ELECTRICAL ENGINEERING
UNIVERSITY of WASHINGTON

THE INTEGRATOR

A LEGACY OF INNOVATION

THE UNIVERSITY OF WASHINGTON DEPARTMENT OF ELECTRICAL ENGINEERING DOCUMENTS SOME OF THE BRIGHTEST MINDS TODAY — UW EE ALUMNI.

A LEGACY OF SOCIETAL IMPACT

UW EE IS AT THE HEART OF HARDWARE AND INTEGRATED SYSTEMS FOR LARGE-SCALE SOCIETAL IMPACT

ASSISTANT PROFESSOR KAI-MEI FU IN THE OPTICAL SPINTRONICS AND SENSING LAB.

Fall 2016

CONTENTS
Fall 2016

INTRO
A Message from the Chair

Dear Alums,

The word legacy holds a powerful position in an academic department. At once, it colors the road ahead for the future promise and echoes the past accomplishments of the department. For the Department of Electrical Engineering, our legacy matters, because it had a dual force in shaping who we are and what UW Electrical Engineering would become — a top U.S. institution for societally focused, innovative research.

I want to thank our alumni, faculty and students for helping to build a lasting legacy. As you read through the Integrator's pages, consider your own impact on UW EE and on society.

There is much for us to be proud of as a community of innovators and pioneers. You will read the stories of several alums who have made a significant impact in their community, in the field and for the world. There are so many more incredible alums that we could not include in the Integrator's limited page space. And you are one of them.

Each graduate from the department leaves not only with a top-tier electrical engineering education, but he or she also leaves with the foundation and tools to have a positive impact on society. I am proud to lead a department with this incredible legacy — exceptional talent in educators, researchers and alums.

This past year, we saw several groundbreaking accomplishments in our research, including the attainment of the world record for synthetic DNA (with no biological components) data storage, a crucial development for knowledge preservation; the development of broadband capability expansion, empowering people and economies around the world; and the use of smart phone applications to inform patients of lung function and hemoglobin levels.

With our faculty, alums and students dedicated to tackling the grand challenges affecting society, we as a community will have a lasting legacy. I look forward to working with you on transforming our department and community to a greater place in its history.

Wishing you all a happy holiday season and a bright New Year!

Radha Poovendran,
Professor and Chair

INTERVIEW

12

OUR LEGACY ON SOCIETY

Technology visionary and inventor, Babak Parviz is one of our own. How do the goals of society fit into his technology plan at Amazon and within his professorship at the University of Washington?

KiloWatts for Humanity

4

EMPOWERED

Ph.D. alum Henry Louie travels to Zambia on a year-long Fulbright to tackle energy poverty by establishing solar- and wind-powered energy systems.

13

LEGACY BECOMES LEGEND

Doug Buck remembers the significant contributions his father, Dudley Buck (BSEE '48), made to the electrical engineering field.

EMPOWERED

An Alum's Journey to Tackle Energy Poverty

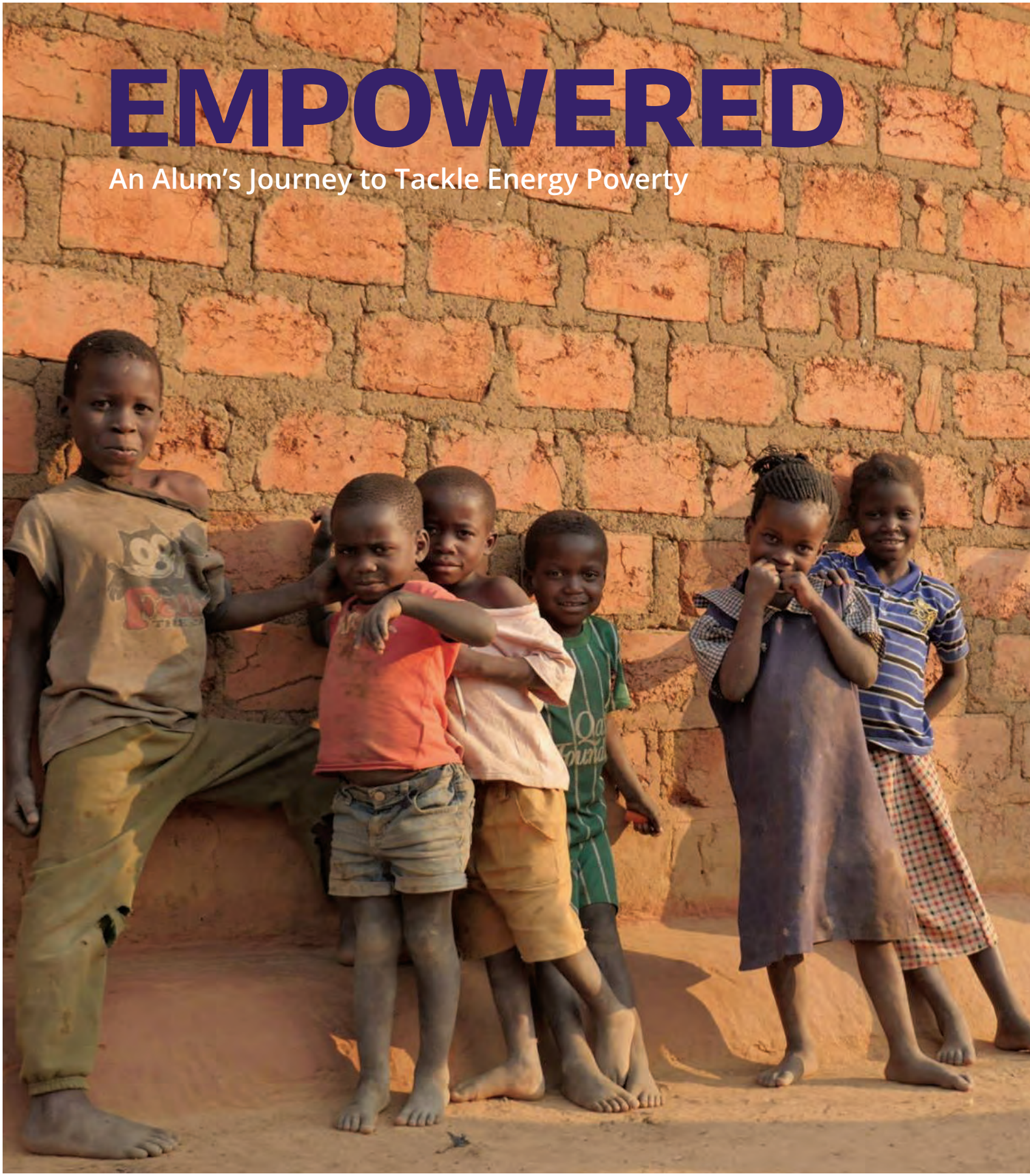


Photo Source: KiloWatts for Humanity

In Kitwe, Zambia

a raw wilderness meets industrial potential. Fruit stands are propped up on top of burning sands. Women tend to the tropical fruit, an array of incandescent color, boldly mirrored in their intricate headresses.

In town, tall 1960s-style highrises flank city streets, cars thrum through choked intersections and weave around endless passersby.

As the second largest city in the nation, Kitwe sets the foundation for economic and industrial development. However, urban potential and actual economic growth and development are not synonymous systems in Zambia.

Less than three percent of rural Zambians live with electricty. For rural communities, power runs like a golden thread through the houses of the lucky. Even in urban cities, like Kitwe, less than 20 percent of people have electricty.

The country's high reliance on hydropower and confined power distribution infrastructure has left the nation with a limited source and lacking structure. Because of the high demand for power, the unstable power grid suffers from constant blackouts.

The Zambian government has put forth new initiatives to preserve power and prevent blackouts. In July 2015, Zambian officials began a load-shedding program. It delivers power on a rolling schedule, offering electricity to different areas at planned times.

It was around the same time the load-shedding program began when Henry Louie (PhD '08), an electrical engineering alum and assistant professor of electrical and computer engineering

at Seattle University, arrived in Zambia. Louie received a Fulbright Award, allowing him to spend a year at Copperbelt University in Kitwe, Zambia. During this year, Louie not only taught courses on power engineering at the university, but he also traveled to remote villages around several African nations to implement power systems.

While in Zambia, Louie worked with KiloWatts for Humanity, a non-profit organization that he co-founded in 2009.

"I worked with KiloWatts for Humanity to establish two solar-powered 'energy kiosks' that provide electricity to communities that are not connected to the grid," Louie said. "Hundreds of people in these villages now have access to electric lights (important for safety and to allow children to study at night), refrigeration and radios/TVs."

These "energy kiosks" or microgrids can supply electricity to a large group of individuals through solar and wind power. In Zambia, most communities do not have access to a broad national grid network. Louie and his team analyzed the conditions of the villages they visited. Then they raised the grant money they needed to install microgrids.

Louie has always had an interest in tackling energy poverty. As a Ph.D. student at the UW, Louie worked on renewable energy forecasting, power system optimi-

Henry Louie (top row, third from right) and his KiloWatts for Humanity volunteers stand in front of a solar-powered energy kiosk they built in Zambia.

zation and electricity markets. After visiting Zambia for the first time in 2009, he realized he wanted to return for a longer period of time to really evaluate the current energy situation. The Fulbright allowed him to do just that.

At Copperbelt University, Louie's research evaluated the effectiveness of load-shedding in conserving energy, as well as its impact on people and the environment.

"While in Zambia, I established a research group at Copperbelt University," Louie said. "We are studying the effects of the on-going electricity shortage in Zambia. Every day we are subjected to 8 hours without electricity. This work is on-going, and I will continue the collaboration with my Zambian colleagues while back at Seattle University."

Louie worked with Zambia's largest power company, ZESCO, to develop models of their rural distribution networks. In addition, he utilized the company's hard data. He compared these results to earlier survey results. Louie and his team surveyed over 200 households in Copperbelt connected to the power grid.

"Without electricity, people are switching to other energy sources like charcoal, which is expensive and can lead to negative environmental outcomes like forest degradation and CO2 emissions," Louie said.

Louie hopes that the results from the survey can galvanize the international community to financially support the implementation of more microgrids and the generation of more power for the nation.

In the United States, energy availability is so prevalent that it is ignored as a luxury. As energy became more commonplace, the U.S. witnesed an increase in industrial and agricultural gains. Additionally, education levels improved with access to light to read and, eventually, the connectivity of computer machines.

Zambia, as well as other African nations like Ethiopia and Liberia, are investing in initiatives to improve quality of life and advance their countries to compete on the world stage. Microgrids and similar energy sources offer the clean, inexpensive power access that is needed for economic, societal and environmental development.

Louie will continue to be a strong advocate for energy access, dedicating his life's work to improving energy poverty around the world.

"In the short-term, I'm especially enjoying having 24-hour access to electricity, internet and clean water," Louie said. "In the longer-term, my colleagues at Seattle University and at KiloWatts for Humanity will continue to establish energy kiosks in energy-impoverished areas."

2015-2016 Fulbright Scholar, Henry Louie, Ph.D. '08

OUR IMPACT:

Recent Research in Review

1

UW EE Leads Office of Naval Research MURI Grant to Defend Against Cyberattacks

Department Chair and lead MURI PI Radha Poovendran and Associate Professor Maryam Fazel receive a highly competitive, $7.5 million MURI Award to support exceptional research.

2

Associate Professor Georg Seelig and MIT Team Up to Improve Medical Diagnostics with NIH Grant

Associate Professor Georg Seelig receives a 5-year, $3 million NIH Grant for groundbreaking work that can diagnose diseases within living cells.

3

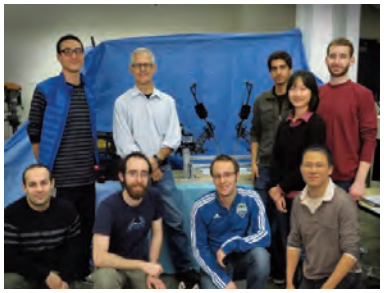
Associate Professor Josh Smith Receives GSK Grant to Develop Rehabilitation Device

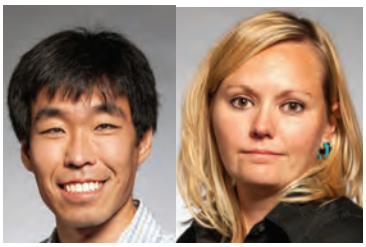
Professor Smith and his team receive $1 million to develop an implantable device that can aid those suffering from spinal cord injuries and incontinence.

4

Professor Blake Hannaford Develops Device to Improve Surgeries, Save Lives

Professor Hannaford and students from the BioRobotics Lab create a semi-autonomous robot, which delivers expert surgical precision to support physicians.

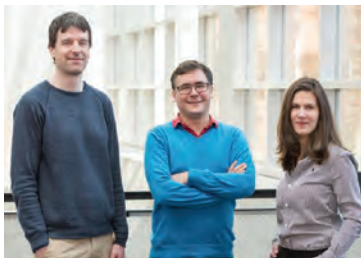




5

UW EE Collaborates with Vanderbilt and Cities of Seattle and Nashville to Build Multi-Modal Transportation

The three-year, proof-of-concept project is part of an NSF US Ignite Grant. The project tackles urban transportation congestion by engaging the individual user.



6

Associate Professor Georg Seelig and Team Achieve World Record in DNA Storage

Professor Seelig, Professor Luis Ceze of CSE and Karin Strauss of Microsoft Research reach a new milestone in the revolutionary process of DNA data storage.

7

Assistant Pro Shlizerman R Award to Inv Mosquitoes' Attraction to

Professor Shlize associate profe biology Jeff Riffe Air Force Office Research Grant the Complex Se of Mosquitoes.

8

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9

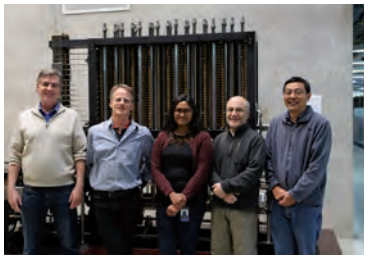
Associate Professor Josh Smith and Graduate Students Develop Implantable Device that Talks Wi-Fi

The "Interscatter" communication device allows brain implants, contact lenses, credit cards and more to deliver information to a smartphone or watch.

10

Ph.D. Students Develop Cost-Effective, Convenient Malaria Diagnostic

Ph.D. students Charles Delahunt and Mayoore Jaiswal worked with Intellectual Ventures to create an effective and cost-efficient malaria diagnostic.



11

Associate Professor Shwetak Patel and Students Develop Tool to Measure Lung Function over the Phone

SpiroCall allows patients to use their phone to test lung function as opposed to traveling to a clinic to use a doctor's spirometer — a significant advancement in rural communities and developing nations.

12

Assistant Professor Eli Shlizerman Unlocks Butterfly's Internal Compass

Professor Shlizerman uncovers the monarch butterfly's migratory patterns, leading to the design of future bio-inspired systems.

13

Assistant Professors Kai-Mei Fu and Arka Majumdar Receive NSF Grant for Secure Communication

The $2 million EFRI grant will support Professors Fu and Majumdar's work to apply quantum mechanics to the development of fundamentally-secure communications.

14

Professor Eve Riskin Leads a New NSF Consortium of Six Universities for Underserved Students

Professor Riskin heads a consortium to provide low-income students with the critical tools needed to succeed in engineering.

Class of 1966

We invited the Electrical Engineering Class of 1966 back to campus — 50 years after they said goodbye.

It was the year

Dr. Martin Luther King Jr. led a powerful campaign in Chicago, "The Sound of Music" sashayed into winning Best Picture at the 38th Annual Academy Awards and Willie Mays, with dazzling grace and impenetrable talent, hit his 512th homerun. It was a year churning from change as protesters lined city streets, rallying for racial equality and wartime peace. Janis Joplin delivered her first live conert, husky and laden with the rhetoric of the times. This was our world 50 years ago.

It was also the year The University of Washington Department of Electrical Engineering gradauted 175 BSEE, MSEE and Ph.D. students. In 2016, for the first time in UW EE history, three of our students from this class returned to campus for the graduation. Over 50 years, our 1966 graduates achieved a lot of incredible accomplishments.

After BSEE alum Russell Bucklin graduated, he worked as an engineer. He then went on to invest in real estate for over 10 years. He is now retired and lives in Seattle.

John Perrault graduated with his BSEE in 1966. After graduation, he spent the majority of his career working in nuclear power plants for General Electric. Before retiring, he worked as an engineering manager for Gray's Harbor on the coast.

Ph.D. alum Bruce Kieburtz's 64-year career began with the U.S. Air Force. Later, he moved on to work for General Electric, Boeing and Bell Telephone Laboratories doing research. He then founded Kieburtz Engineering Consultants in 1990.

Professor and Chair Radha Poovendran (far left) and College of Engineering Dean Michael Bragg (far right) honor Class of 1966 alums Bruce Kieburtz (left middle), John Perrault (center) and Russell Bucklin (right middle).

OUR LEGACY ON SOCIETY

An Interview with visionary tech pioneer Babak Parviz

What does societal impact mean when developing technology?

At Amazon, we like to articulate very clearly how we can make life better for an individual. As we evaluate impact for a single individual, we determine how we can scale the impact to affect many more people. We ask — how can this aggregate to a larger population? Often, it is not enough to account for broad impact on society without looking at an individual, at a single person's experience.

Why is it important?

It would be difficult to argue otherwise. The impact has to be clear to a group of people. For example, if it's clear to a group of engineers that their work can have an impact on an environment, the group will rally around the concept and make it happen. If it's not as obvious, it's usually more difficult to inspire a group into action.

What is one of the first things you worked on where you said — "wow, this has the potential to change lives?"

While I was completing my postdoctoral research fellowship in chemistry and chemical biology, I worked on a biosensor that was meant to operate in resource-poor settings. As the device began to take shape and we could see growing success in our tests, I realized that our work could have real impact and change lives.

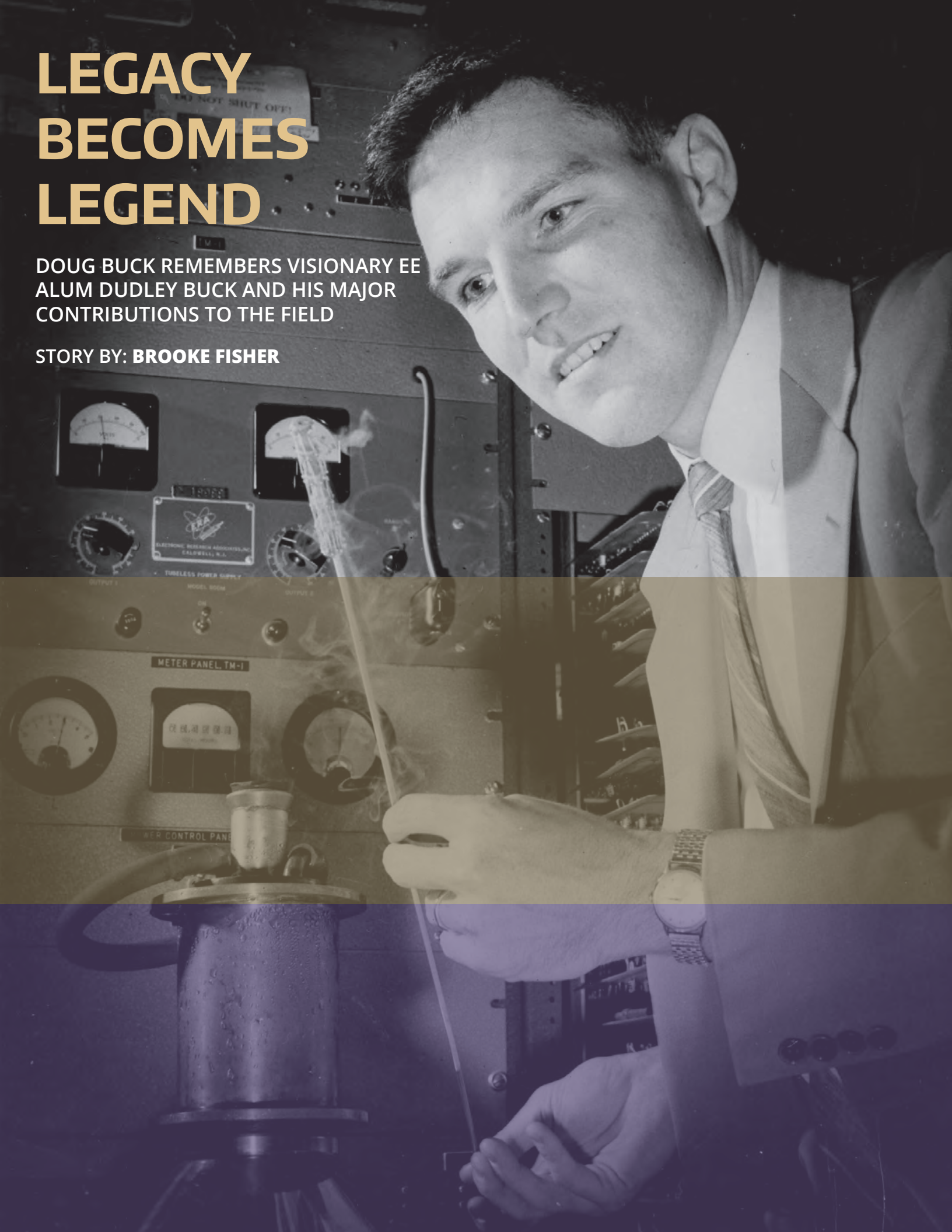
Why is EE at the UW a good place to foster this type of societal impact?

Amazon is very committed to the Pacific Northwest and growing a strong, healthy ecosystem. Additionally, the University of Washington is a great university, and the Department of Electrical Engineering is an incredibly strong department. By supporting EE at the UW, we are investing in cutting-edge, societally focused research. UW EE touches many things at the device level and at the systems level, which has a very sizable impact on the society. The department works on so many different things -- from mastering DNA storage to building medical biosensors. The work also crosses many disciplines; the development of power grids is an example. UW EE touches people and touches society, and I am excited to be a part of it.

LEGACY BECOMES LEGEND

DOUG BUCK REMEMBERS VISIONARY EE ALUM DUDLEY BUCK AND HIS MAJOR CONTRIBUTIONS TO THE FIELD

STORY BY: **BROOKE FISHER**



In the 1950s, even the most advanced computers took up space in several rooms. Dreaming of creating smaller, faster and lower power electronics, alum Dudley Buck (BSEE '48) made much progress toward this goal. His vision ended abruptly, however, with his premature death at the age of 32.

"His notebooks looked exactly like Leonardo da Vinci's, with magnificent details, drawings and clear explanations," Doug Buck said about his father.

After earning his master's and Sc.D. degrees at MIT, Dudley Buck made a name for himself in a short amount of time by developing not only the cryotron, but the precursors to today's flash drives, digital camera, internet searching, computer mouse and quantum computing. Determined that his father's contributions to electrical engineering be remembered, Doug Buck collaborated with Iain Dey, business editor of the Wall Street Journal, who authored a book titled "The Cryotron Files, The True Life Story of Dudley Buck."

"His notebooks looked exactly like Leonardo Da Vinci's, with magnificent details, drawings and clear explanations"

Eager to learn more about the father who passed away suddenly when he was just two years old, Doug Buck reached out to his father's colleagues, including Stanford University Emeritus Professor Bernie Widrow, who was a Massachusetts Institute of Technology (MIT) graduate student at the same time as Dudley Buck.

"He was extremely imaginative and creative," Widrow said about Dudley Buck. "If he had lived, his name would have been a big one in electrical engineering."

Dudley Buck, who grew up in Santa Barbara, California, became interested in engineering during World War II, when engineers were in high demand. After earning his bachelor's degree at UW EE, he joined the U.S. Navy for two years as a communications officer working for the Armed Forces Security Agency. During this assignment, Dudley Buck used early digital computers to collect electronic data about the Soviet Union.

Dudley Buck then spent nine years at MIT, where he earned his graduate degrees and later conducted research and taught. While at MIT, Dudley Buck worked on one of the first digital computers, the Whirlwind Computer, which occupied space in several rooms. While working on the Whirlwind Computer, Dudley Buck gained attention from early computer pioneers and even demonstrated the device to German engineer Konrad Zuse, who invented the first programmable computer in 1941.

One of the characteristics that separated Dudley Buck's work from most electronic engineers is that he worked with the physics

To learn more about the accomplishments of Dudley Buck, visit: www.dudleybuck.com.

of electronics, which at times was at the nuclear level. While Dudley Buck developed many remarkable inventions during his time at MIT, his most notable is the cryotron. Utilizing superconductivity, the cryotron has a magnetic field that can be turned on and off. Dudley Buck envisioned the cryotron as the building block for electronic digital computers, acting as the logic switch and replacing bulky vacuum tubes.

In MIT's Lincoln Laboratory, Dudley Buck also began a related research project, using cryotrons to build what is today known as content-addressable memory, a precursor to internet searching. Content-addressable memory compares search terms against stored data, returning matching entries. In his master's thesis from 1952, Dudley Buck detailed a type of computer memory, called ferroelectric memory, that evolved into the flash drive. Dudley Buck also created the ferrite cores used in magnetic core memory, which was first used in MIT's Whirlwind II Computer, the first non-vacuum tube mass-produced computer. Together with researcher Ken Olsen, Dudley Buck patented a "saturable switch," which allows bits to be sensed without being erased. While other scientists proposed similar ideas, Dudley Buck was the first to make them operational.

Dudley Buck (right) and a classmate stand on the steps of a UW building. Dudley was a member of the National Society of Scabbard and Blade, a national honor society for ROTC members. Circa 1947.

"My dad cracked a lot of the key problems that led to the invention of the first proper computer memory," Doug Buck said.

Dudley Buck's research interests were broad and spanned a variety of subjects. In 1958, he presented a paper to the Institute of Electrical and Electronics Engineers that detailed how to design a chip

Left to right, back row: W. A. Brown, O. Carstensen, W. Seegmiller, C. B. Austin, N. O. Kjelstad, E. S. Michael. Second row: L. Rutten, D. A. Buck, J. S. Birch, M. S. Rogers, W. R. Peterson, J. F. Durkin. Front row: H. K. Ward, F. J. Ravens, W. D. Morgan, T. F. Comick, R. J. Tallman, J. H. Duffy, O. W. Calvin.

RADIO CLUB

Left to right: T. F. Comich, R. J. Tallman, D. R. Peters, W. A. Brown and D. A. Buck.

A yearbook photo of Dudley Buck and classmates circa 1948 (top). The below photo also shows Buck (far right) with other members of the UW Radio Club.

in one process. This led to advancements in microcircuitry, where miniaturized circuits are constructed as wholes rather than from various components. For his work to advance chips, Dudley Buck was hailed as "one of the most imaginative persons" to conduct research on computers by MIT President Emeritus Jerome Wiesner.

Dudley Buck also invented the light gun, an early precursor to today's mouse or touchscreen. During the Cold War, light guns were used to interact with computers to communicate with aircraft and radar stations in real-time. During the Cold War, Dudley Buck also worked on a number of top secret projects including the first hydrogen bomb.

"He worked with a bunch of scientists who locked themselves in a lab and worked out the timing mechanism for the hydrogen bomb in two weeks," Doug Buck said.

As the cryotron's promise grew, Dudley Buck focused his efforts on making the cryotron smaller, faster and lower power. He discovered that as the size of the cryotron became smaller, its speed became greater. Together with his students and researcher Kenneth Shoulders, Dudley Buck made much progress manufacturing thin-film cryotron integrated circuits. The researchers presented a paper titled "An Approach to Microminiature Printed Systems" in December 1958 at the Eastern Joint Computer Conference.

As news spread about the cryotron's potential, several engineers from the National Security Agency (NSA) joined Dudley Buck's research efforts. NSA-funded programs to develop cryotron circuitry were also established by IBM and RCA, followed

by General Electric with a self-funded program. Representing the NSA, Dudley Buck also headed up "Project Lightning" with IBM, which led to the development of a computer system named Harvest, which revolutionized the computer industry with its quick processing speed.

Dudley Buck also worked on the first digital camera as part of the Satellite and Missile Observation System project, led by Louis Ridenour, Chief Scientist of the U.S. Air Force. Dudley Buck developed the memory for the first digital camera, which was used to provide real-time color video feed of the Soviet Union from reconnaissance satellites.

In the midst of his cutting-edge research, Dudley Buck tragically passed away in 1959 from viral pneumonia. Following his death, efforts continued into the 1960s to develop computers from cryotrons. Although GE's cryotron microcircuitry reached advanced levels, and researchers fabricated an operational computer from cryotrons, the introduction of silicon microchips soon overshadowed the cryotron.

Despite this, cryotron research efforts continued at IBM and modified cryotrons, called Josephson junctions, were developed, which are a core element of quantum-computing research that continues today. In 2014, MIT researchers created a new quantum computing chip that they named the "nanocryotron" after Dudley Buck's cryotron.

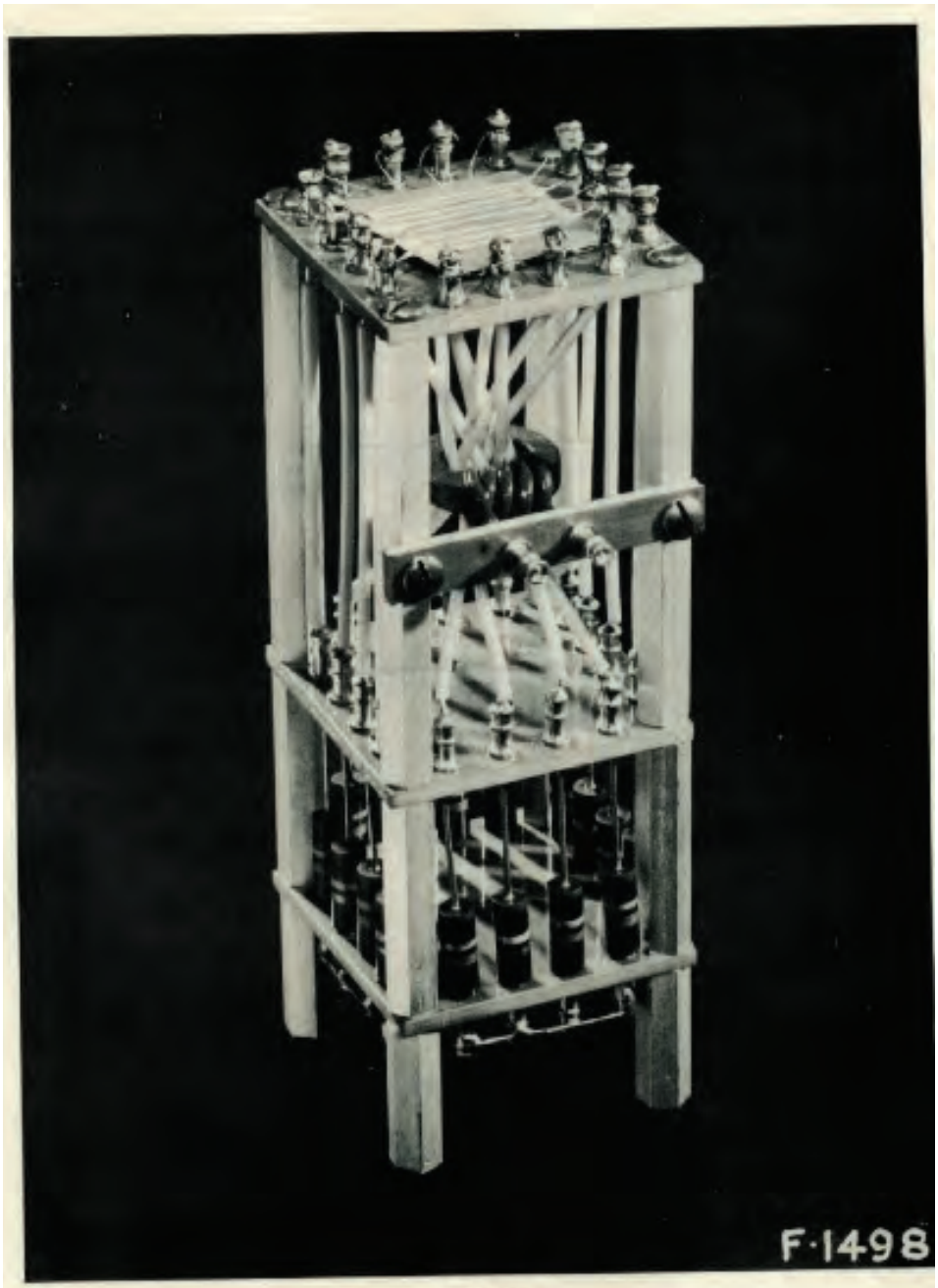
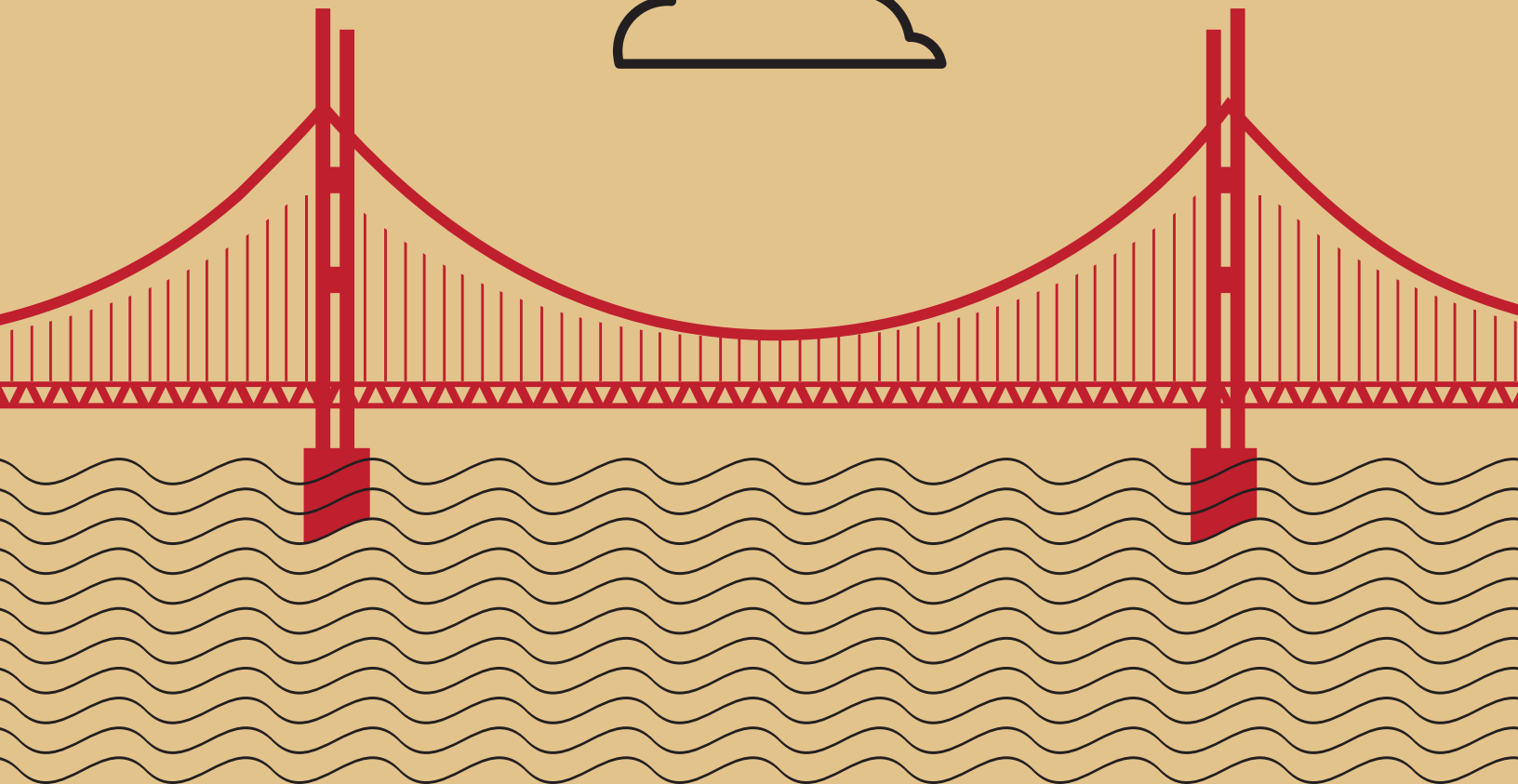


FIG. 19
EIGHT BY EIGHT FERROELECTRIC MEMORY

In his master's thesis from 1952, Dudley Buck invented a type of computer memory that evolved into the flash drive. Called ferroelectric memory, the device pictured contains eight bytes of memory.

THE BAY AREA

WE MET OVER 80 OF OUR BAY AREA ALUMNS TO RECONNECT, REMINISCE AND DISCUSS THE DEPARTMENT'S CURRENT RESEARCH AT THE COMPUTER HISTORY MUSEUM IN MOUNTAIN VIEW



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MOUNTAIN VIEW, CA

First picture: Swagato Chakraborty and Professor John Sahr. Second picture: Sam Huynh, Angellica Huynh, Professor and Chair Radha Poovendran and Jane Huynh. Third picture: David Evans, Professor and Chair Radha Poovendran and William Mohr. Fourth picture: Professor John Sahr and Jeanne Hsu. Fifth picture: Mark Sabol and Mahnaz Sherzoi, director of advancement. Sixth picture: C.K. Chou and Professor Mani Soma.

BOUND TO

Sam Dommer, BSEE ’14

ONE ELECTRICAL ENGINEERING ALUM JOINS A LEGACY — THE UW ROWING TEAM. WITH COMMITMENT, TEAMWORK AND A WILD HEART FOR THE SPORT, HE PUSHES HIMSELF TO THE 2016 RIO OLYMPICS FOR TEAM USA.

THE BOAT

Photo by: Andre Penner/AP Images

Eighty years ago, a group of eight men from the University of Washington propelled past the finish line within one second of the Italian and German rowing teams.

The 1936 Berlin Olympics were as much a choreographed display for Hitler and his Nazi regime as they were a model for Aryan birthright — the thought that a single race proliferated genetic superiority.

The UW team, which had only been rowing together for five months, won the gold in front of Hitler and 75,000 screaming fans for the Third Reich. The U.S. rowing team demonstrated that a group of men from blue-collar roots, a public university and a diverse nation could prevail over the best rowers in the world, handplucked and engineered by a totalitarian regime.

Today, their legacy lives on with the University of Washington rowing team. On Lake Washington, under the soft light of predawn, you can see the slender shells moving synchronously in poetic beat. The oars cut through the chop in a beautiful union of boat, rower and sea.

In the boat, the rowers strain, gasping and huffing through each lurch. The single commands of the coxswain seemingly a part of the directional movement.

The 1936 Olympic Rowing Team all from the University of Washington. Photo credit: The University of Washington Libraries, Special Collections

The University of Washington team is currently third in their region, with hundreds of championships and titles to their name. Sam Dommer (BSEE '14) from Folsom, California, originally decided to join rowing to get in shape. He had no idea that this decision would lead him to the 2016 Rio Olympics. At the UW, Dommer won three intercollegiate Rowing Association national titles with the UW's varsity eight from 2012 to 2014. After graduating with his electrical engineering degree in 2014, Dommer moved to Princeton, New Jersey, to join the U.S. Rowing senior national team.

Although Dommer discovered a passion for rowing, he also

Sam Dommer joined U.S. Rowing after graduating from the UW in 2014. He competed in the Men's Eight, coming in fourth overall in the 2016 Rio Olympics. Photo credit: U.S. Rowing

completed the rigorous electrical engineering program at the UW, while maintaining a tight rowing schedule.

"I knew that I wanted to pursue some sort of engineering degree because both of my parents are engineers," Dommer said. "Growing up they were always talking about interesting projects they were working on or something happening within the company. When I was taking the basic engineering courses, I found EE 215 to be the most interesting. It was one of those classes where you were excited to learn the new material, granted the learning curve was steep, but I loved the challenge. From there, each EE course I took reinforced my idea of majoring in it. It was a lot of hard work between rowing and majoring in embedded systems, but I wouldn't have changed a thing."

The events of 1936 changed the heart of rowing, breathing fresh air into a sport that had previously been for the elite. The distilled essence of what the boys did back then still resonates today with Dommer and his journey to Rio.

"There are a lot of ups and downs during your time competing for a spot on the Olympic team," Dommer said. "Some days I thought I couldn't do it. In the back of my head I always remembered those guys and I told myself, if they can overcome all odds and not only represent their country but win a gold why can't I? Their story helped me stay on a level path and finish out what was probably the most challenging two years of my life."

In 2014, the Huskies Varsity Eight Crew win a fourth straight championship at the IRA Championships. Sam Dommer is fourth from right. Photo credit: University of Washington.

ELECTRICAL ENGINEERING
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Have Stories?

We want to hear them!

Please share your stories about your time in EE, what you're up to now, what your favorite class was -- anything. We enjoy hearing from you. The Integrator was designed for you. You are a part of the rich history of UW EE. To be highlighted in the next Integrator, please email:

Annie Pellicciotti at apell@uw.edu