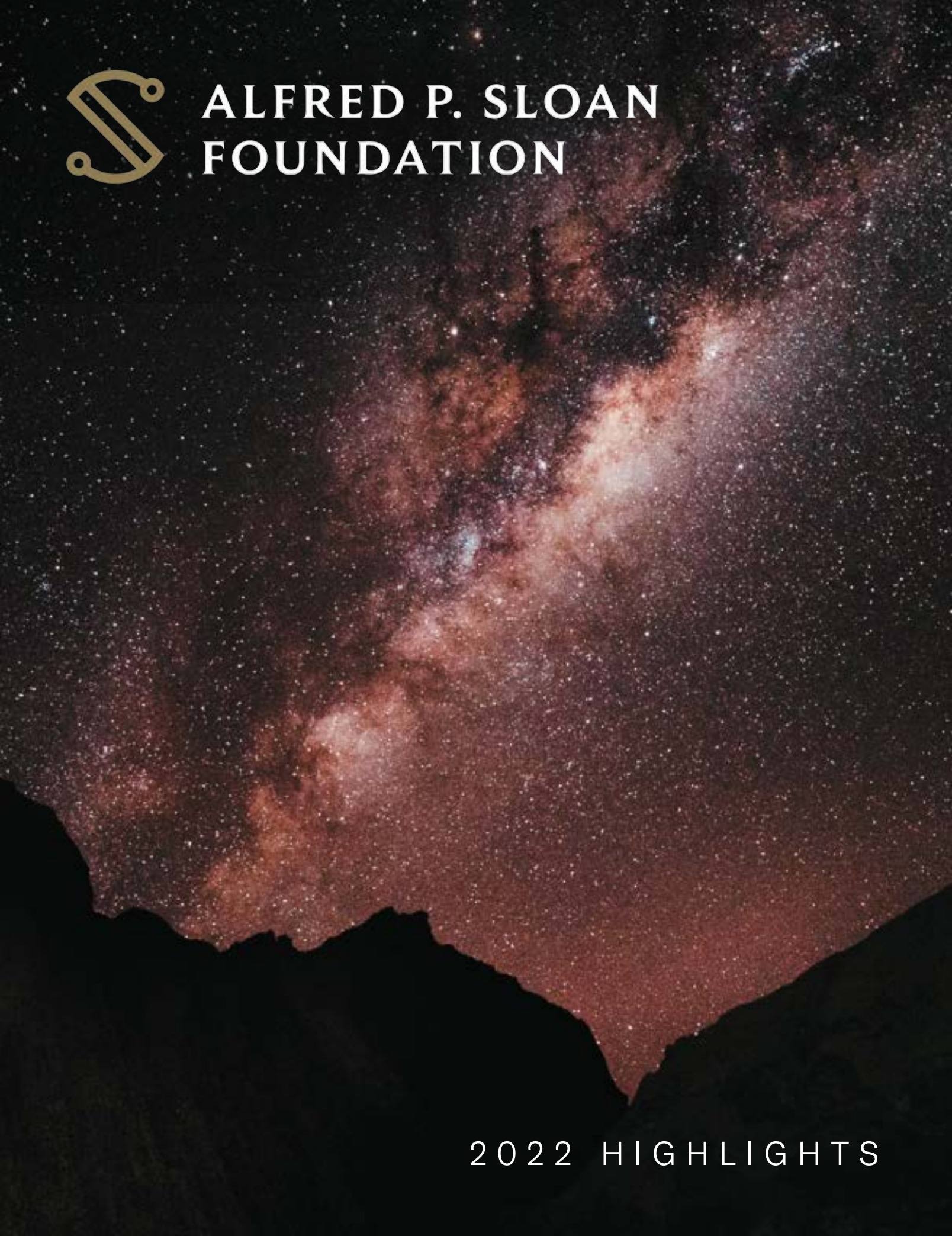

ALFRED P. SLOAN FOUNDATION

2022 HIGHLIGHTS

ALFRED P. SLOAN
FOUNDATION

Contents

Cover: The Milky Way as seen from Chile's Atacama Desert. A new partnership with Chilean astronomers will expand the Sloan Digital Sky Survey to the southern hemisphere, bringing new insights about the structure of the Milky Way, the lifecycle of stars, and galactic evolution.
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The Alfred P. Sloan Foundation is a nonpartisan, not-for-profit grantmaking institution dedicated to improving the welfare of all through the advancement of scientific knowledge. The Foundation works in four different areas to help drive the research frontier forward.

RESEARCH & DISCOVERY The Foundation believes that scientific discovery is a chief driver of economic prosperity and that the research enterprise is a vitally important engine of human progress. We help scholars conduct cutting-edge research across a range of disciplines, from astronomy to particle physics to energy economics. Our research grants focus on underexplored topics; innovative methods; and risky, adventurous projects where success holds the promise of truly transformative discovery.

HIGHER EDUCATION Scientific progress is too important to belong to any one gender, race, or ethnicity. We partner with researchers, educators, administrators, and students on initiatives to increase access to scientific education, enhance meaningful participation in the scientific process, and change the culture of scholarship in ways that make it more open, responsive, and affirming to all.

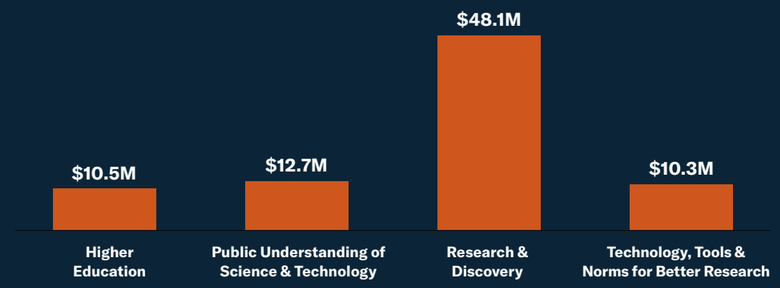
TECHNOLOGY, TOOLS & NORMS FOR BETTER RESEARCH In recent decades, developments like computing and the internet have created new challenges and opportunities for researchers. We work with technologists, programmers, engineers, and scholars to develop innovative new tools, practices, and institutions that give researchers the ability to generate, analyze, and share knowledge at unprecedented speed and scale.

PUBLIC UNDERSTANDING OF SCIENCE & TECHNOLOGY In our increasingly technological world, it is more important than ever that the fruits of scientific discovery be accessible to everyone. We partner with artists across a diverse range of media to help tell stories that expand and deepen public engagement with science and technology.

Founded in 1934 by Alfred P. Sloan Jr., the industrialist who made General Motors a household name, the Sloan Foundation was created out of Mr. Sloan's firsthand experience watching scientific and technological innovation drive prosperity and lift American standards of living. Today, we strive to uphold the legacy of that founding insight and to be guided in all our actions by the values of the scientific enterprise: impartiality, empiricism, curiosity, rigor, and the conviction that a careful, systematic understanding of the forces of nature and society, when applied inventively and wisely, can make the world a better place for all.

2022 Grantmaking at a Glance

As of September 30, 2022, the Sloan Foundation had assets totaling approximately $2.0 billion. During 2022, the Foundation awarded over $87.1 million in grants to support projects across our four focus areas.



* The Foundation awarded an additional $5.4 million in grants to support nonprofit initiatives and New York City-based projects that advance the Foundation's mission.

Making an Impact

At the close of 2022, the endowment of the Alfred P. Sloan Foundation stood at approximately two billion dollars. As prudence and the law require, we spend five percent of that endowment each year. Accounting for operating costs, that allows us to make approximately $90 million in grants annually. That's a lot of money.

Or is it? At Sloan, we spread our grantmaking over seven major programs and a few smaller ones, which means that in a given year no program has more than $15 million to spend. And then there's the scale of the challenges we address: scientific and economic research, the low-carbon energy transition, diversity and inclusion in STEM, the evolving role of information technology in the academy, the public understanding of science. How can we have any impact on these enormous issues with a mere fraction of what government funders and others have available?

That, in a nutshell, is the exciting challenge of running a philanthropy such as Sloan. It's what keeps us up at night, and it's what gets us up in the morning. I'd like to share something about the strategies we use to address that very interesting problem.

The challenge is most acute in basic scientific research. The 2023 budget of the National Science Foundation is approximately $10 billion, three orders of magnitude more than Sloan can invest each year. So, we look to support fields of research that government agencies cannot or will not, perhaps because they're interdisciplinary, or emerging and speculative, or methodologically risky. It takes work to uncover such opportunities; before launching our Matter-to-Life program in 2021, we spent eighteen months considering more than one hundred potential concepts proposed by scientists from a diverse set of fields.

Projects funded under Matter-to-Life explore the physical principles and mechanisms that distinguish living systems from inanimate matter. Research teams are often wildly multidisciplinary, composed of investigators from fields as diverse as physics, chemistry, biology, computer science, mathematics, Earth science, and more. A recent grant, for example, funds a global team seeking to build the first artificial protocell. With the federal funding system organized largely around the disciplines, exciting interdisciplinary work such as this can easily fail to find a home. We believe that our relatively modest resources can have an outsized impact in moving forward such emerging areas of inquiry.

Another role Sloan can play is to support neglected activities within a larger field. Our Energy and Environment program does just that, by funding research to inform the societal transition toward low-carbon energy systems. The overwhelming majority of philanthropic funding for environmental issues (well over 95%, according to studies) supports advocacy of some kind. While there's lots of foundation money devoted to action around climate change, relatively little is spent on dispassionate research on how our energy systems work, how they are likely to evolve, and what that will mean for all of us. We need wise energy policies, and to every extent possible they need to be substantiated with carefully developed evidence.

The value of Sloan support for rigorous, policy-relevant research was powerfully evident in December at the oversubscribed *Energy Insights 2022* conference hosted by Resources For the Future. At that meeting, Sloan grantees in the Energy and Environment program—representing fields as diverse as economics, sociology, chemistry, engineering, and others—spent two days discussing their research, exchanging ideas, interacting with policymakers, and making plans for future work. We were reminded repeatedly of the scarcity of funding for this work, and that Sloan funds, modest though they may be, are having a disproportionate impact on the scholarly community studying these critical issues.

Another opportunity open to foundations is to fund freely available software, datasets, and other tools essential to research. The incentives faced by individual scholars often do not encourage the production of such resources for common use. They are “public goods” in the economic sense—they are not restricted to paying customers, and their use by one person doesn’t preclude use by another. (A classic example of a public good is a lighthouse.) Public goods are, unfortunately, subject to the free-rider problem, and therefore might be funded by no one although many would benefit from them. This is a problem that is often addressed by government support, but it is also an area where foundations can have a significant impact.

We do quite a bit of such funding here at Sloan, so much so that some of us are fond of saying we’re in the “public goods business.” For example, in our Technology program we supported the development of Jupyter laboratory notebooks, a powerful free software tool now used by millions of scientists and science students. Total Sloan investment in Jupyter was only about six million dollars, which represents an enviable bang for our buck. In our Economics program, we noticed that while the burgeoning growth in administrative data (data not collected for research purposes) held by government agencies and the private sector has enormous promise to advance rigorous research in the social sciences, the opportunity for scholars to use this data was limited and exclusive. Sloan funded the development of a network of Administrative Data Research Facilities to provide secure, confidential, and more equitable access to these critical resources, to make them broadly available as public rather than private goods.

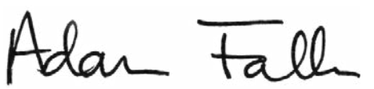
Sometimes, rather than having impact by funding something that others don’t fund, we do so by fostering new and innovative institutional partnerships. A recent exciting example is the Equitable Pathways initiative within our Higher Education program. In Equitable Pathways, we support collaborations between Minority Serving Institutions graduating significant numbers of STEM majors, and universities with strong masters and doctoral programs. These partnerships provide well-crafted pathways for students underrepresented in science to matriculate as graduate students in institutions where those students have historically been excluded. Faculty at both partner institutions learn from each other how to educate and support these students most effectively. In the two years of this program, we have made approximately $10 million in grants and brought together more than 100 institutions. Seeing the nucleation of so many new relationships, we are excited by the powerful impact these modest funds will have on the broader culture of higher education.

Finally, a foundation can have disproportionate impact by bringing more than money to the table. While we hope to do that in all our grantmaking, there are some programs where the funds are quite small, but the impact is especially large because of the way we select grantees and work with them. My favorite example of this is our Books program, an element of our program in the Public Understanding of Science and Economics. Awards here are typically no more than $50,000, and go on to support leave time, travel, editing, and other critical services for authors writing books for the public on subjects related to science or scientists.

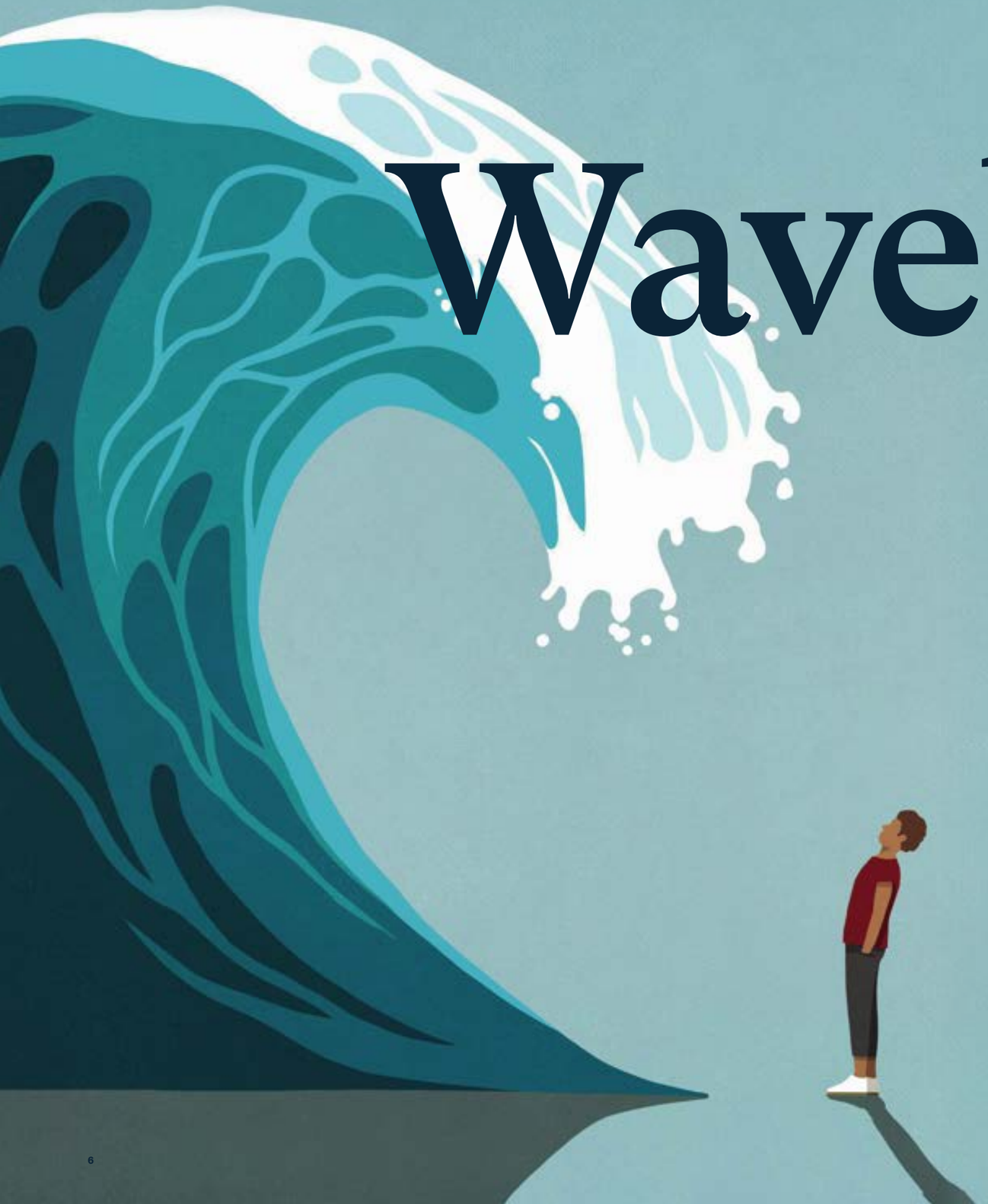
A small amount of money can be incredibly valuable in helping an author make a book better, by allowing them to do additional research, consult with experts, or conduct field visits. Proposals are reviewed by Sloan staff and by a multidisciplinary advisory panel of scientists, who not only choose the most promising proposals but provide authors expert commentary on their projects. Sometimes we’ll add money to a grant to fund a dedicated science advisor, to make sure the science in the book is exactly right. While we spend

less than a million dollars each year on our book program, these are among the most impactful projects the foundation supports, and not only because some Sloan books, like *Hidden Figures*, go on to be popular and influential films.

Identifying strategies to maximize the impact of our grantmaking is not just an intellectual challenge. It’s an ethical imperative. We are the inheritors of the legacy of Alfred P. Sloan, and we have an obligation to do all we can to advance the purposes of the foundation he left us to steward. And because Sloan’s fortune was created not by his hands alone but through the work of many thousands, at General Motors and beyond, our moral obligation to do good with this fortune extends to the whole of American society. We take that obligation, and the extraordinary opportunity that comes with it, very seriously. As I said, it’s what keeps us up at night; it’s what gets us up in the morning. And it’s what drives us to work so hard in the hours in between—our belief that if we do our work well, we can leave the world a better place than we found it.



— Adam F. Falk,
President, Alfred P. Sloan Foundation



The Wavebreaker

A Yale economist is putting together a how-to guide filled with everything we know about how to stem the tide of the next financial tsunami.

The 2008 global financial crisis inflicted devastating social, political, and economic costs on Americans. In just eighteen months, millions lost their homes, millions more lost their jobs, major financial institutions collapsed or had to be bailed out to stave off insolvency, and national GDP plunged 4.3 percent. In response, legislators enacted ambitious new laws designed to prevent future financial crises: they expanded the authority of financial regulators, mandated regular "stress tests" to gauge the vulnerability of bank balance sheets, and enhanced the protection offered to whistleblowers who report bad behavior. The moves represented many experts' best thinking about how to prevent future financial crises.

And it's all doomed to fail. At least that's the take of Yale economist and Alfred P. Sloan Foundation grantee Andrew Metrick. Metrick is an economist who specializes in regulatory failure. Attempts to prevent future financial crises are prudent, he admits, but time has its own brutal logic, and given enough of it, even extremely low probability events will happen with near certainty. That means preventative measures are never enough.

"Even if regulators *could* bring the probability of a future financial crisis to zero, it wouldn't be optimal to do so," says Metrick. "In a pandemic, we could technically bring transmission risk to zero by locking everyone in their homes for eternity, but the trade-offs are so great that it's not a strategy worth considering. It's similar with financial risk—too much would be lost if companies weren't allowed to take risks. Prevention is important but central banks need to prepare for when the next crisis inevitably comes."

Metrick is spearheading a unique effort in financial crisis preparation through the Yale Program on Financial Stability, which he established with Sloan support in 2013. Its latest initiative is the New Bagehot Project, a comprehensive database of more than 500 past financial crisis interventions designed to educate and provide rapid decision support to policymakers during a crisis, including the market liquidity programs used to treat the 1970 downturn

in the commercial paper market and the credit guarantee programs that formed part of the response to 2008. The project takes its name from British economist Walter Bagehot, whose 1873 book *Lombard Street* coined what remains to this day the mantra for fighting financial crises.

"Bagehot's dictum states that, in a crisis, central banks should 'lend freely, against good collateral, at a high interest rate'," says Metrick. "That's a great start but, in addition to lending, there are many things central banks can do to avert catastrophe—capital injections, guarantees, and debt moratoriums, to name a few. A good response to a modern financial crisis needs to consider the full set of available options."

"Even if regulators *could* bring the probability of a future financial crisis to zero, it wouldn't be optimal to do so... Prevention is important but central banks need to prepare for when the next crisis inevitably comes."

—Andrew Metrick, Yale University

British economist Walter Bagehot, the namesake of Andrew Metrick's "New Bagehot Project", coined the mantra for fighting financial crises in his 1873 book *Lombard Street*. Metrick's New Bagehot Project offers a comprehensive set of potential interventions for fighting modern financial crises.

The New Bagehot Project's case studies illustrate the tools of financial crisis response in action, offering a comprehensive set of potential interventions that Metrick says could help policymakers craft their response to the next crisis. By familiarizing themselves with case studies in non-crisis times, Metrick hopes that central bankers will be adept at navigating the New Bagehot Project so they can rapidly create informed policy briefs and sensible response plans when the next crisis comes.

Metrick is also training the next generation of global financial regulators at the Systemic Risk Institute, a six-month program of monthly remote workshops culminating in a one-week forum held at Yale. It's the latest iteration of a Sloan-supported summer school that educates rising stars from central banks around the world. Past speakers at the Institute include financial heavyweights like Ben Bernanke, Tim Geithner, and Hank Paulson, who gave an insiders' retrospective on their response to 2008.

As well as hearing from prominent economists, participants at the Institute take part in simulations of hypothetical financial crises and strategize crisis interventions informed by the New Bagehot Project's case studies. Upcoming simulations include scenarios involving cybersecurity, cryptocurrency, and the climate. Metrick says financial crises share a common underlying structure and that simulations are designed to help central bankers develop a "mindset" rather than preparing for one particular scenario.

"In the coming years, the Yale Program on Financial Stability will continue building bridges between academic and regulatory communities," says Metrick. "Through these collaborations we will spur economics research, strengthen international networks, and ensure the next generation of financial regulators is equipped with the tools they need to best fight future financial crises."

The Systemic Risk Institute at Yale University often features important stakeholders from the U.S. regulatory community, including former Federal Reserve chairman Ben Bernanke, former Treasury Secretary Timothy Geithner, and former Treasury Secretary Hank Paulson, pictured here at a 2018 event in Washington D.C.

Bringing STEM up to Code

The history of 21st century science will be written in code. How will scientists learn to write it?

Advances in computation are rapidly expanding the scientific toolbox, and modern science now requires understanding a new set of tools for working in sophisticated ways with software and data. The twenty-first century chemist needs to know not only chemistry, but how to debug code, how to manage large datasets, and which programming languages are best suited to which tasks.

Ideally, these skills would be taught by academic departments. But the reality is many simply don't have the resources to cover everything, meaning graduate students and other researchers often have to attend expensive coding bootcamps for weeks or months at a time—if, indeed, they're lucky enough to be able to attend such a bootcamp. The Carpentries, a not-for-profit organization based in California, is developing a faster, more inclusive way of equipping the modern scientist with the tools they need.

"We teach software engineering and data science skills to researchers through two-day workshops led by a grassroots community of volunteers," says Kari L. Jordan, Executive Director at The Carpentries. "We're building global capacity in these essential skills to enable great research and using workshops to train participants how to teach their own communities."

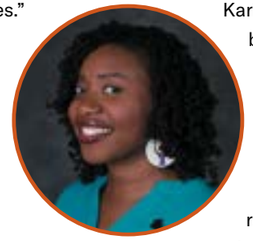
Carpentries workshops teach foundational skills in popular programming languages like Python, open-source data analysis packages like R, and software development systems like Git. The organization also runs a certification program that provides a path for interested volunteers to become instructors themselves, transforming them into a permanent training resource on their campuses. Since its beginnings, and with ongoing support from the Alfred P. Sloan Foundation since 2011, The Carpentries has grown into a network that now boasts 3400 certified instructors who ran, in 2021 alone, more than 300 training workshops across the globe. Jordan estimates that, all told, Carpentries workshops have reached more than 74,000 researchers.

One of those researchers is Samniqueka Halsey, a computational ecologist at the University of Missouri who started facilitating Carpentries workshops in 2017 before becoming a certified instructor. "When I taught myself how to code, it took me two weeks to learn how to import a dataset into R. In a Carpentries workshop, we teach people how to do that in five minutes." Halsey teaches her department's flagship statistics course using the skills she developed in the Carpentries instructor training program. Her students participate in coding sessions to make sure they understand key concepts before working on individual datasets for coursework assignments. "We're clearly meeting an enormous need because every workshop we announce quickly fills up." she says. "In STEM, these skills are simply not optional anymore."

"When I taught myself how to code, it took me two weeks to learn how to import a dataset into R. In a Carpentries workshop, we teach people how to do that in five minutes."

—Samniqueka Halsey, University of Missouri

It's not just her graduate students who are learning invaluable data and coding skills. Halsey also piloted a summer program for high school students, spreading the material from a two-day Carpentries workshop over eight weeks, and extending the impact of The Carpentries' training. "Many of my undergraduate students end up taking jobs with state agencies, which are still using software like Excel to perform tasks that are better suited to Python and R. They're bringing much-needed skills into the public sector—and they're helping modernize America."



Kari L. Jordan

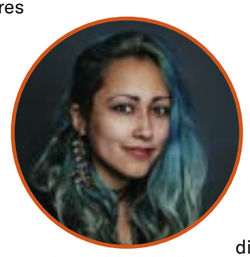
Kari L. Jordan says such impacts are just the beginning. "We want The Carpentries to be the world's leading community of data and coding teachers," she says. "By addressing a fundamental digital skills gap in how researchers conduct their work, we're making sure that modern scientific research is efficient, open, reproducible, and fully inclusive."

All That Glitters

Fang Du, Max Gordon Moore, Ruibo Qian, Gillian Saker, Michael C. Liu

A new play by Anchuli Felicia King asks hard questions about the responsibilities we bear when technology developed in the West ends up in the hands of authoritarians.

Premiering in 2022 at New York's Manhattan Theatre Club, *Golden Shield* explores censorship, surveillance, and accountability. Written by Anchuli Felicia King, the play was developed through the Alfred P. Sloan Foundation's Theater program, which encourages emerging and established playwrights to explore scientific and technological themes in their work. In *Golden Shield*, King tells a tale inspired by the compelling true story of thirteen Chinese dissidents who filed lawsuits against two American companies—Yahoo in 2007 and Cisco in 2011—for helping Chinese authorities build technologies to identify and crush political dissent.



Anchuli Felicia King

What first gripped you about this story?

As a playwright, I'm interested in themes surrounding globalization. Our interconnected global society is in many ways shaped by the decisions of multinational corporations like the firms on which the play is based, so these themes have immediate relevance to audiences. As for the story—about a group of Chinese dissidents mounting a human rights abuse case against an American tech conglomerate—I was gripped from the moment I first read about it. I'd never heard of such a case, and it's fascinating from a legal, geopolitical, and technological perspective. I began researching the involvement of multinational corporations in creating China's 'Great Firewall' and developed the script from there.

Cindy Cheung

What was your creative process in writing the play?

Plays like this require reams of research. For me, writing is an iterative process of reading as much as I can, then sitting at my keyboard and transforming that disconnected research into a story. Artistically, the biggest challenge was turning a dry legal case into something an audience would want to watch, something emotionally compelling and narratively cogent. Politically, there was also the challenge of doing justice to the story—and the real lives involved in the case—without creating problems for the people involved. Thankfully, I'm in the company of talented playwrights who have written politically challenging work who are always generous in their counsel.

What makes this particular story suited to the stage?

The power of storytelling in the theater is its emotional immediacy. When you have an audience sat together in the same space at the same time, it's easy to convey to them the human impacts of what they're witnessing, which is particularly relevant to a story following a human rights abuse case. Experiencing something together generates collective empathy and allows the audience to grapple with the issues they're confronted with in real time. For *Golden Shield*, this heightened empathy allows audiences to feel what the characters are experiencing—and ultimately understand that people everywhere want the same basic freedoms.

What impacts do you hope to have on your audience?

That in some ways we're all complicit. As consumers, we're all indirectly indicted in the oppression of people we'll never meet. The play drives home the message that we are not neutral consumers—such a thing doesn't exist. For people working at multinational corporations, like the firms involved in this legal case, the play illustrates how even small cogs in large machines can impact somebody, somewhere. I hope that the play encourages people to become conscientious global citizens, to acknowledge the power that we have in our globalized, digitized economy, and to have greater empathy for the people impacted by our actions.

"I hope that the play encourages people to become conscientious global citizens, to acknowledge the power that we have in our globalized, digitized economy, and to have greater empathy for the people impacted by our actions."

—Anchuli Felicia King

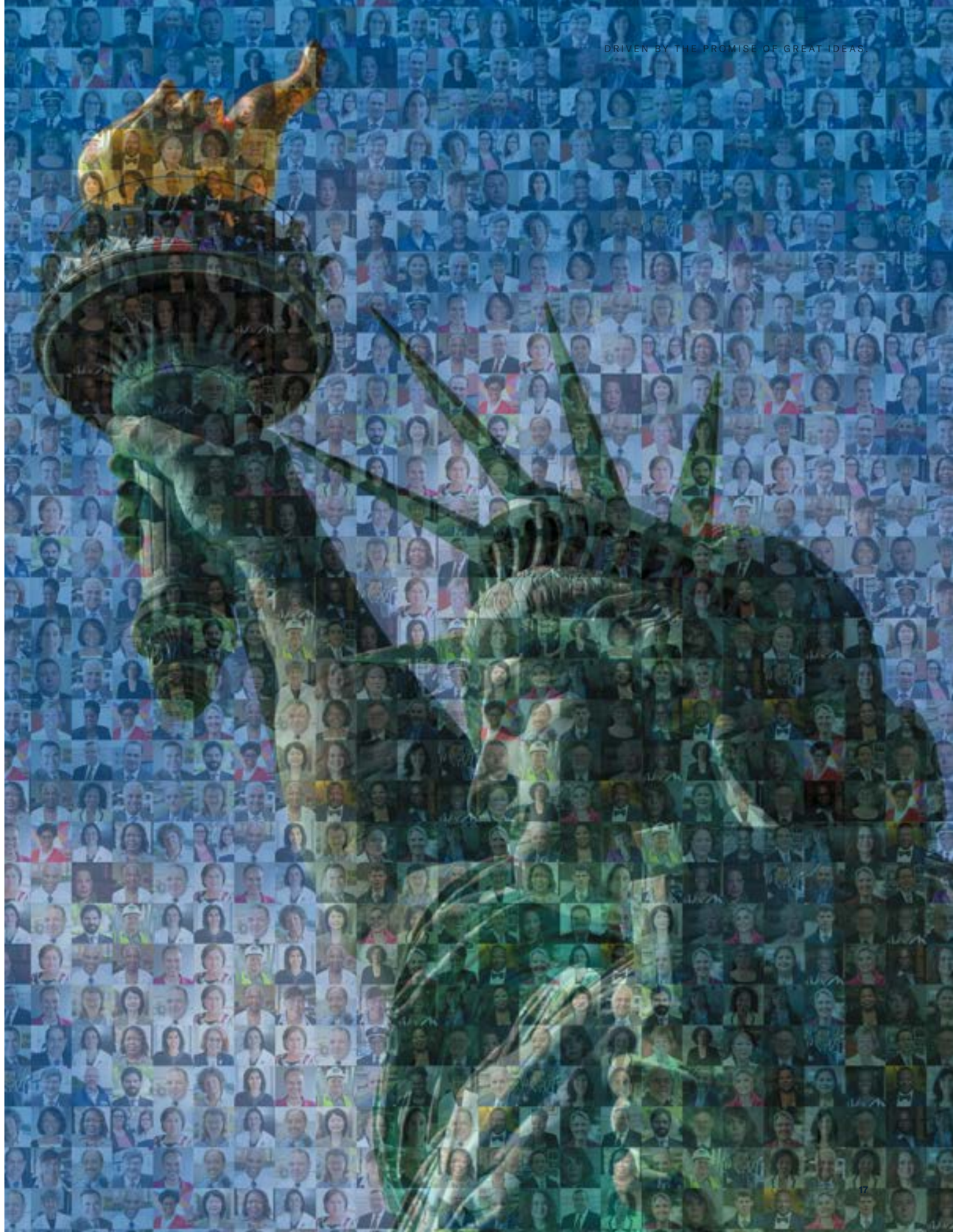
What's next for you—and for *Golden Shield*?

As a writer, I see every project as a fresh opportunity to hone my craft, and to ask myself how I can enlighten my audience more. Ideally, I'll find ways of being more comprehensive and conscientious in my writing, to make sure that I'm always improving. As for the play, theater is necessarily ephemeral. Every night in the house is different, and every production exists in its own unique moment. Each production responds to that moment, then it disappears. That's what makes theater beautiful. I hope that at some point the messages expressed in *Golden Shield* feel dated. Because that would mean that, as a society, we've achieved meaningful moral and ethical progress.

Kristen Hung, Michael C. Liu, Ruibo Qian, Gillian Saker, and Cindy Cheung

The Nobel Prize of Public Service

For almost 50 years, one organization has been honoring the unheralded heroes of the nation's largest city: the public servants that make New York City run.



Since 1973, the Sloan Public Service Awards have honored the extraordinary contributions of New York City's civil servants. Aldrin Rafael Bonilla, Executive Vice President of the Fund for the City of New York, which founded and since 1985 has administered the awards with Sloan support, explains the importance of celebrating public service.

Why do you think it's important to honor public service?
Without the hard work and dedication of civil servants, New York City—and the United States—simply wouldn't function. Everything we interact with is in some way connected to public service, whether it's visible infrastructure like our streets and libraries, or the invisible infrastructure protecting our water and managing our waste. Civil servants create a seamless living experience for New Yorkers and visitors, and they often display enormous courage and creativity in delivering vital city services. So much of what they do is taken for granted, but that shouldn't be the case. That's why we continue to acknowledge and honor their extraordinary contributions that keep our city running smoothly.

How do the Sloan Public Service Awards do that?
Every year we honor six civil servants who display extraordinary dedication to their work with a monetary prize and an award ceremony. While the prize is a gesture of our appreciation, the recognition itself is at the heart of the honor we bestow. We like to think of the Award as the "Nobel Prize of Public Service"—and every year the achievements of our winners are celebrated across multiple media outlets. We try to make sure we include city employees from all agencies and pay particular attention to mid-level staff who may not think anyone is taking notice of their work.

"Without the hard work and dedication of civil servants, New York City—and the United States—simply wouldn't function."

—Aldrin Rafael Bonilla

What are the biggest challenges associated with the Awards?
New York City is arguably the greatest city in the world. And it's by far the largest and most densely populated city in the United States. We have around 325,000 public servants—that's more people than a medium-sized city like Orlando or Pittsburgh—and we select just six winners! That's a massive challenge when you consider how many civil servants are making outstanding contributions, but honorees are representative of their agencies' excellence. It can also be tough to find a way of recognizing individuals within agencies that are going through challenging times. Then, there's the fact that some of our unsung heroes like to stay unsung—being in the spotlight can be overwhelming.

Are there any particularly memorable winners?
I'm a New Yorker, born and raised. Since the Awards started in 1973, our city has lived through some extraordinarily difficult times—the 1975 fiscal crisis, the September 11 attacks, extreme weather events, and the coronavirus pandemic, to name just a few. Through each of these challenging times, the city stood strong and emerged even stronger, thanks in large part to the dedication of our civil servants. Over the years, the Awards have honored a number of the individuals and agencies who endured great trauma and pain through awful circumstances to help the city get back on its feet.

What's the future of public service in New York City?
If history tells us anything, it's that we're going to have unpredictable challenges waiting for us, and we'll need talented civil servants to overcome them. We'll continue to honor and recognize the achievements of all our agencies, large and small. One thing we're thinking about is how we adapt to shifting career preferences. Nowadays, it's less common for someone to give 30 years of service to a single agency, so we need to think creatively about how we recognize excellence in shorter timeframes than we have in the past—so we can continue to encourage and inspire our city's civil servants for the next 50 years. We hope these awards serve to amplify the noble calling of public service.

Learn more about the Sloan Public Service Awards—and the winners—on the Fund for the City of New York's website: fcny.org/awardees

The Faces of Public Service

These are just four of the hundreds of extraordinary New York City public servants honored over the past 50 years with a Sloan Public Service Award. To learn more about the awards and the heroic contributions made by winners, visit the Fund for the City of New York website at fcny.org.

Karen Armstrong

Assistant Commissioner, Queens Adult Services

Department of Probation

Karen Armstrong joined the Department of Probation in 1989 as a probation officer trainee. She now leads a team of 140 who are responsible for 8,000 New Yorkers on probation in Queens. Prior to assuming her position, Armstrong held the same job in Brooklyn, where she started three model programs that connected probation clients to community organizations, government agencies, local businesses, and residents, programs founded on her conviction that probation clients do best when they are supported through meaningful relationships in their community. These programs were so effective that when Armstrong left, Brooklyn led the city in the number of clients who achieved early release from parole for model behavior. Said one colleague, “She makes one of the most difficult jobs look effortless. She never stops working for our clients.”

Joseph Marcellino

Associate Director of Emergency Management

Coney Island Hospital

A nationally recognized authority on public health emergency preparedness, Joseph Marcellino is the guy who expects the unexpected at Coney Island Hospital. When Hurricane Sandy hit in 2012, the hospital flooded, the electricity system failed, and a fire broke out on the hospital campus. Mr. Marcellino oversaw the safe and smooth evacuation of all 250 patients, each with an evacuation kit complete with personal information, diagnoses of medical conditions, and medications. While the hospital was out of operation for six months, Mr. Marcellino helped establish urgent care centers and a pharmacy in south Brooklyn as the hospital worked toward reopening. Dr. Mark Kindschuh, Chairman of Emergency Medicine said, “Our emergency room cannot function without him. We rely on him for large-scale emergencies and for smaller ones like flu surges or multiple-injury car accidents. He saves lives, pure and simple.”

John Gallagher

Deputy Warden in Command, Population/Custody Management

NYC Department of Corrections

In 1989, John Gallagher was assigned to Rikers Island as a rookie Correction Officer. Thirty years later, he is an undisputed leader and fierce advocate for the humane, effective treatment of inmates with mental illness. Due to his efforts, seven jails on Rikers Island now have mental health units which provide support to inmates and serve as a humane alternative to solitary confinement. Over 600 officers have received crisis intervention training on how to deescalate situations involving inmates with mental health issues. Said Commissioner Cynthia Brann, “John Gallagher has been instrumental in evolving the way corrections is practiced in NYC’s jail system, which now serves as a national model for the treatment of mental illness in a correctional setting. The humanity, compassion, and creative thinking John displays embody the very best qualities in a public servant.”

Vilma Raquel Daza

Community Library Manager

Corona Branch, Queens Public Library

Vilma Daza and her staff of 9 full-time employees serve over 18,000 library patrons at the Corona Branch Library each month, making it the busiest library per square foot in all of Queens. As an immigrant to New York from Peru, Daza knows firsthand what an important lifeline a library can be and she has made the Library “the central educational and resource hub of Corona.” Residents line up around the block to register for a wide array of classes; in the summer, programs are offered outdoors in the plaza; and Daza and staff volunteer their time to keep the library open in the morning and evening, beyond regular hours. A colleague notes, “I’ve been working in the Queens Library system for 30 years. I have never met a more passionate, driven, and dedicated individual.”

Neighborhood Watch

The answers to some of the most pressing questions in astronomy may lie locked in the stars and nebulas of our own galaxy. Meet the astronomers who are building the key to that lock in the wilds of the Chilean desert.

A new instrument is joining the fleet at the Las Campanas Observatory in Chile's Atacama Desert. It will map our neighboring galaxies—including those only visible from the southern hemisphere—on a larger scale than ever before. This galactic cartographer, called the Local Volume Mapper, is the latest addition to the Sloan Digital Sky Survey (SDSS), which has been supported by the Alfred P. Sloan Foundation for over 30 years.

The Local Volume Mapper consists of four small telescopes and three optical spectrographs that separate light into its component wavelengths. Together, the equipment will measure the light emitted from the gas and dust between stars in our galaxy, the Milky Way, and nearby galaxies. The telescopes that comprise the Local Volume Mapper are small by modern standards, but the spectrographs they feed light into are extremely sensitive, offering researchers a high-resolution view of nearby star formation and the structure of the interstellar medium. Astronomers around the world will analyze the spectrograph data to learn about the physical properties of nearby galaxies and nebulae, such as their composition, temperature, and velocity.

Solange Ramirez

"The Local Volume Mapper is designed to do a different kind of science," says Solange Ramirez, an astronomer and astrophysicist who serves as SDSS Project Manager at Carnegie Observatories. "Most of astronomy has focused on detecting particular objects, like distant stars. For that, you need a large telescope," Ramirez says. But that is not the case for looking at nearby cosmic features. To map neighboring galaxies and their interstellar media—the extended gas between stars—smaller telescopes will suffice. Astronomers will be able to visualize individual star formation knots and the structures and networks between them.

The Local Volume Mapper will allow scientists to study star formation in stellar nurseries like this one, known as N159. It's located over 160,000 light years away in one of the Milky Way's satellite galaxies, the Large Magellanic Cloud. Hot young stars in N159 emit ultraviolet light, which causes nearby hydrogen gas to glow.

"Chile is home to many talented scientists, and I'm excited to see their contributions to and insights from this incredible trove of data."

—Amelia Stutz

The Local Volume Mapper will connect studies operating at different scales, from relatively small molecular clouds to those exploring entire galaxies. By observing the cosmic features of the Milky Way and nearby galaxies, the Local Volume Mapper will help scientists understand underlying principles about the physics affecting star formation, the structure of the interstellar medium, and galactic evolution.

The Sloan Foundation Telescope at Apache Point Observatory, New Mexico.

Ultimately, the findings will offer new insights into star formation and the role of other stars on this process throughout the stellar lifecycle. "Clouds collapse and become so dense in certain areas that stars form. These stars then affect their natal environment, heating the dense gas that surrounds them. When a star dies, it releases gas back into the interstellar medium, where clouds form once again. Then the cycle repeats," Ramirez says. "Stars are born from the material of this cloud." The Local Volume Mapper will provide a view into these intricate feedback mechanisms on multiple physical scales.

The Atacama Desert, where Las Campanas Observatory is located, has some of the clearest night skies in the world. In exchange for Chile sharing its spectacular view of the cosmos with the global astronomy community, Chilean astronomers will have full access to SDSS data before it's made public. "Chile is home to many talented scientists, and I'm excited to see their contributions to and insights from this incredible trove of data," says Amelia Stutz, an astronomer at the Universidad de Concepción in Chile, one of the many Chilean institutions partnering with SDSS in its latest venture.

Taking a wide view of nearby star formation, the astronomers working with Local Volume Mapper data will contribute to a map of our sliver of space. But the implications extend far beyond our galactic neighborhood. The physical structures and underlying principles at play close by are likely replicated throughout the universe, and the Local Volume Mapper offers a window into the physics of galaxy evolution writ large.

Critical Mass

At the nation's largest gathering of underrepresented scholars one thing is undeniable. The future of academic scholarship is not going to look like the past.

Getting a Ph.D. can be a lonely, isolating experience. Heavy workloads leave little time for friends and family and the rigors of study routinely require long hours spent alone in the library or the lab. This isolation is particularly acute for students from underrepresented groups, where it is not uncommon, particularly in the sciences, for a scholar to be the only Black, Indigenous or Latina/o/x student in their department.

For almost thirty years, the Southern Regional Education Board (SREB) Institute on Teaching and Mentoring has served as the largest and most respected gathering of Black, Indigenous, and Latina/o/x scholars in the country, where it provides critical support to students seeking careers in academia and delivers a welcome antidote to the isolation that can make graduate study so challenging. From just 107 attendees at the first Institute in 1994, this year's four-day event in Atlanta welcomed nearly 1000 for the first in-person conference since the pandemic began.

"We all missed the synergies and inspiration being in person provides, which is a huge part of the value the Institute brings," says Ansley Abraham, director of SREB's State Doctoral Scholars Program, who organizes the event. "It offers a safe and unique forum for underrepresented scholars to develop essential skills, build professional networks, and learn strategies that help them survive the rigors of graduate study—and ultimately transition into the academy as successful members of the professoriate."

The Alfred P. Sloan Foundation is one of the many organizations providing financial support for students attending the event. The nearly 500 attendees supported by the Sloan Foundation, known as Sloan Scholars, are all students from the Foundation's University Centers of Exemplary Mentoring (UCEMs) and the Sloan Indigenous Graduate Partnership (SIGP), two university-based initiatives that collectively seek to recruit, train, and graduate greater numbers of students

Sloan Scholars, faculty and staff gather at the 2022 Institute on Teaching and Mentoring in Atlanta, Georgia.

Two Sloan Scholars from the University of South Florida participate in the Institute's graduation ceremony, which honors and celebrates scholars who recently completed their Ph.D. Dr. Michelle Henderson (left) is now a postdoctoral fellow at the University of South Florida and Dr. Andrea Wright (right) is now a cyber research engineer with the Office of Naval Research.

from underrepresented groups. Each student receives funding that allows them to attend at least two Institutes during their graduate study. Throughout the event, the Sloan Foundation facilitates sessions for Sloan Scholars, faculty, and staff, while the Sloan Scholars Mentoring Network hosts a concurrent bootcamp for recent graduates on the path to the professoriate.

Over four days, participants attended sessions designed to bolster their careers at every step of their journey, including "Transitioning from Historically Black Colleges and Universities to Predominantly White Institutions", "How to thrive when you're the only [blank] in your department", and "Battling Imposter Syndrome". The Institute carefully crafts its workshops to address important topics that are rarely covered in graduate school training, to make sure its scholars are well-positioned to succeed.

With three decades of experience, it's a time-tested approach—and it's working. According to research funded by the National Science Foundation, alumni of the Institute are significantly more likely than the wider pool of American doctorates to hold employment at a four-year college or university. Black and women alumni, in particular, are significantly more likely than their non-Institute peers to hold positions in basic research and faculty positions—the primary focus of STEM graduate training programs.

"We know that community is so important, and we know that the Institute plays a critical role in bringing this community together."

—Ansley Abraham

One scholar remarked, "It's a really powerful experience being in a room with so many Ph.D.s of color from so many disciplines—it's encouraging to hear from people who look like you." Another, meanwhile, commented "Seeing so many Black, Hispanic, and Indigenous faces in these high-level academic and intellectual spaces makes it feel like it's possible for me, too."

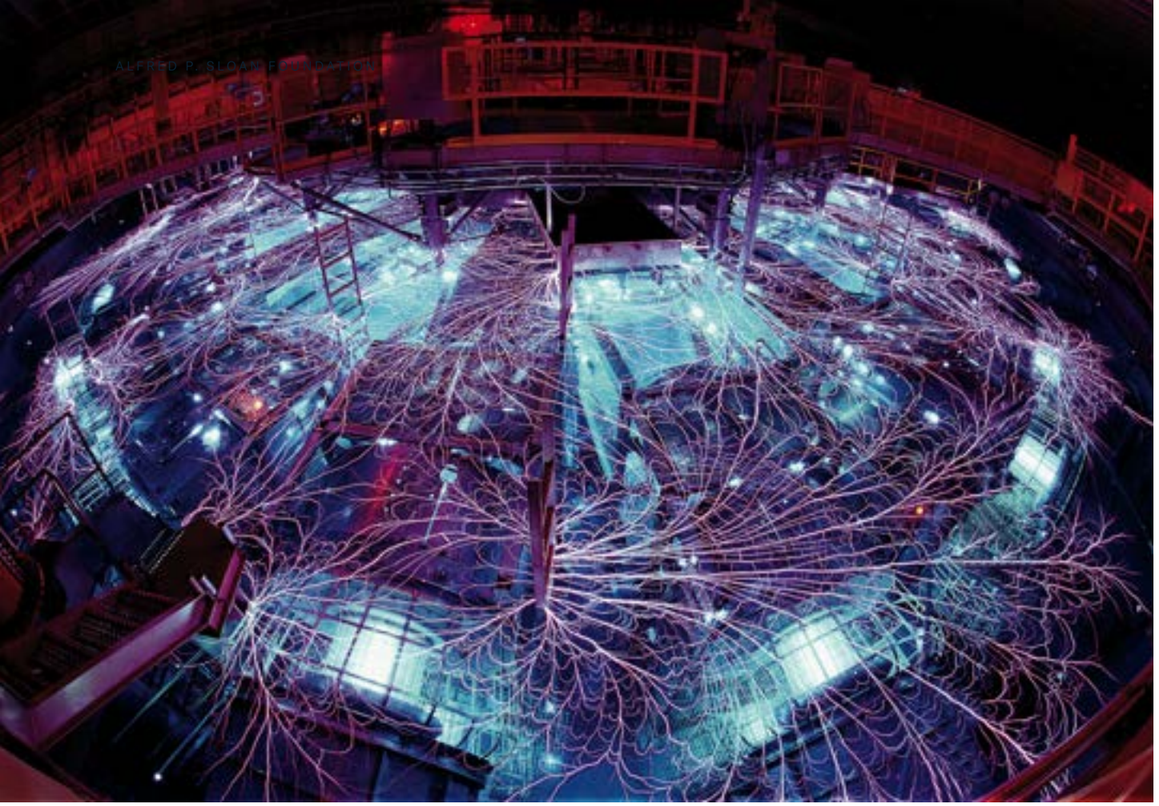
One highlight of the Institute is its graduates' awards banquet, a formal celebration of graduating doctoral scholars—including, this year, those who graduated during the pandemic. The banquet is an important milestone allowing new graduates to reflect as they enter the next chapter of their careers—and a reminder to all attendees that they are part of a talented, supportive, and growing community. One student described witnessing this joyous moment as "the gasoline I needed to finish my thesis".

"We know that community is so important, and we know that the Institute plays a critical role in bringing this community together," says Abraham. "As we approach our thirtieth year, we're paying close attention to how the academy is evolving, so that we can continue to provide this community with the kinds of professional development it needs to flourish."

The 2023 Institute on Teaching and Mentoring will take place in Tampa, Florida, on October 26-29. To find out more, visit sreb.org/institute-teaching-and-mentoring

Dead Air

The key to discovering extrasolar life may hide in an unlikely place: the atmospheres of cold, rocky planets where no living thing could survive.



The Z Pulsed Power Facility at Sandia National Laboratories in Albuquerque, New Mexico. Shahar's team is using "Z"—the largest high frequency electromagnetic wave generator in the world—to understand how volatile substances travel between the interior, surface, and atmosphere during a planet's formation, and how the presence of different starting ingredients can create wildly different planets billions of years later.

The first planet outside our solar system was discovered in 1992. In the thirty years since, exoplanet discovery has been a booming business—astronomers have confirmed more than five thousand in our galaxy alone. This large and growing catalog of extrasolar planets has reopened the enticing possibility that science may be on the verge of answering a mystery as old as astronomy itself—is there life out there? Are we not alone in the universe?

Anat Shahar, a geochemist at the Carnegie Institution for Science, is trying to figure that out. With funding from the Alfred P. Sloan Foundation's new Matter-to-Life program, she's leading a team that's studying the physical and chemical processes that prepare a planet to give rise to biology and, therefore, to an exoplanet's potential to sustain extraterrestrial life.

"We think we know what makes life on Earth possible," Shahar says. "Liquid water is essential for chemical reactions in living things, a magnetic field protects us from the sun's radiation, and plate tectonics cycles crucial nutrients and stabilizes the climate. It's highly likely that a life-sustaining exoplanet will share these important features."

The problem with those life-sustaining features is that they're not visible. Astronomers can't directly see liquid water or plate tectonics on faraway exoplanets, and they can't infer the presence of life on an exoplanet simply based on its size, its density, or its distance to its star. The missing ingredient, Shahar says, is the atmosphere.

"An exoplanet's atmosphere is the best proxy for life," Shahar says. "It's a window into a planet's origins and what's happening on its surface and interior. The atmosphere allows us to track a planet's evolution—from its formation to the point when it's able to sustain life—and might offer clues about whether there's life out there."

"The atmosphere allows us to track a planet's evolution—from its formation to the point when it's able to sustain life—and might offer clues about whether there's life out there."

—Anat Shahar

Ironically, Shahar's search for life is beginning with the study of lifelessness. Her team is investigating the atmospheres of sub-Neptune (smaller than Neptune) rocky planets. They're the most common planets in our galaxy and they share many features with Earth. By combining telescope observations with computer simulations and laboratory experiments, the team hopes to define the general atmospheric signatures of a lifeless planet, known as "abiotic signatures". Then any planets with "biotic signatures"—atmospheres deviating from this baseline—might be capable of sustaining life.

It's an intricate web of inquiry combining experts from many disciplines. For starters, a team of astronomers is figuring out the gases that are present in exoplanet atmospheres. When an exoplanet passes its star, different atmospheric gases filter the light entering the team's telescopes at specific wavelengths, which they can detect with absorption spectroscopy. They can infer the presence of, say, water vapor and carbon dioxide. The idea is to determine whether life is a possibility based on the composition of gases that are observed.

These observations are fed to a team of modelers, who run simulations including sophisticated variables that affect the absorption spectra—like clouds, which affect the scattering of light—to validate the interpretation of what the astronomers are seeing. The modelers are also running simulations looking at critical aspects of exoplanet evolution, events that were also essential to the evolution of Earth, like asteroid collisions and crystallization of the magma ocean.

Some of the models are then brought to life using high-temperature, high-pressure experiments—the team has in its arsenal a hydraulic press capable of squishing samples into a tiny ball mimicking the intensity of a planetary interior, and access to a pulsed power facility that jolts reactants with electricity 1000 times the strength of a lightning bolt. These experiments help the team understand how volatile substances travel between the interior, surface, and atmosphere during a planet's formation, and how the presence of different starting ingredients can create very different planets billions of years later.

"The success of this project, and the future of science, depends on interdisciplinary teams of talented researchers who can combine expertise across disciplines," Shahar says. "I am incredibly excited about the work this team is doing. By embracing new ways of thinking and bridging scientific fields, we hope to bring us a step closer to finding out if there's life on other planets."

Plague Prejudice

When a 14th-century plague strikes a 20th-century city, the results have much to say about how science can fail us, and how we can fail science.

The bubonic plague is mostly known as a Medieval health disaster. When the Black Death swept across the world, it claimed some 50 million lives, making it one of the deadliest pandemics in recorded history. But the culprit, a menacing bacteria called *Yersinia pestis*, didn't stop wreaking havoc in 14th century Europe. At the turn of the 20th century, cargo ships from China brought this unwelcome guest to America's West Coast—and with it, an outbreak of plague that terrorized the residents of San Francisco.

That outbreak is the subject of a 2022 PBS *American Experience* documentary, *Plague at the Golden Gate*, directed by Lishin Yu. The documentary was produced through the Alfred P. Sloan Foundation's Television program, which for two decades has been partnering with *American Experience* to help tell compelling stories about the role of science and technology in American history. *Plague* is by turns a detective story, a political drama, and a cautionary tale about how bias and panic can blind even well-intentioned and purportedly objective scientists.

The city's first plague case was discovered in Chinatown, which led people—including the city's public health experts, headed by a doctor named Joseph Kinyoun—to erroneously conclude that the plague was a disease affecting only Chinese people. Kinyoun's prescriptions for stopping the outbreak were harsh and uncompromising and, Yu makes clear, likely influenced by the fact that the worst of the burdens would fall on San Francisco's politically disempowered Chinese community.

"Kinyoun was this brilliant hard science guy who refused to be deterred by political pushback," says Yu, "no matter how he was painted by the press."

During Kinyoun's tenure as head of San Francisco's Marine Health Service, authorities attempted to contain the plague outbreak with forced quarantines and the burning of businesses and homes, policies that applied almost exclusively to Chinese residents. By weaving historical maps of Chinatown with personal records describing individual plague cases, Yu's team was able to create powerful digital animations that clearly demonstrate the impossibility of plague being confined to

A selection of historical images taken in San Francisco's Chinatown at the turn of the 20th century, depicting everyday life and plague eradication efforts.

"History is important. It offers us a time to reflect, to understand how we got here—so we may learn from the past and move forward forthrightly."

—Lishin Yu

the Chinese community and the absurdity of quarantine boundaries that stratified residents along racial lines.

When a scandal later forced Kinyoun from office, and with the disease still raging, public health efforts were placed in the hands Dr. Rupert Blue, a physician who held a markedly different perspective from his predecessor. "Blue barely made it through medical school," says Yu. "But he had something Kinyoun lacked—social skills."

Blue viewed it as essential to enlist the local Chinese community in the fight against the plague. Partnering with a local man named Wong Chung, his translator, cultural liaison, and eventual friend, Blue established a laboratory inside Chinatown itself which became his beachhead for developing deep relationships and fostering trust with Chinese residents. That trust became the foundation of a community-aided rat eradication program that eventually brought the outbreak to an end.

"By working *with* the Chinese community, it was Blue who ultimately stopped the plague and saved the city," says Yu. "Building trust was integral to our filmmaking, too. Through community networking, we gained access to two San Francisco Chinatown locations, where filming rights were secured for the first time ever. We developed relationships with the descendants of the residents who suffered under plague policies—many who generously granted us materials that strengthened the story in unexpected ways."

The story of the San Francisco plague has powerful lessons to teach about the corrosive effects of bigotry and the power of trust in bringing prejudice—and plague—to an end. Yu hopes that showcasing this history will allow society to avoid repeating past mistakes.

"In this particular outbreak, we got lucky. The main reason why there wasn't an explosion in cases while officials wasted their time on counterproductive race-based policies is basically down to a quirk in flea anatomy—this species only regurgitates a small amount of plague-causing bacteria when it bites. Next time, we might not be so lucky. That's why history is important. It offers us a time to reflect, to understand how we got here—so we may learn from the past and move forward forthrightly."

***Plague at the Golden Gate* can be streamed for free at the American Experience website: pbs.org/wgbh/americanexperience**

Burn Notice

As wildfires rage on our warming planet, one researcher is focused on protecting an undervalued asset: the subterranean infrastructure that makes civilization possible.

We tend to think of wildfires as surface phenomena—a natural thought, considering that's where they start. It's on Earth's surface where the destruction wrought by wildfires is most visible, where flames rage uncontrolled, burning forests and destroying homes. Yet those are only a wildfire's most visible victims. Their intense heat—temperatures regularly reach 1,400° F—can penetrate deep underground, threatening critical infrastructure like water pipes and electrical wires.

Erica Fischer

"A lot of our infrastructure wasn't built with wildfires in mind. Extreme heat can damage plastic water pipes, causing them to leach carcinogenic molecules into our drinking water," says Erica Fischer, a civil engineer at Oregon State University. "During a wildfire, large demands on the water distribution system can also cause depressurization, sucking harmful soot and ash into the pipes. With one in three Americans living in a wildland urban interface community, this is a major public health concern."

Erica Fischer, a civil engineer at Oregon State University, tests drinking water for the presence of carcinogenic molecules. By exposing pipes to extreme heat, Fischer's team is able to simulate the impact of wildfires on critical infrastructure and develop new sensor technologies to improve disaster recovery efforts.

For Fischer, this effort is ultimately about providing communities with access to critical information that will help them make the best decisions in the wake of a disaster.

Fischer is leading an Alfred P. Sloan Foundation-supported team building new technologies to improve wildfire recovery efforts. They're developing two sensors that can be attached to pipes at various points along critical water distribution and energy systems infrastructure. These sensors—a scannable radio-frequency identification chip and a temperature-sensitive color-changing patch—can reveal whether a pipe has been exposed to extreme temperatures, and thus whether water flowing through it may not be safe to drink. They are also expected to have a variety of applications in monitoring underground energy infrastructure like electricity lines.

The team has already tested different pipe materials in a variety of environmental conditions to understand how hot the pipes can get before they become compromised, generating threshold values to calibrate their sensors. The next step is to see if those sensors can survive underground—pipelines are only replaced every few decades, so the sensors can't be easily replaced, and they also need to withstand seasonal fluctuations in temperature and moisture.

The team's next experiment involves burying their sensors with pipes made of commonly-used materials like plastic and copper to see if they have what it takes to survive in the wild. Eventually, the sensors could be integrated with other remote sensing data to inform communities about the extent of damage following a wildfire. "If we are successful, our sensors have the potential to be deployed to measure all kinds of energy system resiliency in the wake of wildfires," Fischer says.

Fischer's team is collaborating with agencies performing large-scale fire tests, including the National Institute of Standards and Technology and the California Department of Forestry and Fire Protection, to discern the composition of soot and ash that can get sucked into damaged pipes. They're also working with communities living in high-risk areas to understand how they can deploy the sensors as part of their routine pipeline maintenance—an important way of keeping adoption costs as low as possible.

"We're working with communities because it's important to know what government agencies can realistically do in a crisis. Some of the wildfire affected communities have water districts that rely on volunteers, so our recommendations have to make sense to that type of organizational structure," says Fischer. "Traditionally, socially vulnerable communities are the most affected communities. These communities are also among the least likely to complain about their situation after a wildfire, so these collaborations also help bring equity to wildfire recovery efforts."

For Fischer, this effort is ultimately about providing communities with access to critical information that will help them make the best decisions in the wake of a disaster. She hopes that her team's new sensors will provide that information, improving the resilience of communities and helping them return to their normal lives as quickly as possible.

Meet the Fellows

Since 1955, the Sloan Research Fellowships have honored the very best young scientists at a pivotal stage in their careers. Here are just a few of the 118 extraordinary researchers that make up the 2022 class of Sloan Research Fellows.

Natalie Bau

Economics

Never take your eye off incentives

Parents invest in their children: they feed them, they teach them, they send them to school, often at great cost to themselves. Across cultures, however, this investment varies significantly. Natalie Bau is an economist with a partial explanation as to why: parents respond to investment returns. It's admittedly a rather cold explanation for something so warm as familial dynamics, but Bau is building a compelling case.

Her work has shown that cultures where children support their parents in old age see more parental investment, and that this investment drops when these societies introduce pension plans giving parents independent financial security. Similarly, Bau has shown that cultures where educated daughters fetch higher dowry-style payments on the marriage market—and, importantly, where parents get a cut of the action—see correspondingly higher parental investment in their daughters' education. Bau's work is part of a larger effort to understand how incentive structures drive human capital investment, and has implications for policymakers interested in building skilled workforces.

Mark Levin

Chemistry

Introducing chemistry's methodological optimizer

The design of new molecules, from pharmaceuticals to pesticides, takes many iterations of a painstaking process called molecular optimization, where small changes are made to the molecule in the attempt to fine-tune its properties. The process is essential—adding or subtracting a single atom can have profound effects—but it's also time-consuming and expensive. Each change requires the synthesis of a completely new batch of molecules from scratch to test out.

Mark Levin is a chemist who is making a name for himself as an optimization optimizer. His work focuses on making the molecular optimization process more efficient, less expensive, and faster. Rather than synthesizing entirely new batches of molecules, Levin has developed a technique for inserting and deleting single atoms into complex organic molecules, allowing chemists to quickly alter the batches of molecules already on hand. The toolbox Levin is building stands to fundamentally change the way chemistry thinks about molecule synthesis and accelerate the pace of development across a wide range of fields.

Pedro Lopes

Computer Science

Cyborgs are science fiction... for now

We're used to operating computers with our minds, communicating our intentions with keystrokes, clicks, and sounds. But humans aren't just minds. Our bodies have a unique language composed in sensations, electrical impulses, and chemical signals. Pedro Lopes is a computer scientist developing devices to listen to that language and, increasingly, talk back. He's made exciting advances in Electronic Muscle Stimulation (EMS), the practice of getting muscle tissue to contract through an external electrical stimulus, which is widely used in prosthetics and physical therapy.

Lopes' vision is a form of EMS more integrated into the body. He developed an arm brace that doesn't just move an arm, but provides feedback to the user's brain about how the arm is being moved. The result is the restoration of a key feature lacking in modern prosthetics: proprioception, the sense of what one's body is doing. Lopes' ambitions are grand and he plans to further pursue the integration of humans and computers, with wide-ranging implications for medicine, education, and virtual reality.

Danielle Speller

Physics

Cracking the origins of matter

Over 85% of the mass density of the universe is detectable only through gravitational effects, rather than direct observation. And our current best models are incomplete. Until recently, many experiments relied on particle collisions or astrophysical observations to explore *higher* energy and mass scales in the search for new physics. Now, new advancements in cryogenic and quantum measurement techniques allow us to explore the signatures of *lower* energy interactions that were previously difficult or impossible to detect. Danielle Speller, an astrophysicist putting these new techniques into action, seeks to understand the nature of matter and mass through low-energy, cryogenic searches for physics beyond the Standard Model.

Speller's work uses ultra-sensitive crystalline heat detectors cooled to a few thousandths of a degree above absolute zero, and tunable microwave cavities in large magnetic fields, to explore the existence of new particles. Her ultimate goal is to find new physics that will help us gain a better understanding of the origin of matter and the interactions governing the natural world.

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