ALFRED P. SLOAN FOUNDATION

2023 HIGHLIGHTS

ALFRED P. SLOAN
FOUNDATION

Contents

Cover: Mark Rylance (left) and Felix Hayes in a production of *Dr. Semmelweis* at London's Harold Pinter Theatre in 2023. Read an interview with playwright Stephen Brown (who co-wrote the play with Rylance) on page 22.

The Alfred P. Sloan Foundation is a non-partisan, 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.

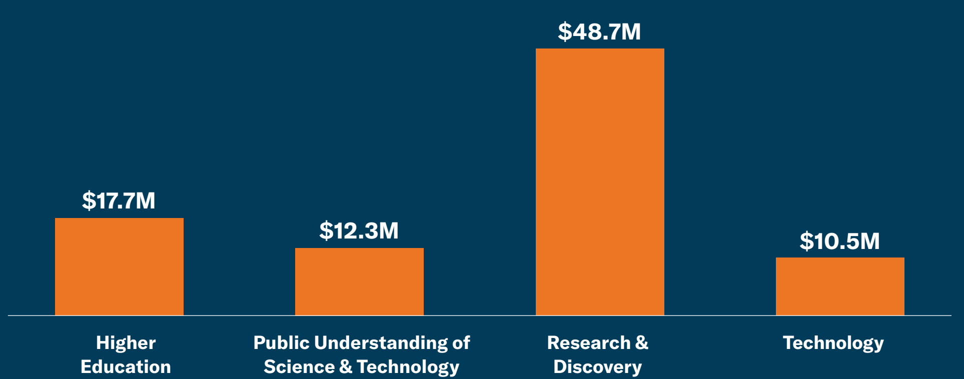
TECHNOLOGY In recent decades, developments like computing and the internet have created new challenges and opportunities for researchers. We work with technologists, programmers, engineers, and scholars to develop innovative new tools, practices, and institutions that give researchers the ability to 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.

2023 Grantmaking at a Glance

As of December 31, 2023, the Sloan Foundation had assets totaling approximately $2.1 billion. During 2023, the Foundation awarded over $92.4 million in grants to support projects across our four focus areas:



* The Foundation awarded an additional $3.1 million in grants to support nonprofit initiatives and New York City-based projects that advance the Foundation's mission.

What it means to be non-partisan

Adam F. Falk

At the Alfred P. Sloan Foundation, we are rigorously non-partisan in the work we fund and in the public statements we make. At a time when opinions on almost every issue seem to fracture along party lines, it's worth reflecting on the origin and implications of our long-standing commitment to non-partisanship.

Of course, as a non-profit institution the Sloan Foundation is prohibited by law from engaging in lobbying or contributing to political campaigns. And we are meticulous about refraining from such activities. But our insistence on being non-partisan does not arise solely from a narrow legal restriction. This commitment flows directly from our values as an institution, from our understanding of the needs of our grantees, and from the role that private philanthropy, properly understood, is meant to play in our society.

What does it mean for us to be non-partisan, beyond meeting the minimal legal requirements? To be clear, one thing it does not imply is a head-in-the-sand refusal to recognize facts about the world simply because they are disputed in some quarters. Sloan's grantmaking programs are often premised on acknowledging uncomfortable realities. For example, the overwhelming scientific evidence that anthropogenic climate change is real underlies and motivates our Energy & Environment program. Similarly, the reality is that Black, Indigenous, and Latine scholars remain underrepresented in science, with troubling consequences both for science itself and for society at large. To effectively address the challenges we face, we must be clear-eyed about what those challenges are.

What being non-partisan does mean is that we do not take a position on the *solutions* to problems such as climate change. Rather, at Sloan we fund research

that provides reliable and impartial information both to policy makers and to the public, so that everyone can participate in making the best possible decisions for our society. The political views or affiliations of prospective grantees play no role in our decision about whether to fund their research. And once we have made a grant for research on a policy-relevant issue, we treat the eventual findings of that research with the same respect, whatever the policy implications may be.

Here are some examples from the past year of how we have used our grantmaking to inform important issues without prejudging solutions. In response to the passage of the Inflation Reduction Act and the Biden Administration's Justice40 Initiative, we issued an open call for proposals for impartial research on ways the upcoming societal transition to a low-carbon energy system might impact marginalized and economically vulnerable communities. After the passage of the CHIPS and Science Act, we deepened our funding in the economics of innovation and began funding research in the historically important, but now largely dormant, economic subfield of industrial policy. And following the Supreme Court ruling effectively outlawing the use of affirmative action in college admissions, Sloan grants to the American Association for the Advancement of Science, the Council of Graduate Schools, and the American Academy of Arts & Sciences provided impartial guidance for universities that wish to pursue diversity goals in a legally permissible manner. In all cases, we work to make sure that research findings are widely shared, that empirical methods are transparent, and that data on which conclusions are based are openly accessible to all.

Why should the Sloan Foundation be so strict about non-partisanship? After all, we care deeply about the climate, so why not advocate directly for specific policies, such as a carbon tax or tax incentives to promote the adoption of electric vehicles? Our unwillingness to weigh in on such issues might surprise those more accustomed to dealing with grassroots advocacy groups. For example, while Sloan funds research that is relevant to decarbonizing the energy sector, we should not be mistaken for a “climate funder” that underwrites groups that advocate for particular policy solutions. While personally I admire the work of many of these groups, this is not what Sloan does.

We are so strict about non-partisanship, in large part, because such restraint protects and empowers our grantees. When a scholar supported by Sloan writes a paper with policy implications, or testifies before a legislative body about their work, or publishes an article in the press explaining the implications of what they've learned, their own credibility shouldn't be questioned because of policy preferences expressed by their funder. In our increasingly polarized political environment, our care in this regard has to be ever more scrupulous.

Our commitment to non-partisanship also flows from our profound respect for democratic values. On complicated, contested political issues, the role of philanthropies such as Sloan should be to use our resources to inform public debate as fully as possible, leaving the decisions themselves to the publicly accountable institutions of democratic governance. We work not to pressure those institutions to make the decisions we think best, but to provision those institutions with the information and resources they need to function as they are intended to.

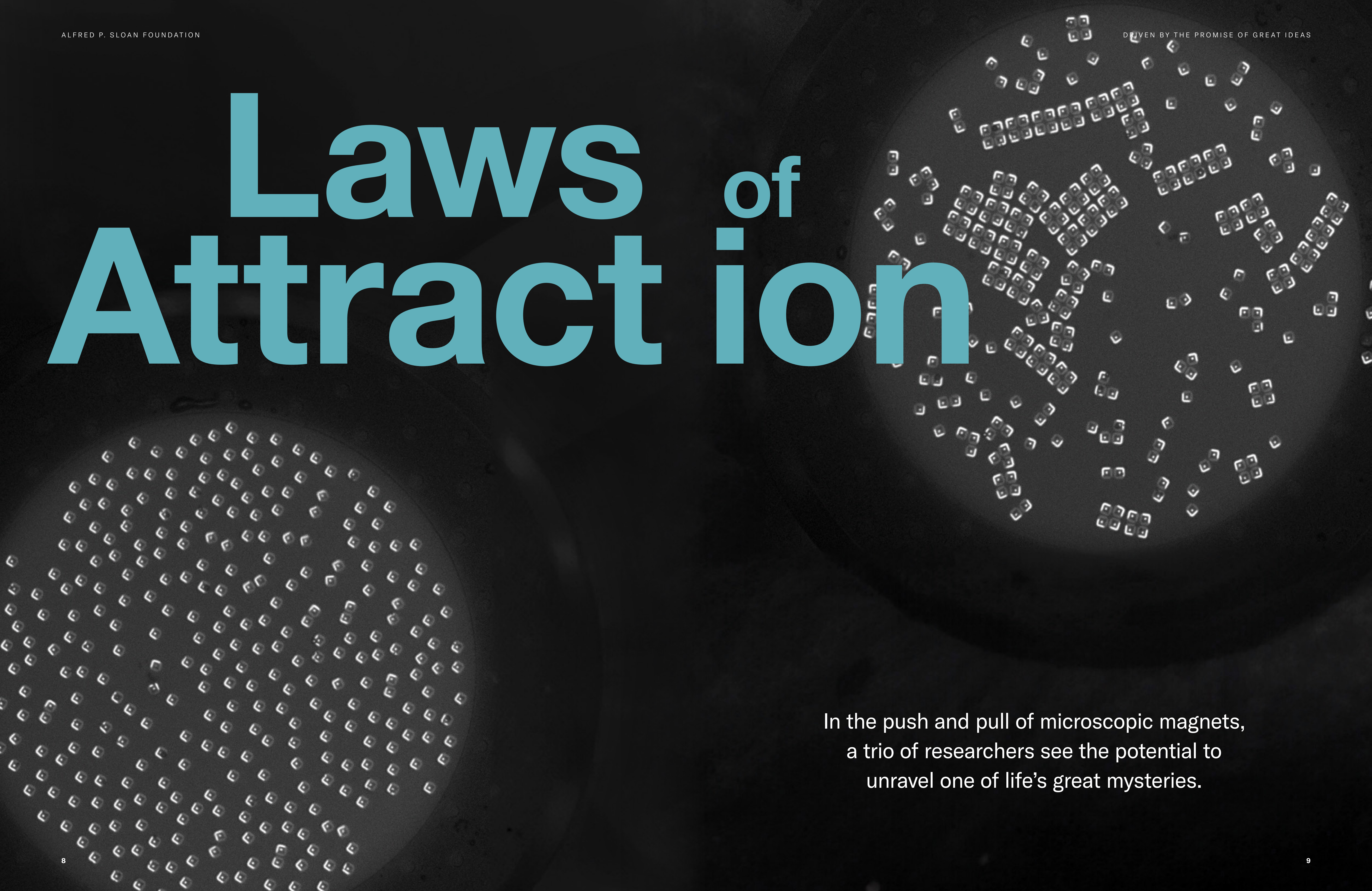
Of course, much of the research Sloan funds is not inherently political, such as the Sloan Digital Sky Survey and our programs in Matter-to-Life and Small-Scale Fundamental Physics. And our non-partisanship certainly does not mean that the writers and artists in the Public Understanding program are prohibited from expressing their views in their Sloan-funded work. In the same spirit that we do not take grantees' political views into account in deciding whether to fund their research, we strictly refrain from exerting editorial pressure on the artists and journalists whom we support.

When a scholar supported by Sloan writes a paper, their own credibility shouldn't be questioned because of policy preferences expressed by their funder.

Most of us at the Sloan Foundation, like most Americans in general, have strong opinions about a wide variety of current policy issues. Our responsibility, when we enter the Sloan offices at Rockefeller Center each day, is to leave those opinions at the door and turn to the work of helping our grantees push forward the frontiers of knowledge. We are privileged to have the opportunity to use the resources of the Foundation for the improvement of our society and our world. Our commitment to non-partisanship, a core principle of the Sloan Foundation for decades, is critical to fulfilling that promise.

Adam Falk

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



Laws of Attraction

In the push and pull of microscopic magnets, a trio of researchers see the potential to unravel one of life's great mysteries.

Physicist Itai Cohen had a troublesome neighbor. “Paul would come into my office and pitch me these totally wild ideas and they were all just insane. And I was like ‘No. We’re never going to do that. This is ridiculous. Leave me alone.’”

The Paul in question is Paul McEuen, a fellow physicist and Cohen’s departmental colleague at Cornell University who occupied the office next door. Despite Cohen’s protestations, Paul would not, in fact, leave him alone. He would keep pitching wild ideas. A good thing, too, because one of those ideas would lead to a high-risk, high-reward collaboration (together with a third colleague, Michael Brenner, and with grant support from the Alfred P. Sloan Foundation) that may end up shedding light on one of the oldest and thorniest mysteries in science.

That mystery is how life begins. Not, mind you, the merely historical question of how life began on Earth, but the deeper, more fundamental question of how we get living systems at all. Evolutionary science has been deft at charting a plausible path suggesting how, starting with simple living systems, we can eventually get salamanders and squids. But science is still in the dark about how we get those simple living systems in the first place, how a universe that starts with only physics can end up with biology.

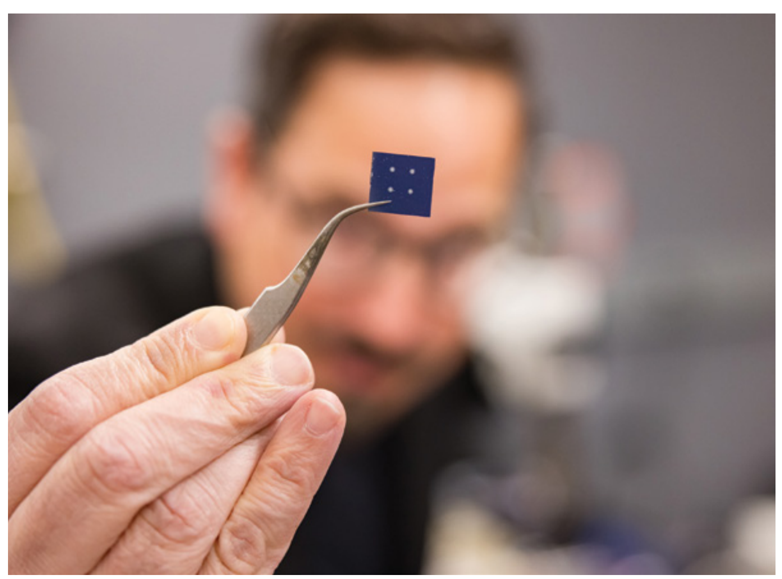
So that’s the mystery. Now for the wild idea. If we want to know how the universe builds a living system from non-living atoms, Itai and Paul and Michael wondered, why not…try to do it ourselves? Why not try to build a system that is lifelike but totally non-organic, one constructed not from proteins or peptides or other molecules that we see in Earth-based life, but from something altogether different: tiny, microscopic magnets?

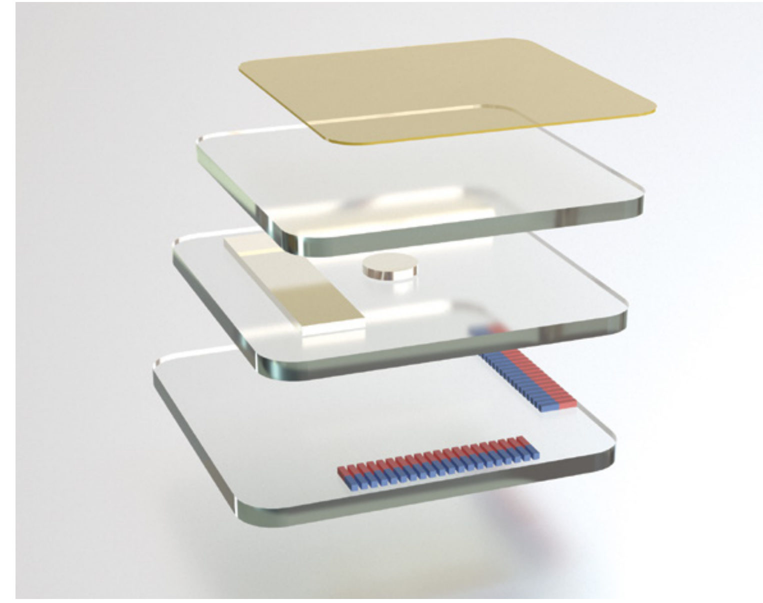
PREVIOUS PAGE: Agitated by an external magnetic field, Cohen’s microscopic magnets, pictured here, whirl and bump into each other, only stabilizing when they combine with others into a pre-designed, four-magnet “tetramer”.

The idea is not as strange as it sounds. Magnets have positive and negative poles which attract the opposite poles of other magnets, forming a bond when they get close enough. That bond is analogous in some ways to the bond that biological molecules form in living systems. Zooming out, it’s easy enough to imagine a side-by-side sequence of such bonds, chained together and mimicking the base-pair structure we see biochemically in DNA. But if you can string together magnets in a way that *looks* like DNA, can you get those magnets to *act* like DNA, too? To replicate? To build other magnet chains from loose magnet parts?

“There’s this guiding mantra for us. ‘If you can build it, then you can understand it (or at least part of it)’,” says Cohen. “The idea is that if you can replicate lifelike processes with a funky magnetic machine, then you can learn something about the paradigms that are governing life. By trying to build a machine that, say, self-replicates, you can come to understand the hurdles that evolution had to go through in order to achieve it.”

Itai Cohen holds a panel. Each of the four dots on the panel is the site of an experiment containing hundreds of square microscale magnets, each 20 millionths of a meter on a side.





Fabricating each magnet involves precisely constructing and combining four distinct, ultrathin layers. From bottom: a glass layer with cobalt nanomagnets to precisely contour the magnetic field; a glass layer with a platinum marker to use when observing the magnets experimentally; a protective glass panel; and a hydrophobic coating. Taken together these four layers are less than a millionth of a meter in height.

Those hurdles are nothing to sneeze at. The squarish magnets Cohen and his team are creating are about 20 microns on a side, less than half the width of a human hair. At that scale, there’s zero room for error in the fabrication process. “They repaired an air duct in our fabrication facility and then nothing worked for six months,” he says. “If anything can go wrong, it does. There’s no paradigm for what we’re doing.”

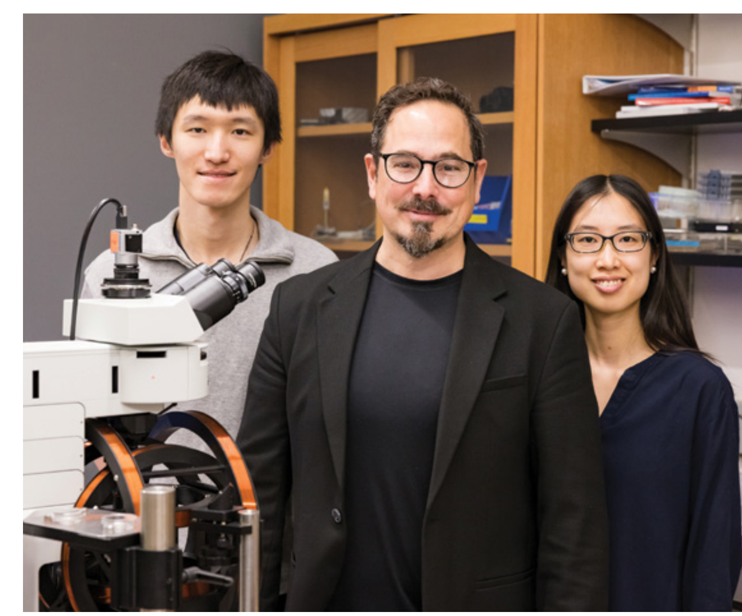
Once the magnets have been constructed, the next step is forming precisely designed structures out of the simple building blocks. The way this gets done in biochemical labs is by putting chemical building blocks together in a solution and then applying heat and a chemical catalyst to get the molecules bumping into each other. This method, though widely used, is well-known to be very slow. “In a typical thermal system, you’re only getting 15 to 25 percent usable product from an experiment lasting several days,” says Cohen. But recent work by the team has made exciting strides on this problem. Instead of agitating the system with heat, Cohen uses an externally applied magnetic field. The research team has figured out how to design the magnets in such a way that when they get into the correct configuration, the various pushes and pulls of each magnet cancel out, decoupling them from the agitating magnetic field. That way, every time the solution is agitated, only the incorrectly assembled magnets are shuffled and remixed. Instead of the 15 to 25 percent success rate in thermal systems, Cohen’s magnetic system success rate can reach up to 93 percent.

“If you can build it, then you can understand it.”

But Cohen says the biggest hurdles still lie ahead. “We now have information sitting magnetically on little bits of particles. Those particles can interact. Can they self-replicate? Can they start to do error correction? Can they behave like tiny machines and catalyze changes in other structures? All of this stuff that life does?” Clearing those hurdles will require doggedness, ambition and, most importantly, more wild ideas. But Cohen is undeterred.

“As soon as you start this, you run into all the problems that life had to overcome. Life had billions of years to do it. Here’s to hoping it takes us less time than that.”

Though Cohen, McEuen, and Brenner are the senior scientists on the magnetic platform project, Cohen (center) is quick to acknowledge that the effort is the result of a much larger team, including his colleagues Dr. Melody Lim (right) and Dr. Zexi Liang.



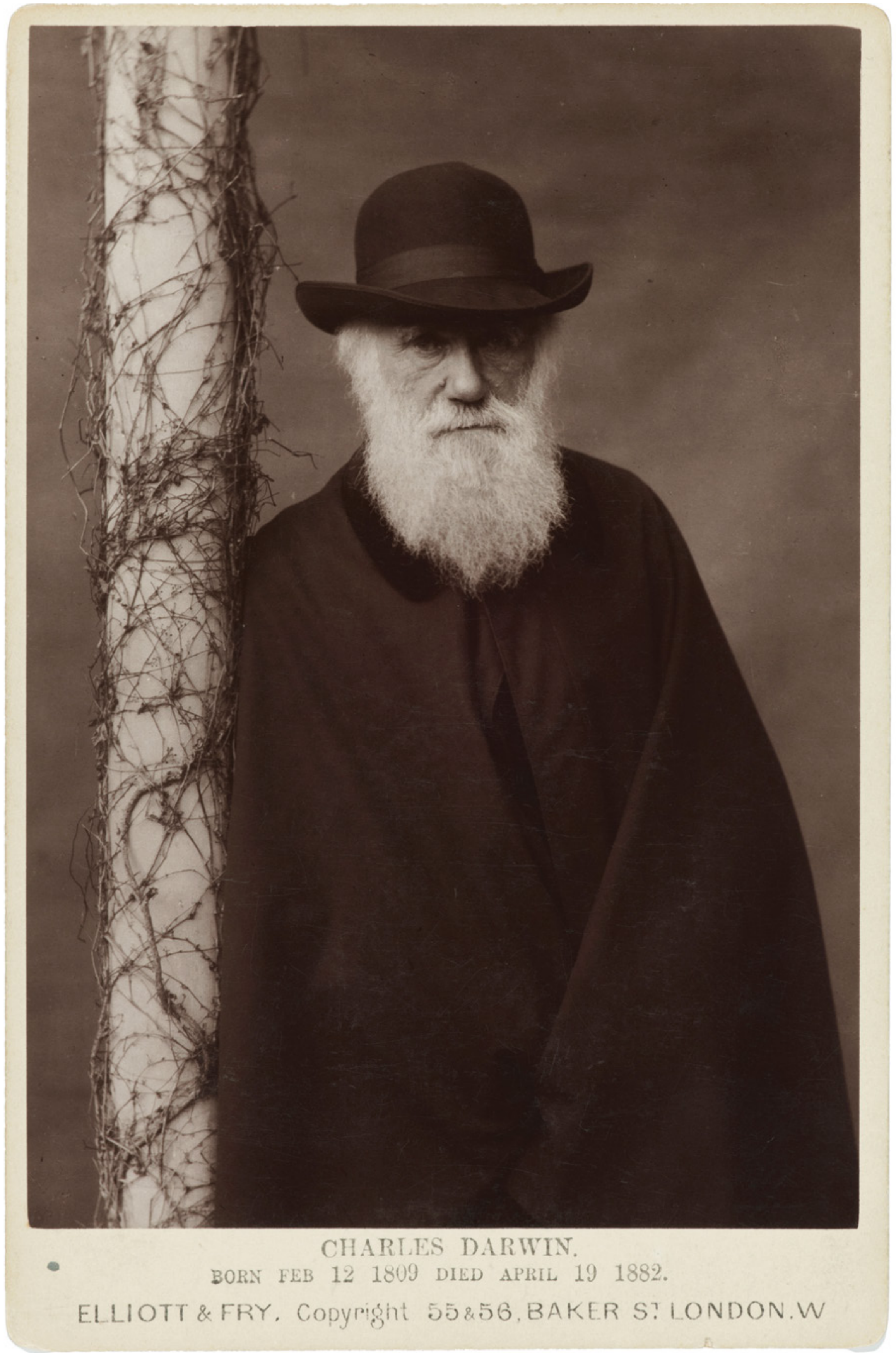
Dear Darwin,

Fifty years of gathering, deciphering, and researching more than 15,000 handwritten letters reveals the evolution of evolutionary theory.

Charles Darwin is widely known as a scientific traveler. His five-year voyage on the H.M.S. *Beagle*, beginning in 1831, which ferried him from Brazil to the Galapagos Archipelago and then across the Pacific to Tahiti and Australia, is arguably the most famous scientific journey ever taken. The observations Darwin made played a key role in his development of the theory of evolution by natural selection, and his widely circulated account of the journey was instrumental in making Darwin a household name.

It may come as a surprise, then, to learn that after returning from that legendary voyage, Darwin rarely ventured from his home in the English countryside. His contact with the outside world was maintained through continual letter-writing. Between 1821 and his death in 1882, Darwin sent or received more than 15,000 letters.

Collecting and transcribing that rich corpus became the passion of two scientific historians, Frederick Burkhardt and Anne Schlabach Burkhardt. Working out



Charles Darwin (1881) at the age of 72, the year before his death.

These letters offer us an insight into why [Darwin's] thinking changed. It's about the process of science.

of a barn near their home in Vermont, and collaborating with Cambridge zoologist Sydney Smith, they began the Darwin Correspondence Project in 1974. And while they knew the task was no small undertaking, neither imagined it would stretch to five decades, continuing years after Frederick's death.

"Fred really knew how to design a long-term project," says James Secord, Darwin Correspondence Project Director, 2006–2023. "He knew that the success of the project depended on the accuracy of the letters' transcription."

Merely assembling the correspondence was an ordeal. Like his ideas, Darwin's letters ended up on every inhabited continent of the globe. Though some 9,000 had been amassed by Cambridge University Library in the UK, 6,000 more were scattered across libraries, museums, and private collections in Europe, Asia, and the Americas. It was more than a decade before the team had collected enough letters to begin detailed editorial work. Complicating matters, Darwin often marked and cut out paragraphs, leaving many letters without dates. "We had to infer dates from the characteristics of the people and what they were writing about," says Secord.

The team made progress, however, and published the first volume of the *Correspondence of Charles Darwin* in 1985. Many more were to come. The final volume, volume 30, was published in 2023. For an archival project of that scale—painstaking and unglamourous editorial work with outputs decades in the future—securing dedicated funding can be challenging. The Alfred P. Sloan Foundation contributed more than $1 million in grants starting in 1994 and continuing to the final volume in 2023.

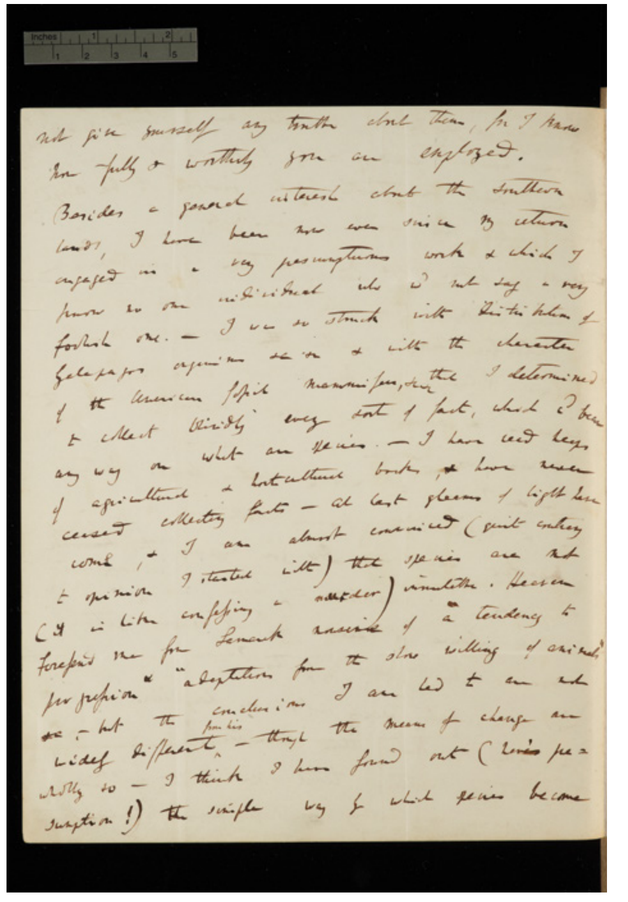
The compiled letters reveal the workings that led up to the making of modern evolutionary theory. That, for Secord, is what is so intriguing about correspondence as historical evidence. "*On The Origin of Species* was revised through six editions as Darwin's thinking changed," says Secord. "These letters offer us an insight into *why* his thinking changed. Who was challenging him to change. This project is about dialogue. It's about the *process* of science."

The collected letters also hold human qualities that field notes and published books do not. They reveal humor and uncertainty and, notably, a willingness to discuss ideas with people from many walks of life.

"It's not just famous names," says Secord. "Darwin was open to receiving contributions from botanists, military and colonial officials, household staff, writers. Working people and women are a big part of the story."

Darwin's frequent, deep exchanges with women might come as a surprise since he professed in public the belief that sexual selection had resulted in the intellectual and physical superiority of males. Yet Secord says that Darwin's correspondence with women—some 150 over his lifetime—suggests a more nuanced story. "He is completely open to discussing ideas with women. Darwin encourages his women correspondents to publish their work. In fact, Caroline Kennard, an American campaigner for women's

Charles Darwin holds his eldest son, William Erasmus. The photo was taken c. 1842, when Darwin would have been around 33 and William around 2 years old. Darwin had a total of ten children with his wife, Emma Wedgwood, seven of whom survived into adulthood, including William.



Letter from Charles Darwin to British botanist and explorer J. D. Hooker (11 January 1844).

education, writes to him asking if he really believes in female intellectual inferiority, and Darwin's response shows that the question was troubling him."

The *Correspondence of Charles Darwin* is now available to both researchers and the public, online as well as in print. It is a mammoth achievement of historical scholarship that has set new standards for similar correspondence projects. But the scholars knew better, even after 50 years, than to call their work the "*Complete*" *Correspondence of Charles Darwin*. Letters are still being discovered, with around 50 new entries submitted and added to the digital edition each year. The process continues.

Meeting of the Minds

A small scientific conference devoted to sparking innovation is leading to big ideas.

How do scientists come up with new ideas? Fiction and folklore have popularized the image of the solitary genius, for whom *eureka* moments occur in isolation, but the reality is that today's science is multi-disciplinary and collaborative. Scialog, a scientific conference series that prioritizes dialogue over panels and presentations, has been harnessing the power of collaboration for more than a decade. A core program of the Research Corporation for Science Advancement (RCSA), Scialog invites early-career scientists to generate promising new ideas by working together.

Since the first Scialog in 2010, meetings have been organized around broad themes of novel science and, in many instances, broader societal importance. Since 2018, the Alfred P. Sloan Foundation has been an intellectual partner in curating Scialog themes, which have included Advanced Energy Storage; Negative Emissions Science; and now Sustainable Minerals, Metals, and Materials. This latest Scialog series will run for three years, beginning in 2024.

"Scialog is such a unique environment to meet new people," says Jenny Y. Yang, a chemist and two-time Scialog Fellow. "Although our academic areas are all different, we have one thing in common: we want to solve an outstanding and challenging scientific problem."

Over four days at a Scialog meeting, participants form teams and craft cutting-edge research proposals. Authors of the best proposals are each awarded over $50,000 per person in seed funding to pursue their idea. For Neil Dasgupta, a mechanical engineer and materials scientist who took part in the 2019 Scialog on Advanced Energy Storage, that incentive made Scialog "an ideal format to nucleate and grow high-risk, high-reward ideas."

Dasgupta's team was awarded Scialog seed funding for a proposal to improve batteries by designing new components that increase battery stability and energy-density. They aimed to use the seed funding to produce preliminary results that could form the basis for grant applications to larger funding organizations.

For Yang, too, the freedom to take risks is what made Scialog so valuable in her professional development. "We are all near the same career stage, so the projects we come up with are entirely new, not extensions of existing research," she says. "Our particular group, working on negative emissions science, is extremely diverse in terms of expertise. We have to be willing to ask questions and teach each other to move our project forward."

"Although our academic areas are all different, we have one thing in common: we want to solve an outstanding and challenging scientific problem."

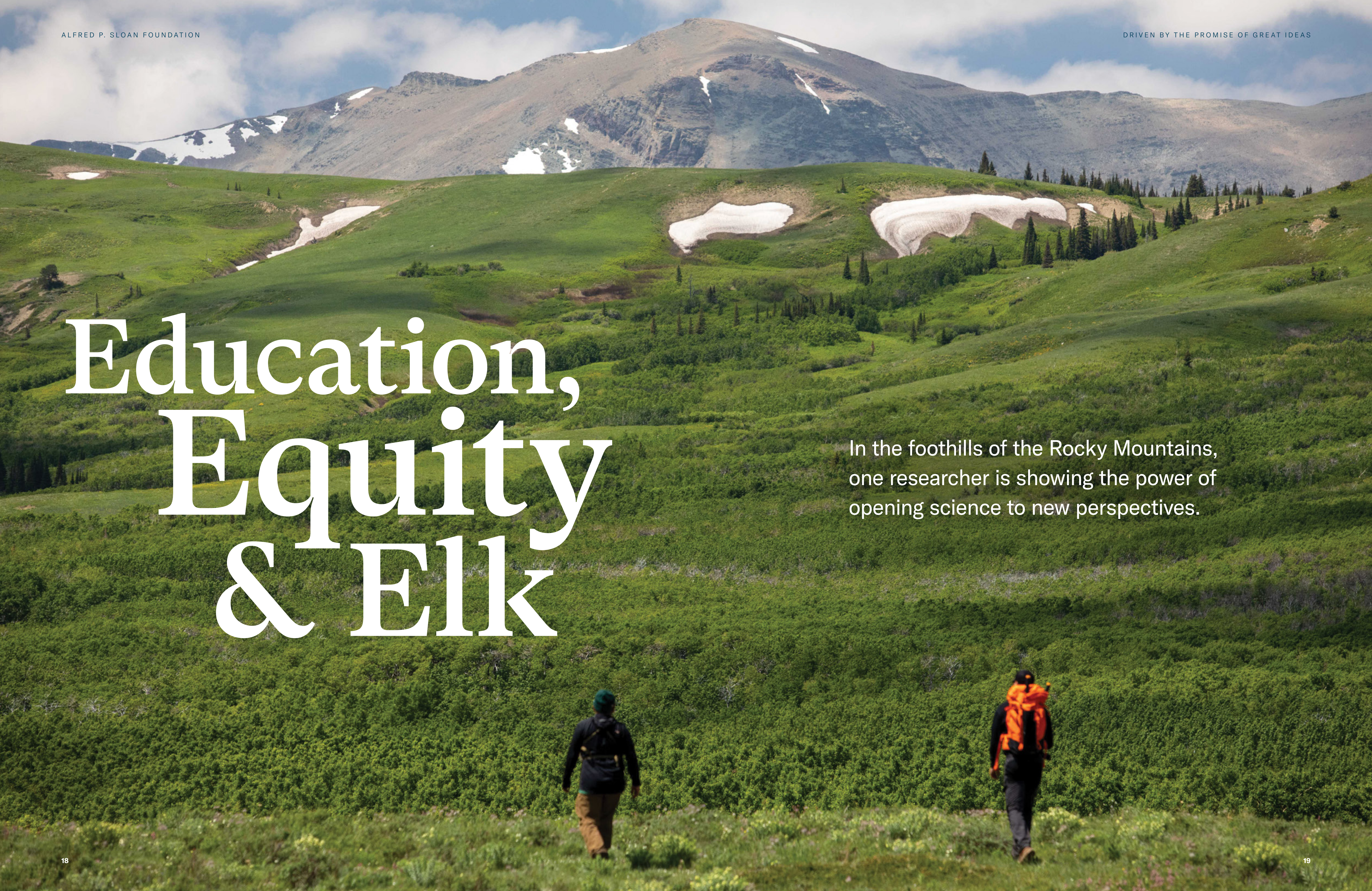
—Jenny Y. Yang
Chemist and Scialog Fellow

In 2021, Yang's team started exploring the idea of combining two energy-intensive processes: saltwater desalinization and carbon dioxide capture from the ocean. Their discussions led them to realize that both processes share several similar technological components,

which, if coupled, would improve efficiency. In early 2023, their Scialog-funded project was rewarded with a $1.4 million grant from the National Oceanic and Atmospheric Administration.

Dasgupta's Scialog team has also found significant success in scaling-up their project from Scialog funding. Their work on batteries has the potential to revolutionize both electric vehicle efficiency and the storage of renewable energy on the grid – two notoriously difficult challenges. Recognizing these innovations, in 2022 the Department of Energy awarded his team nearly $11 million for a new research center on next-generation battery technology, with additional Scialog Fellows joining the growing collaboration. This research will further enable the growth of groundbreaking science that investigates the mechanical and chemical behavior of advanced battery designs.

"The emphasis on fast ideation and articulation of completely new concepts in a seed project were instrumental to follow-on work and funding," Dasgupta says. "And the colleagues that I connected with at Scialog, five years ago, remain close collaborators and friends. We are continuing to watch that seed grow and bear fruit years later."



Education, Equity & Elk

In the foothills of the Rocky Mountains, one researcher is showing the power of opening science to new perspectives.

A scientific workforce as culturally and racially diverse as our society is not only more equitable, it also produces stronger science. For over 20 years, the Alfred P. Sloan Foundation has been collaborating with select colleges and universities around the country, through the Sloan Indigenous Graduate Partnership (SIGP) program, to transform STEM graduate education in ways that support the inclusion of Indigenous students. Daniel Bird, Tribal member from Santo Domingo (Kewa) Pueblo who became involved in the SIGP program in 2017, says he's seen real progress.

"What makes me most hopeful is that in the time it's taken for me to progress from undergraduate, to master's, to PhD candidate, I've seen more and more students like me in my field." Bird is currently pursuing a PhD in Wildlife Biology at the University of Montana. He is investigating elk migration patterns – a project that led him to facilitate a working dialogue between the Blackfeet Tribe and local and state agencies, including Glacier National Park; the United States Geological Survey; and the Montana Department of Fish, Wildlife and Parks. He hopes that a better understanding of elk movement will not only inform wildlife protection policies in and around the national park, but that it will also help to increase the Blackfeet Tribe's access to traditional food and cultural resources.

The research area, which includes ~1.5 million acres of reservation land, is considered a 'food desert.' The nearest supermarkets are a 2-hour drive away, and winter weather can make roads completely inaccessible. "Elk and other game animals are an important source of sustenance and a source of protein for Blackfeet," says Bird. "Understanding the factors affecting elk movement is crucial for creating policies that will improve food security for the Blackfeet Tribe and, in doing so, help maintain their traditional culture."

Although he is not a Tribal member of Blackfeet himself—and the Rocky Mountain Front could not be

Daniel Bird configures an elk tracking collar.

more physically different from the Santo Domingo (Kewa) Pueblo reservation in New Mexico where he grew up—Bird recognizes similar problems related to food insecurity and natural resource management in both communities. "I view Western science as an additional tool to add to our existing Indigenous ecological knowledge, so we can be competitive in stewarding our wildlife and resources."

Driven by his desire to address issues facing Indigenous communities, Daniel Bird finds his role "bridging the gap" between academic institutions and Indigenous communities very motivating. "A lot of times, academics arrive having already decided what an Indigenous community needs. I know I wouldn't want someone who had never lived on a reservation to tell me how to proceed," he says. "I bring a cultural understanding and competence; my university advisors are white males, so it's a different dynamic. I've helped facilitate the inclusion of local folks' perspectives and decisions."

While he is proud of his contribution, he is quick to point out that, at the time he began his PhD, he was unaware of any Blackfeet students who could have done

"I view Western science as an additional tool to add to our existing Indigenous ecological knowledge."

this research within their community. "I do my best to mentor students from Blackfeet. There's a student in my lab group who has transitioned from undergraduate to master's degree since I've been here, and he is also supported by the SIGP program. I hope he's seen me as an ally and continues this work after I leave."

Bird plans to go back home after completing his PhD. He wants to create a wildlife management program for his Tribal community. "We don't currently have one, and there are things I can see we should be doing better to adapt to modern challenges." Now, Bird feels he can contribute valuable skills that his community needs, including the ability to attract external funding and incorporate modern technologies into existing practices. However, he wonders if he would have pursued graduate education at all without the support of the SIGP program.

"Growing up, I didn't have anyone in my family or community who had that level of academic education in my field of study. For the first few years of university, I felt like I was the only Native student around," he says. When SIGP representatives visited his undergraduate campus, they showed Bird that it was possible to be a Native person in an academic environment and to pursue tribally-relevant research. "But I am just one individual with one way of doing things. There are so many different individuals in so many different Tribes who all bring different perspectives. Having not just me, but a diversity of Tribal students will only add to the wealth of knowledge we have overall."

A female elk fitted with a GPS radio collar. Daniel Bird and his colleagues hope that providing a better understanding of the animals' movements will help inform policies that protect important migratory corridors.

Action Figures

From classrooms to courtrooms, economists at J-PAL North America are turning data into decisions.

Imagine a world where every policy decision, from healthcare to education, is backed by real-world evidence, not just good intentions. A rapidly growing number of economists have dedicated themselves to creating that world. Ten years ago, as part of this growing movement, J-PAL North America was founded to achieve the mission of reducing poverty in the region by ensuring social policy is informed by scientific evidence.

In the decade since the North American branch of the Abdul Latif Jameel Poverty Action Lab (J-PAL) was established, researchers there have focused on taking their findings out of academic journals and into society. “What really drives us,” says Laura Feeney, co-executive director of J-PAL North America, “is making sure the results from our studies are *useful* and *used*.”

“We aim to institutionalize the use of evidence across all areas of policymaking,” Feeney says. “To make that happen, we work with implementing partners from the start.” These partners include city, state, and federal agencies; NGOs; and private donors.

J-PAL has found success by demonstrating the effectiveness of their signature methodology, Randomized Controlled Trials (RCTs), in evaluating social policy interventions. In an RCT, researchers compare the outcomes of a group that receives the intervention against a group that does not. Selection to receive the intervention, however, is randomized, allowing differences in outcome to be reliably attributed to the intervention, rather than to a separate cause. “RCTs seek to remove as many sources of bias, like selection bias, as possible,” says Feeney. “They’re seen as the most rigorous form of impact evaluation because of their statistical credibility.”

The range of policies that J-PAL researchers have been able to evaluate and influence is remarkably broad and is part of the reason why the Sloan Foundation was so keen to support the research effort. In New York City, J-PAL economists partnered with the police department to assess methods to reduce court nonappearance rates. They found that sending a text message reminding people of their court dates reduced nonappearance by 26 percent. That translates to 3,700 fewer arrest warrants a year. As a result of this study, New York City court summons forms have been redesigned and text message reminders are now sent to all summons recipients.

Another issue that captured economists’ attention was low take-up of nutritional assistance benefits amongst the elderly. RCTs conducted by J-PAL showed that merely mailing informational leaflets to eligible older adults nearly doubled enrollment, suggesting that a lack of information was posing barriers to older Americans getting the food assistance they need.

Feeney highlights a particularly high-profile example of J-PAL’s influence: their recent study on educational “catch-up” policies. School closures and absenteeism due to the Covid-19 pandemic caused students to learn just 67 percent of the math and 87 percent of the reading that their peers would have learned in more typical years. J-PAL researchers used RCTs to evaluate the effectiveness of tutoring as a catch-up method, and found that the effects of tutoring tend to be strongest amongst students in earlier grades; that tutoring by professional teachers (rather than volunteers or parents) were much more effective; and that tutoring conducted during school hours had larger impacts than tutoring conducted after school.

These findings were cited by the Biden Administration when it announced a national effort to increase access to high-quality tutoring in 2022, and again in 2024 when it released the *Improving Student Achievement Agenda*. The state government of California also drew on this evidence when it allocated $4.6 billion for expanded learning opportunities to help students catch up after pandemic-related setbacks.

“What really drives us is making sure our results are *useful* and *used*.”

—Laura Feeney
Co-Executive Director,
J-PAL North America

All told, in the last 10 years, the findings from J-PAL North America’s 165 evaluations have resulted in more than $518 million in government funds shifted, impacting more than 35 million people – a tenth of the US population. This social-impact-focused work has catalyzed a dramatic shift in the field of evidence-based policymaking; recent federal legislation providing funding for policy evaluations means there is growing interest across all levels of government in using data and evidence to inform social policy.

It is clear that lots of economists are motivated, like Laura Feeney, to put economics to use in reducing poverty and social inequality. Feeney says, “in the last decade, we’ve fostered a network of 265 affiliated researchers across the continent, and trained more than 300 research staff, all of whom believe in the power of empirical evidence to improve policymaking across all areas of social policy.”

Dissident Voices

A 19th-century doctor's pursuit of truth brought him to professional and personal ruin. Nearly two centuries later, a playwright says his story holds important lessons for us all.

Written by playwrights Stephen Brown and Mark Rylance (and supported through a commissioning grant from the Alfred P. Sloan Foundation), *Dr. Semmelweis* tells the true story of Ignaz Semmelweis, a Hungarian physician working in 1840s Vienna. Semmelweis noticed that hundreds of women were dying of infection after childbirth and hypothesized, against the expert consensus of the time, that doctors themselves were infecting the new mothers. Ridiculed by his colleagues for his idea that disease-carrying 'particles,' too tiny to be seen, might be the cause

Mark Rylance (left) and Felix Hayes in the 2023 production of *Dr. Semmelweis* at the Harold Pinter Theatre, London.

of the women's deaths, Semmelweis retreated to his native Hungary in defeat. In 2023, with support from the Alfred P. Sloan Foundation, Sonia Friedman Productions and the National Theatre presented the Bristol Old Vic production of *Dr. Semmelweis*. Directed by Tom Morris, staged at London's Harold Pinter Theatre, and starring *Dr. Semmelweis* co-playwright and award-winning actor Mark Rylance in the title role, the production thrilled audiences and critics alike. We sat down with playwright Stephen Brown to talk about what it takes to speak out against the establishment and the consequences of overlooking the power of ego, emotion, and politics in stories about science.

What attracted you and Mark Rylance to the story of Ignaz Semmelweis? We were fascinated by Semmelweis' character—brilliant, self-destructive, tragic. I saw him as a compelling example of a dissident thinker who, in searching for the truth, came into conflict with the establishment.

We started writing the play in 2015. It was complete coincidence that the themes of the play intersected with the global pandemic. The story suddenly took on a whole new significance. But even without the renewed interest in handwashing and infectious disease, there was modern-day relevance in the story.

What did you learn from your exploration of Semmelweis as a "dissident thinker"? Whistleblowers are often awkward people who don't feel much social pressure to fit in with the group. In this case, not only is Semmelweis introducing new scientific ideas, but he also feels an awkwardness about his identity as an immigrant in Vienna and as a Hungarian, a member of a subjugated group at a time when nationalism within the Austrian Empire was on the rise. It was interesting to develop that awkwardness. Stories of whistleblowers – how they speak up or don't – are timeless.

Amanda Wilkin (center right) and company at the Harold Pinter Theatre, West End, London 2023. Wilkin starred in the role of Dr. Semmelweis' wife, Maria.

Often, science stories are about grand success. Why was it so important for you to emphasize that awkwardness and failure? Writing the play made me think a lot about another extraordinary scientist, Galileo. Under pressure from the Vatican, Galileo is forced to recant his ideas. In the long arc of history, it doesn't matter, because somebody else is able to carry his ideas forward and they become accepted eventually – but Galileo doesn't live to see that. The story with Semmelweis is similar.

"If we tell ourselves science stories that are only about success, then we are lying about the reality of science and the reality of life"

—Stephen Brown, playwright

The play is not about proving Semmelweis was right, it is about showing why we should include emotion and conflict and politics in stories about science. If we tell ourselves science stories that are only about success, then we are lying about the reality of science and the reality of life more generally.

Is that why the play opens with Semmelweis in a state of resignation, *after* he has been driven from Vienna and the medical establishment? Partly, we wanted a flashback structure – Mark Rylance (who plays Dr. Semmelweis) is in his early 60s, so it made sense to flashback to his youth. But it also gave us an aesthetic license to try to create the feeling of being inside someone else's head. And that was important to us, because we really wanted people to connect with Semmelweis' mental state – his retreat into his own head. It's a phenomenon that has affected a lot of so-called geniuses, and I found it very human and moving.

Tell me about the dynamic between women—mothers and midwives—on the one hand, and the doctors on the other. We have records from the time; people knew there was a difference in death rates between two hospital wards (one run by midwives and the other by doctors) within the Vienna General. But the cause was put down to "bad air." Nurse Muller doesn't believe that's true, but as a nurse, her opinions are never sought after. Mothers share knowledge via word-of-mouth that the midwives' ward is safer, but their requests to be treated by midwives are overridden. Semmelweis is the only doctor with the courage to question if perhaps the doctors are at fault.

It remains a contemporary concern. Women are still under-represented in medical studies; there are still people who feel they cannot speak up.

Did anything surprise you about how the play was received? I was surprised by how the presence of the dancers and musicians on stage altered the emotional balance of power. Sometimes they are mothers, sometimes nurses, and their physical presence represents the weight of death on Semmelweis' mind. The closing image is the women. It was much more striking than I anticipated.

We also did a performance specifically for high school students. They reacted quite differently from other audiences. You could hear audible gasps – and they were very angry with Semmelweis for how he treated his wife, even heckling him on stage! There was something very joyful about watching them connect with the characters and each other and seeing that science stories can invoke emotion as strongly as any story.

In the Indoor Chemical Human Emissions and Reactivity (ICHEAR) project, researchers attempted to characterize the chemical impact of human beings on indoor spaces. Here, subjects' respiration is piped into an adjoining chamber to isolate the chemical contributions of respiration from those contributed from emissions by clothing, hair, and skin.

If These Walls Could Talk

A growing community of researchers is deciphering the chemical stories our indoor spaces have to tell.

For indoor chemists, 2023 marks the end of a boom decade. Indoor chemistry is the area of chemical research that examines the mix of chemicals that we inhale, ingest, and absorb in the spaces where we live, work, and play.

The past 10 years have seen significant progress almost everywhere: instrumentation, methods, observational studies, modeling, theory. Gains have been so significant that in October 2023, more than 125 chemists convened in Washington, DC to take stock, celebrate their achievements, and cast their eyes forward to the next chapter of research. To Charles J. Weschler, a veteran chemist who has been working in the field since the 1970s and who, together with William W. Nazaroff, was invited to give the keynote at the conference, the advancements have been impossible to miss.

"Indoor chemistry research has been occurring since the mid-1960s," he said, but added that progress in those early decades was frustratingly slow and uneven. "The funding just wasn't there. The EPA funds lots of environmental chemistry, but their regulatory authority is outdoors. And there wasn't (yet) enough of a link between indoor chemical exposures and health outcomes to draw attention from funding agencies like the National Institutes of Health. Studies got done, but they were often passion projects, things you did on the side."

That began to change in 2013 with the launch of the Sloan Foundation's Chemistry of Indoor Environment program, an initiative to jumpstart a more concentrated, systematic examination of the chemistry going on in indoor spaces. Over the next 7 years, led by program director Paula J. Olsiewski, Sloan made $23 million in grants to support indoor chemistry research that had slipped through the cracks of the federal funding system. Projects included basic measurements and data collection; analysis of chemical absorption and emission rates from indoor surfaces; modeling of indoor chemical processes; and two field campaigns that ran controlled experiments in test homes at the University of Texas, Austin and the National Institute of Standards and Technology. Weschler said that these field campaigns, dubbed HomeChem and CASA, respectively, were particularly important as the field grew.

Undergraduate Erin Katz calibrates a high-resolution aerosol mass spectrometer as part of the 2018 HOMEChem field campaign that ran experiments on a test home in Texas. Katz is now pursuing her PhD in atmospheric chemistry at UC Berkeley.

> "This is the National Academies saying indoor chemistry is worth investing in."

"Field campaigns make for great science. In HomeChem, for example, research teams from more than a dozen different universities came to the same house to study the same environment, each bringing their own instruments and ideas. Instead of a single isolated experiment revealing a tiny piece of the indoor chemistry jigsaw puzzle, you get a whole bunch of pieces at once."

Weschler says that the accelerated pace of funding supercharged progress in the field, though what we've learned may not be well-received by those averse to housework. "One of the many things we've learned—it comes out very clearly in the research—is how connected indoor air and surfaces are. Carpets and counters and furniture are all extremely rich chemical reservoirs. That's where the chemicals are coming from. You can flush out airborne chemicals by opening windows, but once you close them, the air becomes almost as dirty as it was. There's no substitute for dusting and vacuuming, and wiping things down. To clean the air, you need to clean the surfaces."

The growing body of research has caught the attention of the US National Academies of Science. In 2022, the Academies published a consensus study, *Why Indoor Chemistry Matters*, that summarized the state of knowledge in the field and identified important questions still to be addressed. "This is a big deal," says Weschler. "This is the National Academies saying 'Indoor chemistry is an important field; this is something worth investing in.'"

Dr. Marina Vance cooks during an experiment in the CASA field campaign to measure the chemical effects of ordinary activities.

And it's not just the US that is taking notice. To Weschler, one of most wide-ranging impacts of Sloan-funded research is how it has catalyzed research internationally. "There's so much exciting science going on abroad now. The UK. Denmark. Sweden. Germany. China. And every time you dig into the details, there's some sort of Sloan connection."

Back in the Washington conference center, filled with indoor environmental chemists, you might think that attention would be on all the fascinating chemistry happening in the room. But the real focus was on a different sort of chemistry. "The science is deeply important," Weschler said, but just as important are the bonds that enable researchers to come together and forge a research agenda as a community. "When you get this community together, you see modelers talking to experimentalists, young researchers talking to established veterans, all communicating in ways where the chemistry just *clicks*."

Hardware Unchained

Open source principles revolutionized software. A pioneering group of technologists promises to do the same for hardware.

From Android-powered smartphones, to Linux-powered servers, to WordPress-powered websites, open source software platforms have become the backbone of the digital landscape. Unburdened by restrictive copyright licenses and the fear of infringement lawsuits, developers working on open source software are free to experiment, modify, transform, innovate, and share, making these communities some of the most dynamic intellectual ecosystems in the world.

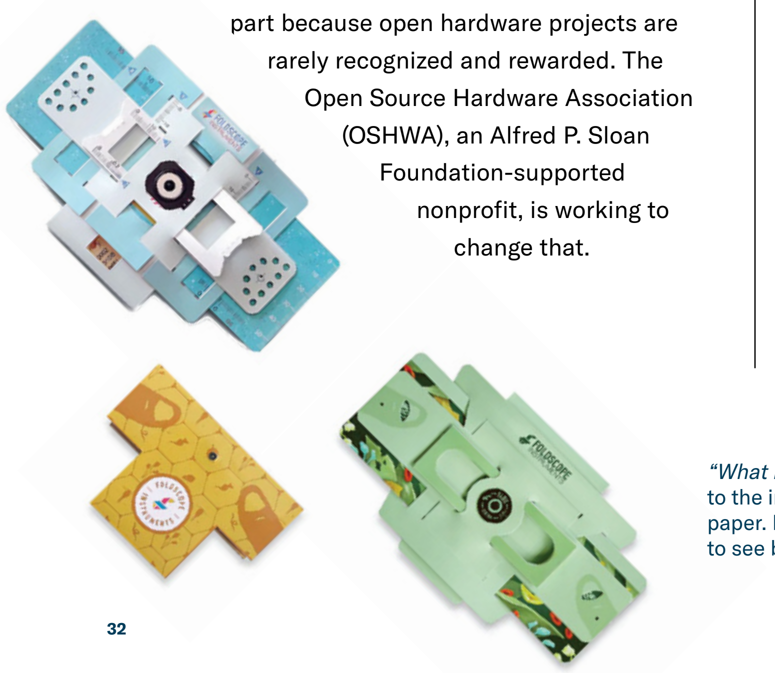
A global community of dedicated technologists is working to expand open source principles and practices from software to hardware. Open source hardware promises to do for physical objects—including scientific equipment—what open source software has done for code. While many private sector companies work in open hardware, adoption has been slower at US colleges and universities, in part because open hardware projects are rarely recognized and rewarded. The Open Source Hardware Association (OSHWA), an Alfred P. Sloan Foundation-supported nonprofit, is working to change that.

"Open source hardware has the potential to revolutionize the scientific enterprise," says OSHWA Director Alicia Gibb Seidle. "By freely sharing hardware designs, researchers can accelerate discoveries, build upon each other's work, and create a more inclusive scientific community."

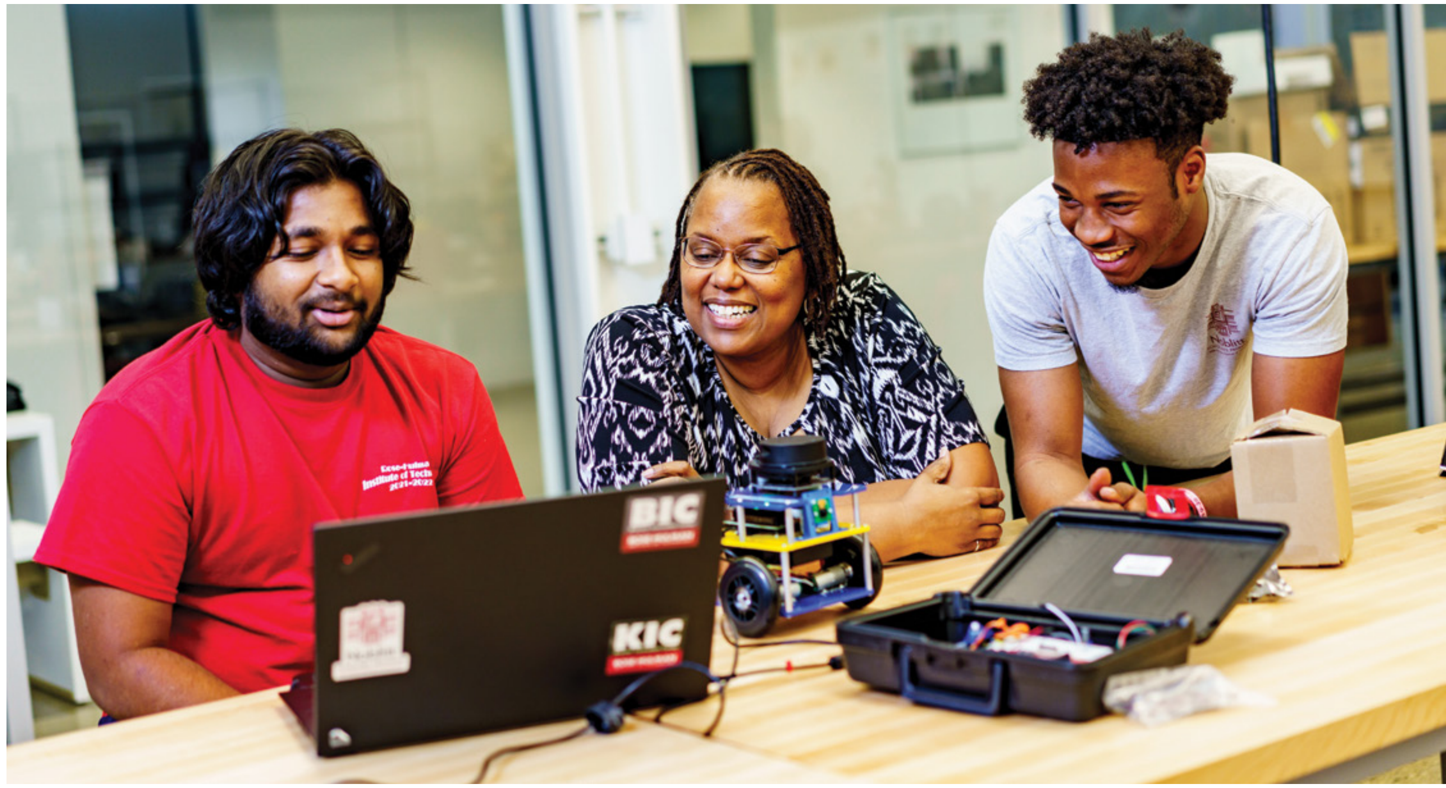
"We're working closely with academics building truly amazing things, and the administrators responsible for their performance metrics, to make sure their efforts are incentivized and their contributions recognized."

OSHWA is flipping the script at universities through a prestigious new fellowship—Open Hardware Creators in Academia—seeking to recognize academics who are blazing trails in the open hardware movement. Every two years, Gibb Seidle and her team select nine fellows to participate in the program, with each receiving $50,000-$100,000 to formalize their ideas, share them broadly, and introduce undergraduate students into the flourishing world of open source hardware.

The inaugural cohort of Open Hardware Creators in Academia has already demonstrated enormous success in bringing innovative open source hardware to the masses. Manu Prakash, a professor of bioengineering at Stanford University, was awarded a fellowship after developing a low-cost microscope made of paper—in contrast to the expensive equipment sitting on laboratory benches around the world. Costing just $1 to produce, Prakash's "foldscope" has now reached 1.8 million budding scientists in 160 countries.



"What is the best microscope you can build with $1?" That question led to the invention of the Foldscope, a foldable microscope made mostly of paper. Foldscope's lens has a magnification of 140x, which allows users to see bacteria, blood cells, and single-celled organisms like diatoms.



"Robotics brings together mechanics, electronics, software, human-robot interaction, sociology, psychology, and the arts in a way that offers something to everyone," says Carlotta Berry (center).

The cohort also includes robotics pioneer Carlotta Berry, an electrical engineer at Rose-Hulman Institute of Technology who is—as she puts it— "bringing robotics to the streets" with a selection of bots built for everyone from small kids to PhDs. Berry is unique among the fellows in her engagement with young people through social media. Her online persona, @NoireSTEMinist, has attracted a keen following on Instagram, TikTok, and Twitter, including thousands of aspiring scientists from marginalized communities.

"The beautiful thing about robots as service, research, and teaching tools is that they represent the intersection of so many fields," Berry says. "They bring together mechanics, electronics, software, human-robot interaction, sociology, psychology, and the arts in a way that offers something to everyone—from the young novice to the seasoned expert."

The FAST & The Curious

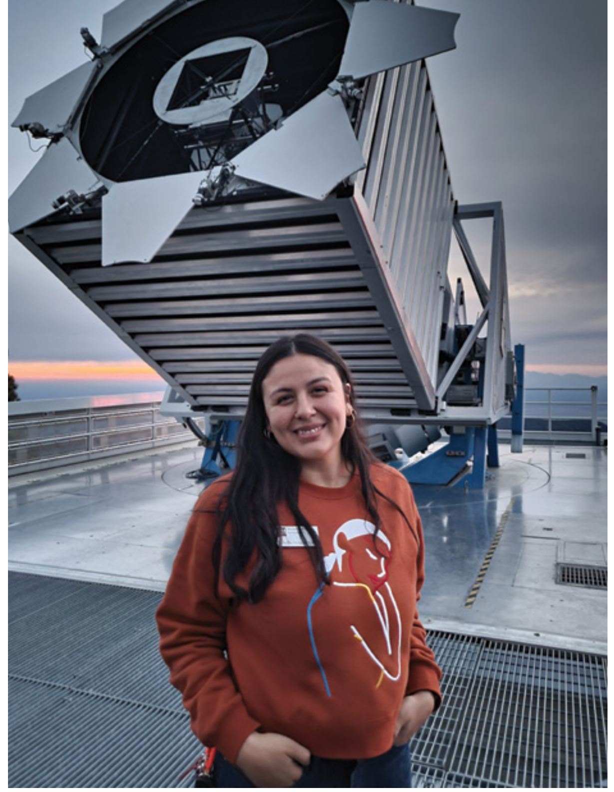
The scientists behind one of the world's most cited telescopes are confronting a question as big and complicated as the galaxies they study: who gets to be an astronomer?

Star trails: long exposure times allow photographers to capture diurnal circles, the apparent motion of stars in the night sky caused by Earth's rotation.

Dr. Juna Kollmeier is an astronomer, which is to say her job is to look out and up. As Director of the fifth phase of the Sloan Digital Sky Survey (SDSS), Kollmeier leads a global collaborative of astronomers at over 60 universities who have come together to study the cosmos. SDSS's goal is to create a detailed map of the night sky. The data it has collected through its two telescopes—one in the New Mexico desert and the other in the Chilean Andes—has led to exciting new discoveries bearing on some of the most fundamental questions in astronomy, from the expansion rate of the universe, to the evolution of the Milky Way, to the lifecycle of stars. It has been a successful effort, and over two decades SDSS has become one of the most cited surveys in the history of astronomy.

What is less obvious about Kollmeier and her collaborators, however, is how much time they spend looking, not upward at the mysteries of stars and nebulas, but inward at the practice and community of astronomy itself—and at who gets the opportunity to explore those mysteries in the first place. The statistics on that front are troubling. In 2022, US universities awarded 204 PhDs in astronomy or astrophysics. Of those 204, only 16 self-identified as Black or Latine. That is just 8 percent from groups that make up 33 percent of the total US population. "An average astronomy program graduates fewer than one underrepresented minority scholar per decade," Kollmeier says.

So, in 2015, with support from the Alfred P. Sloan Foundation, SDSS launched a new initiative designed to help bring more Black and Latine students into the field. Dubbed FAST (short for Faculty and Student Teams), the initiative has a simple and common-sense premise: if you engage students early and in a compelling way in the actual practice of astronomy, some of them will end up becoming astronomers. FAST makes grants to astronomy labs around the country to hire undergraduate students to help with real astronomy projects, working on data collected by SDSS telescopes. Colorado College astronomer Dhanesh Krishnarao, who was tapped to run the FAST program, says that though slots at FAST-funded astronomy labs are open to any student regardless of race or ethnicity, they are particularly compelling to those students the field has historically had trouble attracting. "The FAST program helps in two ways: by providing funding for students and by giving them access to real data and real research environments. Often, underrepresented students do not have the financial or social support to gain that experience," says Krishnarao.



Priscilla Holgiun Luna, FAST program graduate, stands in front of the Sloan Foundation telescope at Apache Point Observatory in New Mexico.

> **"An average astronomy program graduates fewer than one underrepresented minority scholar per decade."**

That was exactly the case for Priscilla Holguin Luna, a Latina undergraduate at California Polytechnic State University who received a FAST stipend to work in the lab of astronomer Louise Edwards. In Edwards' lab, Holguin Luna was tasked with pulling together a sample of galaxies from SDSS data to use in the study of how galaxies move, grow, and brighten over time. The FAST grant allowed her to focus on astronomy instead of her finances. "A huge part of why this project was so awesome," she says, "was that [FAST] paid me for the research I did during the summer. I didn't have to work any other jobs."

Though the stipend is crucial to allowing students to participate, Edwards stresses that the real impact lies in the contact with astronomy itself. "It is well-documented that early research experiences give students that feeling of 'Yes, I am a scientist!'—a sense of belonging to an academic community." Students are engaged not in busy-work but actual science. "It is real, publishable work," Edwards noted.

Data are still being collected on the effects of the FAST program, but initial results are encouraging. Since the program's inception, FAST grants to teams around the country have supported a total of 70 students. Of those 70, 10 students from underrepresented ethnicities have already opted to pursue graduate degrees in astronomy. That may seem small, but when the entire United States awards astronomy PhDs to only 16 underrepresented scholars each year, 10 PhDs moves the needle.

One of those 10 is Priscilla Holguin Luna. After her experience in Edwards' lab, she decided to pursue a PhD in astronomy at the University of New Mexico. She is scheduled to graduate in 2025.

Located in the mountains outside Cloudcroft, New Mexico, Apache Point Observatory is the site of the Sloan Foundation telescope (pictured, left).

Growth Opportunity

In classrooms across New York City, this nonprofit is planting seeds in the newest scientific minds.

New York City elementary school students care for their plants grown using a classroom hydroponic system.

Atop the Javits Center in Manhattan's Hell's Kitchen sits one of the nation's largest rooftop farms. Its 6.75 acres are home to manicured rows of leafy greens, an apple orchard, honeybee hives, and—on a sunny spring day in May 2023—991 New York City students from 35 public schools across the five boroughs. Normally, a situation involving a thousand children surrounded by a million bees would be cause for concern, but this is cause for celebration. These kids are budding scientists and they've spent the last year immersed in hydroponic farming, growing plants in nutrient-rich, water-based solutions. And now they've gathered to present their findings.

This event is the culmination of a year of hands-on science education made possible through New York Sun Works, an Alfred P. Sloan Foundation-supported non-profit that builds innovative hydroponic labs in schools to teach the science of sustainability through urban farming. For almost 20 years, NY Sun Works has partnered with schools in underserved communities to deliver high-quality science education—and inspire the next generation of environmental innovators.

"We believe deeply in the power of hands-on learning," says Manuela Zamora, Executive Director at NY Sun Works. "By bringing nature into the classroom, we're helping students develop a deeper connection to the natural world, inspiring curiosity and environmental stewardship, and preparing students to tackle the pressing challenges of sustainability and climate change."

NY Sun Works has developed comprehensive curricula to make the most of these indoor farms at every step of the educational process. From elementary school to high school, students learn to master hydroponic farming from seed to harvest, blossoming into fully-fledged farmer-scientists who care for growing seedlings, and the hydroponic systems that support them, throughout the academic year. The curricula also serve as a dynamic vehicle for delivering core scientific content in biology, chemistry, and ecology.

By the time students reach high school, they are running experiments, formulating hypotheses, and tinkering with variables like light and water to explore their effects on plant growth. The NY Sun Works curricula integrate with existing science lesson plans and meet all city- and state-mandated course requirements. The time spent in NY Sun Works labs, for example, is formally recognized in fulfillment of the state's high school standardized tests.

NY Sun Works also provides ongoing support to teachers through weekly visits from a dedicated hydroponic specialist—to make sure the systems are working correctly and to guide teachers in operating and teaching with the equipment. They've now trained over 750 teachers running 250 hydroponics labs, ultimately reaching 122,000 New York City students. The majority of those students live outside Manhattan in New York's outer boroughs, and over 75 percent come from low-income communities.

"Inadequate access to high-quality science education is a pervasive problem across the United States, particularly for low-income and minoritized students," Zamora says. "We take a proactive approach to ensuring zip code, race, and socioeconomic status aren't barriers to receiving our program, and we work closely with district superintendents and local city council members to bring public funding to the schools and communities where it's needed most."

"Every child deserves a quality science education that ignites their curiosity and fosters a passion for discovery. We're working tirelessly to deliver that to every child in New York City."

Meet the Fellows

Since 1955, the Sloan Research Fellowships have honored the very best early-career scientists at a pivotal stage in their careers. Here are just a few of the 125 extraordinary researchers that make up the class of 2023 Sloan Research Fellows.

Shane Campbell-Staton

Earth System Science

Animal evolution in the age of the Anthropocene

Humans aren't just the products of evolution, we're also a cause of it. As we move into and alter ecosystems to better suit our own purposes, we create new evolutionary pressures—pressures that require adaptation by other species, often in profound ways.

Shane Campbell-Staton is exploring the ways in which animals are evolving in response to human behavior. He has cataloged how lizards in cities across Puerto Rico have rapidly evolved to tolerate warmer temperatures, enabling them to better endure intense urban heat. In a study of ivory poaching in Mozambique, Campbell-Staton found that tuskless African elephants were five times more likely to survive than their tusked relatives, resulting in a dramatic and rapid increase of tuskless individuals in the population. This change is likely much more than aesthetic. The genes Campbell-Staton found to be associated with tusklessness regulate elephant tooth growth, which may change what the elephants eat and how they behave in their environment – changes which may have cascading consequences that impact the entire African savannah ecosystem.

Manasi Deshpande

Economics

Optimizing social safety net programs for disadvantaged communities

Manasi Deshpande has a passion for bringing empirical evidence to contentious economic policy debates. Pouring over the fine print of records at the Social Security Administration, she uncovered a policy change that introduced a discontinuity in Supplemental Security Income (SSI) payments. Minors born after a specific date would have their payments discontinued on their 18th birthday. Minors born before that date would continue receiving payments as adults.

This arbitrary cut-off allowed Deshpande to rigorously analyze what happens when people lose their SSI. She found that a few got jobs to replace lost SSI income, but many turned instead to income-generating criminal activity, like theft, prostitution, and the sale of illicit drugs. The crime response was so significant, she found, that the government lost nearly as much in enforcement and incarceration costs as it gained through saved SSI payments, a finding with big implications for the design of social safety net programs.

Roya Ensafi

Computer Science

Protecting billions of users from internet censorship and surveillance

Roya Ensafi attributes her passion for an open internet to her childhood in Iran, a country where the governing regime often clamps down on public discussion of its policies. This led her to a tough problem: detecting internet censorship by governments and particularly those governments that work hard to conceal their censorship by limiting researcher access to data.

In a series of innovative breakthroughs, Ensafi showed how, by analyzing the subtle impacts select messages have on a computer network, an outsider can detect when communication is being restricted. These insights led to her founding of Censored Planet, the world's first global censorship observatory. Since its 2018 launch, Censored Planet has detected and documented previously invisible censorship practices in Kazakhstan and Russia, has garnered media attention from watchdogs and activists the world over, and has quickly become an indispensable tool in the fight for an open internet.

Brian Liau

Chemistry

Decoding the epigenome's role in human health and disease

We know that the *epi*genome—chemical markers on the genome that don't change its DNA sequence—is an important regulator of gene expression, heritable across cell division, and implicated in diseases ranging from birth defects to diabetes. The epigenome is critical to understanding the genome, although many of its precise biological roles remain unresolved.

Brian Liau is the very definition of an interdisciplinary researcher. He is melding methods from his chemistry training with genomic technologies typically used in biology to make important strides in our ability to probe the human epigenome. Dubbing this new crossover discipline "chemical genomics," Liau has combined chemical inhibitors with CRISPR-based genome editing tools to mutate proteins directly in a cell, enabling him to identify mutations associated with drug resistance and cancer cell proliferation. Liau's methods hold immense promise for advancing our understanding of the epigenome and, in time, for developing new therapies to treat human disease.

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