STRUCTURES

A PUBLICATION OF THE HAUPTMAN-WOODWARD INSTITUTE WINTER 2019

RE:INVENTING COOL

TRANSFORMING DISCOVERY THROUGH CRYO-EM

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Cryo-EM is turning protein research on its head

HWI is taking a huge leap forward, using Cryo-EM instruments to study life and disease like never before

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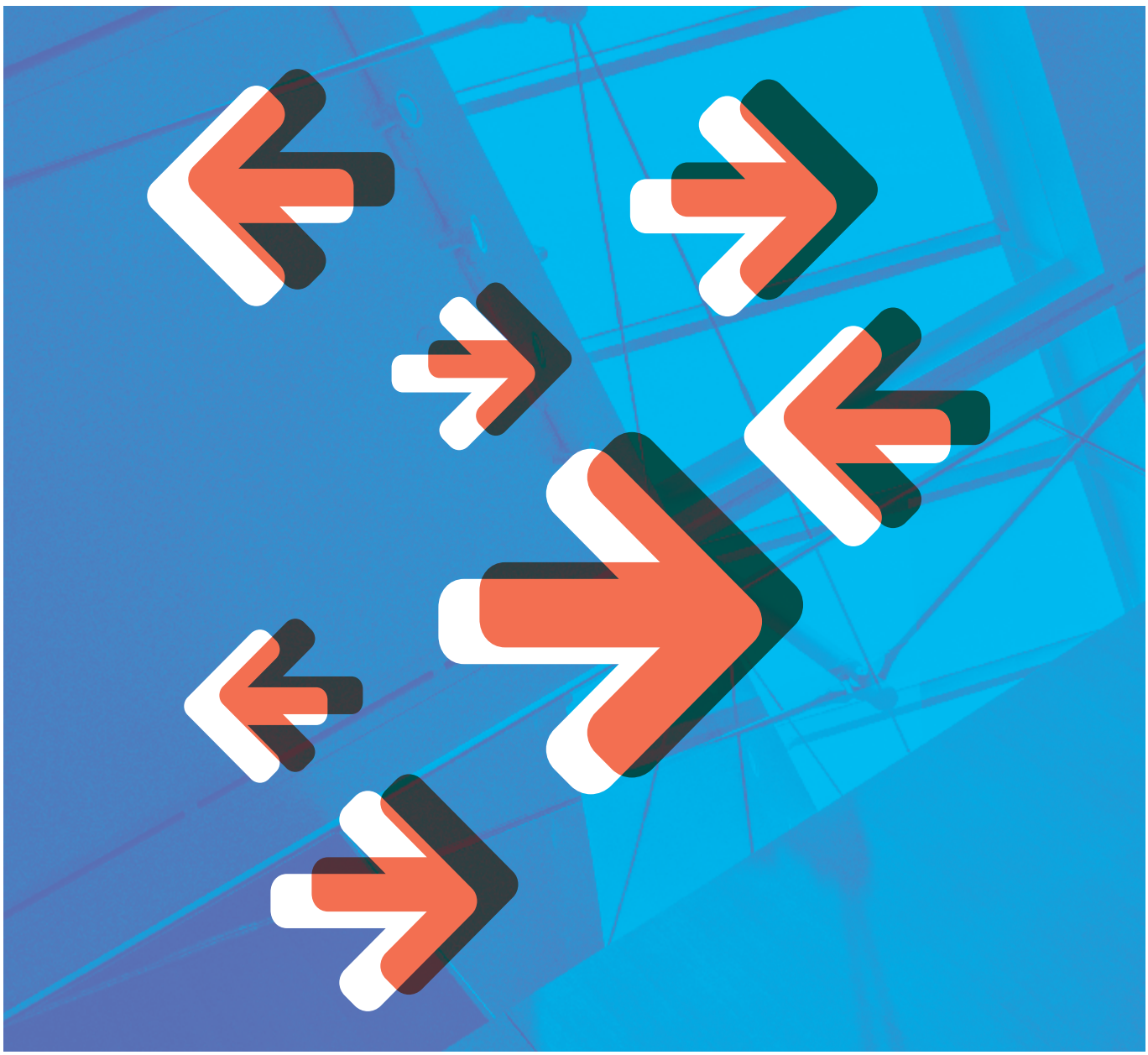

You too can make an impact in a multitude of ways and create your own legacy—page 40

SPOTLIGHT

STRUCTURES

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OUR BUILDING. OUR ARCHITECT:

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CANNONDESIGN

HWI's 73,000 sq ft building was designed by world renowned architect Mehrdad Yazdani. The building was planned with a three part geometry: a rectilinear translucent laboratory wing, a curved office wing and a three story atrium joining the two. The building has been recognized with numerous architectural awards.

A MESSAGE FROM THE CEO

EDWARD SNELL, PHD

President & CEO
Hauptman-Woodward
Medical Research Institute

Welcome to the Fall 2019 issue of Structures. In our winter issue we had a cover story that celebrated women in science, their impact on our Institute, and their scientific impact today and tomorrow. In this issue, our cover story is about a technology that revolutionizes our science and keeps Hauptman-Woodward at the forefront of structural biology research for years to come. The technology is cryo-electron microscopy or Cryo-EM. It's a mouthful, but the cryo bit means cold, electrons are what it uses, and it is a microscope that allows us to visualize many of the biological machines that we currently spend so long trying to coax into crystals.

This is tremendously exciting for our scientists and the patients that our research eventually reaches. With Cryo-EM we can visualize disease targets, biological machines, which were previously inaccessible to us and accelerate the research on ones we currently study. We can see how machines work together. In a slightly different mode of operation, we can look at how new potential drugs interact with their targets. This allows us to visualize and optimize therapeutic interactions. This technology is at the cutting edge of structural biology research worldwide, but it is completely complementary with our existing research capabilities. Even more exciting is that it makes structural biology far more accessible to researchers in general. For almost twenty years we have worked with over 1,000 laboratories worldwide to produce crystals, helping their research efforts. With Cryo-EM we have an approach that accelerates the process of studying disease and while studying therapeutic interactions, it also creates them in a physical sense with researchers locally by eliminating barriers to structural biology which will be a tremendous opportunity for researchers on the Buffalo Niagara Medical Campus and beyond.

Cryo-EM, with the capability we plan, is in great demand. Our center will operate as a facility for all in Western New York, enabling academics and industry who may not be able to afford this technology access to it at a critical time.

While Cryo-EM is our major focus recently, this issue also notes other important developments. We welcome new board members and note the energy driving what can only be described as very constructive engagement. We also have some new staff members that have joined us, including Dr. Diana Monteiro who comes from Portugal by way of Germany, and Dr. Miranda Lynch who is working closely with researchers at Roswell Park. Dr. Monteiro features in this issue. There is a lot more content that I can cover briefly and I encourage you to enjoy, ask questions, and also check out our website at hwi.buffalo.edu.

Thank you for supporting HWI and your help in making a difference.

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A vaccine for the Zika virus was developed in 18 months with the use of Cryo-EM

SPOTLIGHT

TOM GRANT

Thomas Grant, PhD receives $1.33 million NIH award to develop methods for visualizing how drugs interact with their targets

DR. THOMAS GRANT'S WORK IN EXPERIMENTAL DATA ANALYSIS and algorithm development for the National Science Foundation BioXFEL Science and Technology Center managed by HWI has resulted in the National Institutes of Health (NIH) supporting his new "High-resolution molecular recognition of ligands using solution X-ray scattering" project with $1.33M. Funding from the NIH will enable Dr. Grant to research and develop new techniques to analyze data from biological molecules—possible drug targets.

With this support, Dr. Grant will hire a team of researchers to assist in developing software and refining the algorithms to better understand the structural changes that occur when drugs bind to molecules in our bodies.

"This has the potential to impact many of us in countless ways. Drug designers often don't know which drug is going to work on a disease they are targeting. This new approach has the ability to take data from numerous techniques and combine it to theoretically get high-resolution information on the changes that occur when introducing a new drug without having to perform a new experiment over and over. This will allow us to be more productive and more efficient in our approach to drug effectiveness. That has value for all of us," says Dr. Grant.

The collaborators involved in this creative energy solution are all based in Western New York and are working as a team to develop a replicable model that not only meets HWI's needs, but sets a baseline for best practices across the industry

PRESS CONFERENCE

Powerful Partners

New York State Senator Tim Kennedy (D-Buffalo) was joined by Senator Todd Kaminsky (D-Long Island), Chairman of the Senate Environmental Conservation Committee, as well as Assembly Majority Leader Crystal Peoples-Stokes at the former American Axle site on East Delavan Avenue Thursday to discuss groundbreaking green technology developed at the site that will soon be making its way to HWI.

Lithium battery storage technology developed by Viridi Parente will be used to support the high-powered, state-of-the-art Cryo-Electron microscope being installed at HWI's facility on the Buffalo Niagara Medical Campus. Due to its unique nature, this lithium technology has not been used in New York State before. As a result, with Senator Kennedy and Majority Leader Peoples-Stokes' assistance, HWI had to secure a variance from the New York State Department of State.

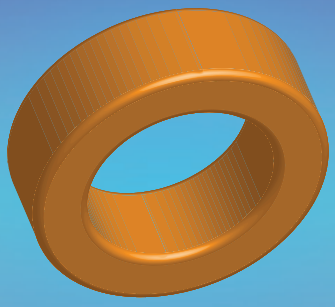
"This partnership between Viridi Parente and the Hauptman-Woodward Medical Research Institute is a shining example of the amazing potential of state-of-the-art technology being developed right here in Buffalo," said Majority Leader Peoples-Stokes. "The lithium battery storage technology being developed by Viridi Parente, along with HWI's Cryo-Electron microscope, will help create advances in the medical field, as well as jobs for Western New York."

"The technology we are developing here on Buffalo's East Side does more than fit squarely within the renewable energy vision articulated by New York State, it places Buffalo at the leading edge of renewable energy development," added Jon M. Williams, Chairman and CEO, Viridi Parente. "The fact that this breakthrough technology is being developed on the East Side and will see its first application just minutes away on the Buffalo Niagara Medical Campus, where it will support the innovative research taking place at Hauptman-Woodward, is a victory for the entire region and for the resurgence of the East Side."

To read more about the project see page 11.

These storage cells will be part of a pack to supplement HWI's energy supply up to 600 kwh

THE FUTURE OF RESEARCH AT HWI LOOKS COOL



TO CONTINUE OUR NOBEL PRIZE WINNING AND LIFESAVING WORK, HWI IS ESTABLISHING A CRYO-EM CENTER that will allow our team to investigate the "machines" in our cells in a new, transformative way answering research questions that have been, until now, largely unexplained.

By utilizing this cutting-edge technology, discoveries once expected to take years or even decades could potentially occur in months.

Proteins are the basic structures of life and are key to unraveling its secrets. They are also the pharmaceuticals targets which improve our quality of life and the lives of the people we love. So why does HWI study proteins? When we understand what a protein looks like, we have insight into how it works, or when it doesn't work correctly, why that is so. When we can answer these questions, we can develop new drugs helping our bodies work more effectively and providing treatment and cures for diseases, such as cancer.

For more than 60 years, HWI has been a leading force in the discipline of structural biology focused on finding novel ways to improve human health by studying the root causes of disease, as well as potential therapies, at their basic molecular level. In order to enhance and expand these research efforts, HWI is establishing a state-of-the-art center that utilizes Cryo-electron microscopy (Cryo-EM) at its home on the Buffalo Niagara Medical Campus (BNMC). HWI is currently in the process of installing our initial microscope with the ultimate goal of acquiring others.

Previous methods in structural biology have 20% success rates. Cryo-EM has surpassed 80%

A rendering of the
James H. Cummings Visitor Lounge
in the new center

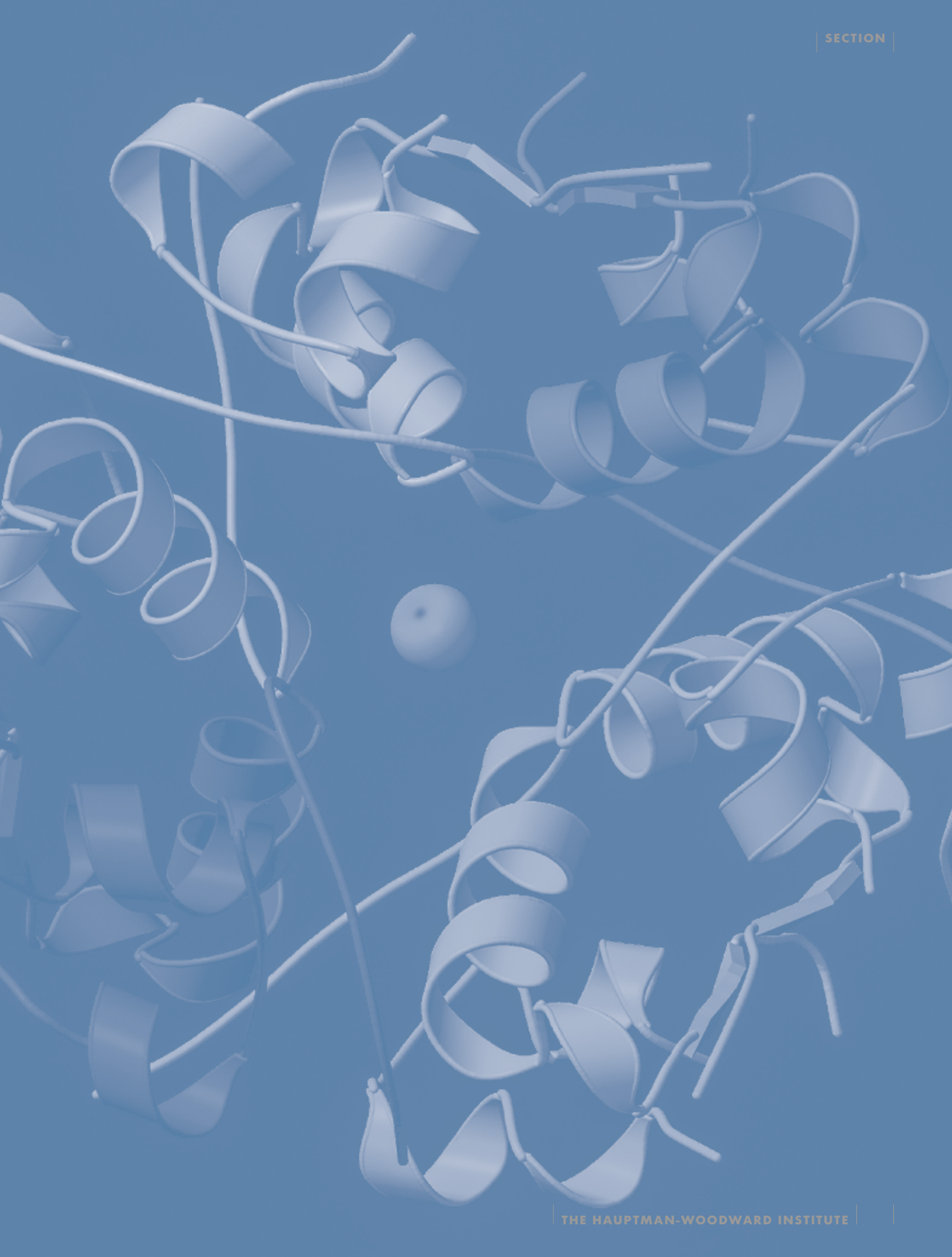
With the installation of the first microscope, the Institute is primed to become the regional resource for this revolutionary technology that will impact health care while simultaneously forming collaborations and linking fundamental research to clinical applications. The center will bring both groundbreaking medical discoveries and dynamic advancement for, not only HWI, but for numerous partners including the University at Buffalo, Rochester Institute of Technology, Roswell Park Comprehensive Cancer Center, the University of Rochester Medical Center, the BNMC, and industry partners.

"HWI has always been a world leader in structural biology research developing many of the technologies in use by the field today. The availability of Cryo-EM technology will aid our own research, extend collaborations on the BNMC campus, and accelerate the pace of research. The unique structure of the center enables this cutting-edge technology to be available to both academics and nascent biotech startups in a manner that would otherwise not be possible without the cooperation of so many regional partners and supporters.

A Cryo-electron microscope is no ordinary laboratory microscope. It is a high-powered electron microscope that takes proteins frozen in motion and uses beams of electrons to visualize what those proteins look like. The resulting three dimensional images provide details of how they function and how to design a drug to aid failing functionality. The microscope's greatest feature provides researchers with the ability to fast-track medical discoveries, greatly reducing research timelines.

Cryo-EM has already made significant breakthroughs in visualizing biological molecules and their interactions with other proteins and drug targets allowing scientists to understand the molecular basis of disease and how to stop it. It enables our researchers to answer questions that had previously been off limits with unprecedented speed.

This center will attract intellectual and financial capital to Buffalo, becoming a magnet to help recruit top research scientists. It will permit access for small, medium and large biotech companies to maximize the investment in the resource, ultimately growing the WNY bio-tech ecosystem and making it attractive to grow the biotech economy in the region. The center will benefit both academia and applied scientific discovery.



MAKING SPACE AT HWI

Each microscope will have its own room containing many automated elements. Researchers remain in control rooms outside the microscope rooms during operation because even the most minute temperature change, vibration or even sound could disrupt the machinery. Rooms are being renovated on the first floor of the Institute to accommodate the microscope as well as a control room, a sample preparation laboratory and a visitor center. The James H. Cummings Foundation made the lead gift for the fundraising effort to bring this center to fruition and thus, the visitor center is being named for the Foundation.

Each microscope is about 12½ feet tall and weighs 2 tons, and can hold multiple samples at once. It moves samples in and out of placement in an automated manner so that thousands of images can be recorded, and then processed into computer generated 3-D images. These instruments will enable researchers at the Institute to view the structure of biological machines, which carry out bodily processes, in their native states and across scales from cells to molecules to atoms.

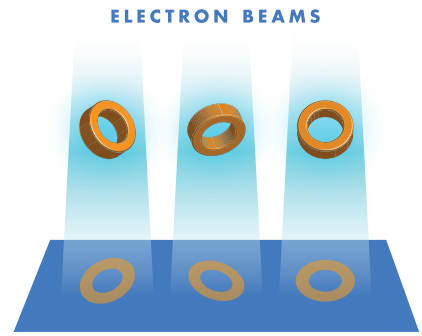
This imaging is facilitated by new high-tech cameras capable of directly recording electrons rather than conventional cameras that must first convert the electron's energy to light, losing sensitivity in the process. Advances in direct electron detector technology in the past five years have been credited with what many scientists call the "Resolution Revolution" that enabled Cryo-EM to reach the point where it is today, rivaling more traditional methods that take much longer.

HOW DOES CRYO-EM (CRYO-ELECTRON MICROSCOPY) WORK?

A Cryo-electron microscope is a high-powered electron microscope that allows visualization of biological molecules and their interaction with other proteins and drug targets, allowing us to understand the molecular basis of disease. The process all begins with a protein, the basic machinery of life. In order to understand how a protein functions, we need to know what it looks like, and Cryo-EM accelerates this process by leaps and bounds.

A protein sample destined for the electron microscope is placed in a liquid solution that is similar to their native environment inside cells. This preserves the sample's integrity. The protein sample is flash-frozen and kept frozen at below -320°F until it is sent to the electron microscope.

The high-powered electron microscope then focuses beams of electrons through



HOW IT WORKS

Electron beams pass through samples containing millions of key proteins that have been frozen in a variety of placements. The Cryo-EM microscope captures two-dimensional images of each protein, and analysis of these images permits research teams to reconstruct their structures in 3D.

the frozen sample containing millions of proteins trapped in a variety of placements. It then captures two-dimensional images of each protein, and research teams utilize powerful software algorithms to generate three-dimensional images of the proteins at near-atomic resolution. This allows our structural biologists to visualize what those proteins look like, study the detail of how they function, and potentially design a drug to aid that function when it fails.

Prior to Cryo-EM technology, most protein structures have been solved using X-ray crystallography, a technique that HWI has spearheaded for decades and is considered the gold-standard technique for visualizing a protein. This process requires the crystallization of biological machines and then probing them with electromagnetic radiation. While profoundly helpful, this technique comes with limitations – it is slow and difficult.

For one, most proteins move through different shapes, or conformations, as they go about their work, giving us clues as to how they function. However, these motions are absent when structures crystallize which prevents us from analyzing the full range of shapes that allow proteins to do the jobs nature assigned. Secondly, not all proteins can be crystallized as some are too fragile to withstand the process, and others too flexible so they cannot be neatly packed into a three-dimensional crystal. Cryo-EM doesn't require crystals, and while it does have its own limitations, success is much more probable than failure for many of the samples important for human health.

ENERGY SOLUTION

The HWI Cryo-EM microscopes have a high energy demand and require a consistent and reliable supply of quality energy. The use of an on-site lithium storage device developed by Viridi Parente, a Buffalo based energy firm, will help HWI realize significant cost savings by lowering peak electricity demand and reducing costly infrastructure upgrades, while also easing the burden on the BNMC's electricity supply.

The use of Viridi Parente's technology delivers the needed solution as a cost-effective, green-energy model that supports the Institute's current energy demands, the addition of the microscopes, and expansion. The lithium storage device will draw electricity from the grid during off-peak times, when demand and costs are low. During higher usage times, the microscope will draw upon the stored power, providing an uninterrupted and clean source of electricity. Viridi Parente, is using this project as a success model to

These storage cells will be part of a pack to supplement HWI's energy supply up to 600 kWh

“The partners involved in this project have tailored a solution for HWI, but the impact goes far beyond the Cryo-EM center. The battery system is a demonstration of smart, balanced economic development that reduces our carbon footprint while growing our economy for the industries of tomorrow.”

JON M. WILLIAMS, CEO OF VIRIDI PARENTE

demonstrate for others on the BNMC, and statewide, how this technology can be effective in a research setting.

"The partners involved in this project have tailored a solution for HWI, but the impact goes far beyond the Cryo-EM center," said Jon M. Williams, CEO of Viridi Parente. "The battery system is a demonstration of smart, balanced economic development that reduces our carbon footprint while growing our economy for the industries of tomorrow."

The storage device will be integrated with HWI's building automation system controlled by Stark Technology. The optimization platform will leverage the storage device to generate savings from peak demand management while incorporating its flexibility in a broader strategy to participate in demand response and other revenue generating market activity.

The collaborators involved in this creative energy solution are all based in Western New York and are working as a team to develop a replicable model that not only meets HWI's needs, but sets a baseline for best practices throughout the industry. National Grid has been a helpful partner in making this pilot project a reality.

This project, initiated by Paul Tyno from the BNMC, established a team of local practitioners resulting in this creative energy solution which evolved holistically into an economic development opportunity. "Our objective was to position HWI to maximize economic value through efficient use of distributed resources, such as storage, upgraded building systems and controls along with building automation, while simultaneously achieving sustainability objectives," said Paul Tyno.

In parallel with the scientists and researchers at HWI using the microscopes to advance their work, UB engineering students and faculty will use the battery storage system to study the practical applications of renewable energy in the innovation economy.

With the integration of the battery and more energy-efficient building controls, HWI will be a showpiece for this energy approach. The Institute will also be a model for others in the energy community as a predictable user of our community's electrical infrastructure.

CONNECTING IDEAS TO ACTION

AN INTERVIEW WITH CHRISTINA ORSI, UNIVERSITY AT BUFFALO ASSOCIATE VICE PRESIDENT FOR ECONOMIC DEVELOPMENT

THIS PAST MAY, some of Western New York's top innovators, including officials from the University at Buffalo and Hauptman-Woodward Medical Research Institute, were joined by regional leaders and partners to launch the collaborative Innovation Hub, a dynamic initiative established to bring technology innovations to life against a Buffalo Niagara backdrop now brimming with startup energy.

The Hub will close the gap between innovators and the marketplace, making it easier for business and entrepreneurs to collaborate with student, faculty, and researchers to move their ideas to impactful products and services. This cohesive connection will work to strengthen the region's comprehensive network of innovation, support, talent, and expertise, all while adding to the vitality and environment of opportunity that is essential to spurring entrepreneurial success.

WHAT ARE THE OVERALL AIMS OF THE UB INNOVATION HUB?

CHRISTINA ORSI: The Innovation Hub initiative is focused on facilitating collaboration between the incredible technology and innovation that happens every day at the University at Buffalo and our talented research and clinical care partners, like Hauptman-Woodward, to commercialize more innovations in the Buffalo area. From new medical diagnostics, to new therapeutics and vaccines, we're producing advancements in the lab, classroom and clinic that can translate into actual commercial products and companies that can grow here and have a profound impact on both the local and global economy.

WHAT MAKES UB AN IDEAL PLACE FOR SUCH A CONNECTED INITIATIVE?

CO: UB is a top ranked public university. We have over 30,000 students, with 12 different colleges and multiple research partners that cover medical, pharmacy, law, management, and everything in between. As a research university, we have an extensive foundation of invention already taking place at our Buffalo-area campuses.

This gives us a phenomenal base for innovation through the intense and intricate research that happens here in all different disciplines, every single day.

These capabilities are enhanced further by our tremendous and talented student body, most of who come from outside of Western New York. The more we can support and engage them in the startup ecosystem, the more opportunity we have to help create the next generation of skilled innovators for our community.

We also have a commitment to our regional economy. Through our Office of Business and Entrepreneur Partnerships, we are focused on building connections between our research and clinical partners to the Buffalo business and entrepreneur community, helping to further build the innovation economy.

DOES THE BUFFALO NIAGARA REGION'S SUPPORT OF ENTREPRENEURS CURRENTLY HELP CREATE A SYNERGY BETWEEN THE HUB, THE CITY AND ITS SURROUNDING REGION?

CO: Absolutely. The region continues to develop as a thriving entrepreneurial ecosystem, but really vibrant ecosystems are not built with just one institution, incubator, fund, or a handful of startups. It takes a community that is networked together to provide funding, facilities, expertise and innovation. Regional entrepreneurial initiatives like Launch New York, 43North, Techstars and now, the Innovation Hub initiative, are fostering bright, innovative minds in the region. The more that we can build a connected ecosystem of innovators and entrepreneurs, the stronger our region will become.

As we collectively build a network of mentors to lend their time and skill to prepare the next generation of aspiring entrepreneurs across Innovation Hub research partners organizations, we can transfer expertise to eventually multiply our successes.

University at Buffalo

+

HAUPTMAN–WOODWARD
MEDICAL RESEARCH INSTITUTE

30,000 students, with 12 different colleges and multiple research partners cover medical, pharmacy, law, management, and everything in between make UB an ideal research partner

WHAT DOES THE PARTNERSHIP WITH HAUPTMAN-WOODWARD INSTITUTE (HWI) SAY ABOUT THE HUB'S COMMITMENT TO RESEARCHERS AND THEIR EXPERTISE?

CO: The Institute has a rich history of research and innovation, and is one of UB's longest-standing partners among these entities. Through the Innovation Hub network and collaborations with partners like Hauptman-Woodward, we're able to translate more innovations into commercial, viable products through local startups.

CAN YOU PROVIDE AN EXAMPLE OF THIS TYPE OF HUB-ENABLED COLLABORATION?

CO: Of course. For example, Hauptman-Woodward's research in structural biology is absolutely critical in the development of new drug design. Through the network of Innovation Hub partners like Roswell Park Comprehensive Cancer Center, we have a number of faculty working in all different drug discovery areas, from cancer, to AIDS, to cardiovascular disease and more. Their work is developing new potential drug targets, and the research and services at Hauptman-Woodward are a critical component for addressing these targets.

So, not only is HWI an innovator in its own right, but it's now a critical component to providing expertise to help carry forward other innovations from UB and Roswell around different drug development targets.

WHEN IMAGINING THE INNOVATION HUB AND ITS COLLABORATIVE DEVELOPMENT FIVE YEARS FROM NOW, WHAT DOES ITS SUCCESS LOOK LIKE?

CO: Success would look like we have taken many new novel innovations from the lab, placed them with dozens of new startups growing in Western New York, and have made steady progress toward bringing new products to the market. Success looks like a community that continues to be a destination for ambitious entrepreneurs, and that fosters and retains talented graduating students who either go on to start their own company or become part of an impressive talent pool in a thriving Western New York startup ecosystem.

With the Innovation Hub's help, this ecosystem will be one thriving with outside capital, incredible technology and innovations, and entrepreneurial activity that's made our community desirable for global investment.

"The Hub will close the gap between innovators and the marketplace, making it easier for business and technology leaders to collaborate with student entrepreneurs, faculty and researchers."

—CHRISTINA ORSI

THE INTERNS OF SUMMER

THE INSTITUTE CURRENTLY HOSTS TWO UNIQUE SUMMER INTERNSHIP PROGRAMS: HWI's traditional Summer Internship Program and National Science Foundation's (NSF) BioXFEL (Biology with X-ray Free Electron Lasers) Summer Research Internship program. Each program runs for 10 weeks, and students learn real-life lab procedures and receive training on fundamental techniques and protocols.

The Summer Internship program was designed to involve students in science projects. They gain practical research experience by working hand-in-hand with world-renowned scientists as they use state-of-the-art equipment in the fields of molecular biology, crystallography, X-ray diffraction, and data analysis.

For nearly 50 years, HWI has prepared students for careers in research and science through its immersive summer internship programs. Top students from universities and colleges throughout the country interested in pursuing careers in science or medicine vie for these coveted apprenticeships and once selected have the unique opportunity to work with world-renowned HWI scientists.

As the Institute expands its internship programs, the key focus remains the same—cultivate the next generation of researchers and keep them aware of the exciting career opportunities that exist in Western New York.

HWI also manages the NSF's BioXFEL Summer Research Internship program, which was introduced in 2014 and focuses on a broader range of STEM fields. This program places students at HWI, as well as the University at Buffalo, Arizona State University, Rice University, and the University of Wisconsin-Milwaukee. Students are required to conduct research that aligns with the BioXFEL Science and Technology Center's mission, which is to develop the use of X-ray free-electron lasers to study biological molecules.

"HWI's internship programs allow students to get practical hands-on research experience," says William Bauer, PhD who oversees the HWI and NSF BioXFEL summer internship programs. "Sometimes that takes place in a lab, and in other cases, projects may be computer science-based. Either way, they are still gaining valuable experience."

Both internship programs require students to make contributions to research projects, complete challenging experiments and attend educational workshops. At the end of the summer, students give a short presentation on their research findings to their peers and HWI's scientific staff.

"Students get real research experience and learn new concepts. We try to match students' interests and prior educational experience to specific research projects because we want these programs to be useful to them as they build their careers and progress toward their final goals," says Dr. Bauer.

HWI's internship programs are near and dear to Dr. Bauer's heart. He started his career at the Institute as an intern in 2001 while attending Elmira College. Throughout his scientific career, Dr. Bauer has had the opportunity to mentor and manage a diverse group of undergraduate students. These experiences have been extremely rewarding for both Dr. Bauer and the students with whom he has worked. "The difference between mentoring students and conducting scientific research is that you get to see the results from your education efforts more immediately than you would from the research alone. Students learn a lot in our 10-week internship programs, but they may not always see the final results of their research projects. While we may not immediately realize the impact the science makes, it's immensely rewarding to educate and witness the impact you're making in the lives of students as we help shape their careers," says Dr. Bauer.

To date, more than 350 undergraduate students have completed summer internship programs at HWI. Many previous interns chose careers in scientific research, and some, such as Dr. Bauer, have continued their careers at HWI. Other students have followed different career paths and now work as medical doctors and pharmacists.

MOLLY DENMAN

KAILEY FERGER

KORINNE MILLS

ALYSSA ROHAN IS AN UNDERGRADUATE STUDENT AT BATES COLLEGE IN MAINE WHERE SHE IS A NEUROSCIENCE MAJOR AND SPANISH MINOR.

HOW WERE YOU INTRODUCED TO HWI? "I heard about all of the advances made in the medical field and the research and discovery process happening at HWI through my family. I was also searching for a deeper research experience, so I applied to HWI's Internship program in order to explore research opportunities to see if I like it."

WHAT FIELD OF STUDY ARE YOU LOOKING TO PURSUE IN YOUR CAREER PATH? "I am interested in psychiatry, but I don't know if I want to pursue a research career in psychiatry or practice as a medical doctor. I applied to HWI's Summer Internship program so that I could try out new things and explore research opportunities."

WHAT PROJECT ARE YOU WORKING ON THIS SUMMER? "I am working with Dr. Snell, and we chose two proteins that interact together to help the cell fight the negative effects of radiation. Dr. Bauer is helping me process these proteins to eventually develop a crystal structure. I realize that probably won't happen during my 10-week program, but it's a rewarding experience nonetheless."

ALANI ALDARONDO-TORRES

ALYSSA ROHAN

NATALIA CRESPO-ROSADO

WHAT DO YOU LIKE ABOUT YOUR INTERNSHIP AT HWI? "It's really amazing to be working with other people who know so much about this field and are so dedicated to it. We have access to technology that you don't have in other places. I have really enjoyed meeting the other interns and discussing their projects with them. The environment is collaborative and everyone has been so helpful in showing me how to run tests and figure out specific lab protocols. HWI also presents workshops, so we learn about funding for grad school and how to present scientific data. Overall this internship provides a very holistic approach to research and education."

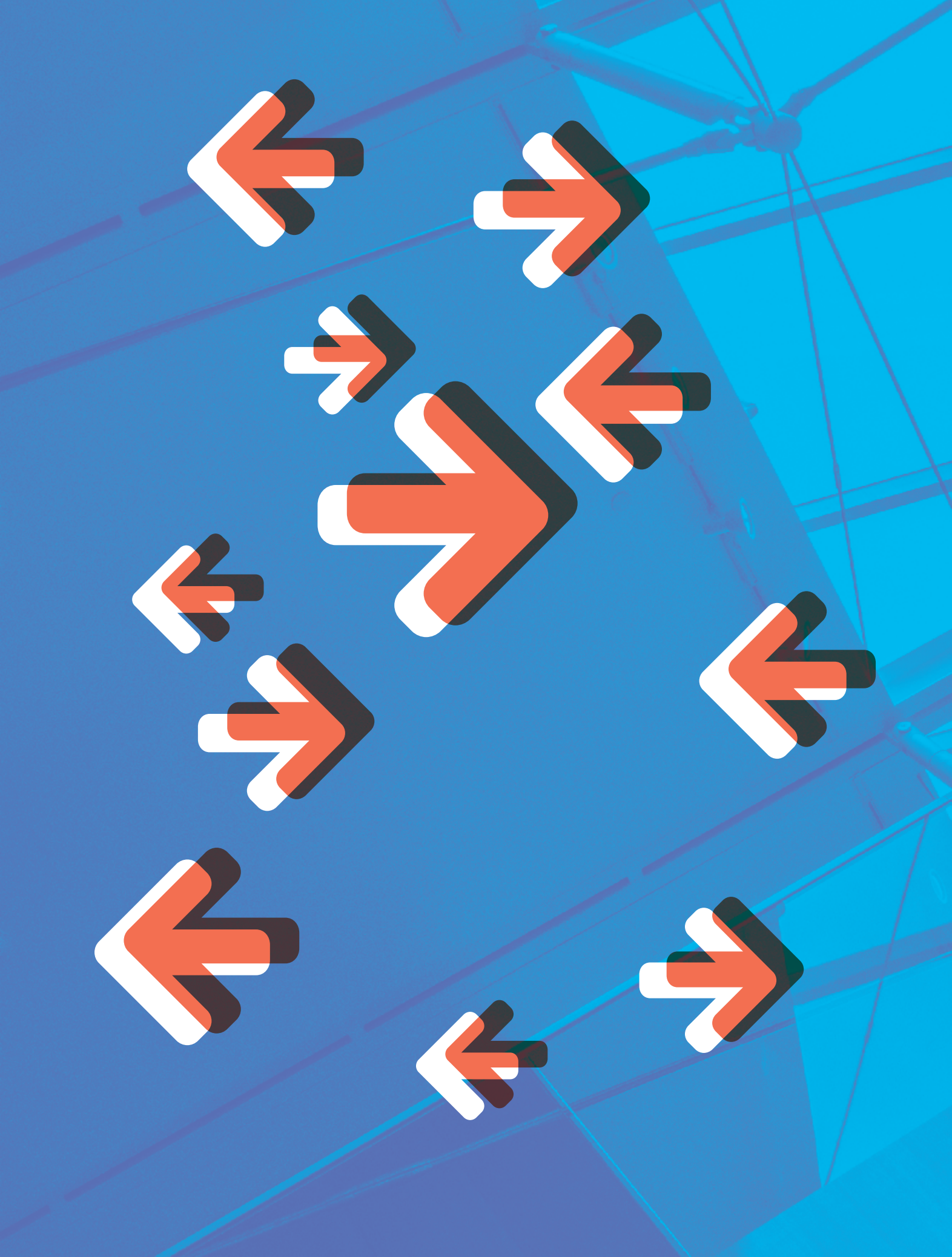
KAILEY FERGER JUST GRADUATED FROM THE UNIVERSITY OF ROCHESTER AND NEXT YEAR SHE WILL ATTEND GRADUATE SCHOOL AT UC BERKELEY.

WHY HWI? "I came to HWI in order to get practical research experience because next year, I plan on attending graduate school and eventually pursue a PhD I wanted to get experience working in a lab, particularly in a dry lab, which means I work on a computer and not in an actual research laboratory. I'm pursuing a graduate degree in computational biology, so I wanted more experience working a 9-5 job while working on one project and being advised by a faculty member."

WHAT PROJECT ARE YOU WORKING ON? "I joined Dr. Sarah Bowman's team, and I am working on a data mining project where I access databases and extract a lot of information from them. I then try to make sense of the data using different programming techniques, such as Python and R. I work with those languages in order to extract the information and run tests and create graphs to try to come up with some conclusions from these databases. They contain a lot of historical data that HWI has collected over the past 20 years, and no one has ever really tried to analyze it before. We are just trying to organize the data and put it into a format that makes sense."

"So far I really like interning here. This experience has helped me confirm that this is the type of atmosphere I thrive in. I get to work independently on projects, and I also get to make a lot of the decisions. My mentor is always there for guidance, but it's great to be able to take a project and run with it. I think this experience is preparing me pretty well for grad school."

WHAT DO YOU WANT TO BE WHEN YOU GROW UP? "I think I want to be a researcher or scientist in the biotech industry after I earn my PhD, so I am more interested in working in private industry as opposed to academia. I am not sure of what aspect of biotech right now, but I know it's a big field and it's growing. The kind of experience and knowledge that I am gaining at HWI will help guide me and give me the skill set in order to make that decision later on."



PUSHING BOUNDARIES THROUGH COLLABORATION

DIANA MONTEIRO, PHD JOINS HWI AND SPARKS CROSS COLLABORATIVE RESEARCH WITH THE UNIVERSITY AT BUFFALO

This past spring, Diana Monteiro, PhD joined the Institute as a research associate to establish a new synthetic chemistry laboratory that complements and expands HWI's work in biochemistry and structural biology. It is the first lab of its kind at HWI. As an accomplished researcher with expertise in chemistry and structural biology, Dr. Monteiro's work focuses on bridging the gap between chemistry and biology through the development of unique chemical tools that will enable the imaging of molecular machines in real-time.

"Building a synthetic laboratory at HWI promotes the overlap of knowledge across chemistry and biochemistry, making this the ideal environment to push the boundaries of structural biology and drug design to answer some very challenging questions," said Monteiro.

Dr. Monteiro joins HWI from the Center for Ultrafast Imaging at the University of Hamburg in Germany, where, as a postdoctoral research fellow, she developed reliable microfluidic platforms to minimize the use of precious protein samples in time-resolved experiments. She holds a Master of Science in Medicinal Chemistry from the University of Leeds, where she also earned a doctorate in Structural Molecular Biology from the University's Astbury Centre.

"Building a synthetic laboratory at HWI promotes the overlap of knowledge across chemistry and biochemistry, making this the ideal environment to push the boundaries of structural biology and drug design to answer some very challenging questions,"

— DIANA MONTEIRO, PHD

One of Dr. Monteiro's areas of research at HWI is centered on a cross-collaboration with Martin Trebbin, PhD, Empire Innovation Assistant Professor at the University at Buffalo's (UB) Department of Chemistry. Together, Drs. Monteiro and Trebbin develop new methods to visualize, at atomic resolution, the changes biological macromolecules undergo as they function. With these new and unique tools, they can watch biological machines in action to understand how they function normally and why, at times, they fail. These cutting-edge time-resolved structural biology experiments will ultimately provide a glimpse into the cause of diseases and allow for the development of new novel therapies- designed drugs- to stop them.

According to Dr. Monteiro, one of the most difficult aspects of the experimental design is how to make proteins start their function on command so that they can be properly imaged and analyzed. "There are really two ways of doing this, and one of them is through chemistry. For instance, if a protein needs a small molecule to work, we can use chemistry to make an inactive version of it and then activate it at will using a short light pulse. All the proteins in the sample remain in a resting state until we shine a light. This activates the small molecule and synchronizes all the protein's movement," said Monteiro.

Dr. Trebbin, on the other hand, uses rapid mixing to kick start protein activity on demand. "For me, as a chemist, watching these protein machines move and function became a fascination. For some proteins, mixing was more suitable than chemistry for synchronization. That's how our interests overlapped and brought about the collaboration for these complex experiments. Together we are addressing challenging scientific questions," said Monteiro.

A chemist by training, Dr. Trebbin's interdisciplinary research focuses on experimental methods for the generation of "molecular movies"—imaging of matter at ultrafast times at atomic resolution. "Since my very early years as a scientist, it was my goal to unravel the dynamics and structure-function relationship of matter in order to design new materials and revolutionize medicine" said Trebbin. Since early 2009, he has been working on state-of-the-art

"...in the end, we want society to benefit from these insights which will help to design new drugs and find new cures.

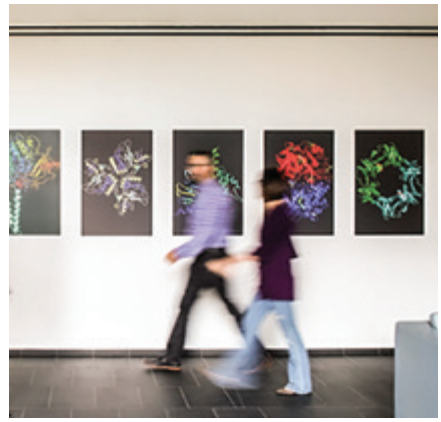
— MARTIN TREBBIN, PHD

microfluidics in combination with modern protein structure determination techniques to pursue this goal. In August 2018, Dr. Trebbin joined the University at Buffalo to continue his work.

"The current collaboration in Buffalo with Dr. Monteiro originated from the work we did together in Hamburg. It's something that will continue here because it matches very well with the National Science Foundation BioXFEL Science and Technology Center cluster of which we are a part. Using cutting-edge techniques, my lab creates tailored devices that can control the smallest fluid volumes, and that are optimized for protein structure determination. This combination not only enables the collection of high-resolution structural data from scarcely available materials, but it also allows for flow synthesis and continuous processing of samples. The resulting insights allow scientists to answer new questions in medicine, structural biology and materials sciences," said Trebbin.

As their research is quite complex, collaborations are vital, starting with Buffalo cross-campus projects and expanding well beyond to other countries and, very importantly, national facilities. "We do a lot of the work in the lab, but we always need access to large national facilities to carry out the final experiments. To succeed in these complex experiments, collaboration is needed with the teams at these facilities. It is much easier to develop and apply new methods when the facilities teams are willing to help and push the capabilities of their instruments. Besides the collaboration with Dr. Trebbin at UB, I am still actively working with groups in Hamburg, Leeds, and other members of the NSF BioXFEL center. This exchange is very exciting and really great for HWI and UB," said Monteiro.

"We are a part of this strong international scientific community that is dedicated to developing the tools that allow us to see how biological molecular machines work in order to shed light on the molecular causes of diseases. In the end, we want society to benefit from these insights which will help to design new drugs and find new cures. I think that making the move to Buffalo was a great choice for the both of us because of the tremendous support and excellent research environment here," said Trebbin.

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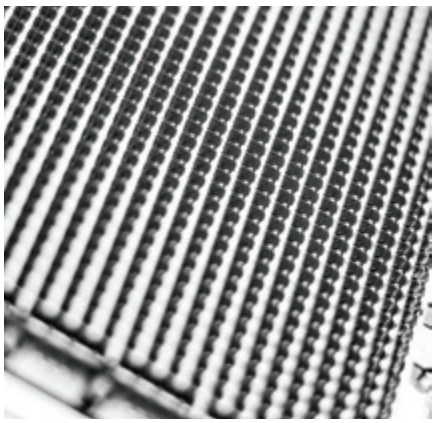


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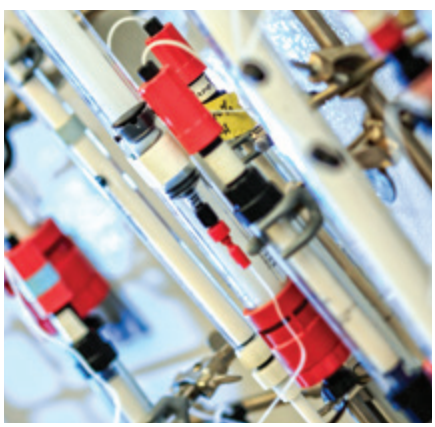

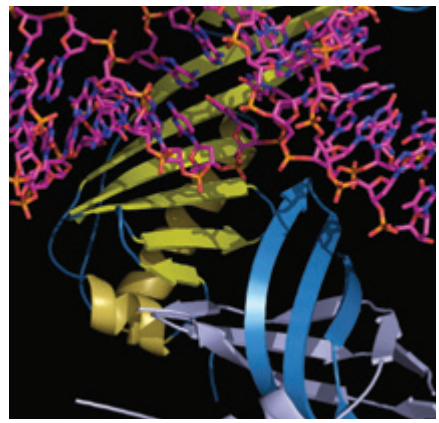

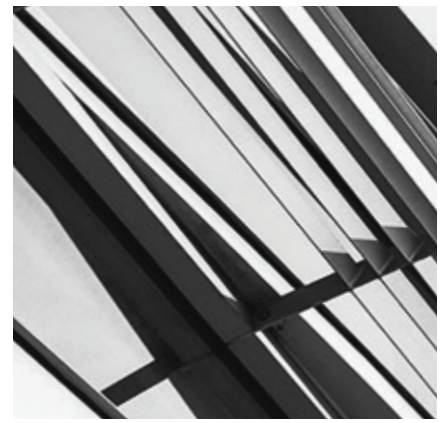


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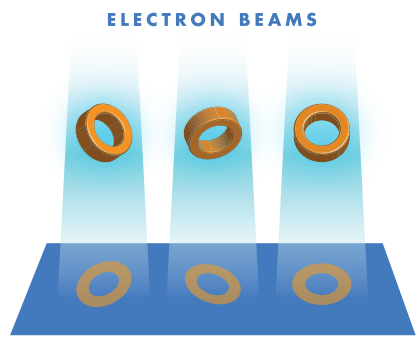

ELECTRON BEAMS

INNOVATE, DISCOVER, EDUCATE

Three of the most recent University at Buffalo students who have studied at HWI for their PhD's have been awarded the UB Medical School's Dean's Award for their dissertation

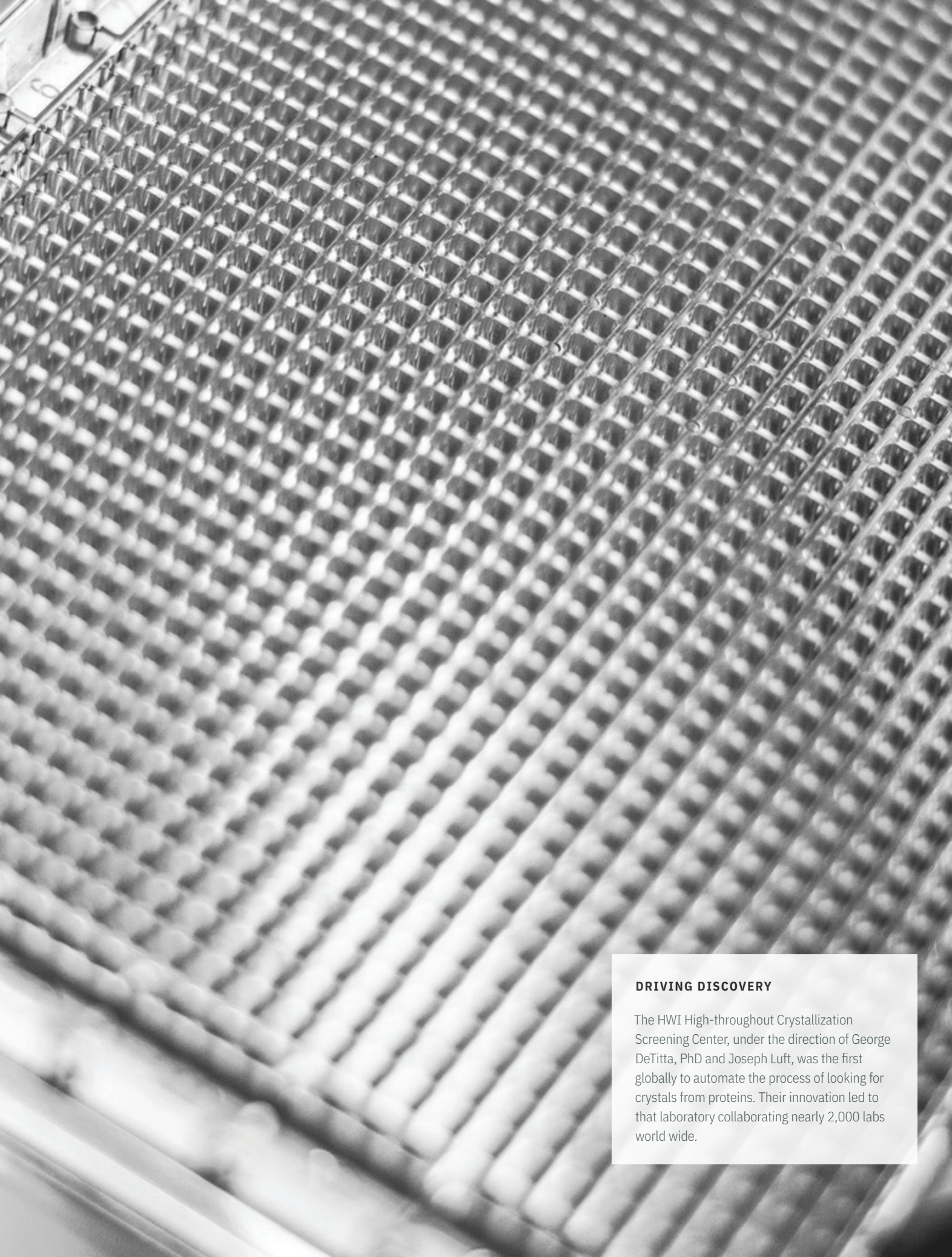
TIMOTHY STACHOWSKI WINS A 2019 LINUS PAULING POSTER PRIZE AT THE ACA ANNUAL MEETING

Timothy Stachowski, a University at Buffalo PhD candidate, studying in the Snell Group at HWI, was awarded one of the Linus Pauling Poster Prizes at the 2019 American Crystallographic Association (ACA) meeting. The international meeting focused on X-ray crystallography, one of HWI's strongest methods in structural biology. The prize was established by the ACA to recognize promising young researchers in honor of Nobel laureate Linus Pauling, a pioneer in crystal structure research.

Stachowski's poster was titled "Structural consequences on TGFB-1 activation from near therapeutic X-ray doses." The work for the poster was done as part of his doctoral thesis project, and it is the first study to make use of tools designed to understand and mitigate radiation damage in the crystallography setting. Tim's research provides visibility into the impact of therapeutic processes—specifically the type of radiation that patients experience during cancer treatment or that first responders experience during a nuclear accident.

"There is a large gap between the magnitude of radiation that is used in structural biology methods and what is used in medical applications. We are trying to bridge that gap by adapting current techniques and developing new ones to understand how protein structure is affected by therapeutic levels of radiation. This approach includes repeating these experiments, many times, at low radiation levels to capture high-resolution structural information," says Stachowski.

Stachowski is a 4th-year Biophysics PhD candidate at the Roswell Park Comprehensive Cancer Center and the University at Buffalo. He is mentored by Dr. Edward H. Snell, President and CEO of HWI. "Tim is pioneering a new research area that will have direct impact on the clinical use of radiation therapy," Dr. Snell said of Stachowski's research.



DRIVING DISCOVERY

The HWI High-throughout Crystallization Screening Center, under the direction of George DeTitta, PhD and Joseph Luft, was the first globally to automate the process of looking for crystals from proteins. Their innovation led to that laboratory collaborating nearly 2,000 labs world wide.

HAUPTMAN SOCIETY MEMBERS

MEET E.J. AND MARTHA BURKE

A DAY AT THE BEACH usually means sunshine, sand, good friends—and crystallography? For E.J. and Martha Burke, it was their connection to Bay Beach in Canada that led them to become strong supporters of Hauptman-Woodward Medical Research Institute.

"We were introduced to the Institute years ago by our good friends (the late) Dick & Skip Wadsworth, who were our neighbors up at Bay Beach," explained E.J.. "Over the years we came to know the groundbreaking work done at HWI, and have been so impressed with the caliber of science and researchers here."

While E.J. grew up in Buffalo, he moved away for college and a life in banking, which is how he met Martha, who is originally from Stillwater, Oklahoma. They were management trainees together at the same bank in Oklahoma City. Martha was an Oil & Gas Banker and E.J. was a Commercial Real Estate Lender. They spent eight years in Oklahoma City before moving to Kansas City to raise their family.

In 1997, E.J. and Martha started a commercial mortgage company in Kansas City that they sold to KeyBank in 2000. Today, KeyBank employs 400 people at the company the Burke's started more than 20 years ago. After the sale, E.J. went on to work for KeyBank, eventually moving to Cleveland and becoming Co-President of Key Community Bank.

Although living in other cities, E.J. maintained his hometown pride for Buffalo. Once E.J. agreed to serve the Institute on the Board of Directors, he reconnected with Dr. Jane Griffin, Emeritus HWI Researcher, whom he knew growing up having been a good friend of one of Dr. Griffin's sons.

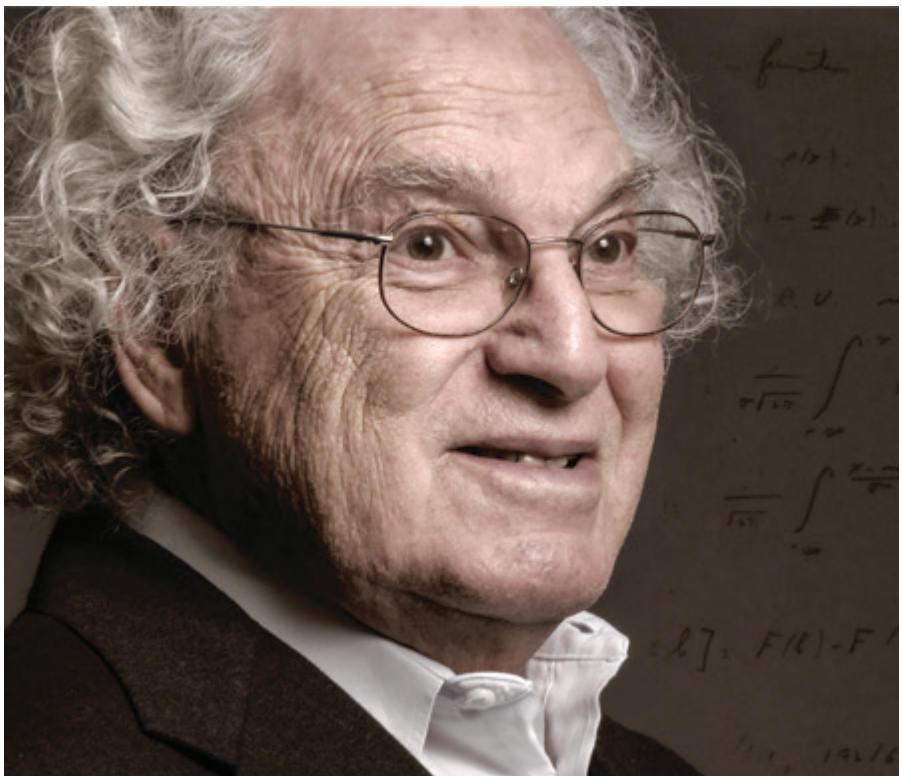
Today, E.J. serves as Vice Chair on the HWI Board of Directors, and is currently leading the long range planning efforts. Both he and Martha speak enthusiastically about the excitement around building the new Cryo-EM center, which will have wide-spread impact on Institute, but also the Buffalo Niagara Medical Campus, Western New York, and medical research as a whole.

"Martha and I both have had family members that have experienced some form of diseases, and when we think about what that investment does – it allows some very talented, dedicated people to do basic research," said Burke. "It's not done for intellectual property, it's done to improve human health and well being. There aren't that many organizations that do that, and at the same time has the entrepreneurial, collegial atmosphere that they have at HWI. Supporting HWI is an opportunity to help some people do some great things, and at the same time give back to a community that I grew up in."

Martha added, "I've always been amazed by the fact that Dr. Hauptman, a Nobel-prize winning scientist, chose to spend the peak of his career in Buffalo and it's not better known. I see such an opportunity for us to continue to highlight the importance of his namesake Institute, both throughout Western New York and beyond."

"Martha and I have both had family members who have experienced some form of disease, and when we think about what that investment does—it allows some very talented, dedicated people to do basic research."

THE 2019 HAUPTMAN SOCIETY



The Hauptman Society was created in 2008 to honor corporate or individual donors who contribute leadership gifts of $1,000 or more annually.

These gifts support HWI's mission and the pursuit of life-altering research.

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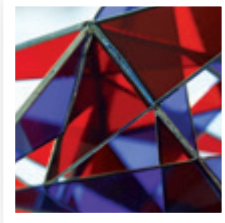
HWI received a legacy gift of more than $600,000 from the estate of Mrs. Albertine K. Moran, who had supported the Institute prior to her passing in July

Helen Woodward Rivas Society

THE MEDICAL FOUNDATION OF BUFFALO was established with a generous gift of $3 million from Helen Woodward Rivas in 1956 (the equivalent of $28 million in today's economy). Her philanthropy set the foundation for what today is the Hauptman-Woodward Medical Research Institute as we know it- an institute committed to science and transformative research through education, discovery, and innovation.

To carry on her legacy and inspire others to make lasting gifts the Helen Woodward Rivas Society was founded. The Rivas Society allows longtime supporters to include HWI in their estate plans. Including a charitable bequest in your will is a simple way to make a lasting gift to your community and to further HWI's mission.

For more information about the Helen Woodward Rivas Society please contact Lisa LaTrovato, HWI Director of Development at 716.898.8624.



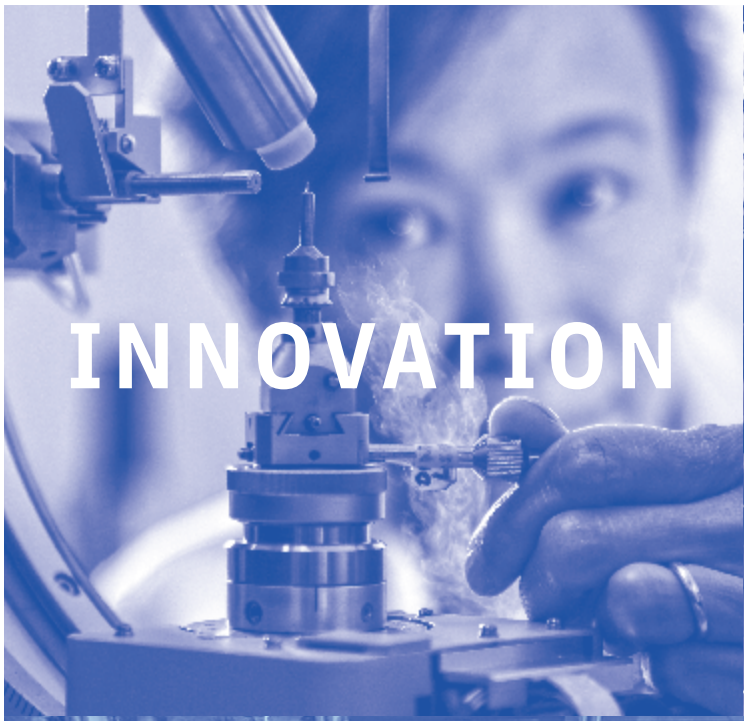
In recognition of her service and philanthropy to HWI, Emily was gifted with one of Dr. Hauptman's stained glass creations

A big HWI thank you to Emily Constantine Doren

EMILY CONSTANTINE DOREN has a long-standing history with HWI as the great-granddaughter of Helen Woodward Rivas, HWI's benefactor. Without question, Emily shares a passion for biomedical research exhibited across her family, and thus, fittingly served on the HWI board for 9 years. Emily's commitment to HWI over that tenure resulted in numerous meaningful impacts on the organization's fundraising, governance and business development efforts, to name a few. Emily's talents, leadership, and vision helped navigate HWI toward the next frontier of discovery in the rich history of the Institute.

Emily's personal philanthropy, coupled with her corporate support of HWI via her business Lace & Day, have initiated new programs at the Institute for the advancement of HWI's mission. Her generosity is a model for each of us.

Please join us in thanking Emily for her outstanding contributions to Hauptman-Woodward's biomedical research mission.



WAYS TO GIVE

HAUPTMAN-WOODWARD was founded because of philanthropy which then became a legacy for Helen Woodward Rivas. You too can make an impact in a multitude of ways and create your own legacy. We welcome you to contact HWI's Director of Development, Lisa LaTrovato at llatrovato@hwi.buffalo.edu or 716.898.8624 to discuss the numerous manners in which you can contribute and make a difference.

HAUPTMAN SOCIETY

The Hauptman Society was created in 2008 to honor corporate or individual donors who contribute leadership unrestricted gifts of $1,000 or more annually.

These gifts support HWI's mission and the pursuit of life-altering research. Membership advantages include our Annual member event, an invitation to exclusive speaker series, behind the scenes tour of HWI and the diffraction lab, upon request, and your name on the Hauptman Society plaque in the lobby.

MONTHLY GIVING

It is an easy, convenient, cost effective way to donate to HWI and make an impact. Your donation will be automatically charged to your credit card every month without you needing to do anything.

The same amount will be deducted on the same day of every month until you tell us you would like to increase, decrease or stop your donation.

PLANNED GIVING

A planned gift is a contribution that is arranged in the present and is allocated at a future date. These gifts historically for HWI have made significant impact at critical junctures in our history and we thank the donors who had the foresight of giving in this manner. Examples of planned gifts are listed below.

- Gifts of Appreciated Securities
- Gift of Personal Property
- Retirement Plan Gifts
- Life Insurance Gifts
- Gifts of Real Estate
- Planned Gifts
- Bequests
- Gift Annuities

IN MEMORY/HONOR OF

A donation to HWI is a thoughtful way to express your sympathy for the loss of a loved one or to honor someone special in your life or in the industry.

THE JANE F. GRIFFIN PHD EDUCATION FUND

This fund was established in 2016 to recognize HWI Emeritus Researcher Jane F. Griffin, PhD for her longstanding commitment and establishment of HWI's education programs. The Griffin Fund supports undergraduate students with paid summer internships to work with HWI research teams and gain practical, hands-on experience in a research setting. Many students have gone on to publish results of their work from this program.

STAFFORD FELLOWSHIP

HWI has a rich history in educating the next generation of scientists. Fellowships permit new talent to be supported over the course of their studies with our world renowned research groups. The Stafford Fellowship, established by HWI Emeritus Board Chair Constance Stafford Constantine, is our longest standing fellowship and has supported numerous PhD candidates who are now prospering scholars. Donors can contribute additional funds to this fellowship that already exists.

ENDOWMENTS

Many individuals chose to contribute funds to the Institute that will ensure their gifts will continue to give for years, if not decades to come. Funds contributed to an endowed chair recognize an individual or a family's legacy. Three endowed chairs exists at HWI that have varying missions, they are listed below. Contributions to these chairs which are not yet fully funded are a tremendous way to honor the spirit of both the mission of the chair and for who they are named.

Don and Vicky Hess Endowed Chair

The goal of the Donald and Victoria Hess Endowment fund is to raise permanent funds to further secure the financial strength of Hauptman-Woodward Medical Research Institute.

Herbert Hauptman Nobel Laureate Endowed Chair

This fund will support the work of an outstanding scientist whose work, echoing that of Dr. Hauptman, bridges the gap between pure science and biomedicine.

William L. Duax Endowed Chair in Crystallography

The purpose of the fund is to support the scientific work and teaching of Dr. William L. Duax, and of future generations of Hauptman-Woodward scientists.

Create your own endowment

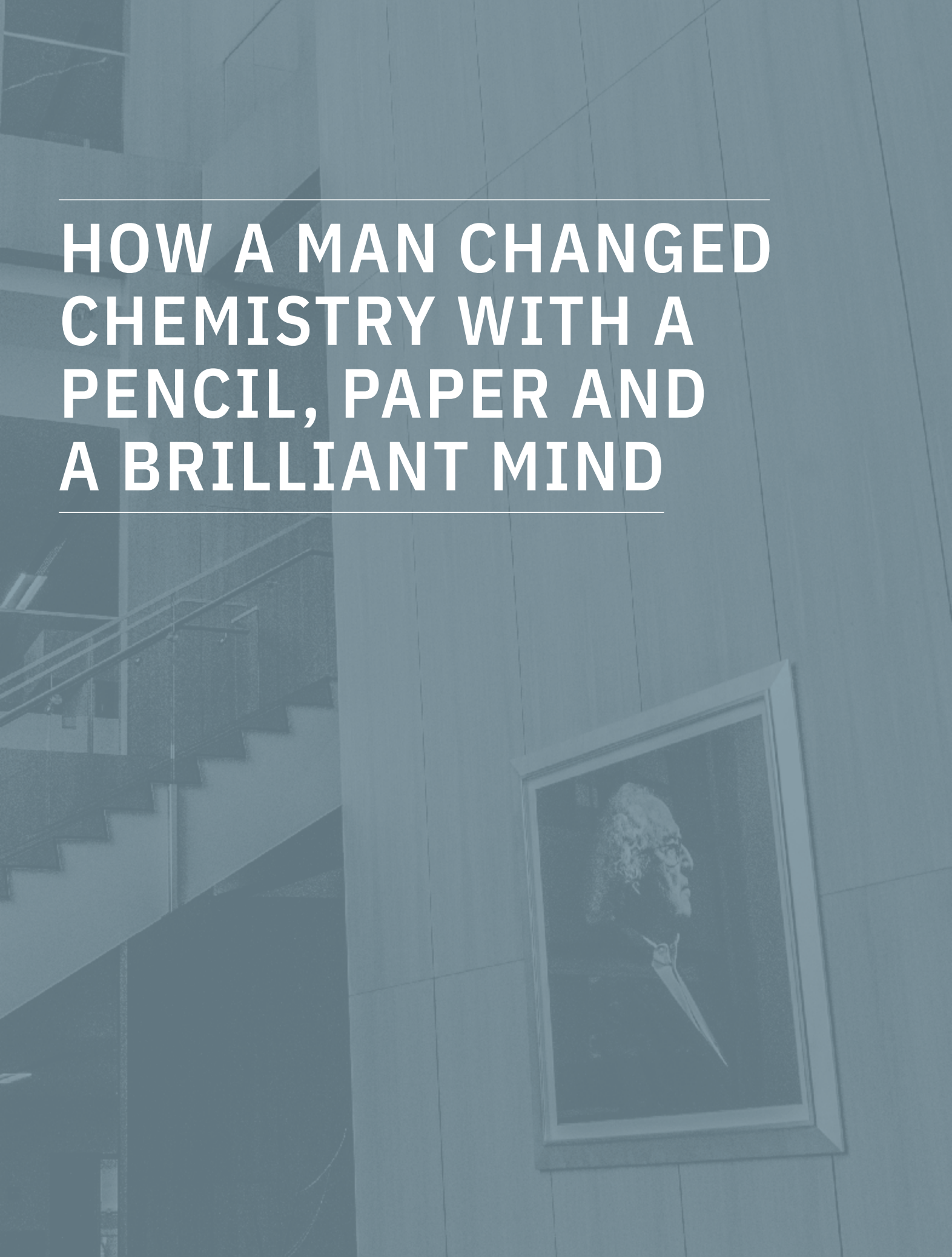
Endowed Funds can be used to establish a chair that will enable HWI to recruit the very best scientist who will have discretionary income to support their efforts from the chair they hold.

You can read more about these opportunities on our website at hwi.buffalo.edu/giving

BEGINNINGS

WITH HELEN WOODWARD RIVAS'S ESTABLISHING GIFT IN 1956, the Medical Foundation of Buffalo, which is now Hauptman-Woodward Institute, purchased this carriage house on Delaware Avenue in Buffalo, New York. This housed the newly established Foundation until fire destroyed the site in 1963 and the group moved to new space on High and Ellicott Streets where it remained until the opening of our new facility at 700 Ellicott in 2003. HWI was the first new construction at the time on what is now the Buffalo Niagara Medical Campus.

HOW A MAN CHANGED CHEMISTRY WITH A PENCIL, PAPER AND A BRILLIANT MIND



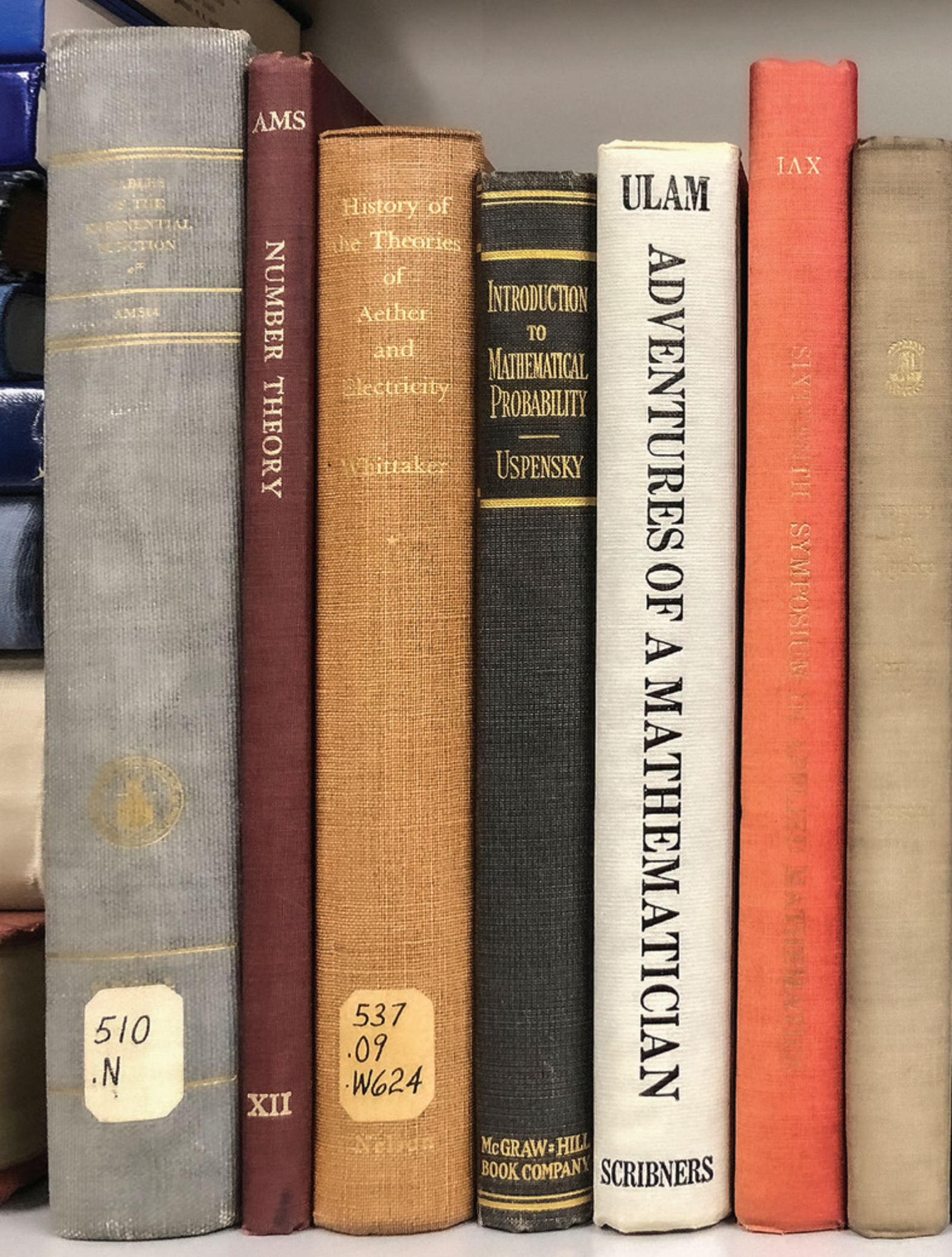
Herbert Hauptman was awarded the Nobel Prize in Chemistry in 1985

It has been nearly 35 years since Dr. Herbert A. Hauptman won the Nobel Prize in Chemistry, but his achievements continue to impact advances in science today. Once faced with grave criticism, Hauptman's "direct methods" technique has led to the solution of thousands of molecular structures, and as a result, allowed for better drug design in order to combat some of society's deadliest diseases.

THE LEGACY At a very young age, Dr. Herbert A. Hauptman became interested in mathematics and he excelled at it. When most other children were outside playing ball, he was at the library reading math books. Chasing his dream, he went on to earn all of his degrees in mathematics beginning with a Bachelor of Science degree from the City College of New York in 1937, a Master's degree from Columbia University in 1939, and a PhD from the University of Maryland in 1955.

Dr. Hauptman's work towards the techniques that eventually gained him the Nobel Prize in Chemistry began around 1950, when he was employed at the Naval Research Laboratory in Washington, D.C. While there, he met Dr. Jerome Karle, a chemist and fellow graduate of the City College of New York. Dr. Karle introduced Dr. Hauptman to a unique problem in chemistry, one that had baffled researchers for decades—the phase problem. In order for scientists to determine the shape of a molecule, the phase problem has to be solved from diffraction data typically using a complex technique called X-ray crystallography. When researchers can define a molecule's shape, they can understand how it functions, which gives them a greater understanding of life processes and clearer insight into the causes of disease.

Since 1912, chemists had known that a beam of X-rays directed towards a crystal is scattered when it strikes atoms, and the scattered radiation forms a diffraction pattern that can be recorded on film. The challenge for most chemists, however, was in learning how to work backwards from the diffraction pattern to the three-dimensional structure of the molecules. Solving even the simplest molecular structure could take months or even years of educated guess work. Because it was so complex, the scientific community believed that it could not be done, not even in principle. But, Dr. Hauptman was not convinced. He was certain that the answer was in mathematics, not in chemistry, so he set out to solve the phase problem using a complex mathematical formula, which he called "direct methods." With nothing more than a pencil, paper and brilliant mind, he solved a very simple three-dimensional structure using his complex mathematical formula.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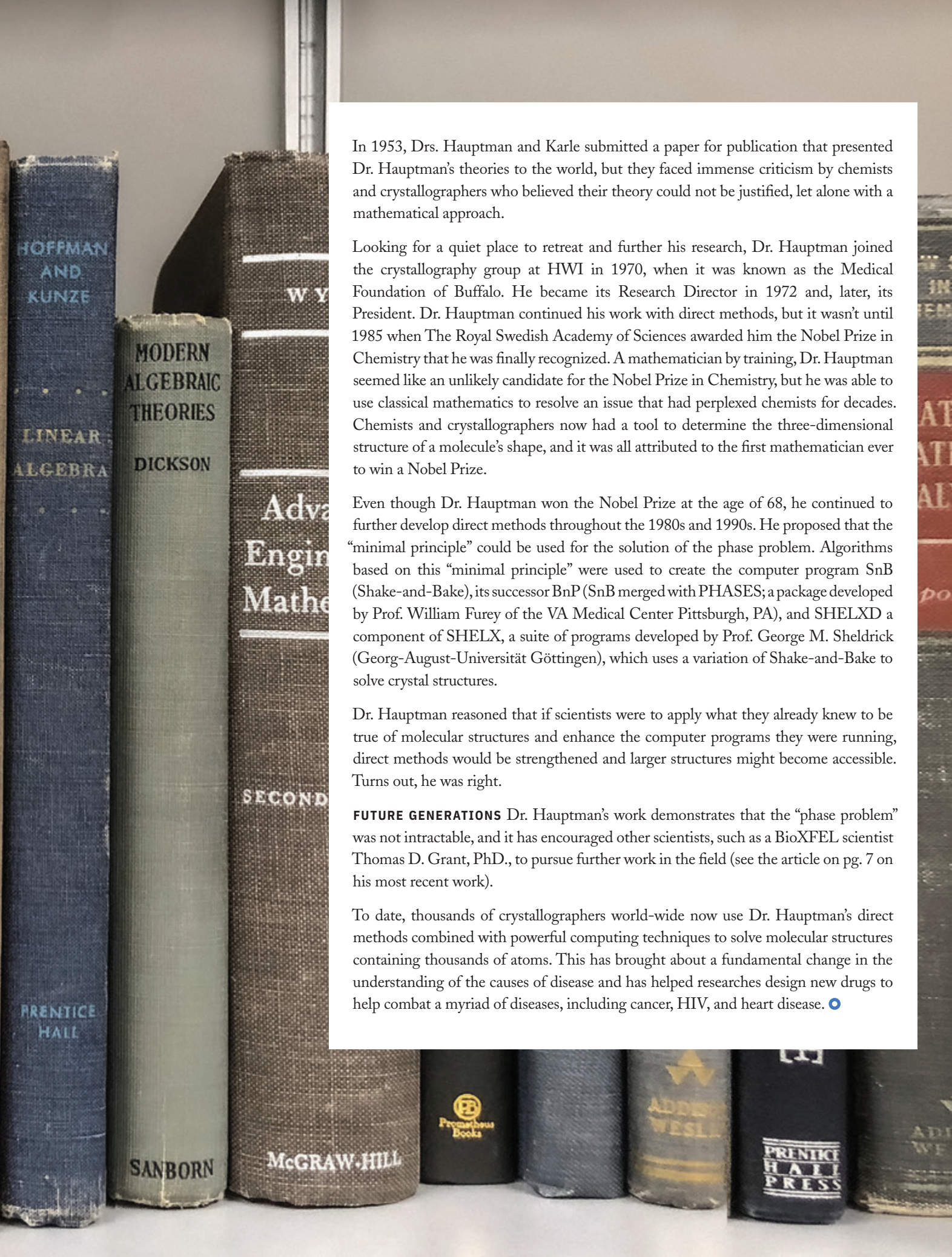

In 1953, Drs. Hauptman and Karle submitted a paper for publication that presented Dr. Hauptman's theories to the world, but they faced immense criticism by chemists and crystallographers who believed their theory could not be justified, let alone with a mathematical approach.

Looking for a quiet place to retreat and further his research, Dr. Hauptman joined the crystallography group at HWI in 1970, when it was known as the Medical Foundation of Buffalo. He became its Research Director in 1972 and, later, its President. Dr. Hauptman continued his work with direct methods, but it wasn't until 1985 when The Royal Swedish Academy of Sciences awarded him the Nobel Prize in Chemistry that he was finally recognized. A mathematician by training, Dr. Hauptman seemed like an unlikely candidate for the Nobel Prize in Chemistry, but he was able to use classical mathematics to resolve an issue that had perplexed chemists for decades. Chemists and crystallographers now had a tool to determine the three-dimensional structure of a molecule's shape, and it was all attributed to the first mathematician ever to win a Nobel Prize.

Even though Dr. Hauptman won the Nobel Prize at the age of 68, he continued to further develop direct methods throughout the 1980s and 1990s. He proposed that the "minimal principle" could be used for the solution of the phase problem. Algorithms based on this "minimal principle" were used to create the computer program SnB (Shake-and-Bake), its successor BnP (SnB merged with PHASES; a package developed by Prof. William Furey of the VA Medical Center Pittsburgh, PA), and SHELXD a component of SHELX, a suite of programs developed by Prof. George M. Sheldrick (Georg-August-Universität Göttingen), which uses a variation of Shake-and-Bake to solve crystal structures.

Dr. Hauptman reasoned that if scientists were to apply what they already knew to be true of molecular structures and enhance the computer programs they were running, direct methods would be strengthened and larger structures might become accessible. Turns out, he was right.

FUTURE GENERATIONS Dr. Hauptman's work demonstrates that the "phase problem" was not intractable, and it has encouraged other scientists, such as a BioXFEL scientist Thomas D. Grant, PhD., to pursue further work in the field (see the article on pg. 7 on his most recent work).

To date, thousands of crystallographers world-wide now use Dr. Hauptman's direct methods combined with powerful computing techniques to solve molecular structures containing thousands of atoms. This has brought about a fundamental change in the understanding of the causes of disease and has helped researches design new drugs to help combat a myriad of diseases, including cancer, HIV, and heart disease.

NOBEL PRIZE WINNERS ASSOCIATED WITH CRYSTALLOGRAPHY

Dr. Hauptman was one of many Nobel Prize recipients whose scientific achievements have been directly related to, or involved the use of, crystallographic methods and techniques.

2017 CHEMISTRY
Jacques Dubochet, Joachim Frank and Richard Henderson
For developing cryo electron microscopy for the high resolution structure determination of biomolecules in solution

2013 CHEMISTRY
M. Karplus, M. Levitt and A. Warshel
For the development of multiscale models for complex chemical systems

2012 CHEMISTRY
R. J. Lefkowitz and B. K. Kobilka
For studies of G protein coupled receptors

2011 CHEMISTRY
D. Shechtman
For the discovery of quasicrystals

2010 PHYSICS
A. Geim and K. Novoselov
For groundbreaking experiments regarding the two dimensional material graphene

2009 CHEMISTRY
V. Ramakrishnan, T. A. Steitz and A. E. Yonath
Studies of the structure and function of the ribosome

2006 CHEMISTRY
R. D. Kornberg
Studies of the molecular basis of eukaryotic transcription

2003 CHEMISTRY
P. Agre and R. MacKinnon
Discoveries concerning channels in cell membranes

1997 CHEMISTRY
P. D. Boyer, J. E. Walker and J. C. Skou
Elucidation of the enzymatic mechanism underlying the synthesis of adenosine triphosphate (ATP) and discovery of an ion transporting enzyme

1996 CHEMISTRY
R. Curl, H. Kroto and R. Smalley
Discovery of the fullerene form of carbon

1994 PHYSICS
C. Shull and N. Brockhouse
Neutron diffraction

1992 PHYSICS
G. Charpak
Discovery of the multi wire proportional chamber

1991 PHYSICS
P. G. de Gennes
Methods of discovering order in simple systems can be applied to polymers and liquid crystals

1988 CHEMISTRY
J. Deisenhofer, R. Huber and H. Michel
For the determination of the three dimensional structure of a photosynthetic reaction center

1985 CHEMISTRY
H. Hauptman and J. Karle
Development of direct methods for the determination of crystal structures

1982 CHEMISTRY
A. Klug
Development of crystallographic electron microscopy and discovery of the structure of biologically important nucleic acid protein complexes

1976 CHEMISTRY
W. N. Lipscomb
Structure of boranes

1972 CHEMISTRY
C. B. Anfinsen
Folding of protein chains

1964 CHEMISTRY
D. Hodgkin
Structure of many biochemical substances including Vitamin B12

1962 PHYSIOLOGY OR MEDICINE
F. Crick, J. Watson and M. Wilkins
The helical structure of DNA

1962 CHEMISTRY
J. C. Kendrew and M. Perutz
For their studies of the structures of globular proteins

1954 CHEMISTRY
L. C. Pauling
For his research into the nature of the chemical bond and its application to the elucidation of the structure of complex substances

1946 CHEMISTRY
J. B. Sumner
For his discovery that enzymes can be crystallised

1937 PHYSICS
C. J. Davisson and G. Thompson
Diffraction of electrons by crystals

1936 CHEMISTRY
P. J. W. Debye
For his contributions to our knowledge of molecular structure through his investigations on dipole moments and on the diffraction of X rays and electrons in gases

1929 PHYSICS
L. V. de Broglie
The wave nature of the electron

1917 PHYSICS
C. G. Barkla
Discovery of the characteristic Röntgen radiation of the elements

1915 PHYSICS
W. H. Bragg and W. L. Bragg
Use of X rays to determine crystal structure

1914 PHYSICS
M. Von Laue
Diffraction of X rays by crystals

1901 PHYSICS
W. C. Röntgen
Discovery of X rays

STEVE BELL IS MANAGING PARTNER AT STEVE BELL COMMUNICATIONS, LLC. *which he started in late 2018 to counsel clients on crisis and reputation management. Prior, he spent 12 years at Mower (previously Eric Mower + Associates) leading the advertising agency's crisis and reputation management practice. Steve also spent 30 years as a journalist for the Associated Press and held numerous senior editor roles at The Buffalo News.*

HWI TAPS INTO BUFFALO'S BEST

STEVE'S FORMAL INTRODUCTION TO HWI came a little under a year ago when he was hired by the Institute, as a consultant, to assist with several media-related projects. At the time, Steve realized he had a lot more to learn about HWI, and as he worked hand-in-hand with the Institute, he developed a greater understanding of its research focus, its groundbreaking work, and its legacy. His appreciation for the Institute did not go unnoticed, and when HWI Board Member Michele Heffernan reached out and invited Steve to join the Board of Directors, he jumped at the opportunity.

"I said 'I absolutely would'—because this opportunity is just so different from other boards I've served," he explains. Steve has held previous board positions with The Buffalo Urban League, the United Way of Buffalo and Erie County, and Erie County Medical Center Foundation. He recently joined the boards of Buffalo Prep and Hilbert College.

"My volunteer theme has traditionally been racial justice, education for all, and equal opportunity. Even though this position is a little bit different, I think that the work HWI does can be so beneficial to everybody. That's very appealing," he said.

YOUR ROLE AND STRATEGY MOVING FORWARD:

"I will definitely draw on my experience to help HWI become better known, better understood, and more fully appreciated for what it does."

"I also look forward to this opportunity because it presents a challenge. I've always enjoyed challenges. Stepping outside of your comfort zone, as much as that's a cliché, is really a healthy exercise. Being on HWI's board is a little bit out of character for me, both thematically with what I've done in my volunteer life and also by subject matter. Hopefully I can bring some nontraditional thinking to the board as someone who is stronger in the humanities than in scientific thought."

WHAT IS HWI'S ROLE IN BUFFALO'S TRANSFORMATION:

"I think that there is the potential for spin-offs from the research conducted at HWI. I don't know enough to say specifically what that would mean, but I think they're developing cutting-edge medical research. When the scientists hit a Eureka moment, that could and should be leveraged into a start-up that helps Buffalo and helps the world in general."

RENITA DISTEFANO IS THE VICE PRESIDENT OF INFORMATION TECHNOLOGY AND CHIEF INFORMATION OFFICER FOR SENECA GAMING CORPORATION *where she is responsible for defining, articulating, and driving the information technology strategy for multi-property gaming and hospitality operations.*

RENITA FIRST HEARD ABOUT HWI when helping her daughter, a UB physics major, find a summer internship program. Renita reached out to her colleague and HWI Emeritus Board Chair, Judith Feldman, who arranged for Renita and her daughter to tour HWI.

"Initially, I was most impressed by HWI's commitment to educational programs, and the National Science Foundation BioXFEL Internship was what really drew me to the Institute. It's obvious to me that their role in advancing research in their field is formidable. As I became more familiar with HWI, it became clear that they are a connection to innovation. The Institute is in the heart and center of Buffalo's medical corridor, and it's connected to the medical community, the regional universities, and the community as a whole. All of that together is really impressive to me."

WHAT AREA OF HWI'S RESEARCH INTERESTS YOU?

"I was born and raised on the Seneca territory at the Cattaraugus reservation, and I am a member of the Seneca Nation. So, another thing that attracted me to HWI was their research on diabetes. The Native American community is very broadly and deeply affected by diabetes, cancer, lupus and other auto-immune disorders. HWI's research in these areas and how it ties into their mission statement left a profound impression on me. We celebrate Cure•osity. We develop the cures for tomorrow, today. To know that's their mission and to see it in action potentially benefiting global, human health, that's exciting."

YOUR INITIAL IMPRESSION OF THE BOARD:

"It's a diverse group of dynamic individuals. There are men and women of different ages, ethnicities, and professional disciplines. There is immense passion here. The people who serve on HWI's Board and those who work at the Institute take great pride in their work and it shows."

AS A BOARD MEMBER, HOW WOULD YOU CONTRIBUTE TO HWI'S GROWTH?

"As a technologist and business leader, I would like to bring a different perspective to the Board to help HWI achieve its mission.

I'm very interested in STEM (Science, Technology, Engineering, and Math) programs and preserving the research opportunities HWI provides to students pursuing careers in these fields. As a child, mathematics was always a favorite of mine. You can't have science without math, right? So, I am very interested in helping HWI promote its STEM efforts because one of my roles is to facilitate, foster, and encourage people working in the technology field or any of the STEM fields. It's a personal commitment I have made in my career, and I'd like to ensure that these programs are available to students moving forward."

COMMUNITY INVOLVEMENT:

Renita serves on the Medaille College Business Department Advisory Board, as well as the Tribal Net Advisory Board.

RICHARD HAMISTER IS THE NEW YORK REGIONAL PRESIDENT FOR NORTHWEST BANK *where he oversees 35 full-service bank branches and more than 300 employees across New York State. With more than 30 years' experience in financial services, he leads the efforts to grow Northwest Bank's presence and profitability across the state.*

RICK (AS HIS FRIENDS CALL HIM) HAMISTER first learned about HWI many years ago through friends who served on HWI's Board of Directors. When he received an unexpected and unique opportunity to join the board, he welcomed it with open arms.

"Current HWI Chairman, John Horn, and I collaborate professionally. Last summer, he asked if I might be interested in joining HWI's board. Most of my nonprofit work and even corporate work is pretty straightforward, so being a part of an organization like HWI is fascinating. The Institute's work is important, and I am excited to be involved," he explains.

WHAT AREA OF HWI'S RESEARCH INTERESTS YOU?

"As a life-long resident of the Buffalo area, I was very familiar with Dr. Hauptman's legacy. But, when I attended HWI's annual meeting and heard CEO Edward Snell talk about the Institute's Alzheimer's research, it hit home. Alzheimer's is a generational disease in my family, and as I age, it becomes more important to me that scientists are researching it. Perhaps we will find some solutions in the next 20 years before it affects this generation, or even worse, our children. I'd like to help ensure HWI has the funds needed to continue researching this debilitating disease. I plan to lend my background in business to help them get there."

HOW DO YOU VIEW HWI'S ROLE AS PART OF BUFFALO'S GROWING BUFFALO NIAGARA MEDICAL CAMPUS?

"I think HWI's role is cutting-edge. There are many different aspects of the Campus as a whole. They are creating potential treatments for patients. It's more than just basic medical science. HWI comes in on the research end and will create future opportunities.

The Institute provides a foundation for students interested in medical research and guides them in their career paths. So that's why it's important that we have funding available to bring kids in and to make sure the scientists have the tools they need to continue novel research."

YOUR CONTRIBUTION TO THE HWI BOARD:

"My background is in business and finance, so I am going to work closely with the Board to make sure that the fundraising efforts are sufficient to fund the critical needs of the scientists. We also need to be prudent to run the operations. I think we have many great opportunities in front of us, and Buffalo could really be on the map for innovative research. This is carrying on the legacy of Dr. Hauptman."

COMMUNITY INVOLVEMENT:

Rick has been involved with several community organizations throughout the past 30 years, including the Alzheimer's Association, Hilbert College, Leadership Buffalo, Orchard Park Chamber of Commerce, and Orchard Park Country Club.

A GALA TO CELEBRATE SCIENCE

The Institute shined on Saturday, October 5th as friends and partners came out for Re:Inventing Cool, the gala to celebrate science and recognize key members of the HWI community. Everyone in attendance was tremendously generous and supported HWI s latest initiative The Cryo-electron Microscopy Center. The Institute thanks specifically M&T Bank and Stark Tech Group for their lead sponsorships which contributed to a wonderful evening.

HONOREES

GEORGE F. KOEPF MD AWARD

David Hohn, MD, President Emeritus and Executive Director of Health Policy for Roswell Park Comprehensive Cancer Center

HELEN WOODWARD RIVAS AWARD

Emily Constantine Doren, Owner of Lace & Day

OUTSTANDING SERVICE AWARD

Christopher T. Greene, Esq., Barclay Damon

232 attendees
$163,000 total raised

RE:INVENTING COOL

OUR HWI BOARD OF DIRECTORS AND OFFICERS

OFFICERS

John G. Horn, Esq.
Chair of the Board

E. J. Burke
Vice Chair of the Board

Edward H. Snell, PhD
President and CEO

Jill Bond, Esq.
Secretary

Richard Hamister
Chair of the Finance Committee

Anne Kent
Chief Financial Officer

Jill Szczesek, PhD
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Steven Bell
William J. Constantine
Renita DiStefano
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Venu Govindaraju, PhD
Michele Heffernan, Esq.
Richard Mueller
Philip D. Nobel
James Obletz
Kunle Odunsi, MD, PhD
Anthony P. Pandolfi, CFP
Sam Russo, CPA
Franca Trincia, CPA

FEBRUARY 6TH INTERNATIONAL BIOXFEL CONFERENCE IN SAN DIEGO, CA

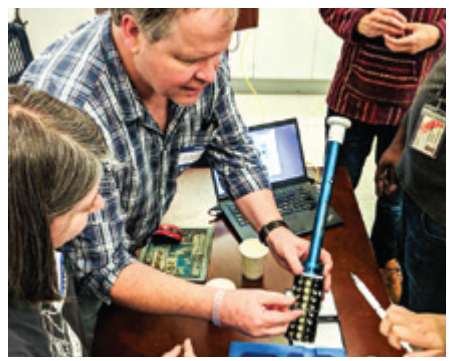
The National Science Foundation BioXFEL Science and Technology Center is entering its 7th year. The Center holds an annual conference of international accord and this year was no exception. The meeting drew world renowned researchers as well as up and coming students and postdocs from over 10 countries and 12 states.

2019 HIGHLIGHTS

173 participants attended 6 sessions and a Sample Delivery Exhibition

53% came from outside the Center

MARCH BIOXFEL DATA COLLECTION WORKSHOP AT UNIVERSITY OF PUERTO RICO



JULY SUMMER INTERNS

Kailey Ferger, Alani Aldarondo-Torres, Korinne Mills, Molly Denman, Natalia Crespo-Rosado & Alyssa Rohan joined us for the summer intern program.

READ THEIR THOUGHTS ON PAGE 22

OCTOBER KEVIN GUEST HOUSE

HWI Gala Floral arrangements dropped off to BNMC Partner, The Kevin Guest House

HWI RECEIVES THE FIRST CRYO-EM MICROSCOPE

NOVEMBER ASSOCIATION OF FUNDRAISING PROFESSIONALS LUNCHEON

HWI honored the James H. Cummings Foundation for their longstanding support of the Institute

COMING IN 2020

JANUARY 27, 2020

WRITE WINNING GRANT PROPOSALS WORKSHOP

San Juan, Puerto Rico

JANUARY 28-30, 2020

NSF BIOXFEL 2020 CONFERENCE

San Juan, Puerto Rico

MAY 21, 2020

HAUPTMAN SOCIETY RECEPTION

We celebrate HWI's closest friends

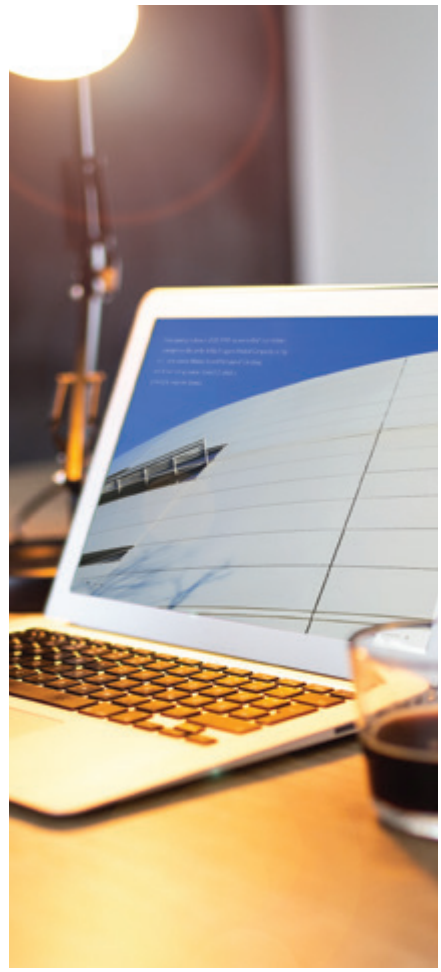
JUNE 19, 2020

BREWING SCIENCE

The Institute brings back the brew

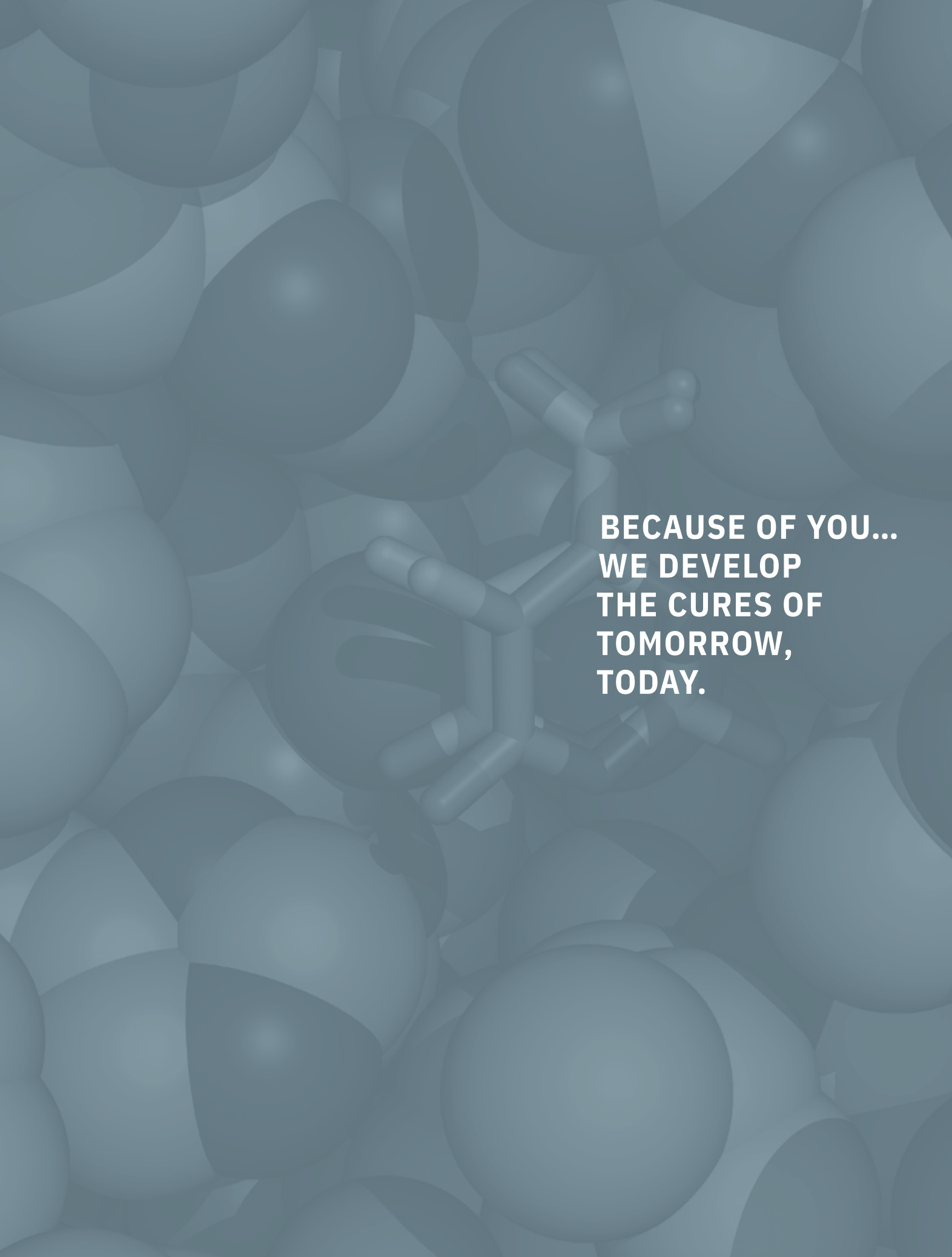
FALL 2020

HWI RIEDEL WITH A TWIST



READ STRUCTURES WHEREVER YOU ARE

Explore the digital magazine at
hwi.buffalo.edu/structures


BECAUSE OF YOU...
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TOMORROW,
TODAY.

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