William Wu

Honors General Chemistry Achievement Award

DOCTORAL DEGREES AWARDED

Bo Cao, Ph.D. Chemistry

Additive Manufacturing of Mechanoresponsive Polymers

(Affiliate Associate Professor AJ Boydston)

Zuzana Culakova, Ph.D. Chemistry

Late Transition Metal Pre-Catalysts for the Hydrogenation of Carbonyl-Containing Substrates

(Affiliate Professor Karen I. Goldberg)

Emma L. D'Ambro, Ph.D. Chemistry

Molecular Composition, Volatility, and Formation Mechanisms of Biogenic Secondary Organic Aerosol

(Professor Joel A. Thornton, Atmospheric Sciences)

Andy Dang, Ph.D. Chemistry

Novel Mass Spectrometry Techniques Implementing UV Action Spectroscopy for the Characterization of DNA Cation Radicals and Transition Metal Complexes

(Professor František Tureček)

Chen Dong, Ph.D. Chemistry

Programming Bacterial Gene Expression Using Synthetic CRISPR-Cas Transcriptional Regulators

(Assistant Professor Jesse Zalatan)

Rachel M. Eaton, Ph.D. Chemistry

Design and Characterization of Novel Tandem Ion Mobility Mass Spectrometry Instrumentation

(Assistant Professor Matt Bush)

Michael J. Enright, Ph.D. Chemistry

Synthesis of Colloidal Semiconductor Heterostructures for Photocatalysis

(Associate Professor Brandi Cossairt)

Erin N. Fagnan, Ph.D. Chemistry

Mechanisms for Scaffold-Mediated Regulation of Kinase Activity in the Wnt Signaling Pathway

(Assistant Professor Jesse Zalatan)

Yunshan Fan, Ph.D. Chemistry

Probing Electrochemical Processes of Single Entities at the Electrode/Solution Interface

(Professor Bo Zhang)

Hannah C. Feldman, Ph.D. Chemistry

Pharmacological Modulation and Functional Characterization of the Protein Kinase-Endoribonuclease IRE1a

(Professor Dustin J. Maly)

Lauren Gagnon, Ph.D. Chemistry

Advancements in Single Molecule Localization Microscopy for Improved Multichannel, 3-Dimensional, and Structurally Dense Imaging

(Assistant Professor Joshua C. Vaughan)

Sonam Kaur Ghag, Ph.D. Chemistry

Bead-Based Chemistries to Quantitate Antibody Responses to Multiple Plasmodium Falciparum and Plasmodium Vivax Antigens

(Professor Pradipsinh K. Rathod)

Katherine Ann Graham, Ph.D. Chemistry

Characterization of Trp-Cage and Its Circular Permutation

(Professor Emeritus Niels Andersen)

Chu Han, Ph.D. Chemistry

Electrochemical Characterization of Nanomaterials and Development of New Electrochemical Methods

(Professor Bo Zhang)

1 DONG HYEOK SONG **2** YUNSHAN FAN **3** HONGBIN LIU **4** VIKTORIA PAKHNYUK **5** SOO NEE TAN

Shushan He, Ph.D. Chemistry

Using Molecular Dynamics Simulations and Statistical Modeling to Explore Membrane Structure and Membrane-Protein Interactions

(Assistant Professor Lutz Maibaum)

Kira E. Hughes, Ph.D. Chemistry

Exploring the Photophysics of Engineered and Intrinsic Charge-Carrier Trapping Processes in Semiconductor Nanocrystals

(Professor Daniel R. Gamelin)

Raymond Jin, Ph.D. Chemistry

Molecular Dynamics Simulations of DNA Hybridization and Dynamic Force Spectroscopy

(Assistant Professor Lutz Maibaum)

Victoria K. Kensy, Ph.D. Chemistry

Investigations into the Synthesis and Reactivity of Polynorbornene Frameworks

(Affiliate Associate Professor AJ Boydston)

Jeremy D. Lehner, Ph.D. Chemistry

Computational Modeling of Dynamic Electron Paramagnetic Resonance Spectra

(Associate Professor Stefan Stoll)

Hongbin Liu, Ph.D. Chemistry

Modeling Nanomaterials with Efficient and Accurate Electronic Structure Methods

(Professor Xiaosong Li)

Pengtao Lu, Ph.D. Chemistry

Development of Organic Photoredox-Mediated Ring-Opening Metathesis Polymerization through Expanded Functionalities of Initiators and Monomers

(Affiliate Associate Professor AJ Boydston)

Yongtian Luo, Ph.D. Chemistry

Theoretical and Computational Studies of the Lateral Phases on a Multicomponent Lipid-Bilayer Surface

(Assistant Professor Lutz Maibaum)

Julia Nguyen, Ph.D. Chemistry

Cross-Coupling of Alkenyl Gold Complexes with Alkyl Electrophiles and Nickel Catalyzed Hydroarylation of Alkenes

(Professor Gojko Lalic)

Jarred Z. Olson, Ph.D. Chemistry

Leveraging Operando Characterization Methods to Reveal Failure and Optimization Mechanisms of Group IV Semiconductor Battery Anodes

(Assistant Professor Cody W. Schlenker)

Viktoria V. Pakhnyuk, Ph.D. Chemistry

Elucidating Structural Effects of Conjugated Polymers on Charge Transport and Durability for Organic Electronics and Development of Stretchable Semiconducting Materials

(Professor Christine K. Luscombe, Materials Science & Engineering)

Nihit Pokhrel, Ph.D. Chemistry

Understanding Lipid Membranes' Interactions with Small Molecules, Cholesterol, and Clay Surface Using Molecular Dynamics Computer Simulation

(Assistant Professor Lutz Maibaum)

Soo Nee Tan, Ph.D. Chemistry

Dissecting Mechanisms of Antimalarials Using CRISPR/Cas9 Editing in Plasmodium Falciparum

(Professor Pradipsinh K. Rathod)

Samuel David Whedon, Ph.D. Chemistry

Chemical Strategies for Investigation of Deubiquitinases

(Associate Professor Champak Chatterjee)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Reestablishing contact with our postdoctoral research alumni

The Department of Chemistry is hoping to reestablish contact with our former postdoctoral research associates. We have contact information for just a small number of the hundreds of postdocs who have studied with us through the years. Can you help us? Do you know the whereabouts of any postdocs you knew or worked with when you were at the UW? If so, we would appreciate you contacting them on our behalf to ask them to email us at chemdept@uw.edu. Thank you!

Our Donors

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The UW Department of Chemistry is fortunate to have literally thousands of friends and alumni, and we are deeply indebted to those named here who generously give back. With your help, we provide state of the art education to today's students. Thank you!

If you are among our chemistry or biochemistry alumni who have not yet given back to the Department of Chemistry, we hope you will reconsider that choice. Students, faculty, and staff are the beneficiaries of your gifts. Unlike decades ago, when gift-derived funds played a small role in our programs, annual gifts and endowment-derived funds are now critical to every aspect of our teaching and research. Help the current generation of students realize their dreams with your gift today.

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LETTER FROM THE CHAIR *continued from page 1*

chemistry department had more than two). I invite you to visit our website http://depts.washington.edu/chem/ to read more about the aforementioned awards, and turn to page 12 for the list of faculty awards from the past year.

Our department has worked hard to develop a sense of collegiality and community here. You are a part of it as well, and our students recognize and appreciate your support. Thank you for your gifts and your presence that support us in our work.

Wishing you and yours happy holidays,

D. Michael Heinekey
Professor and Chair

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Robert E. Synovec, Co-Associate Chair for Graduate Education
Xiaosong Li, Co-Associate Chair for Graduate Education
Gary Drobny, Associate Chair for Undergraduate Education
Deborah Wiegand, Director of Entry-Level Programs

CONTRIBUTORS
Diana Knight, Assistant to the Chair
Seoyeon Hong, Ph.C.
Creative Communications

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