GW RESEARCH

THE GEORGE WASHINGTON UNIVERSITY
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FROM THE VICE PRESIDENT FOR RESEARCH

In medicine, different imaging techniques reveal different things. Fusing those images—CT scans, MRIs, X-rays—into a single, perfectly squared visual, perhaps before a surgery, could offer a much more complete picture. That's what biomedical engineering professor Murray Loew was working on about a decade ago when he happened to mention his research in conversation with a scientist from the National Gallery of Art.

Researchers had long known that various bands of light, like infrared and X-rays, could be used to glimpse beneath the surface of paintings, turning up false starts and abandoned sketches. But the work of comparing the different images—often by sight, side by side—was wrenching. Commercial photo software helped, but only so much.

It lacked the exactitude of, say, *medical imaging* ...

Partnerships, like the one that emerged from Loew's chat, continuously extend GW into the world while drawing others into our midst.

That means GW researchers are enmeshed near and far, and some of those partnerships you'll find detailed on these pages: from the art historian studying the meeting room of the all-powerful U.S. Senate Appropriations Committee (p. 26), funded by the U.S. Capitol Historical Society; to an analysis commissioned by the governor of Puerto Rico that led to a dramatic recalculation of the death toll from Hurricane Maria (p. 14); and a joint lab that's been established between GW and France's National Center for Scientific Research (p. 15), which will answer questions at the crossroads of genetics, the environment, big data and society.

Elsewhere, GW is part of broad, longstanding endeavors—like the founding of a National Institutes of Health-funded D.C. Center for AIDS Research, and the establishment of an NIH-funded Clinical and Translational Science Institute alongside Children's National—as well as new, cutting-edge industry partnerships, like GW's recent selection by a leading global financial institution to build a cybersecurity curriculum for some of its senior technology leaders.

What's exciting about these relationships, however serendipitous or well-plotted, is the unknown ahead.

As for Murray Loew, his work with the National Gallery of Art led to new software that automates that precise alignment of different types of images, then to a $500,000 National Science Foundation grant and the creation of hardware and software tools to map the chemical signatures of pigments and binding materials used in paints, to aid the work of historians and conservators. And most recently, it's led to a National Endowment for the Humanities-funded project (p. 4), in which Loew is helping the Library of Congress save a set of rare, 19th-century glass musical instruments.

And all because he wanted to give doctors a better look inside the body.

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WILLIAM ATKINS

FEATURES

DEPARTMENTS

FRONT COVER: **A hand-knit heart by Annette M. Thomson, MSIST '08, based on a pattern by Teal Larsen**

BACK COVER: **Fingerprint installation by Sienna Long and John McGlasson, which was photographed by Matt Hodgkins**

This 1910s photo shows a woman dressed as Pocahontas as part of a ceremony during the Washington's Birthday Celebration in Laredo, Texas. Founded in 1898, the WBC continues today.

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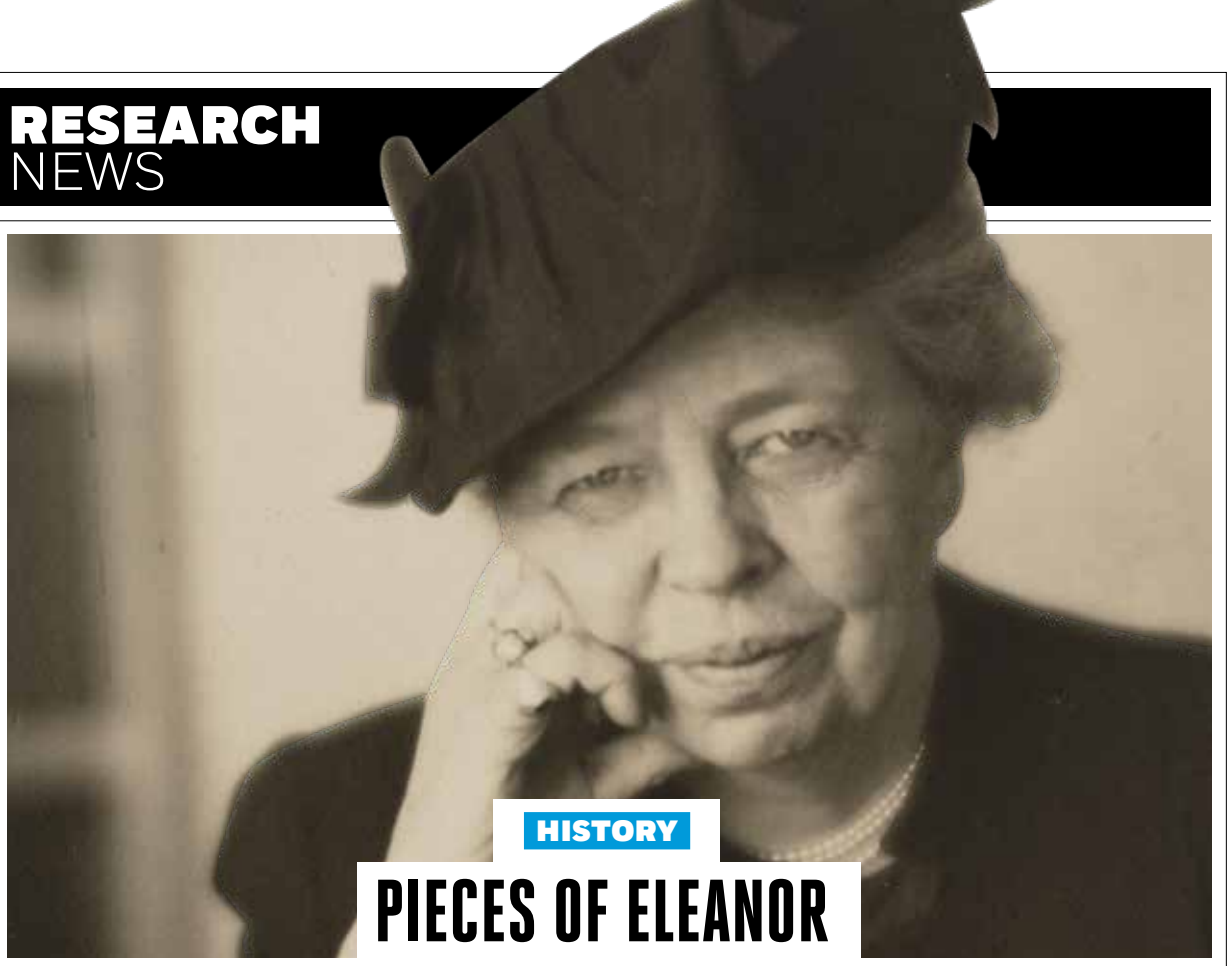

HISTORY

PIECES OF ELEANOR

For nearly two decades, researchers have followed a transnational paper trail to create a later-in-life political portrait of Eleanor Roosevelt, post-FDR and unbound after a dozen years in the White House. // By John DiConsiglio

She was a towering figure through some of the nation's greatest crises—the Great Depression, World War II, the Cold War—and a champion of human rights, women's rights and racial justice. Along the way, first lady and later diplomat Eleanor Roosevelt amassed a trail of words that included 8,336 newspaper columns, 27 books and nearly 600 articles. She averaged 75 speeches a year, penned up to 150 letters a day (and received two to four times that) and, over the years, hosted eight radio programs and three TV shows.

For 18 years, it's been the mission of the History Department's Eleanor Roosevelt Papers Project to create a public archive of that vast trove.

And while the project has collected from every phase of Roosevelt's public life—from her marriage to Franklin Delano Roosevelt in 1905 (her uncle and then-President Theodore Roosevelt gave away the bride) to her death in 1962—its work primarily targets the era after she left the White House in 1945.

Those 17 years were among Roosevelt's most productive, nearly eclipsing her time as first lady, but are perhaps the least studied.

"Our historical memory of her is usually in her role as first lady, but that only captures a small part of the identity she assumes in American public life," says Project Director Christopher Brick, BA '02. "Her career isn't over, by any stretch of the imagination, when FDR dies. She continued to shape politics, international law and human rights."

It's a period that included her service as chair of the UN Human Rights Commission, where she was the chief proponent and central architect of the Universal Declaration of Human Rights. She traveled the world and met with foreign leaders such as David Ben-Gurion in Israel, Jawaharlal Nehru in India and—twice—Nikita Khrushchev in the Soviet Union.

During that time, Roosevelt also continued to campaign for civil and women's rights, taking high-profile stances to dismantle Jim Crow and oppose Joseph McCarthy. She challenged the nation to live up to

NATIONAL PORTRAIT GALLERY, SMITHSONIAN INSTITUTION; BEQUEST OF PHYLLIS FENNER

the same ideals it espoused to the world.

"Until we have complete equality of opportunity in every field, equal rights socially and economically," she wrote in December 1945, "we cannot consider ourselves a real democracy."

Founded in 2000 by retired Research Professor of History Allida Black, PhD '93, the project is funded primarily through grants from the National Archives and the National Endowment for the Humanities. Scouring more than 250 archives—from the Library of Congress to the FDR Library in Hyde Park, N.Y., to collections in nine other countries—its initial goal was to publish a five-volume print edition of the most important papers and unpublished correspondence from Roosevelt's later political life.

Volumes I and II—covering 1945-1952 and featuring, respectively, forewords by Hillary and Bill Clinton—were published in 2006 and 2012. And the final three volumes are currently in production. The team recently was awarded $195,000 from the National Archives to support the completion of the third installment, covering 1953-1955, which could be published by 2020.

As the project evolved, its scope expanded to include digital initiatives and audio archives from Roosevelt's entire public life, with staff and student researchers spending thousands of hours, Brick says, uncovering, transcribing and reviewing Roosevelt recordings.

"Honoring Eleanor Roosevelt's extraordinary record means making this material available to a broad swath of people—not just historians, but students and anybody who wants to learn about this remarkable woman," says Project Editor Christy Regenhardt, BA '95. "Eleanor Roosevelt's legacy is part of our American story, and these items are valuable pieces of American heritage."

Brick and his colleagues have uncovered a series of historical treasures: photos of Roosevelt with Tuskegee Airmen; audio conversations with Albert Einstein and John Steinbeck; records of a flight with Amelia Earhart during which both women took the plane's controls. Along the way, the staff has become intimately familiar with their subject.

"I've found myself searching through a collection of letters in our filing room and ending up sitting on the floor crying my eyes out over how moving their content is," says Lee Febos, a history major and student research assistant.

They are words that continue to resonate.

In 2013, the project was awarded a special designation by UNESCO as part of its historical heritage register. And in 2017, *Hamilton* creator Lin-Manuel Miranda retweeted a Roosevelt quotation—"We have to get over our complacency and stop thinking that democracy is something we have achieved and no longer have to work for"—causing an immediate 500-follower boost for the project's Twitter account.

"Her voice is every bit as relevant today as it ever has been," Brick says. GWR

Roosevelt as drawn mid-century by Charles Johnson Post

IN THE ARCHIVE

100,000
documents

500
audio and visual recordings; some rare, like her radio address to the nation hours after the Pearl Harbor bombing

5,000
photographs

3
shelves of binders recreating Roosevelt's daily schedule

40
boxes of Christmas cards

8,000
"My Day" newspaper columns

NOT IN THE ARCHIVE

12
redacted pages from a 3,000-page FBI file detailing J. Edgar Hoover's targeting of Eleanor Roosevelt as a suspected communist sympathizer. The project is suing the federal government for the pages, which likely deal with Roosevelt's trips to the Soviet Union in 1957 and 1958.

NATIONAL PORTRAIT GALLERY, SMITHSONIAN INSTITUTION

ENGINEERING

A GLASS FROM THE PAST

A professor is working to classify the condition of historical glass, starting with 19th-century flutes.

School of Engineering and Applied Science Professor Murray Loew, an expert in medical imaging and image analysis, is trying to save rare, historical flutes—the ones that play music, not hold champagne—from deterioration and improve preservation guidelines for historical glass.

"Different people will look at the same piece of glass and define it differently," says Loew, who in 2017, along with research partners at the Library of Congress and Catholic University, received a three-year grant from the National Endowment for the Humanities to research historical 19th-century glass. "So one of our goals is to provide objective, reproducible measures that can describe the glass as it ages."

The team is developing a decision tree to help conservators evaluate the condition of glass artifacts, since symptoms of deterioration are often described with vague, undefined words like "weeping" or "crizzling."

Claude Laurent, a 19th-century inventor who lived in Paris, designed the glass flutes at the center of this project.

In 1806, he patented a design for flutes made out of "crystal," which today we would call leaded glass. At that time, flutes were primarily made out of wood and ivory, and those flutes would crack and change tone with temperature and humidity

BOTH PAGS: LIBRARY OF CONGRESS

fluctuations.

Laurent's crystal flutes were highly refractive glass, which made them sparkly and beautiful, even before he added artistic flairs such as jeweled keys. These flutes were owned by the elites of the day and have become collectors' items over the past 200 years. The Library of Congress has several, including one gifted to President James Madison.

A few years ago, a concerned curator at the Library of Congress noticed that in her more than 20 years on the job, the Library's flutes had changed slightly. She had an X-ray elemental analysis done and determined that not only are many flutes degrading, but that they're made from potash glass—a less stable and lower-quality glass than the crystal Laurent had patented.

"We don't know why Laurent substituted potash glass, a potassium silicate glass," says Lynn Brostoff, a research chemist at the Library of Congress and project collaborator. "We think he might have been trying to save money; we're not sure. We don't want to cast aspersions on his character, but we're pretty sure it would have been less expensive."

The team has done ultraviolet and X-ray imaging on the glass flutes and on aged replicas created in a Catholic University lab. By using the entire light spectrum for both imaging and chemical analysis, researchers will be able to collect as much information about the flutes as possible. Most of the analysis has been done at the Library of Congress to avoid moving the valuable flutes, but last year researchers brought some of the flutes to GW Hospital for a CT scan.

The team also brought a Laurent flute to GW's optical coherence tomography lab, where researchers are creating 2D and 3D images of the glass surface. This technique is most commonly used by ophthalmologists.

In small, community museums and historical societies across the country, there are boxes of artifacts that sometimes sit untouched for generations. Small budgets and space restrictions often force many interesting items into storage for long periods.

The tools that will be published at the end of this project are designed to be useful for conservators and curators at all institutions—not just those with the kinds of resources available to the Library of Congress.

"We'd like to have a way that somebody who doesn't have any equipment, or very little, could get some preliminary understanding of their glass," Loew says. "It would be good to be able to sort your collection into 'OK' and 'at-risk,' and the NEH would like them to be able to do it at minimal cost."

—Kristen Mitchell

PUBLIC HEALTH

HEART TROUBLE

Study: Pre-hospital care for women with heart attack symptoms, cardiac arrest lags behind men

Women with heart attack symptoms treated by emergency medical services after a 911 call are less likely to receive aspirin, to be resuscitated or to be transported in an ambulance using lights and sirens, a new study has found.

The differences between care received by women and men were "modest" but statistically significant, the researchers say, and they warn that even a small difference translates to tens of thousands of patients.

"Pretty much all of the treatments that we looked at are evidence-based and known to have an effect on mortality," says the study's lead author Melissa McCarthy, a professor of health policy and management in the Milken Institute School of Public Health and of emergency medicine at the School of Medicine and Health Sciences. "What was interesting about the findings is that they were pretty much always in the same direction, just a difference in the magnitude. Every treatment we looked at, women got it less frequently than men."

In the management of chest pains, for instance, the researchers found women were 2.8 percent less likely than men to receive aspirin, amounting to around 24,800 women in this study. Women with chest pains were 4.6 percent less likely than men to be transported using lights and sirens, although overall, researchers concluded, there was "no meaningful difference" in transport time. For calls involving cardiac arrest, women were 1.3 percent less likely to be resuscitated.

The researchers analyzed data from 2010 to 2013, pulled from a database that collects EMS patient care reports from 46 states, and they narrowed the study to patients ages 40 and older with chest pains or cardiac arrest, which totaled nearly 2.5 million records.

The study appeared in December in the journal *Women's Health Issues,* which is published by the Jacobs Institute of Women's Health based at the Milken Institute School of Public Health.

—Kristen Mitchell

ENVIRONMENT

AN EYE ON PERMAFROST

A research project that tracks permafrost in the Arctic was awarded $1.2 million last year by the National Science Foundation to continue one of the longest-running observations of a region most vulnerable to climate change.

The project, known as Circumpolar Active Layer Monitoring (or CALM) Network, launched in 1991 and has been independently supported through NSF grants since 1998. Led by Associate Professor of Geography Nikolay Shiklomanov, the project for nearly three decades has been collecting data on permafrost—ground that remains frozen for at least two consecutive years. Permafrost underlies about 25 percent of the land in the Northern Hemisphere, including the majority of Alaska, Canada and Russia.

Researchers began studying permafrost to better understand the engineering implications of building on frozen ground. Today permafrost is at the fore of the global conversation about climate change, which makes data from the project's more than 200 Arctic and sub-Arctic sites extremely valuable.

"For some of these sites, we have 25 years of records, and we are now beginning to see some really interesting stuff," Shiklomanov says. "We clearly see how permafrost at some of our sites, especially in the Eurasian Arctic, has started to degrade completely."

As permafrost thaws, it releases long-trapped carbon into the atmosphere. Researchers have observed that, in some areas, the southern boundary of permafrost has been shifting north, Shiklomanov says.

The five-year renewal grant from the NSF will enable the researchers—who run the project in collaboration with Northern Michigan University and with cooperating researchers from more than a dozen countries—to increase the number and quality of observations taken at CALM Network sites, Shiklomanov says. The grant also will help fund the logistics of conducting fieldwork, which often involves students like Nina Feldman, BA '17, a geography graduate student whose work with the project took her to Russia in 2017 and Alaska in 2018.

"For most people, it's not on their radar, especially when it comes to climate change," she says of the Arctic region. "People focus on ... cities in the U.S., rising sea levels and whatnot. But people in the Arctic are actually living through climate change. You go there for like a month and you can actually see what is happening and how it is impacting them."

—Kristen Mitchell

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NEUROSCIENCE

OVERRIDING THE EYE

The human brain allocates attention based on the known size of an object, not the way it's perceived.

Although a stop sign at an intersection appears to be larger than a parked car across the street, a new study shows that people will pay attention to an object based on its real-world size rather than how it's perceived by the eye.

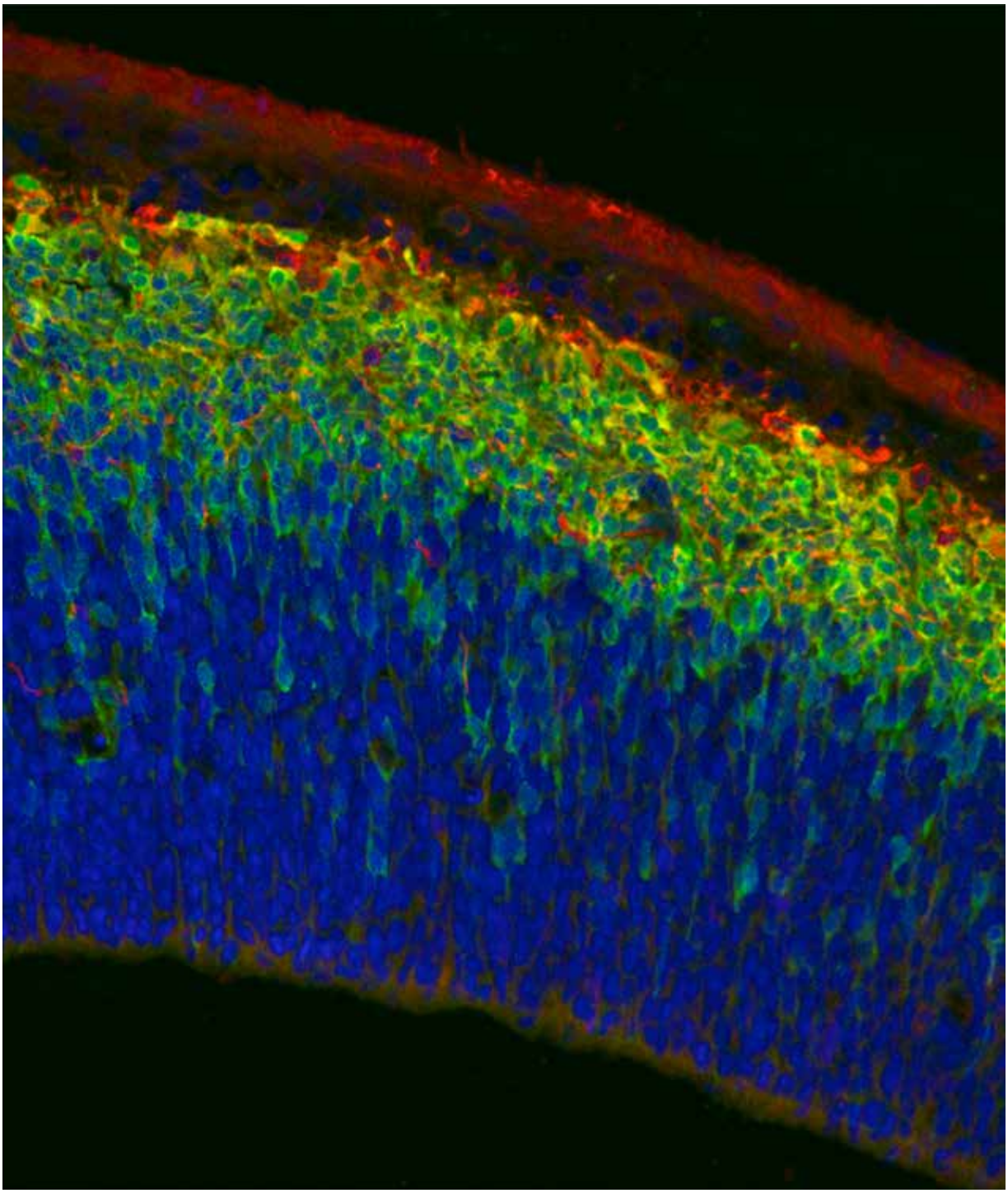
"Since a person can only pay attention to a limited amount of information at a time, our brain uses object size to determine how much attention to allocate to that object," says Sarah Shomstein, a professor of cognitive neuroscience, who led the study. "However, the way our eyes perceive an object can be different from its actual size, such as a car appearing large when it is close and small when it is far. Our study has shown for the first time that the brain adjusts attention based on our knowledge of an object's size, not how our eyes view it."

The findings were published in January in the journal *Nature Human Behavior.*

To determine whether the brain differentially allocates attention depending on an object's size, the researchers showed participants images of small and large everyday objects such as a domino or billiards table, but presented them at an identical size. The team measured how long it took people to identify probe targets that were embedded within object images.

They found that responses were quicker across known smaller real-world-sized objects compared to larger ones, even though the space occupied by both objects on the eye was the same.

"If objects are of identical size on your eye, but you know that one of them is smaller—such as a domino nearby versus a pool table far away—you allocate more attention to the smaller item," Shomstein says. "Your knowledge of the object's size overrides its physical size, thereby adjusting how much attention your brain allocates to the objects." GWR



ART OF SCIENCE

Neurons (seen in red and yellow) arise from apical and basal progenitor stem cells (blue and green, respectively) in this image by doctoral student Samantha Dow, one of the winners from last year's Art of Science image contest at the School of Medicine and Health Sciences.

COURTESY SCHOOL OF MEDICINE AND HEALTH SCIENCES

MEDICINE

NEW 'DECOY' PLATELETS MAY FIGHT CLOTS, CANCER

A new reversible, drug-free therapy could reduce the risk of blood clots and potentially prevent the spread of cancer in patients, according to a new study.

The approach involves modifying human platelets—small blood cells that help the body form clots to stop bleeding—to create what are, essentially, decoys. The decoys are still capable of binding to some cells but will not aggregate or carry out the other normal platelet functions, including chemical signaling associated with the clotting process.

"The therapy could prevent clotting in high-risk patients just before they undergo surgery or could be given to cancer patients alongside chemotherapy to prevent existing tumors from spreading," says Anne-Laure Papa, an assistant professor of biomedical engineering, who was a postdoctoral fellow at Harvard University's Wyss Institute when the research was conducted.

The research, conducted on lab-on-a-chip devices that can simulate environments in the body, like blood vessels, was published in February in the journal *Science Translational Medicine.*

Platelets play a vital role in stopping bleeding and helping to protect against minor and life-threatening bleeding. But hyperactive platelets also can contribute to disorders such as severe blood clots, heart disease and cancer. While several antiplatelet drugs fight clots, their blood-thinning effects are not easily reversed, leaving patients vulnerable if they develop unexpected severe bleeding or are in need of an emergency surgical procedure.

Platelets also play an important part in cancer metastasis by binding to tumor cells and protecting them from the body's immune system and sheer stress as they circulate in the bloodstream.

To create the decoy platelets, the research team stripped natural human platelets of their inner structures and removed their basic activation and aggregation abilities. The decoy platelets became about one-third the size of a regular platelet but retained a majority of the adhesion receptors on their surface. This allows them to bind to other cells in the bloodstream, such as cancer cells, but not become active during the blood-clotting process.

The researchers quickly reversed the effects of the decoys on normal platelets by introducing fresh platelets into the blood. GWR

LAW

A NOTED AUTHORITY

Repository of music copyright cases finds a home at the law school

GW Law is now home to a free, online database detailing every music copyright infringement case litigated in the U.S. since the first dispute in 1844.

The Music Copyright Infringement Resource documents more than 200 cases through narrative descriptions and other contexts, including judges' opinions, sheet music, and audio and video recordings. For more than a decade, it's been widely used and cited by academics, practitioners, journalists and others.

The database was established by Charles Cronin, a lawyer and musician in Los Angeles, who will continue to expand the project as a visiting scholar at GW Law. It stems from his efforts to research a high-profile dispute in the 1980s involving the Bee Gees.

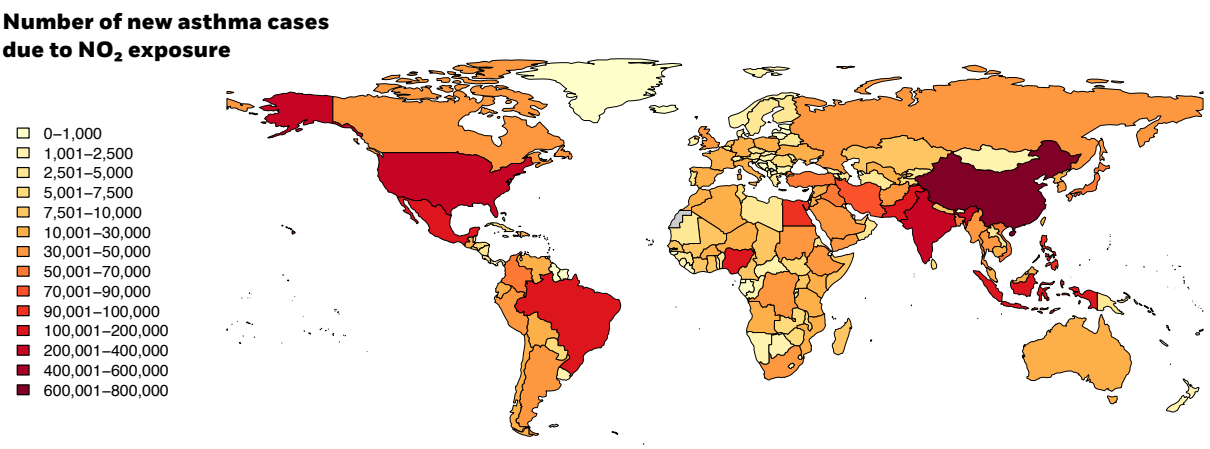
"Reviewing prior case law dealing with music copyright infringement, I realized how difficult it was to form an opinion as to the merits of the claims without seeing and/or hearing the disputed works," he says.

Cronin began tracking down sheet music and recordings of works at issue in these disputes.

The project is sponsored by GW Law's Intellectual Property Law Program and its Jacob Burns Law Library.

Robert Brauneis, a professor of law, co-director of the Intellectual Property Program and an expert on the song "Happy Birthday to You," says the MCIR is a unique resource because it covers both cases that resulted in published opinions and cases that were filed and then settled.

GW Law students are working with Cronin and Brauneis as research assistants to maintain and expand the website on current music copyright issues. GWR



PUBLIC HEALTH

MILLIONS OF NEW ASTHMA CASES, E.R. VISITS LINKED TO POLLUTION

A pair of first-of-their-kind studies finds that air pollutants may cause millions of new cases of childhood asthma and potentially tens of millions of emergency room visits each year.

Researchers in one study, published in April in the *The Lancet Planetary Health,* estimate that each year 4 million new pediatric asthma cases worldwide might be attributable to exposure to nitrogen dioxide air pollution, which primarily comes from motor vehicle exhaust.

The study, based on data from 2010 to 2015, is the first to quantify the worldwide burden of new pediatric asthma cases linked to traffic-related nitrogen dioxide, using a method that takes into account high exposures to this pollutant that occur near busy roads, says Susan C. Anenberg, PhD, the study's senior author and an associate professor of environmental and occupational health.

"Globally, we found that about 13 percent of asthma cases among children were attributable to nitrogen dioxide pollution, and that ranges up to about 50 percent in individual cities worldwide," Anenberg says. "These really are preventable cases of asthma. These are children who did not need to be diagnosed with asthma, who are getting asthma because of their exposure to ambient air pollution."

Linking global datasets on nitrogen dioxide concentrations, pediatric populations, asthma incidence rates and epidemiological evidence, the researchers were able to make estimates for 194 countries and 125 major cities.

Researchers also found that about 92 percent of new asthma cases in the study occurred in areas that are still within the World Health Organization's guideline on nitrogen dioxide levels.

"That finding suggests that the WHO guideline ... may need to be reevaluated to make sure it is sufficiently protective of children's health," says Pattanun Achakulwisut, the study's lead author and a GW postdoctoral scientist.

Meanwhile, a separate study led by Anenberg estimates that other types of air pollution may trigger as many as 33 million asthma-related emergency room visits globally each year.

Scientists have long known that breathing in air sullied by car emissions and other pollutants could trigger asthma attacks, but the new study is the first to quantify air pollution's impact on asthma cases around the globe.

The study, published last October in the journal *Environmental Health Perspectives,* analyzed data for 54 countries and Hong Kong and found that ozone—a pollutant generated when car, power plant and other types of emissions interact with sunlight—may trigger between 9 million and 23 million asthma ER visits each year, and that fine particulate matter—small particles that can lodge deep in the lungs—may account for between 5 million and 10 million visits.

About half of the asthma ER visits were estimated to occur in South and East Asian countries, notably India and China, the researchers found. And although air in the U.S. is relatively clean by comparison, ozone was estimated to contribute 8 to 21 percent of asthma ER visits and fine particulate matter 3 to 11 percent. GWR

COURTESY SUSAN C. ANENBERG FROM LANCET PLANETARY HEALTH, 2019, VOL. 3, ISSUE 4: E166-78

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CONSERVATION

A GUT CHECK FOR BLACK RHINOS IN CAPTIVITY

As the population of the African black rhino has plummeted over the past 60 years—down more than 90 percent to about 5,000 individuals—the 100 or so black rhinos living in North American zoological institutions have been viewed as an insurance policy against extinction. But black rhinos in captivity face diseases not found in their wild counterparts, which may even be an impediment to them reproducing.

Part of the problem, a team of researchers finds, could be in their gut.

Studies have suggested that differences in animals' microbiomes—the society of microbes found in and on the body—may influence the health of mammals. So researchers, co-led by Keith Crandall, director of GW's Computational Biology Institute, and Budhan Pukazhenthi, a research physiologist at the Smithsonian's National Zoo and Conservation Biology Institute, compared the gut microbiomes of wild and captive black rhinos.

The team extracted, sequenced and analyzed DNA from 25 fecal samples collected from 17 wild rhinos and eight in captivity. And the results, published this May in the journal *Scientific Reports,* did turn up differences in the microbial communities between them.

The rhinos in captivity had some gut microbes also found in domesticated livestock. And while wild rhinos had more bacteria that are geared toward the breaking down of fibrous plant material, the bacterial community in captive rhinos seemed more calibrated for breaking down carbohydrates, which could point to a lack of nutrients, an imbalance in the gut and changes to immune function.

The researchers suggested a larger study be done to confirm the findings, and recommended changing the diets of captive rhinos to better reflect food consumed in the wild and the natural, wild rhino microbiome. GWR

STUDENT RESEARCH

LIFTING A FOG OFF THE MIDDLE AGES

By John DiConsiglio

Pity the medieval period. The era stretching from roughly the years 1000 to 1500 is often dismissed as a wasteland of intellectual and artistic darkness, overshadowed by Enlightenment stars from Da Vinci to Gutenberg.

But the period had its highlights: It saw the invention of vertical windmills, eye spectacles and mechanical clocks, as well as the founding of universities like Cambridge and Oxford. And now art history and political science major Mackenzie White is adding one more overlooked accomplishment to the medieval short list: weather forecasting.

Over the past year, the senior has studied ancient almanacs for the ways medieval meteorologists combined science, religion and astrology to predict the weather. Funded by a Sigelman Undergraduate Research Enhancement Award, her work attempts to help reclaim the Middle Ages from history's scorn.

"We think of the medieval person as uneducated, struggling through the mud and living in a time when everything was terrible, then someone flips a switch and we suddenly get the aesthetics and advances of the Enlightenment," White says. "But things were changing in the Middle Ages. And it wasn't all for the worse."

For her undergraduate thesis, White focused on the late medieval period—from 1400 to 1500—in a European landscape ravaged by the Crusades and bubonic plague. But social change was on the horizon in medieval England. The economy was shifting from serfdom to free labor. More peasants rented acres from wealthy landlords as a new class of yeomen owned and cultivated their own small properties.

"The self-awareness that came with economic independence led to a desire among ordinary people to understand the world around them," White says.

Often they turned to astrology—at the time considered an irrefutable science—for answers. In the case of medieval farmers, their questions tended to revolve around the weather.

"If you were a farming peasant or rising in social class, you wanted to understand weather patterns to create a better yield in your harvest," White says. "You wanted to know when it would rain and thunder and even when to travel for feast days and saints' celebrations."

Astrologers used a combination of observations, Christian myths and the zodiac to create elaborately illustrated almanacs that purported to predict the weather. White examined scores of these calfskin-bound booklets and found that, while medieval forecasters weren't especially good at reading weather beyond observable patterns, the almanacs provided a window into the science, culture and thought processes of the era.

Most of White's project focused on a well-worn 1433 almanac she found in New York City's Morgan Library and Museum. The five-foot-

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> "THEY WERE BECOMING AWARE OF A WORLD BEYOND THE PATCH OF LAND THEY LIVED ON. AND IF THEY COULDN'T CONTROL THAT WORLD, GIVE THEM CREDIT FOR TRYING TO FIGURE IT OUT."

long by five-inch-wide manuscript was designed to fold into a stack of 38 panels—roughly the size of a pack of baseball cards.

Since almanac owners often were illiterate, symbols substituted for words. White studied many of the meticulously rendered drawings by connecting the dots between zodiac signs and the months of the year. For example, Sagittarius—November—was typically represented by an ax or, in the 1433 document, the image of a wood-chopping farmer. Another scene depicted two men fighting with swords. Above them was a sickle, one of the zodiac symbols for March.

"It's like figuring out an art puzzle," she says. "You tease out the meanings from the images."

White conceived of her project during a class on religious myth and metaphor taught by art history professor Barbara von Barghahn. Von Barghahn introduced her to the idea of theophanous visions—the notion of God appearing to man as physical manifestations in nature, like floods or fire. White's search for theophanic art led her to the medieval almanacs.

White's thesis adviser Elizabeth Williams, an assistant curator of the Byzantine Collection at Dumbarton Oaks and a former GW Dumbarton Oaks Postdoctoral Fellow, says her work "disrupts any narratives that medieval people were superstitious or blind followers of tradition or religion. She's able to show that scientific thinking wasn't an invention of the Renaissance or Enlightenment."

"Not a lot of great things happened to people in the medieval era," says White, who plans to pursue a master's degree in museum studies next year. "But they were becoming aware of a world beyond the patch of land they lived on. And if they couldn't control that world, give them credit for trying to figure it out." GWR

COURTESY MACKENZIE WHITE

Senior Mackenzie White was among more than 600 students who presented their research this spring during the two-day, universitywide Research Days, the event's 24th year.

GENETICS

BLUNTING PARASITES WITH CRISPR

Researchers for the first time have used new gene-editing technology to limit the impact of the parasites responsible for schistosomiasis and liver fluke infection, tropical diseases that affect millions of people around the world.

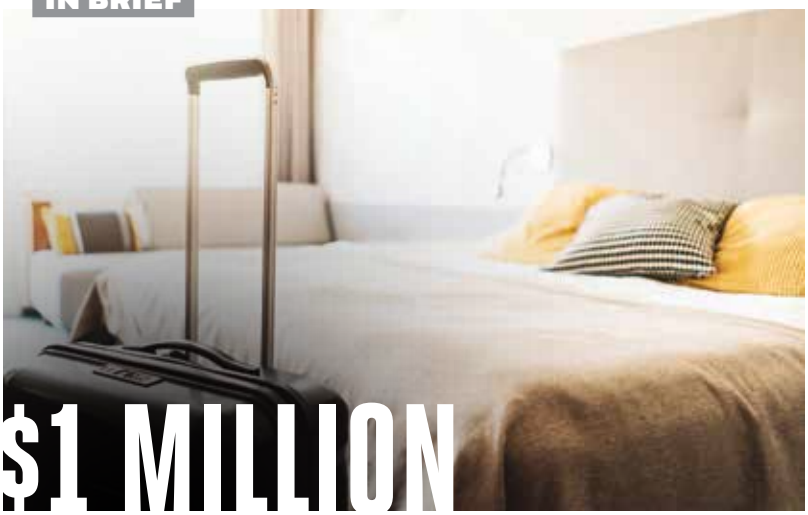
"The genes we 'knocked out' using [gene-editing tool] CRISPR/Cas9 resulted in markedly diminished symptoms of infection in our animal models," says lead author Paul Brindley, who is a professor of microbiology, immunology and tropical medicine at the GW School of Medicine and Health Sciences.

The findings appeared in January in two papers in the journal *eLife*.

The new technology allows researchers to target and deactivate the genetic information that's needed to produce a particular protein. While the tool has been used in other species, it was unknown whether it could be applied to *Schistosoma mansoni* and *Opisthorchis viverrini,* the parasitic worms responsible for schistosomiasis and liver fluke infection.

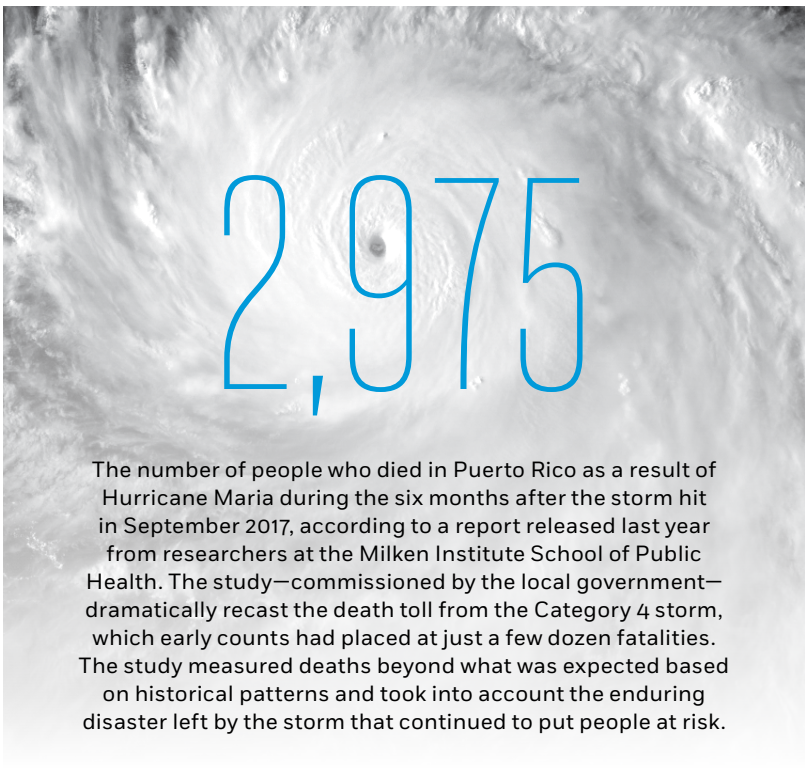
Schistosomiasis can cause damage to the liver and kidneys, bladder cancer and infertility, among other problems, while liver fluke infection can cause a type of liver cancer called bile duct cancer. In both cases, Brindley's team was able to stem the release of damage-causing proteins and significantly reduce the impact of these conditions. GWR

IN BRIEF



$1 MILLION

The amount awarded by the U.S. Department of Justice to computer science professor Robert Pless to expand work on a hotel-photo database he helped create that's aimed at combating human trafficking. Traffickers post photos of survivors that often are taken in hotel rooms; using the database, law enforcement officials can scan for matches that may bolster investigations. The database compiles hundreds of images per day, submitted by more than 250,000 users of the smartphone app TraffickCam, and images curated from travel websites.



2,975

The number of people who died in Puerto Rico as a result of Hurricane Maria during the six months after the storm hit in September 2017, according to a report released last year from researchers at the Milken Institute School of Public Health. The study—commissioned by the local government—dramatically recast the death toll from the Category 4 storm, which early counts had placed at just a few dozen fatalities. The study measured deaths beyond what was expected based on historical patterns and took into account the enduring disaster left by the storm that continued to put people at risk.

HOTEL ROOM: ISTOCK.COM/SPYDERSKIDOO / HURRICANE MARIA: THE NAVAL RESEARCH LABORATORY/ NOAA

GW's History Department is the new home of the *History News Network*, a popular newsletter and website that publishes original essays by historians and aggregates history-related material to help put current events into historical context. In December, *HNN* founding editor Rick Shenkman passed the title of editor-in-chief to Kyla Sommes, BA '13, PhD '19.

Pioneering researcher and conservationist **JANE GOODALL** visited computer science professor James Hahn's Motion Capture and Analysis Laboratory this spring, where researchers captured her likeness and movements for a new educational platform they're building. The project, called Virtual Jane, is a partnership with the Jane Goodall Institute and is housed in the GW Innovation Center. The project team includes students studying an array of fields, from computer science and business to art and anthropology. The team hopes to launch a version of Virtual Jane by the end of 2020.

JANE GOODALL: WILLIAM ATKINS / DINO RECONSTRUCTION: VIKTOR RADERMACHER

Researchers working in western China uncovered a new early-Cretaceous dinosaur species that helps fill in the evolution of bird-like alvarezsaurs, which transitioned from having relatively long arms, three-digit hands and sharp teeth to having "highly specialized" mole-like arms, a single claw and reduced teeth. The expedition that found *Xiyunykus pengi* (above, second from left) was co-led by GW's James Clark, the Ronald Weintraub Professor of Biology.

Anthropology and international affairs professor Hugh Gusterson this spring was awarded a John Simon Guggenheim Memorial Foundation Fellowship. He was one of 168 selected in the U.S. and Canada out of nearly 3,000 applicants. He'll use the funding to finish a book that examines the U.S. decision to end nuclear testing after the Cold War and the subsequent reinvention of the weapons-making field using simulation technology. The book comes as experts fear the last major U.S.-Russian arms treaty may be allowed to expire, which could spark a new arms race.

"The vast majority of Americans believe vaccines are safe and effective, but looking at Twitter gives the impression that there is a lot of debate."

—**DAVID BRONIATOWSKI,** an assistant professor in the Department of Engineering Management and Systems Engineering, on a study he led that found Twitter bots and Russian trolls—including some now known to have interfered in the 2016 U.S. election—promoted discord by playing to both sides of the debate or spreading false information about vaccines on Twitter.

GW and France's National Center for Scientific Research last year formed a partnership to create a joint laboratory that will conduct research at the intersection of genetics, environment, big data and society. The lab, called EpiDaPo (Epigenetics, Data, Politics), is led by Eric Vilain, chair of GW's Department of Genomics and Precision Medicine, and deputy director Michel Dubois, a sociologist and senior research fellow at the French National Center for Scientific Research.

Q&A

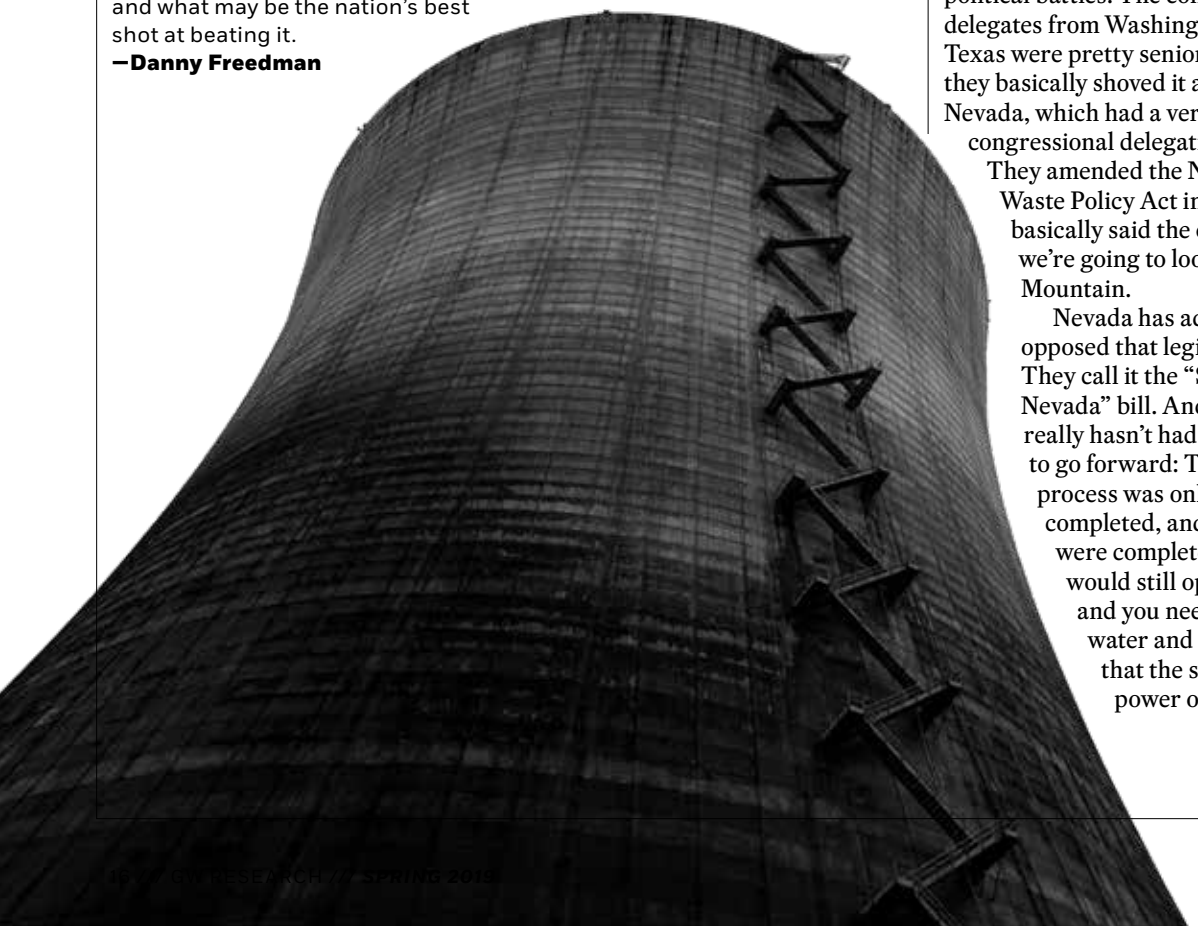
'AN EVER TIGHTENING GORDIAN KNOT'

A new report finds the fate of spent nuclear fuel in the U.S. hopelessly tangled and calls for a radical "reset."

The spent nuclear fuel, more than 80,000 tons of it, sits at dozens of sites across the U.S., waiting for somewhere to be. It's supposed to be deep beneath the surface, a thousand-year-to-all-time solution, but decades of effort and billions of dollars have led only to political stalemate. So last year a group of experts—including **Allison Macfarlane,** a GW professor and director of the Institute for International Science and Technology Policy—convened five public meetings hosted by GW and Stanford University. In a report last fall, the group concluded that the nation's spent nuclear fuel is "caught in an ever-tightening Gordian Knot," an impossible tangle of science, law and politics, which won't be untied. Instead the group calls for a "reset," a new start. And this time they want to bypass politicians altogether.

Macfarlane, who chaired the U.S. Nuclear Regulatory Commission from 2012 to 2014, discussed the nuclear knot and what may be the nation's best shot at beating it.

—Danny Freedman



ISTOCK.COM/ DAVID HAGERMAN

How did we get into this mess?

Well we created the mess—all the waste—and we created it without having a plan for what we were going to do with it.

In the 1980s there was a concerted effort for the government to do something with this waste, and so they did, with the Nuclear Waste Policy Act. And it was actually quite a well-thought-out piece of legislation.

In 1986, when the Department of Energy got down to three top candidates—one was in the Texas panhandle, one was at the Nevada test site where Yucca Mountain is, and one was in Washington state—Congress balked at the price tag associated with characterizing those sites and then started to have political battles. The congressional delegates from Washington and Texas were pretty senior and they basically shoved it all off on Nevada, which had a very junior congressional delegation.

They amended the Nuclear Waste Policy Act in 1987 and basically said the only place we're going to look is Yucca Mountain.

Nevada has adamantly opposed that legislation. They call it the "Screw Nevada" bill. And Congress really hasn't had a stomach to go forward: The licensing process was only half completed, and even if it were completed, Nevada would still oppose it, and you need access to water and other things that the state has power over.

What are we doing with this stuff, if we're not storing it?
It's all at the reactors where it was produced, and some high-level waste is at the Department of Energy nuclear weapons complex facilities. So it's at 65 sites around the country. And that doesn't seem like a good plan, does it?

Every nuclear power plant has to have a cooling pool for spent fuel. But the pools were never intended to have the spent fuel very long. Most pools are full, or close to full, so most plants have these steel-lined, concrete overpack storage casks where the fuel can go after about five years in the pool, until some of the radiation has dissipated.

This is totally temporary. They're licensed for 20 years and we don't know how long they'll last. Of the early ones that were licensed in the 1980s, their licenses have been extended once. Maybe they're going to be extended twice, we'll see. We're still trying to understand some of the aging issues associated with these casks.

Is a "reset" possible?
Sure. If we didn't think it were possible, we wouldn't have done this. What really struck us is, if you look at other countries that are making much more progress—like Canada, Finland, Sweden, Switzerland—it's not their governments that are managing the spent fuel, it's the utility companies that made the spent fuel. They're the ones in charge of managing and finding a final disposal facility. It works a lot better because they have a financial incentive and they own all the stuff—they know where it is, they know how old it is, they know its status.

In the past, groups in the U.S. have offered up different models of managing this material. The Blue Ribbon Commission on America's Nuclear Future that President Obama put together, which I was a member of, recommended a federal corporation, like New York's Port Authority or the Tennessee Valley Authority, which are corporations but still government entities. What we're saying in this report is: Don't bother with that. Just give it over to the nuclear industry. They made this, they know what it is, they should manage it.

Of course, companies have their own interests. Were there concerns about that?
Initially I think some of us had those concerns, but it will all be regulated, right? So it just sort of dawned on a lot of us that, well actually, maybe this is a really good idea. Maybe this is the one way to make it work. Because right now, politicians aren't really interested in solving this problem, they're interested in getting elected again.

It would have to be established by the nuclear industry, but also be independent from them; you can't have the CEOs meddling. It would have a CEO, a board structure, a management structure. That will last a lot longer than having it be a federal agency where you have changing faces every two to four years. And then you would still have a role for congressional oversight, and it would be regulated by the Nuclear Regulatory Commission, just like reactors. We're comfortable with nuclear power plants being run by corporations, why shouldn't we be comfortable with this?

The other panels, as you said, have sounded the alarm and called for similar changes. What's different this time?
With all the other ones there was some kind of government role. Now we're saying: Let's forget about the government. After 30 years of failure, that's pretty good evidence for me that they're not succeeding.

The report also advocates for a more participatory approach, one that gives communities the chance to consent or even volunteer. Will they volunteer?
Well, they already have. That's kind of the sad thing about this whole situation. There's a site in southeastern New Mexico and one in Texas, and they're sort of ready to dip their toes into this process. But because Congress is just so focused on Yucca Mountain, we're going to lose these people. I think a combination looking for volunteers, but also approaching communities that are comfortable with nuclear technology, is important.

What's the incentive for those communities?
Well, they'll have jobs. These projects take a long time. First you have to do years' worth of technical analyses, then it's going to take a while to construct it and load the fuel, and then you want to monitor it for a hundred years. There are not many industrial facilities that you're sure will provide jobs for over a hundred years.

Where do the recommendations go?
We've been to Congress. We talked to the nuclear industry folks. The next step is to offer more detail about the legal and the financial piece of this; those were questions that we got.

It's a long shot, but I think really we need outside-of-the-box thinking right now, because we're not getting anywhere just hammering away at the same old arguments. GWR

SHELF LIFE

❶ *William Howard Taft. The American Presidents Series: The 27th President, 1909-1913* (Times Books, 2018)

By Jeffrey Rosen, professor of law

While recent books address President Taft's character, foreign policy, progressive conservatism, psychology and relationship with the press, this one focuses on his interpretation of the Constitution. As the only president (1909-13) who was also chief justice of the U.S. Supreme Court (1921-30)—and even oversaw the building's construction—Taft approached his presidency as a judge, not a politician chasing popularity; his true significance comes into focus when the two roles are viewed collectively, Rosen writes. Taft's wife put it best when she sought to keep a gift that he felt violated the emoluments clause: "he stood firmly by the Constitution, as usual."

❷ *A Modern Contagion: Imperialism and Public Health in Iran's Age of Cholera* (Johns Hopkins University Press, 2019)

By Amir A. Afkhami, MD '03, associate professor of psychiatry and behavioral sciences, and of global health

A 2008 cholera outbreak in Iran—complicated by the country's international isolation and by a regular flow of religious pilgrims who helped spread the disease—represents only the latest flash point in an ongoing epic between the nation and the gastrointestinal condition. The disease had a "formative role" in the development of modern Iran in the 19th and 20th centuries, Afkhami writes. One example cited in the book: Iran's 1906 Constitutional Revolution, which occurred two years after a cholera outbreak, couldn't have happened but for an increasingly secular view of outbreaks as preventable medical problems rather than inevitable divinely mandated ones.

❸ *Ronald Reagan and the Space Frontier* (Palgrave Macmillan, 2019)

By John Logsdon, professor emeritus of political science and international affairs

President Reagan inherited a space program that was at a crossroads, with a transition team informing the president-elect that the agency was "without clear purpose or direction." Unlike John F. Kennedy, whose interest in space was wrapped up in the Cold War, Reagan saw civilian space exploration as manifest destiny, and he "personally would turn out to be the most pro-space U.S. president, before or since," Logsdon writes. Major achievements under his watch include creating a permanent orbiting outpost, supporting private sector involvement and forming lasting international space partnerships.

> **Reagan saw civilian space exploration as manifest destiny and he "personally would turn out to be the most pro-space U.S. president, before or since."**

❹ *The Kingdom of God Has No Borders: A Global History of American Evangelicals* (Oxford University Press, 2018)

By Melani McAlister, professor of American studies and international affairs

The story about American evangelicalism which is often told—that Billy Graham led a group after World War II "out of the churches and into the voting booths, transforming American politics"—is only partially true, according to this book. "Those believers did not stop at the voting booth—or at the borders. They marched out across the globe and became enmeshed in global politics." But as much as God's kingdom may be without borders, the missionaries found the geopolitical world is not.

❺ *The Molecule of More: How a Single Chemical in Your Brain Drives Love, Sex, and Creativity—and Will Determine the Fate of the Human Race* (BenBella Books, 2018)

By Daniel Z. Lieberman, professor of psychiatry and behavioral sciences, and Michael E. Long

A handful of chemicals govern satisfaction with one's achievements, but a single molecule, dopamine, is responsible for motivating people "to pursue, to control, and to possess the world beyond your immediate grasp," the authors write. ".... whether it's reaching across the table for the salt shaker, flying to the moon in a spaceship, or worshipping a god beyond space and time."

❻ *Not for Long: The Life and Career of the NFL Athlete* (Oxford University Press, 2018)

By Robert W. Turner II, assistant professor of clinical research and leadership, and of neurology

The title's play on the acronym "NFL" refers to the many factors—from injury to family matters to contract negotiations—that can

COVERS: MATT HODGKINS

derail a career in football. The author knows how tough it can be for an athlete because it's his story. He felt "a crisis in my very soul" after a career in pro football leagues, including briefly in the NFL. Now a sociologist, Turner interviewed 140 current and former professional, collegiate and high school athletes to better understand "what should happen when your not-for-long career comes to a screeching halt."

❼ *Identity Crisis: The 2016 Presidential Campaign and the Battle for the Meaning of America* (Princeton University Press, 2018)

By John Sides, professor of political science, Michael Tesler and Lynn Vavreck

Violence and divisive language at campaign events, which Donald Trump appeared to condone, revealed what the election was really about: "a debate about not only what would, as Trump put it, 'make America great again,' but who is America—and American—in the first place," the authors write. While race, ethnicity, religion, gender, nationality and partisanship have long divided Americans, they write, "What made this election distinctive was how much those identities mattered to voters."

—Menachem Wecker

MORE OF YOU

FINGERPRINT INSTALLATION: SIENNA LONG, JOHN MCGLASSON / PHOTOS: MATT HODGKINS

HEART: HAND KNIT BY ANNETTE M. THOMSON, MSIST '08. FROM A PATTERN BY TEAL LARSEN VIA ETSY.COM

As 3D printing comes of age, researchers turn to 4D printing, and the possibility of building replacement organs from patients' own stem cells.

BY SARAH C.P. WILLIAMS

SHE WANTS TO BUILD A BEATING HUMAN HEART.

Not just a heart-shaped blob of cells and not an organ that beats to an off-kilter cadence. She wants to make from scratch—using something not far removed from an inkjet printer—a heart that surgeons can transplant into a person's body to keep them alive. This heart, Lijie Grace Zhang imagines, could be personalized with a patient's own cells and be created on-demand by a 3D printer in a matter of hours to treat heart failure.

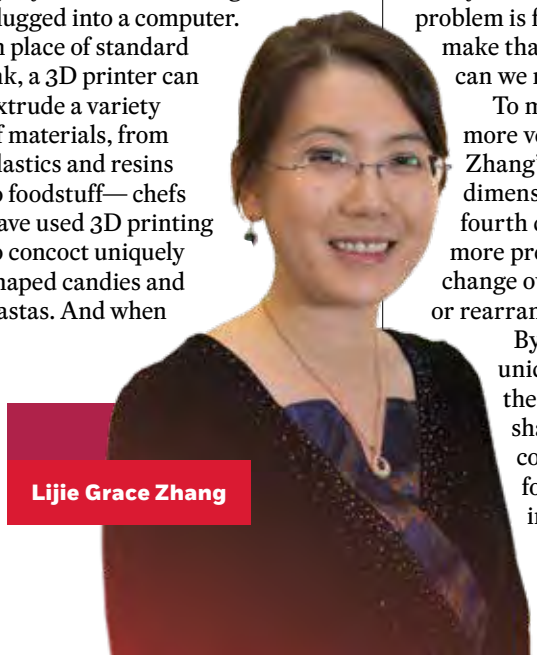
Zhang, an associate professor in the School of Engineering and Applied Science, admits the goal of a printed, transplantable heart is likely decades away. But as she works toward it, the smaller feats along the way carry their own potential to revolutionize medicine. Zhang's lab is among just a few in the country using a cutting-edge 4D bioprinting approach to create moving, responsive shapes that can carry out myriad tasks in the human body. Her approach might allow engineered blood vessels implanted into a child to grow as they age, or a drug-delivery device to open like a blooming flower when it reaches the right organ.

In 3D printing, three-dimensional solid objects are created, layer by layer, based on a design plugged into a computer. In place of standard ink, a 3D printer can extrude a variety of materials, from plastics and resins to foodstuff— chefs have used 3D printing to concoct uniquely shaped candies and pastas. And when scientists discovered that living cells can survive the trip through a 3D printer, they began printing layers of cells in the shapes of organs—heart cells in the exact shape of a human heart and liver cells in the shape of a liver, for instance.

"People have bioprinted hearts already," Zhang says. "But the problem is functional: How can we make that 3D heart work? How can we make it beat?"

To make these inert organs more versatile and useful, Zhang's team is adding a new dimension to bioprinting—a fourth dimension: *time,* or more precisely, the ability to change over time, shifting shape or rearranging molecules.

By printing in 4D with unique nanomaterials, the scientists can design shapes they're able to control using external forces—light or heat, for instance. Then human



Lijie Grace Zhang

ZHANG: WILLIAM ATKINS

cells can be layered onto that shape-changing scaffold.

BEFORE 2010, WHEN SHE became a GW faculty member, Zhang had never used a 3D printer. She studied chemical engineering in China, then flew halfway around the world for a graduate program at Brown University in Rhode Island, where—despite never having worked with living cells before—she joined a biomedical engineering lab in which culturing cells was an everyday task. By the time she arrived at GW, she had jumped around two more times, with fellowships at Rice University and Harvard, developing nanomaterials for cartilage and bone regeneration.

At GW, Zhang became part of the Department for Mechanical & Aerospace Engineering, another unlikely move—they'd been looking for expertise in biomaterials, she says—that shaped the arc of her research ever since.

"I was suddenly surrounded by these mechanical engineering students with very different backgrounds than my own," Zhang says. "They excelled in mathematics and design and modeling. They already had expertise in using 3D printing to make device prototypes."

For Zhang, it was more intriguing than intimidating. She immediately saw the promise in applying the new 3D technology to tissue engineering—she could take material similar to the injectable bone substitutes she'd engineered, for instance, and print it in the shape of a bone to create entirely new types of artificial joints and prosthetics. So Zhang's inventive students built a custom 3D printer (and then another and another) for her lab. And as she forged ahead into 3D—and then 4D—printing, Zhang branched out from bones and cartilage to just about every organ in the body.

"She tells everyone that they can pick any organ they want to study and she'll support them," says postdoctoral fellow Timothy Esworthy. "So we have people join the lab and get really excited about new organs; livers and muscles and hearts and brains."

That diversity, and the knack Zhang has for bringing together expertise in so many areas, is part of why the Zhang lab has gained a reputation as a hotspot of innovation.

"I'd certainly describe her as a top-caliber researcher," says Michael McAlpine of the University of Minnesota, whose 3D and 4D bioprinting work overlaps with Zhang's in many areas. "She's brought a lot of high-quality work to the field."

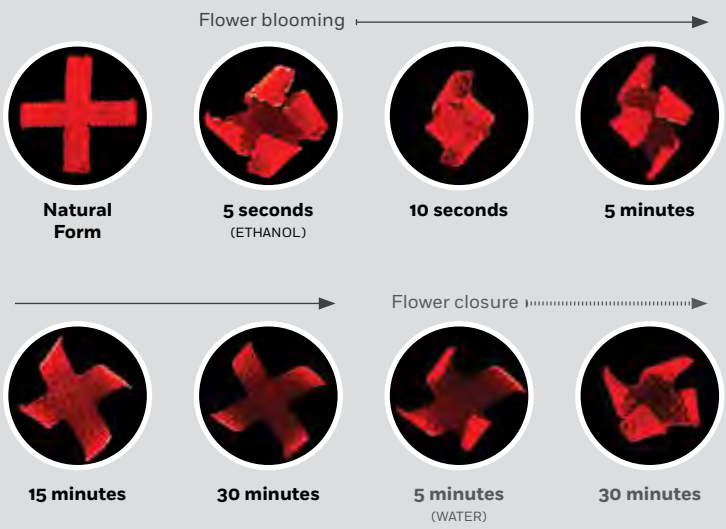
TODAY, THE CLOSEST THING that the Zhang lab has made to a beating heart is a thin patch just half a centimeter in diameter. It contains a mixture of stem cells isolated from human bone marrow and, despite its diminutive size, could someday change the way people recover from heart attacks. Other researchers have tried injecting similar mixtures of stem cells into injured hearts, but the very power of the organ keeps that approach from being successful—as the heart beats, even weakly, it pushes cells out to the rest of the body instead of keeping their healing power close. But a bioprinted patch, Zhang has shown, can hold the cells in place on the heart as they form new tissue.

A perfect scaffold for harnessing stem cells and encouraging them to grow into mature heart tissue has two qualities that are hard to achieve: tiny—really tiny—grooves and the ability to bend and move.

The grooves, which must be mere fractions of a millimeter wide,

FROM FLAT TO FLOWER BUD

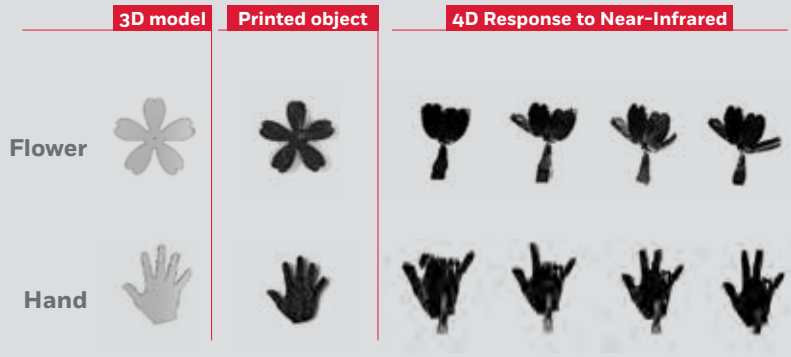
Zhang and her colleagues demonstrate the reversible, shape-changing effect of their process with this 4D-printed structure that opens and closes like a flower, published in a cover article last year in the journal *Advanced Biosystems*. The structure is shown first in its natural form, then scrunching and slowly flattening as it's immersed in ethanol, then gradually recoiling again in response to immersion in water.



COURTESY ZHANG LAB

A SAFE, NIMBLE APPROACH

This year in the journal *Nano Research*, Zhang's team demonstrated a 4D-printing nanomaterial that could be controlled using near-infrared light, which would be safe for human tissue—unlike the use of temperature, solvents or ultraviolet light—and brings the research a step closer toward reality.



help align cells so they can form a continuous, unbroken sheet. And the motion— ideally close to that of a beating heart— helps coax the stem cells to become heart cells rather than other kinds of cells.

"PEOPLE HAVE BIOPRINTED HEARTS ALREADY," ZHANG SAYS. "BUT THE PROBLEM IS FUNCTIONAL: HOW CAN WE MAKE THAT 3D HEART WORK? HOW CAN WE MAKE IT BEAT?"

To build a patch with those qualities, Zhang starts with an ink developed by her lab in 2016, called smart soybean oil epoxidized acrylate, or SOEA. It's considered safe in the human body and, importantly, it turns from a thick liquid into a solid in response to light from a laser. That means it can be used in a type of 3D printing called photolithography. In that type of printing, rather than extrude an ink directly, the computer-controlled printer directs a laser in precise patterns into a vat of liquid resin, such as SOEA. As the laser moves, it solidifies section after section of the resin, creating a three-dimensional solid object that emerges from the liquid.

SOEA has another property that makes it ideal for 4D printing: when a solid, printed SOEA scaffold is cooled, the temperature change affects the way its molecules link together, pulling them taut and flattening the shape. But when it's warmed again, the scaffold spontaneously curls up, like a roly-poly bug hiding from danger. While there are other photolithography inks that can change shape, few are safe in humans and other animals.

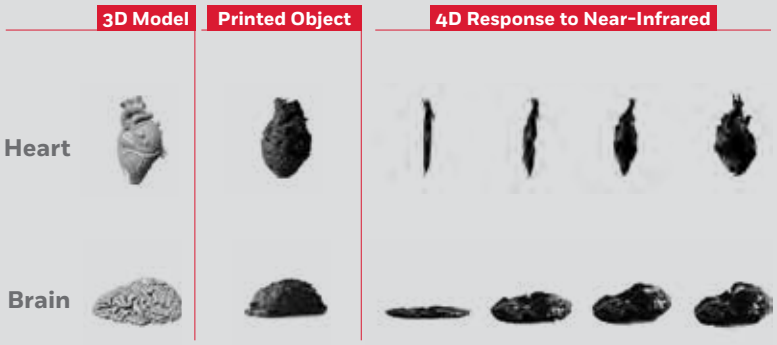
Making a cardiac patch using photolithography and SOEA gives it the ability to flex, but the technique isn't ideal for creating micro-sized grooves. For that, Zhang and her colleagues use a second type of 3D printing—stereolithography, which uses a more precise laser beam of a different intensity to form channels in the patch after it's been formed by photolithography.

In 2018, Zhang reported in the journal *Biofabrication* that stem cells grown on these double-printed 4D cardiac patches are more efficient at maturing into heart cells than those grown on other types of scaffolds. Her lab has already tested one 3D-printed patch—although not the bendable, SOEA version— in mice with heart injuries similar to those seen in the aftermath of a heart attack, and the patch helped the mice recover normal heart function.

"With the 4D patch, we'll be able to have these shape-changing effects that might move in conjunction with a beating heart," says Zhang. "So I think the success we've already seen with the 3D patch will be amplified with the 4D version."

A PRINTED OBJECT THAT can furl and unfurl—and at the same time act as a scaffold for living cells—has a plethora of other uses

HEARTBEAT THREAD: MATT HODGKINS



"WITH 4D PRINTING WE CAN NOT ONLY SPECIFY HOW CELLS ARE PLACED TO MIMIC THE ACTUAL CIRCUITRY OF THE BRAIN, WE CAN NOW CONTROL THIS SHAPE CHANGE AS WELL."

4D PRINTING DEMO: COURTESY ZHANG LAB

in the human body. For instance, Zhang is one of the only researchers in the U.S. applying 4D bioprinting technologies to brain tissue. In a developing embryo, the surface of the brain buckles and folds as it grows, eventually resulting in the organ's wrinkly texture. This folding signals neural stem cells to differentiate into mature brain cells. And folding is just the kind of motion that a printed nanomaterial can achieve.

"The brain is arguably the most complicated tissue that exists in the body," says Esworthy, who helps lead brain tissue projects in the Zhang lab. "But with 4D printing we can not only specify how cells are placed to mimic the actual circuitry of the brain, we can now control this shape change as well."

To that end, the researchers have 3D printed a scaffold in a kinked shape that mimics the brain's folds. With heat, they can pull the resulting shape flat to seed it with stem cells. Over the course of a few weeks the scaffold begins to refold, eventually assuming its original shape. Cells proliferate and mature in the troughs of each kink—the same pattern seen in developing embryos. It's an approach that may improve methods for growing brain cells for research and clinical use.

To really affect change in the human body, though, researchers still need better ways to remotely, and quickly, control the 3D-printed organs.

Temperatures and solvents affect structural change slowly—over hours or days—and aren't ideal for use in the body, where temperatures and chemical conditions need to remain stable. The use of light is an option, and a number of other responsive materials use ultraviolet light to affect change over mere seconds, but it can damage human cells. So Esworthy, Zhang and others have developed a new nanomaterial, which they described this year in the journal *Nano Research,* that changes shape in response to infrared light instead, which Esworthy says is safe for human cells. Engineered neural tissue that's implanted in the brain would still be reachable by infrared, too, he says.

INSIDE THE NEXT DECADE, Zhang predicts the emergence of 4D-printed tissues that can help guide the treatment of diseases, albeit without being transplanted into a person. Organs-on-chips have already gained notoriety as tiny, often very simplified, replicas of human organs that can be used to test the effects of drugs. With 4D printing, more complex replicas could be built from a patient's own cells to determine whether a particular drug works to treat conditions like heart disease, or neurological, gastrointestinal or breathing disorders, Zhang says, or whether it might carry side effects.

"The future is now," says Esworthy. "We're really entering into the age of personalized medicine, and 4D tissue models like this could allow doctors to do more accurate drug testing so we're not just playing the game of prescribing one thing after another."

4D bioprinting, of course, is still very much in its infancy. 3D printers now appear in elementary schools, libraries and co-working spaces, and are being used to make everything from shoes and bicycles to robotic hands. But Zhang and McAlpine, of the University of Minnesota, were two of the first researchers to integrate 3D printing into tissue engineering less than a decade ago.

"At the time both our groups started in this field, there were not many people doing it," says McAlpine. "We got into it early and are both recognized as early pioneers. But now there's been an absolute explosion in interest. Things that were really novel a year or two ago are commonplace now."

There still are challenges. Zhang says she'd like to come up with more versatile inks that are safe for use in humans, and printers with better resolution are needed for more precise control over nanomaterials. And even if the devices that Zhang is producing now are small, and don't yet operate within the body, her ideas loom large.

"I think printed organs that we can fabricate and put in patients will be realized within our lifetimes," she says. "And it will be a significant milestone in human history." GWR

ACROSS THE WALLS AND CEILING OF THE U.S. SENATE APPROPRIATIONS COMMITTEE MEETING ROOM, A PROFESSOR FINDS THE NARRATIVE OF A "NEW ROME ON THE POTOMAC" AND THE ARTIST'S ELUSIVE SOURCE OF INSPIRATION.

THE (OTHER)

ETERNAL CITY

BY MENACHEM WECKER

Two of Brumidi's figures, adapted from Pompeian art, that adorn the walls of a Senate meeting room

THE ROOM MANAGES, AT ONCE, TO BE DIZZYING AND MEDITATIVE. Frescoes and filigree enrobe the walls and high ceiling, an embarrassment of gilded splendor that's disarmed by dim lighting and broad fields of calming blue paint. Windows on the room's lone outward-facing wall catch the sunlight and frame a postcard-worthy view of the Washington Monument.

It's called S-127, a cavernous meeting room that's part of what is now the Senate Appropriations Committee's suite at the U.S. Capitol. For a century and a half, the room has been held by some of the nation's most powerful people, and the message of the art—mythological beings and symbols of seaborne prowess—matches their influence. But until recently, no one had fully decoded the room's symbolism.

It was designed and painted in the late 1850s by Constantino Brumidi, an Italian refugee sometimes referred to as "the Michelangelo of the Capitol." In S-127 he'd wanted to forge a new visual language for the relatively young American republic, one that would telegraph power and echo America's claim to the classical Greco-Roman legacy.

"Just like our Founding Fathers were constructing a new nation rooted in ancient Greece and Rome, just as they were doing this in terms of political structures and philosophical values and statesmanship, they were also interested in creating a new Rome on the Potomac," says Elise Friedland, an associate professor of classics and art history. Friedland has spent the past two years analyzing the room's complex visuals, first with seed money from GW's Office of the Vice President for Research, then with a fellowship from the U.S. Capitol Historical Society.

The thinking of the nation's leaders, she says, was that "in order to put this capital literally on the map, it'd better look like ancient Rome. And this [the Senate meeting room and works throughout the Capitol] was part and parcel of the continuation of that well into the 19th and even early 20th centuries."

To do that, Brumidi drew upon a style—characterized by faux marble, solid blocks of blue, and floating and realistic figurative vignettes—that unmistakably conjures ancient Pompeii. The Roman city entombed by volcanic ash in the first century was being excavated intensively at the time and yielding some of its biggest finds. Co-opting designs uncovered there conferred an air of sophistication and luxury in Brumidi's day.

"This is really the only room that is this coherent in Pompeian style and subject matter," Friedland says.

But why this iconography and these motifs? And how? Brumidi likely needed more than imagination to design so intricate a room, she reasoned, but the trail seemed largely to begin and end with his final art on the walls. To try to understand, Friedland went hunting for a 160-year-old muse.

IT TOOK SOME CONVINCING FOR FRIEDLAND TO TAKE ON THE PROJECT.

In spring 2013 and in 2016, she took students in her course, "Greece & Rome in Washington, D.C.," to tour the Capitol, where both trips included being taken to room S-127. Two successive curators for the Architect of the Capitol, Barbara Wolanin and the current curator, Michele Cohen, asked Friedland—an expert on Greek and Roman sculpture in the Roman Near East—if she wanted to be the first scholar to study the room in depth.

"I thought to myself, *That is after Constantine, and I can't help you after AD 324 ...,*" Friedland says. "*Plus, that's painting, and I do sculpture.*"

She declined to Wolanin, and three years later to Cohen.

But being asked twice in three years to research Brumidi's work there did give Friedland pause. She mulled it over with her dissertation adviser ("I was thinking, 'Before I go off the ranch completely ...'") and, now reasonably assured her

MAIDENS: COURTESY ARCHITECT OF THE CAPITOL

The U.S. Senate Appropriations Committee meeting room originally housed the Committee on Naval Affairs, and still bears Brumidi's effort to telegraph a notion of U.S. dominance on the water and the nation's claim to the Greco-Roman legacy.

ROBERT ALEXANDER / CONTRIBUTOR / GETTY IMAGES

background might possibly bridge ancient Rome and early U.S. public art, she began to dig.

The room S-127 was Brumidi's first full-scale assignment in the Capitol, a job he would parlay into 25 years of work (with dozens of assistants) to adorn the building's interior—including his 4,600-square-foot *Apotheosis of Washington* in the eye of the Rotunda—up until his death in 1880.

Brumidi had worked for popes in his native Rome, but came out on the wrong side of a revolution there. He eventually was pardoned and allowed to leave for America.

He arrived in New York in 1852, where painted churches, among other things. And in 1855, Brumidi began his work at the Capitol.

The meeting room S-127 only came to be occupied by the influential, federal-purse-string-holding Senate Appropriations Committee in 1912. Originally the room housed the Senate Committee on Naval Affairs—and later the Committee on Armed Services, the Committee on the Philippines and, temporarily, the Government Printing Office—so most of Brumidi's illustrations there deal with the ocean.

On the ceiling's longest axis, he painted America (cast as a Native American woman), sea goddess Amphitrite, love goddess Venus and sea nymph Thetis. On two smaller axes, which bisect the longer one of female deities, Brumidi painted wind god Aeolus and sea gods Neptune, Oceanus and Nereus, the last of which the Greek poet Homer called the "Old Man of the Sea."

Sixteen sea nymphs ride waterborne monsters, dolphins and a turtle, among other fauna. On the walls, maidens float in voids of blue and bear nautical objects—a compass, an anchor, a map—and staffs spearheaded with the American flag.

"The message is, 'We have our naval power growing out of these marine deities of the Greco-Roman world,'" Friedland says.

One of the floating maidens, a maenad, or female follower of Dionysus, wears flowing robes and carries an American flag. She holds the flag pole with her outstretched right hand, and the flag goes over her right shoulder and behind her head. The figure's left hand reaches forward, and she strides forward with her right foot.

Wolanin, the former curator for the Architect of the Capitol, previously had identified this as a near-exact copy of a first-century Pompeian fresco, now in the collection of Naples' Museo Archeologico Nazionale. In that painting, a maenad is carrying a drum or tambourine in her right hand, and a thyrsus, a staff culminating in foliage, in her left. Brumidi essentially had just swapped in new attributes.

Wolanin, Cohen and now Friedland were left to wonder whether the maiden was the sole quotation from the art of Pompeii, with Brumidi's mind filling the rest of the room, or whether—as Friedland suspected—more sources of inspiration were out there to be found.

After two months of looking and turning up nothing, Friedland was getting nervous.

Her research turned up plenty of illustrations of that lone maenad. But then, in a desk-sized, three-part book called *Beautiful Ornament and Remarkable Paintings from Pompeii, Herculaneum, and Stabiae* by Wilhelm Zahn, a German decorative painter who lived in Pompeii in the early 1800s, she found an illustration of the entire wall that held the maenad.

"And as I was looking at this drawing and saying, 'Yes, there's our maenad,' I started realizing: Hold on. I recognize other things, like these columns, right?" she told an audience last year at a lecture at the Library of Congress. "... I also recognized those columns, and then I realized that it turns out that Constantino Brumidi based his entire design of the room on this one drawing."

The book's author, Zahn, was unknown to Friedland, though it turned out he was an important figure in the development of color lithography and a friend of the famous writer Johann Wolfgang von Goethe.

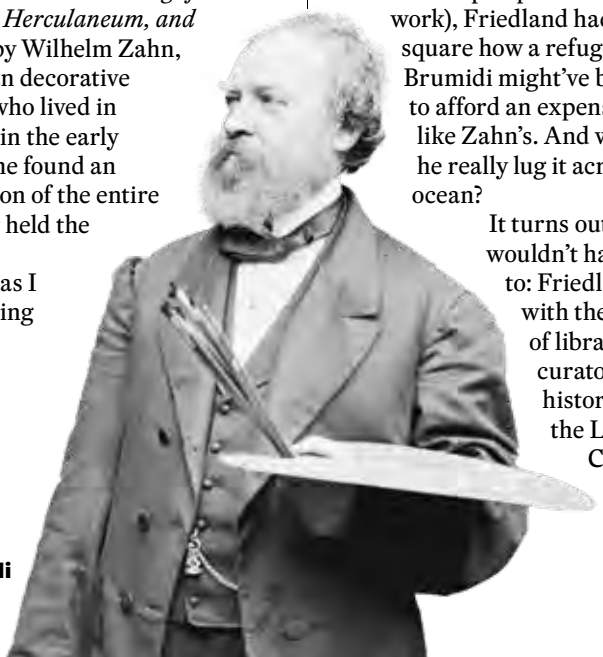
"[Zahn] was just hanging around [in Pompeii] while things were being discovered and drawing them," Friedland said at the library.

Friedland points to another floating figure in Zahn's book and then to her near-twin on the wall of S-127: "She was a victory goddess, carrying a trophy. So you just, y'know, lose the wings and change the trophy into a pennant—and you've got to put clothes on all these people in 19th-century America—and there you have another floating figure."

Answering one research question, though, has a way of raising new ones.

Now that it seemed much of Brumidi's work in the room could be traced back to Pompeii directly via Zahn (it's common for artists to draw upon predecessors' work), Friedland had to square how a refugee like Brumidi might've been able to afford an expensive book like Zahn's. And would he really lug it across an ocean?

It turns out, he wouldn't have had to: Friedland, with the help of librarians, curators and historians at the Library of Congress,

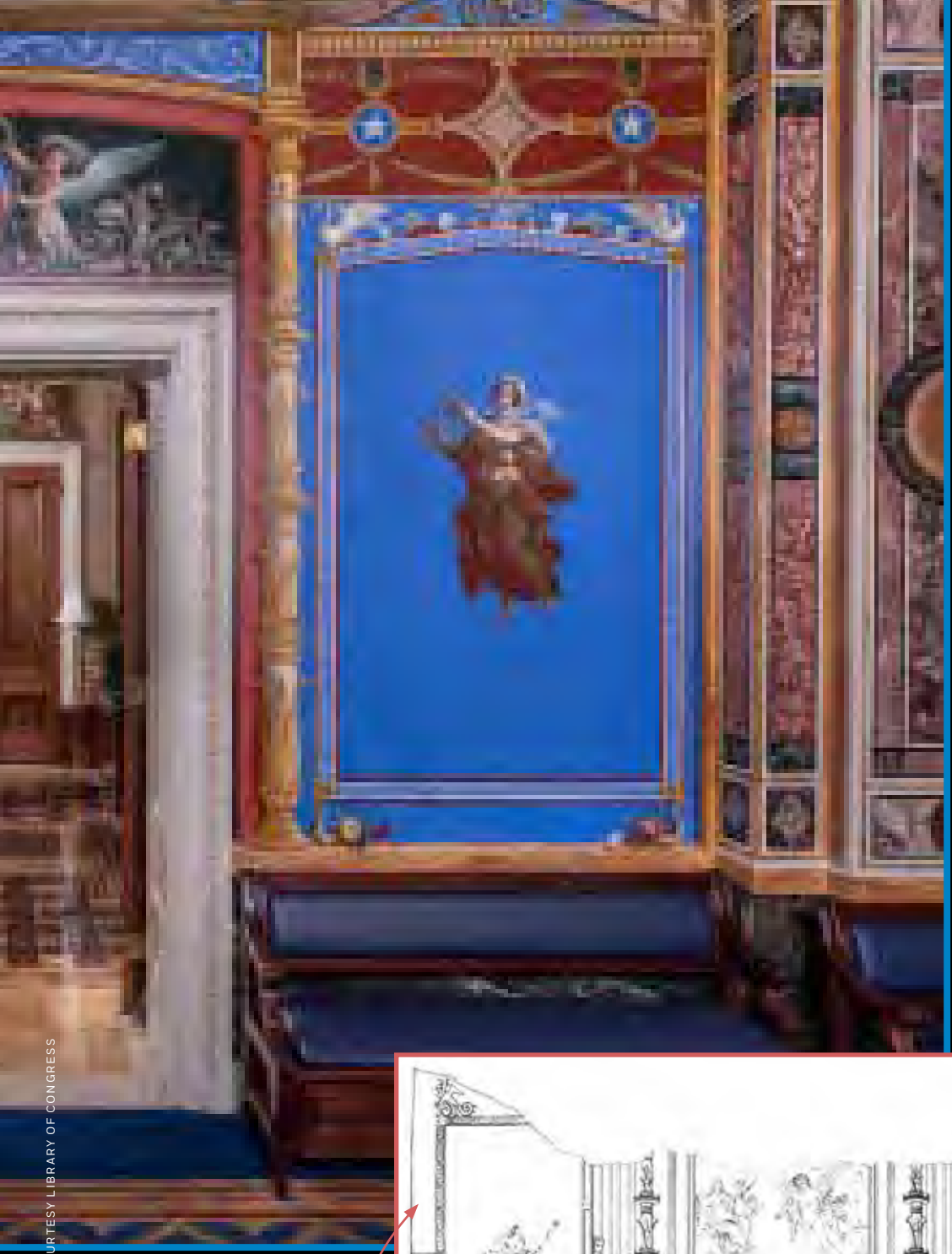


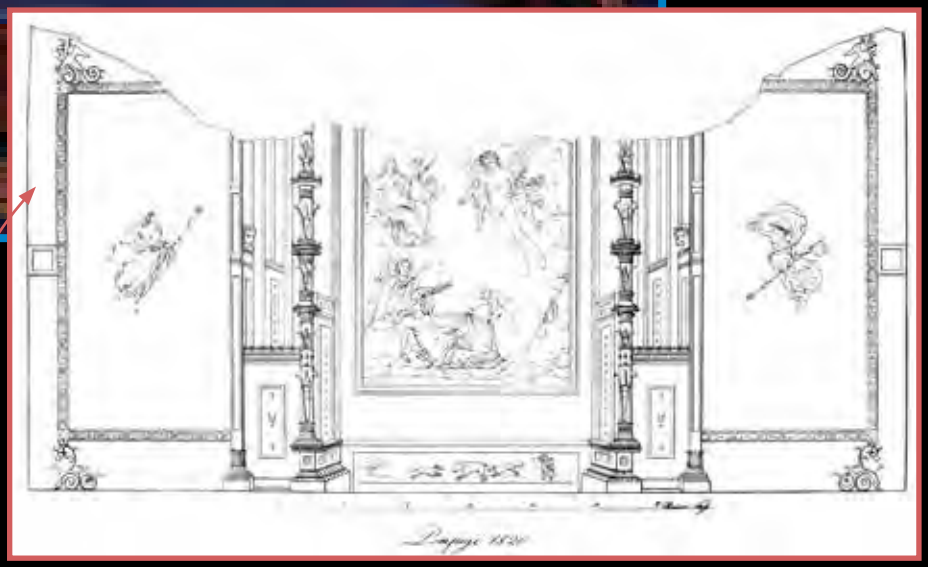
Constantino Brumidi

BRADY-HANDY PHOTOGRAPH COLLECTION/LIBRARY OF CONGRESS/PRINTS AND PHOTOGRAPHS DIVISION

Barbara Wolanin, a former curator for the Architect of the Capitol, had previously identified a figure on the wall of S-127 (ABOVE) as a near-exact copy of Pompeian fresco (FAR LEFT) that now resides in a museum—except for the objects held by the figure, which have been swapped for a flag. Friedland found another match (LEFT) in a book by Wilhelm Zahn.

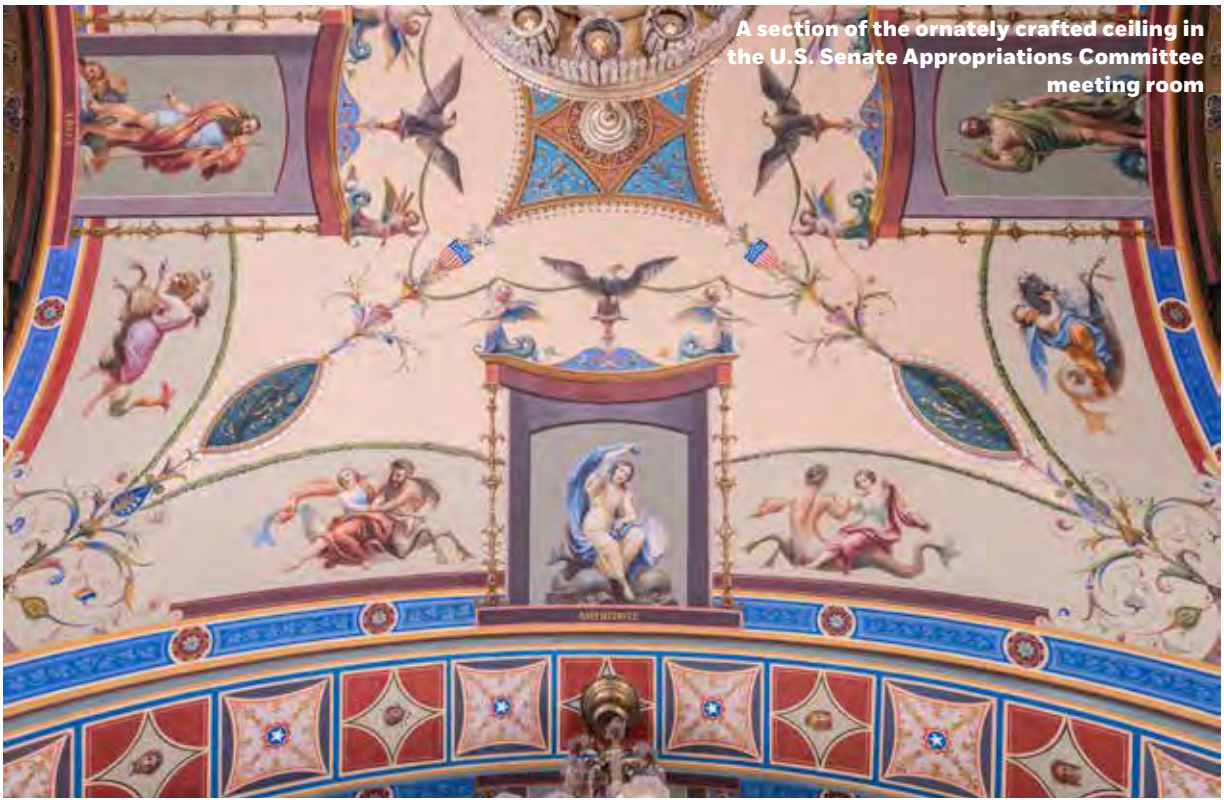
TOP: COURTESY ARCHITECT OF THE CAPITOL / INSET FAR LEFT: SCALA/ART RESOURCE, NY / INSET LITHOGRAPH: DETAIL FROM ZAHN, PL. 32, COURTESY LIBRARY OF CONGRESS





INSET: DETAIL FROM ZAHN, PL. 13, COURTESY LIBRARY OF CONGRESS

RIGHT A lithograph Friedland found in Zahn's book appears to have been—from its intricate columns, floating figures and layout—Brumidi's inspiration for the Senate meeting room S-127 (ABOVE)



A section of the ornately crafted ceiling in the U.S. Senate Appropriations Committee meeting room

identified a copy deep in the library's storage. That would seem to answer the question, but it would help if she could show that Brumidi could have accessed one of the library's volumes.

Inspecting library markings on the book, she learned it was in the Library of Congress collection by 1849. "That's in plenty of time for our hero to consult them," Friedland told the lecture audience.

But *did* he?

Friedland turned to a transcript of a journal kept by Montgomery Meigs, the engineer who oversaw part of the construction of the Capitol and who commissioned Brumidi. She found an entry from after the room's completion in 1858, in which Meigs writes that Brumidi's room is "better than the examples from Pompeii in the book of ...," but only a blank space follows. Meigs wrote in something called Pitman shorthand, and the word there had stumped the person deciphering it two decades ago.

Friedland has called the system of scribbles and dots "impenetrable" to the uninitiated. But with the help of the library she was able to consult another Pitman transcriber who decoded the inscrutable word: Zahn.

The assembled puzzle pieces have yielded some unexpected insights, Friedland says—about the role of art books "to transmit ideas and values" across worlds; the impact of color lithography on painting and politics; and the reach of libraries.

"At the time," Friedland says, "the Library of Congress was housed *in* the U.S. Capitol, so these books were very accessible to Brumidi ... [and] only a major library would own them."

The findings also add fuel to the original idea of a young nation attempting to associate itself with a long, illustrious past and the power of mythic realms.

"They were serious about founding a new Rome on the Potomac," Friedland says. "Where this place is situated looks like the bend in the Tiber. We have a Tiber Creek here."

D.C.'s boundary stones recall ancient Rome, as well, she says.

"I like to refer to Meigs as the American Medici," says Cohen, the curator for the architect of the Capitol, during a visit inside S-127. "He wanted the new Capitol to be a palace, as well as a temple of democracy. He really wanted to rival European palaces."

And the value placed on that can be seen in the payroll: By 1857, Brumidi was being paid $10 per day, outearning $8 for members of Congress and $6 for Meigs, she says.

RESTORATIONS OF THE ROOM OVER THE YEARS HAD MUDDIED SOME OF THE COLORS, perhaps to the point that its unique qualities eluded scholarly interest, and a 2003-2005 cleaning returned the colors to

COURTESY ARCHITECT OF THE CAPITOL

At the Library of Congres, Friedland admires the table-sized folio of Wilhelm Zahn's work that she identified as Brumidi's inspiration for S-127.

Brumidi's original scheme, particularly returning very green backgrounds to their blue origins.

"That often happens when you are dealing with historic spaces and art—that if you're not seeing the original intent, you could be misguided and not recognize how good something is," Cohen says. "I definitely think that contributed to the lack of research."

Friedland, who's findings will be pubished this summer in the U.S. Capitol Historical Society's journal, *The Capitol Dome,* is already finding other layers of inquiry.

One of the more perplexing elements in the painted landscape are small heads that one could be forgiven for missing amid all of the other business of the design. Some have been described as "colonists," although Friedland prefers "sailors." But the baffling ones are of Native Americans. Looking at the latter, Friedland saw parallels to ancient depictions of Medusa, the mythological monster or Gorgon, who had live snakes for hair and who turned everyone who saw her to stone. (Perseus, who killed Medusa, had to look at her only through his shield to avoid petrification.)

Where the white, vibrant sailors are cast in flattering three-quarter view, the Native Americans are shown straight-on; they look comparatively puffy to Friedland, "and they have weird stuff under their necks," she says. "That's how ancient people pictured Medusa, and she's a monster."

Friedland plans to research further the degree to which these particular heads were "othering" Native Americans. Just as Brumidi drew from the then-fashionable designs of Pompeii at a time when the city was undergoing some of its most extensive excavations, his portrayal of indigenous Americans may also have been consistent with continuing conflicts between white and Native Americans, particularly as gold rushes and other opportunities brought white Americans further west.

"This room," she says, "could take a lifetime to do." GWR

JOSHUA YOSPYN

AN INSTANT CLASSIC

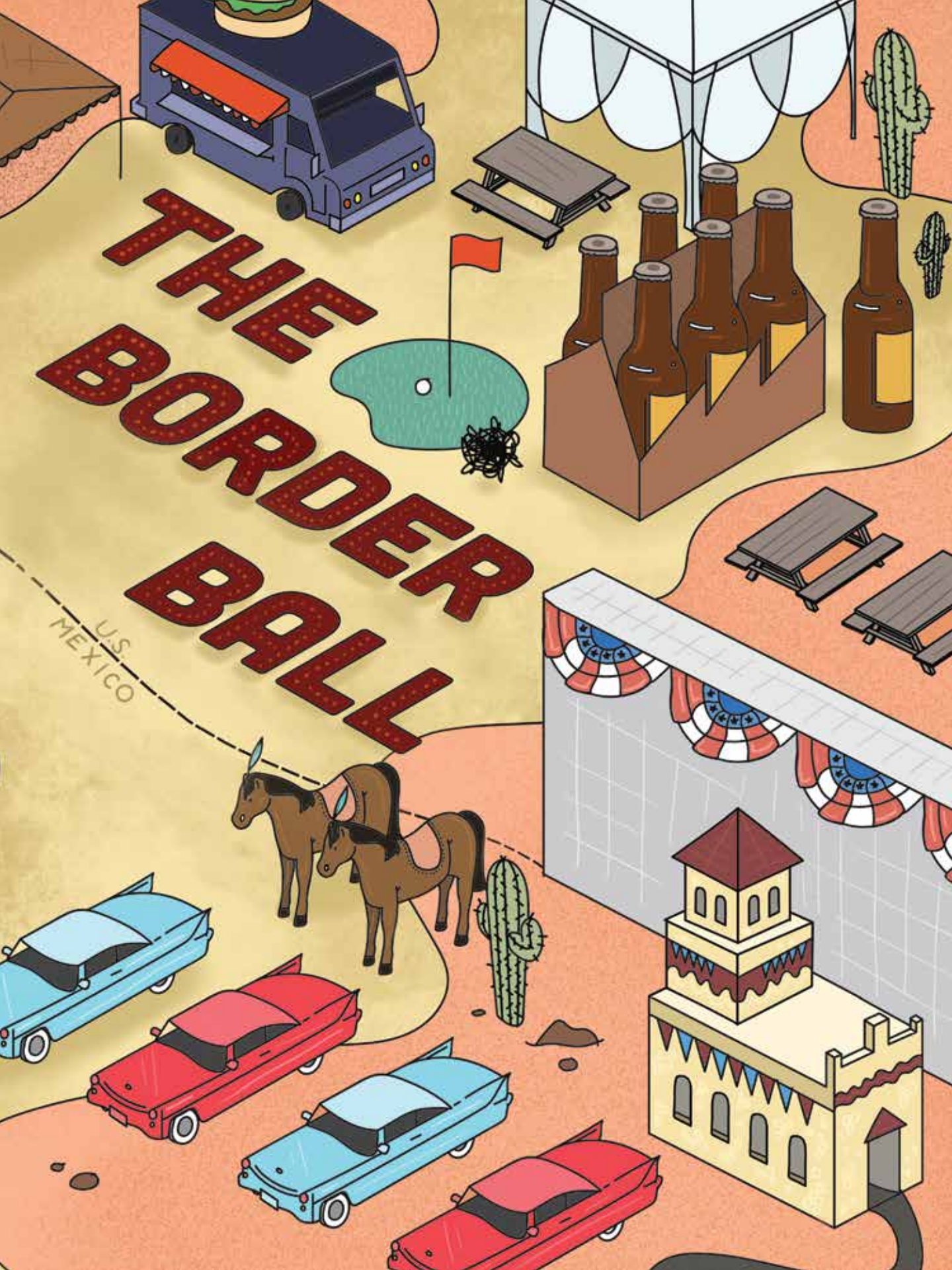
In Friedland's course examining Greek and Roman influences around Washington, D.C., each student is tasked with mining the history of a landmark or monument in the city, researching its classical models and how they came to be translated into "a new, American monument," Friedland says.

For instance, the National Building Museum—formerly the Pension Building—was completed in the late 1860s, and Friedland asked one student to research a series of niches encircling the top of the walls, just below the ceiling, at the center of the building. When the student sought clues to the patron's original intent for those niches, she found parallels to what Friedland had taught the class about the extensive sculptural display at Augustus' Forum in the center of Rome, which one scholar called the "First Hall of Fame."

The student found notes from Montgomery Meigs, the engineer who oversaw part of the construction of the U.S. Capitol (and who commissioned Brumidi's work), to create a "Great Hall of Americans," with busts of U.S. military heroes, including Andrew Jackson. Meigs even planned to include the bust of a first-century Roman general, Gnaeus Domitius Corbulo. That part never came to fruition, but the history uncovered was an example of late 18th- and 19th-century works which the students had studied; an example of how artists, architects and patrons were "very purposive, educated and determined in their adoption and adaptation of Greek and Roman models in constructing the civic art and architecture of D.C.," Friedland says.

The course has led to a planned book, tentatively titled *Classical Washington: Greece & Rome in the Art and Architecture of D.C.* GWR

ILLUSTRATION: HEATHER OESTERLING


THE BORDER BALL
U.S.
MEXICO

Noche Mexicana, a WBC event that celebrates Mexican culture, in the 1940s

WEBB COUNTY HERITAGE FOUNDATION

FOR MORE THAN A CENTURY, A U.S. BORDER TOWN AND ITS MEXICAN COUNTERPART HAVE THROWN A FESTIVAL TO MARK GEORGE WASHINGTON'S BIRTHDAY.

Since 1898, border town and busiest U.S. inland port Laredo, Texas, and its twin city across a curlycue in the Rio Grande, Nuevo Laredo, have thrown a joint party for George Washington's birthday.

Born out of efforts to Americanize a historically Mexican area, the Washington's Birthday Celebration has grown from a two-day event to a February-long festival. Now it fetes the southern border's binational culture as much as our founding-est of Founding Fathers, if not more. It is, to an outlander, a strange occurrence.

Elaine Peña went home to understand why, and what it says about people and dividing lines.

STORY
MATTHEW STOSS

ILLUSTRATIONS
HEATHER OESTERLING

It can even be strange to the initiated. GW American Studies associate professor Elaine Peña grew up in Laredo, and the bizarre to-do—it stews together July the 4th, Mardi Gras and a very large county fair—has puzzled the 40-year-old her whole life.

The WBC itinerary is as vast as it is incongruous. There are about 30 events every year. Among them are the expected and obvious (George and Martha impersonators, a carnival, a parade), the less expected but understandable (a jalapeño eating contest, a classic car

show, an air show, two debutante balls, a 5K) and the not at all expected and also very weird (a comedy jam, Pocahontas being given a key to the city in a ceremony that kicks off the parade).

Peña has been around the WBC since she was a kid. She and her three siblings moved around a lot but never seemed to live more than a few blocks from the parade, during which Peña would sometimes sell soda and bottled water to make extra money. As she got older, Peña found the WBC more and more confusing, especially its bedizened portrayal of Native Americans.

"I felt uncomfortable watching the pageant," Peña says by phone from Scotland, where she's spending the spring semester as a visiting scholar at the University of Edinburgh. "I had questions about it and I didn't know who to talk to because everybody seemed to take its content for granted. It was something that I wanted to understand, and then it was something that ended up being extremely complicated."

An anthropologist who specializes in religion and ritual, Peña has researched professionally the origins, implications and form of the Washington's Birthday Celebration for more than a decade. She's explored the Laredo and Nuevo Laredo's town archives and those of local organizations like the Webb County Heritage Foundation—Laredo is the county seat of Webb County—and the Washington's Birthday Celebration Association, helping the WBCA catalogue some of its old timey photos.

Peña is the first person to academically and so exhaustively study the WBC, becoming perhaps *the* expert on the event. Along the way, she broke news about the fraternal order that founded the WBC and, most notably, the beginnings of *paso libre*, a now retired tradition that from the 1950s to the 1970s allowed people to move between the United States and Mexico without a passport.

Peña's also attended several WBCs in an ethnographic capacity, most recently in 2017. She wanted to see if the festival would be different in a world where noted wall enthusiast Donald Trump is president of the United States.

"Everything went just the same, even with all of this anti-border politicking that had really informed the campaign," Peña says. "It just went on as usual."

Peña says her research started with her trying to figure out how and why the WBC's less than politically correct depiction of Native Americans had persisted into more enlightened times. But the research morphed to become a more encompassing study of the festival.

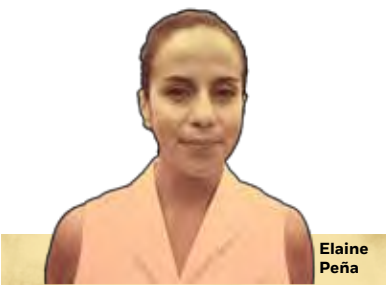
Thirteen years later, after $11,000 in seven grants—notably she was awarded a National Endowment for the Humanities grant and a Ford Foundation Postdoctoral Fellowship—$20,000 from GW and quite a chunk of her own money, Peña's got her second book.

In fall 2020, University of Texas Press will publish the tentatively titled *The Festive Border: Ritual, Infrastructure, and Cooperation at the Port-of-Laredo*.

"It took me 10 years to figure out that I didn't know what I thought I knew," says Peña, whose first book, *Performing Piety: Making Space Sacred with the Virgin of Guadalupe*, spun out of her PhD dissertation. She got her doctorate in 2006 from Northwestern. Postdoctoral fellowships at Illinois and Yale followed. "It's not just one thing or the other. It's not just caricature. It's not just class. It's not just citizenship. Those two cities, although they're on different sides of an international boundary line, they're connected in deeper ways. It may seem like these kind of performances undermine that bond, but the thing is, that bond is actually linked to both of the cities as a port of entry."

The halcyon moment of the WBC is the *abrazo* (embrace) ceremony

"An efficient border—a border without a wall—is a win-win for everyone and it doesn't have to undermine national identity. I think that's the point of the book and that's why it was so important for me to work on and develop the story in a way to cover all my bases and leave no stone untouched as best I could."



Elaine Peña

COURTESY ELAINE PEÑA

in the middle of the Juárez-Lincoln International Bridge. There, officials and children share a few hugs in the name of amity between abutting countries that in 1848 exchanged custody of Laredo after the United States won the Mexican-American War.

"What the book figures out is, yes, on the surface and even deep into these traditions, as misguided as they seem, there is a logic to it—an economic logic to it," Peña says. "But then there's another part of it which is, yeah, it may seem bizarre to celebrate George Washington's birthday, but for me that became more a question of not, 'What's wrong with it?' but how is this related more to our general thinking about patriotism? Proper geography? About where American history thrives? The proper place for American history?

"In other words, you can find America everywhere, in theory, but where do you expect to find it in a way that persists in its proper place?"

The 2019 Washington's Birthday Celebration, officially the 123rd—Peña discovered proto versions as early as the 1870s—attracted House Speaker Nancy Pelosi. She is the highest ranking U.S. official to attend a WBC, which always has drawn local and state poobahs while their national equivalents essentially have standing invites. Two sitting presidents, Dwight Eisenhower and Jimmy Carter, flirted with a pop-in. Neither made one.

Pelosi's appearance was overtly political. With the Trump administration's focus on the U.S. southern border and its walling off, the once largely anonymous—at least beyond the Texas borderlands—and innocuous WBC is drawing national glances.

"Even with everything going on, it hasn't affected the celebration," says U.S. Rep. Henry Cuellar, a Laredo native who's been his hometown's congressman since 2005. A Democrat, he serves Texas' 28th District. He also years ago played the baritone and marched with his high school's band in the WBC parade. "In fact, it's still very strong. This rhetoric—it's just the wrong rhetoric. People who live further away from the border are usually the ones who don't understand the border."

Trump visited Laredo in July 2015 while campaigning for president and met with local officials, including Mayor Pete Saenz, a Laredo native and Democrat elected in 2014.

"We took it as an opportunity," Saenz says, "to visit with him and tell him how we live here and how we do business here and how important commerce and trade is and about our relationship with Mexico."

Trump got 22.8 percent of Webb County's vote in the 2016 presidential election. Hillary Clinton got 74.3 percent.

Laredo, a town regularly immortalized in cowboy fiction and country song, is about 150 miles south of the closest major American city, San Antonio, and it's one half of an international metro area. Combined, Laredo and Nuevo Laredo have a population of more than 630,000, only about 70,000 people fewer than Washington, D.C. Laredo's population is about 260,700, 95 percent of it Latino.

The city is home to the second busiest of the United States' 328 ports, 29 of which are in Texas. In 2018, Laredo handled $235 billion in trade, 98 percent of it with Mexico, and accounted for 5.6 percent of all U.S.-international trade. Los Angeles, the busiest U.S. port, saw $299 billion in trade, 7.1 percent of all U.S.-international trade.

More than 11 million pedestrians, cars and trucks move from Mexico to the United States through Laredo every year, and the port of Laredo is responsible for more than 360,000 jobs and contributes more than $52 billion to Texas' GDP. Mexican tourism alone accounts for up to 50 percent of Laredo's retail sales. In 2017, the most recent year for which complete figures are available, that amounted to about $1.7 billion.

Washington's Birthday Celebration

BY THE NUMBERS

A look at some facts and figures

400,000
The average attendees a year

$150,000
What the Washington's Birthday Celebration Association spends to advertise the festival, including about

$73,000
in out-of-town markets such as Austin, Dallas and San Antonio as well as border cities in Mexico

$30,000
The annual amount Laredo spends in hotel expenses for participants and dignitaries

11–15%
The percentage of parade participants who are from out of town

$15 million
The approximate annual revenue for Laredo generated by the WBC

The Washington's Birthday Celebration remains vital. It continues to be well and thoroughly partied, drawing about 400,000 people each year and generating tens of millions of dollars for Laredo while replenishing and sustaining the old and commodious relationship between two countries and two Laredos, for which the border has always been the most invisible of lines.

"It's like everything goes into [high definition]," Peña says of the festival. "All of a sudden, everything becomes sparkly, and the things that are being done on a day-to-day basis, they're done in a more perfect way. ... It's the best version of the port."

The Improved Order of Red Men, a still-extant fraternal society founded in 1834 and modeled on the Sons of Liberty, invented the WBC in 1898. The idea was to use a birthday party for Washington, whose birthday became a federal holiday in 1879, as a fun way to nudge Laredo's Mexican residents toward a more alacritous Americanization. (A George Washington birthday party, Peña discovered, was something the Baltimore-founded Red Men tried to institute wherever it had chapters.)

As they did for their then-64-year-old organization, the Red Men again co-opted Native American imagery, devising facsimiles of Native American rites, rituals and terms and inserting them into the budding WBC. The Red Men believed the Indian motif to be uniquely American (and thus non-European because Europe had no Indians), which made it useful to a group of people claiming patriotic urges trying to sell another group of people on Americanism.

The original Laredoan observing of George Washington's birthday included a reenactment of the Boston Tea Party—another time in history when white people "played Indian"—and a staged Native American raid on city hall. It ended with the townsfolk surrendering, turning their other cheeks and

Beyond the border, GW researchers are exploring the nuances and implications of U.S. immigration, including, on the pages that follow, perspectives on mental health and on the workforce.

Distress Signals

Recent policy shifts have left immigrant Latino parents—even those in the U.S. legally—at risk for anxiety and depression, which could have a ripple effect on the next generation.

A slate of new research is examining the psychological distress on immigrant Latino families that's stemming from recent shifts in U.S. immigration policy, and the potential downstream effects.

In a study published last year in the *Journal of Adolescent Health,* a team led by Kathleen Roche, an associate professor of prevention and community health, and Elizabeth Vaquera, director of GW's Cisneros Hispanic Leadership Institute, found that new immigration policies and news coverage in the fall of 2017 had taken a significant behavioral and emotional toll on immigrant Latino parents of teenagers—even among parents who were in the U.S. legally.

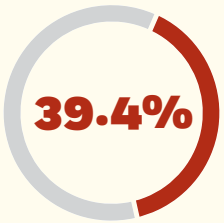
The study involved 213 parents recruited from a suburb of a large mid-Atlantic city. One-third were undocumented and two-thirds were living in the U.S. legally, either as citizens, permanent residents or under temporary protected status. Virtually all of their teenage children were U.S. citizens or protected under Deferred Action Childhood Arrivals, or DACA.

Nearly 66 percent of the parents told researchers they very often or always worried about family members being separated; nearly 40 percent said they frequently avoided seeking medical care, help from police or support from social services; and almost half reported that recent immigration events had led them to very often or always warn teens to stay away from authorities and to change behaviors, such as where the youth hang out.

The stress was associated with parents being at a higher risk for anxiety, depression and other mental health issues, the researchers say, but it also can cascade down to their children.

The findings, the researchers write, "raise serious concerns about the health and well-being of U.S. Latino adolescents. ... These behaviors directly threaten youth's safety and mental and physical health and can be indirectly harmful by way of parents' psychological distress."

The researchers now are trying to measure that effect, collecting data for a follow-up study based on interviews with more than 300 teenage children of immigrant Latino parents.



Percentage of immigrant Latino parents in the fall 2017 survey who said they had avoided seeking medical care, help from police or social services support in response to immigration policy shifts and news at the time.

Separately, Roche is leading a bigger, longer-term and wider-ranging study of Latino youth in immigrant families to better understand their world and how to promote their well-being. The five-year study, supported by $2.66 million from the National Institutes of Health, is following about 550 middle-schoolers and more than 250 of their mothers or mother-like figures.

"Many of these children and teens are at elevated risk for substance abuse, mental health problems and risky behavior, which if not addressed have adverse lifelong consequences for health and social functioning," Roche says.

The researchers say they hope to identify how neighborhood and school settings shape the teens' adjustments during school transitions, and how discrimination, language barriers and the presence of other Latinos in neighborhoods and schools affect parenting and stress among immigrant Latino families.

"The results of the study could help policymakers devise interventions to help immigrant families, and especially children, adapt and thrive in the United States," Roche says. GWR

1. **An aerial view of the parade in the late 1940s, early 1950s**
2. **A dancer at Noche Mexicana in 1939** 3. **A car decorated for the parade in the 1920s** 4. **A woman and man in Martha and George Washington costumes at a Colonial ball in 1964**

giving Pocahontas a key to Laredo.

So, to review: A group of (mostly) white guys calling themselves the Improved Order of Red Men decided that to make a Mexican town more American, they would dress up like Indians and invoke Pocahontas in the deified name of George Washington. But then the festival got subsumed by the Mexican influence it was meant to dilute and today the WBC above all else promotes multicultural goodwill and positive international relations. You can kind of see why *all this* took Peña more than a decade.

"There a lot of disparate parts about this that don't really make any chronological sense—or geographical or historical sense," says Margarita Araiza, who for 23 years has been the executive director of the Webb County Heritage Foundation. "But that's what you get when you have a people desperately trying to create a holiday that doesn't fit. What had been celebrated prior to that were all the Mexican holidays because everybody here was ethnically Mexican and still felt that way."

The WBC has been adjusted and audited since its inaugural throwing to fit the wants and times of its celebrants. Starting in 1957, it featured the aforementioned *paso libre*—the "free pass." For four days in February, Americans and Mexicans could, without paperwork or the haranguing of Customs, move at their festal leisure between Mexico and the United States. The two governments ended that in 1976. Officially, it was for saftey

1, 3, 4: WEBB COUNTY HERITAGE FOUNDATION / 2: WASHINGTON'S BIRTHDAY CELEBRATION ASSOCIATION

reasons. In 1977, they opened a new, Interstate 35-feeding and pedestrian-unfriendly bridge, the Juárez-Lincoln, and the governments wanted to use their shiny new thing for all WBC-related ceremonies. (Formerly the Gateway to the Americas International Bridge had been used. It was pedestrian-friendly, and the Mexican and U.S. governments, Peña found, started paso libre to promote goodwill after a years-long toll dispute.) Unofficially, paso libre ended because there was too much immigration-related political pressure to continue the tradition.

Years before all that, the WBC planners canceled the bullfight. They long ago abolished the Boston Tea Party reenactment and the Indian raid. But the Native American imagery endures, albeit more befitting a Vegas residency than living history, and Pocahontas retains her starring role.

One of the debutante balls is named for her (the other for Martha Washington), even though Pocahontas never went anywhere near Laredo, which the Spanish founded in 1755 as a ferry crossing. The Powhatan princess—the Lipan are the Native American tribe natural to the region—died 138 years earlier.

George Washington, born Feb. 22, 1732, never visited Laredo, either, but he was nevertheless made an agitprop in its service. The WBC planners marketed Washington as a kind of syncretic demigod—the "only white man in Indian heaven"—to make him, the most American of Americans, as saleable as possible to the most people. Pan-Americanism's popularity in the late 19th century made this easier.

Ostensibly the Washington's Birthday Celebration is still about celebrating George Washington's birthday, but it's evolved to be more.

"It's kind of hard to have a purely, I suppose you'd say, Anglo American-type celebration without it morphing into a Mexican American celebration," Araiza says.

"The Hispanic population

Adding Dimensions

In the workforce and in the military, teasing out the nuanced role of immigrants.

The effects of immigrants on the wages of native-born workers is a topic that's been widely studied, but the research primarily has focused on the impact to low-skilled men, paying little attention to women.

"When asking 'Are immigrants taking our jobs?' policymakers and mainstream labor economists are largely only looking at native-born men," says Eiko Strader, an assistant professor of public policy and of women's, gender and sexuality studies. "But native-born women are also in the labor market. Why is nobody looking at them?"

It's a question Strader would tackle in her dissertation at the University of Massachusetts Amherst and in her research since joining GW two years ago, bringing a sociologist's lens to the subject and reflecting a more nuanced relationship between the U.S. and its immigrant workforce.

"When asking, 'Are immigrants taking our jobs?' policymakers and mainstream labor economists are largely only looking at native-born men. But native-born women are also in the labor market. Why is nobody looking at them?"

Pulling from U.S. Census data, Strader has found that many native-born women in the workforce actually benefit from migrant domestic workers. The ability to outsource household work likely helps native-born women work longer hours and earn higher wages.

"It's more likely that native-born men are actually competing with native-born women in the marketplace—not, as most models assume, with immigrants," she says.

The research suggests a new model for comparative sociological and economic data, and won the 2018 Distinguished Dissertation Award in social sciences from the Council of Graduate Schools. The prize was awarded to just two dissertations—one in the social sciences and one from mathematics, physical sciences or engineering.

Strader has since expanded on that work to include more dimensions into the equation, like immigrants who are highly skilled, or those who have varied levels of education and experience, and a different set of variables for native-born women, too.

"When you bring in intersectionality, the story gets too complicated," she says. "Instead of having an easy elevator pitch summary that immigrants are or aren't taking jobs, the issue is really complex."

Strader is also studying the role of immigrants in the military. The armed services have offered a path to citizenship since the nation's founding, she says, but that pipeline and opportunities for immigrants to serve have narrowed as immigration has become a marquee political issue. The military offers a sort of closed-circuit comparator to the U.S. workforce that Strader also has used to study whether mothers earn lower wages than childless women (they do, but in different patterns than civilians), and the job performance of ex-felons (they're promoted more quickly than others).

Immigrants in the military, she's found, tend to "stick around longer, they're less likely to have a bad-conduct discharge ... They also are promoted at a higher and faster rate compared to native-born citizens," she says.

In many ways, Strader's research focus is a product of her time as a high school exchange student in Boise, Idaho.

A native of Japan, her first impressions of the U.S. were not entirely favorable. She hoped to be embraced by a diverse, inclusive community; instead, fellow students teased her, and teachers often relegated her to remedial classes. Still, even after returning to Japan, she was fascinated by America's struggles with inequality.

"I had to rethink what I thought I knew about the U.S." she says. "It wasn't a place where everyone was treated equally. But Americans are aware that they are not perfect and they try to do something about it. I found that complicated and exciting." GWR

1. **Laredo Mayor Pete Saenz gives the key to the city to the woman portraying Pocahontas in the 2016 parade** 2. **Children dressed in traditional Colonial attire ride a float during the 2018 parade** 3. **Children embrace during the 2014 *abrazo* bridge ceremony** 4. **A woman dances during the 2018 parade**

has always been dominant economically, socially, politically, like other parts of Texas, and so it was not a rebellion by any means. At that point the immigrants were Northern Europeans, so they were the ones who wanted to create the American holiday but [the relationship] was always very friendly. The, shall we say, 'social elite' were always dominated by ethnic Mexicans, so they were always included in the whole planning and execution of the celebration, and after a couple of years, George Washington was ethnic Hispanic as well as Anglo American—whoever portrayed George Washington [in the WBC]."

Now the WBC dominates Februaries in Laredo. Formerly it reached not much outside the vicinage of Texas. Once in a while, though, a curious media outlet will wander down for a story about the festival's grab bag origins and how George Washington came to be commemorated so ebulliently so far from where it seemed ethnographically eloquent. Araiza says the point is often missed.

"They kind of come toward it with a patronizing attitude—'What would a bunch of Mexicans want to have to do with George Washington?'" Araiza says. "Most people realize, 'Oh yeah, I get it,' after they hear about it, but sometimes they try to spin it as if it were an Anglo versus Mexican thing, and the Anglos were all in charge and the Mexicans were somehow subservient or oppressed, but that's historically inaccurate. And I just hope that with the exposures of the whole thing and through Elaine's book and everything else, that that comes through."

Some in the United States would like us to believe that the southern border is hell's frontier and that the Rio Grande might as well be the Acheron. On one side of this line is America, where things are American, and on the other side is Mexico, where things are not American.

This, Elaine Peña says, mustering the might of a lifetime's

1, 2, 4: WASHINGTON'S BIRTHDAY CELEBRATION ASSOCIATION / 3: ELAINE PEÑA

study, is very, very not true.

"It wasn't necessarily like, 'Oh, this is what Anglo Americans do and this is what Mexican Americans do and this is what Mexicans do,'" Peña says. "In a border environment, mostly everyone is bilingual. Before Sept. 11, it was way easier just to cross back and forth—or at least for someone with a U.S. passport or a border crossing card. It wasn't really like, 'Well, this is America and this is Mexico. America is white and Mexico is brown.' It wasn't really like that, ever. But I was just fascinated by how these things that were American could be American and echo Mexico in the same conversation."

"One of the points of this book," Peña continues, "is that you can have these regional expectations. But the fact of the matter is that we are absolutely interconnected. When you think about trade, when you think about the things that we take for granted—the price systems. All of that is made possible by efficient borders that take care of trade while taking care of security. Immigration in the larger scheme of things is not the border's first and foremost problem. Immigration always takes center stage—or illegal immigration, I may say—but that is part of the dysfunction of American politics and it has been for a very long time."

Too many nuanced issues, Peña says, are debased to talking points.

"It allows them to get into the story of the border without having to manage the way the rhetoric around immigration has been weaponized for centuries," she says. "Then once they get into the story, maybe they'll be able to see the economics of it, that the economics of it aren't actually that perplexing.

"An efficient border—a border without a wall—is a win-win for everyone and it doesn't have to undermine national identity. I think that's the point of the book and that's why it was so important for me to work on and develop the story in a way to cover all my bases and leave no stone untouched as best I could."

When Peña started officially researching the Washington's Birthday Celebration, it was to assuage a childhood bewilderment. The festival didn't make sense, and she found its lingering use of Native American imagery antiquated and discomfiting. But like everything else about the WBC, it's a blending of almost a century and a quarter of customs from new and older eras. It's a natural agglomeration of two familiar sides in an isolated place. It's as organic as it is unavoidable.

"It goes on because there's so much to celebrate," Peña says. "There's so much expectation about the celebration that it transcends whether something is politically correct or not or whether something is in its proper place or not, whether patriotism is in its proper geography. It's something that is so deeply entrenched in the families, in the leisure time activities, in the character of the port of entry. Too many things will be lost if something comes undone."

The WBC now honors Mexican identity and culture alongside George Washington and American history. It in recent decades added a Miguel Hidalgo stand-in to the bridge ceremony. He joined the traditional arrangement of four children—an American boy and girl in Colonial clothes, and a Mexican boy and girl in traditional Mexican clothes—hugging at the bridge's midpoint. Borders, in a cultural sense, are imaginary, and if they aren't, they're made more of air than steel.

"Even if they wanted to separate the United States and Mexico," Peña says, "they never really figured out how to do that." GWR

LAUNCHPAD

Danya Sherman, center, celebrates her win at eMerge Americas.

ROY LLERA

ENTREPRENEURSHIP

IN MIAMI, GW SHINES

At the eMerge Americas conference, a student's drug-detecting cocktail napkin tops a startup competition, and faculty and administrators discuss the future of innovation.

Student entrepreneur Danya Sherman outpitched more than 100 startup competitors from around the world in April to win the grand prize at the eMerge Americas annual conference in Miami Beach.

Sherman's company, KnoNap, developed a cocktail napkin that can detect the presence of various date-rape-related drugs in drinks.

"As a university student and also representing my university, bringing home that win to Washington, D.C., was one of the most humbling experiences," said Sherman, an Elliott School of International Affairs senior.

Sherman won $100,000 in Google Cloud credits and expenses for a trip to San Francisco to meet with tech accelerator Y Combinator's CEO Michael Seibel.

The win capped two busy days for GW at the eMerge Americas conference that attracted about 15,000 people. It was the university's first time participating in the conference, and GW came in as a sponsor and with President Thomas LeBlanc and GW faculty taking part in keynote talks, panel discussions and research presentations.

LeBlanc, on a panel with U.S. Rep. Darren Soto (D-Fla.), JD '04, discussed ways higher education and government can promote and support technology and innovation.

"My view is every single student needs to have access to the skillset for the quantitative analysis of data using technology," he said. "Whatever they are studying, they have to have that, and we want to be a university that provides that."

Jim Chung, GW's associate vice president for research, innovation

ROY LLERA

and entrepreneurship, discussed innovation programs at GW, including those with its partners nationally and internationally, like the National Science Foundation's Innovation Corps program.

By giving researchers tools and a road map for commercialization, the D.C. I-Corps node—which GW runs with the University of Maryland, Virginia Tech and Johns Hopkins University—has trained more than 5,000 researchers in the mid-Atlantic, he said, and has taught the model in 14 countries.

"We are not doing business plans, we are teaching entrepreneurs to create business models," Chung said. "We are focusing on customer development rather than product development. We are teaching scientists and engineers to use their own process of the scientific method for launching their own startups."

Sherman, of KnoNap, had arrived at the finals after multiple preliminary rounds, including a pitch contest at GW. There judges selected KnoNap and two other GW teams to advance to Miami: Nanochon, which creates 3D-printed knee cartilage implants; and M-Size Me, a digital obesity-management tool to help doctors explain an obesity diagnosis and help teens achieve weight-loss goals. GWR

Six faculty researchers showcased their research at the conference:

Cancer-Fighting Cold Plasma

Michael Keidar, the James Clark Professor of Engineering at the School of Engineering and Applied Science, developed a cold plasma technology that targets and kills cancer cells during surgery without harming healthy tissue, a finding that could revolutionize cancer treatment.

Data Privacy App

Tian Lan and **Guru Venkataramani**, associate professors in the Department of Electrical and Computer Engineering, have worked with their team to develop a learning-based malware protection tool that can notify users about data leakage on Android mobile devices.

Virtual-Reality Infant Intubation

James Hahn, a professor in the Department of Computer Science, worked with an interdisciplinary team to develop a virtual-reality training program to help medical residents learn to intubate newborns. Physicians typically have less than 30 seconds to intervene when a newborn is having trouble breathing.

Water Purification Via Nanotechnology

Danmeng Shuai, an assistant professor in the Department of Civil and Environmental Engineering, and his team have created an affordable material called graphitic carbon nitride that can purify water using solar energy. The material kills bacteria and viruses and also can help destroy chemicals, like pharmaceuticals, that may contaminate groundwater. His lab is studying whether the material also could be used as a pathogen-killing surface coating in hospitals, for things like doorknobs and tables.

Wearable Health Sensors

Zhenyu Li, an associate professor of biomedical engineering, leads a team of engineers who have incorporated advanced electrocardiogram capabilities into a wearable, personalized cardiac monitoring ring, which could be a replacement for costly, in-hospital ECGs. The team also is designing and fabricating a wearable lab-on-a-patch that monitors alcohol in sweat.

Predicting Visual Search Performance

Stephen Mitroff, a professor of cognitive neuroscience in the Department of Psychology, and his colleagues have developed a tool that tests how well prospective and current airport security officers perform visual searches.

CLOCKWISE FROM TOP **Manyung Emma Hon from Plast-ways; Chloe King of Last Call; Nihal Satyadev of YouthCare; and Edith Leiva of Dulceology**

STARTUPS

WASTE NOT

New businesses addressing food surplus, throwaway corporate gifts and plastic trash in landfills topped GW's annual New Venture Competition.

By Tatyana Hopkins

In an effort to alleviate both the strain of people facing food insecurity and of restaurant food waste, a GW alumna and a student have designed a tool to bring together the two groups' complementary needs.

The online marketplace, Last Call, works with restaurants to offer surplus meals at a discount—$5 or less—and alerts its users to the deal. It was born out of the experience of co-founder and CEO Erin McGeoy, BBA '18, an athlete and scholarship recipient who skipped meals and relied, in part, on free food from university events to help fill her plate.

"Businesses face huge barriers to getting food from their restaurant to a food pantry, resulting in millions of meals going to waste each year while millions of Americans go to bed hungry every day," co-founder Chloe King, a senior at the Elliott School of International Affairs, said in April during the final round of GW's New Venture Competition. "We help businesses sell out instead of throw out."

The team won big in the finals, topping the competition's social-venture track and taking home $45,000 in cash prizes, plus a $100,000 Google Cloud package.

The competition—organized by GW's Office of Innovation and Entrepreneurship within the Office of the Vice President for Research—offered teams the chance to compete for a portion of $200,000 in unrestricted cash prizes, as well as more than $600,000 in kind prizes.

The New Venture Competition this year drew more than 215 teams. Winners were selected from three tracks: social, tech and new ventures. Each of the first-place track winners was awarded $20,000 to fund their ventures.

Edith Levia, a graduate student studying interaction design, represented Dulceology, which won the new-venture track. The online bakery sells caramel sandwich cookies made with the Latin-American confection dulce de leche for corporations to give to their clients, as opposed to traditional small items, like pens, key fobs or lanyards.

One-third of corporate promotional gifts and keepsakes are discarded, Levia said, and she hopes that her treats will express a unique sense of gratitude that will prevent further waste. She also noted that food gifting is a $20 billion market.

"You think we're here to make cookies, but we're really here to make dough," she joked.

Manyung Emma Hon's Plast-Ways won the tech track. The junior mathematics major's startup uses naturally-occurring, plastic-eating microbes that would expand the lifetime of landfills by reducing the time it takes plastic to degrade, from 1,000 years to as few as six weeks. GWR

BOTH PAGES: WILLIAM ATKINS

At the finals of the New Venture Competition in April, GW Provost Forrest Maltzman noted that the contest had launched more than 50 successful ventures. Here's a look at one of them operating in the realm of mental health.

Senior **Kyrah Altman** has been trying to change the world for as long as she can remember. Now she's doing it, through her own nonprofit that aims to change the landscape of mental health education for young people.

Altman is the executive director of LEAD (Let's Empower, Advocate and Do), Inc., an organization she co-founded with friends in high school, and that she's refined and incorporated during college. The nonprofit aims to provide health educators with a holistic health curriculum, one that incorporates mental health and social and emotional learning into outdated and physical-health-focused frameworks.

It's the kind of knowledge Altman says she could have used as a high school student, as she navigated a challenging and traumatic youth that left her feeling anxious, depressed and in crisis.

"For me, knowing I wasn't alone would have been helpful and empowering," Altman says.

Altman channeled her distress into planning events and fundraisers for social change. She and her friends found that mental health intersected with every issue they cared about, from addiction to gun violence, and they were inspired to create LEAD and advocate for changes to their high school's outdated health education curriculum.

The group's founders put the organization on hold during college, but Altman kept returning to the mission. She decided to reboot LEAD for the 2016 New Venture Competition, seeing if she could develop the idea into a business selling a mental health curriculum and training to school districts.

With the help of workshops and seminars from the Office of Innovation and Entrepreneurship, she claimed second place overall in the contest and recognition as the best social venture, taking home $32,500 in seed funding, more than $10,000 in in-kind prizes and a plan for her future.

Over the past few years, Altman's life has been a whirlwind, juggling school work with her job as leader of a nonprofit. She incorporated LEAD in 2016, and the organization created its Health Educator Toolkit, comprising TryHealth—a pilot for a supplemental health curriculum that meets national education standards, including information on seeking help for mental health and on stress management and coping skills—and an online platform for teachers, called HealthLab, which offers screening tools, data collection techniques and other resources for how to help students in crisis.

LEAD has also expanded its training opportunities for educators, which dive deeper into subjects like trauma-informed teaching and mindfulness in the classroom.

"We are trying to revolutionize health education and push the limits [of] what we view [as] the ideal health class for high school students, with the information we wish we had, but never received," she says.

Last year, Altman was named the regional winner of the Entrepreneurs' Organization Global Student Entrepreneurship Awards, and then went on to take third place at the national level this year. And, as Altman prepares to turn her full attention to LEAD after graduation, the organization now is in the midst of a campaign to raise $100,000 that would enable LEAD to move toward the goal of getting the Health Educator Toolkit into the hands of every health educator in the U.S. by 2025.

"When I first started taking my mental health seriously, I was in crisis," Altman says. "If we're able to focus on early intervention and helping kids proactively when signs and symptoms first start appearing, then it's not going to get to that crisis situation, and their recovery is going to be faster and more effective, as well."

—Kristen Mitchell

"WE ARE TRYING TO REVOLUTIONIZE HEALTH EDUCATION AND PUSH THE LIMITS [OF] WHAT WE VIEW [AS] THE IDEAL HEALTH CLASS FOR HIGH SCHOOL STUDENTS, WITH THE INFORMATION WE WISH WE HAD, BUT NEVER RECEIVED."

OTHER WINNERS INCLUDED:

ALLDOTs provides a complex, automated dual-target system for pavement condition detection and maintenance-planning optimization. ($10,000)
Ali Gerami Matin (SEAS '21), and Mohammad Shams (SEAS '19)

District Connect is a mobile grocery store that provides healthy and affordable food. ($7,500)
Gabby Levet (SPH '21), Winona Francis (MBA '18; CERT '18) and Ariel Hensley

Knowledge to Own is an online platform to get free money to buy a home. ($5,000)
Alberto Estrella (GWSB '18), Trevor McGraw (GWSB '18), Kin Wah Koo (GWSB '18) and Thomas Walsh (GWSB '18)

Mobility Innovators is a compact tray designed for U.S. veterans who are wheelchair bound and lack independence. ($5,000)
Jonathan Lau (SEAS '22), Justina Pruski (SEAS '21), Raymond Yau (SEAS '22) and Giavanna Corazza (SEAS '22)

Obious is an online marketplace for buying and selling group experiences. ($2,500)
Eleanor Parry (GWSB '19), Jiani Xu (GWSB '20), and Daniel Noake

Perpetua presents Meerkat, a climate-controlled glovebox that makes it possible to use modern point-of-care medical labs in the developing world. ($12,500)
Randall Ray (SMHS '22), Parker Johnson (SEAS '19) and Nirmal Ravi

Spiro, a wearable bracelet that helps identify children's asthma triggers to decrease morbidity and mortality in a severity-enriched cohort. ($15,000)
Sajani Desai (SMHS '22), Rachael Herrera (SMHS '22), Abhya Vij (SMHS '22), and Sonia Samant (SMHS '22)

Takin' it Easy is an automated pill dispenser providing medical safety and autonomy for users and families. ($5,000)
Sydney Bailes (SEAS '19), Caitlyn Pratt (SEAS '21), and Solomon Abrams (GWSB '19)

Viva Vita makes aging engaging with empowering virtual-reality technology. ($5,000)
Carleigh Berryman (GWSB '19), Julianna Yee (GWSB '19), Dylan Tally (GWSB '19) and Dakota Sinder (GWSB '19)

Voxion provides a solution for consumer-facing businesses to build custom voice applications. ($2,500)
Sam Bunger (SEAS '21), Saramarie Puzzanghera (SEAS '22), Nathaniel Bury (SEAS '22), and Ryan Fornara

WATTerWagon increases water-carrying capacity and eliminates strenuous labor for hundreds of millions living in rural water-scarce regions. ($7,500)
Christian Trummer (SEAS '21) and Jagan Doodala (CCAS '19)

YouthCare is an intergenerational memory-care social enterprise that partners trained student volunteers and persons with early-stage dementia. ($15,000)
Nihal Satyadev (SPH '19) and Arjun Vadlamudi

Other Ways to Get Involved in Entrepreneurship at GW:

Summer Startup Accelerator
This intensive, nine-week residential program offers student entrepreneurs the resources they need to build fundable business ventures.

Mentors-in-Residence
Entrepreneurs and business executives are available weekdays for office hours to provide guidance.

Events/Programs
GW's Office of Innovation and Entrepreneurship works with George Hacks and other organizations, such as GW Data, to host hackathons. It also hosts an annual startup career fair, lectures, networking events and the GW Innovation Exchange, an online community for students looking for team members and mentors.

I-Corps
GW is one of only a few universities to host multiple National Science Foundation Innovation Corps (or I-Corps) programs, which provide hands-on training and access to up to $50,000 in funding to technology-based business ideas and research.

Courses
Entrepreneurship courses are offered at the undergraduate and graduate levels at various GW schools.

For more information, visit *innovation.gwu.edu*

WILLIAM ATKINS

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