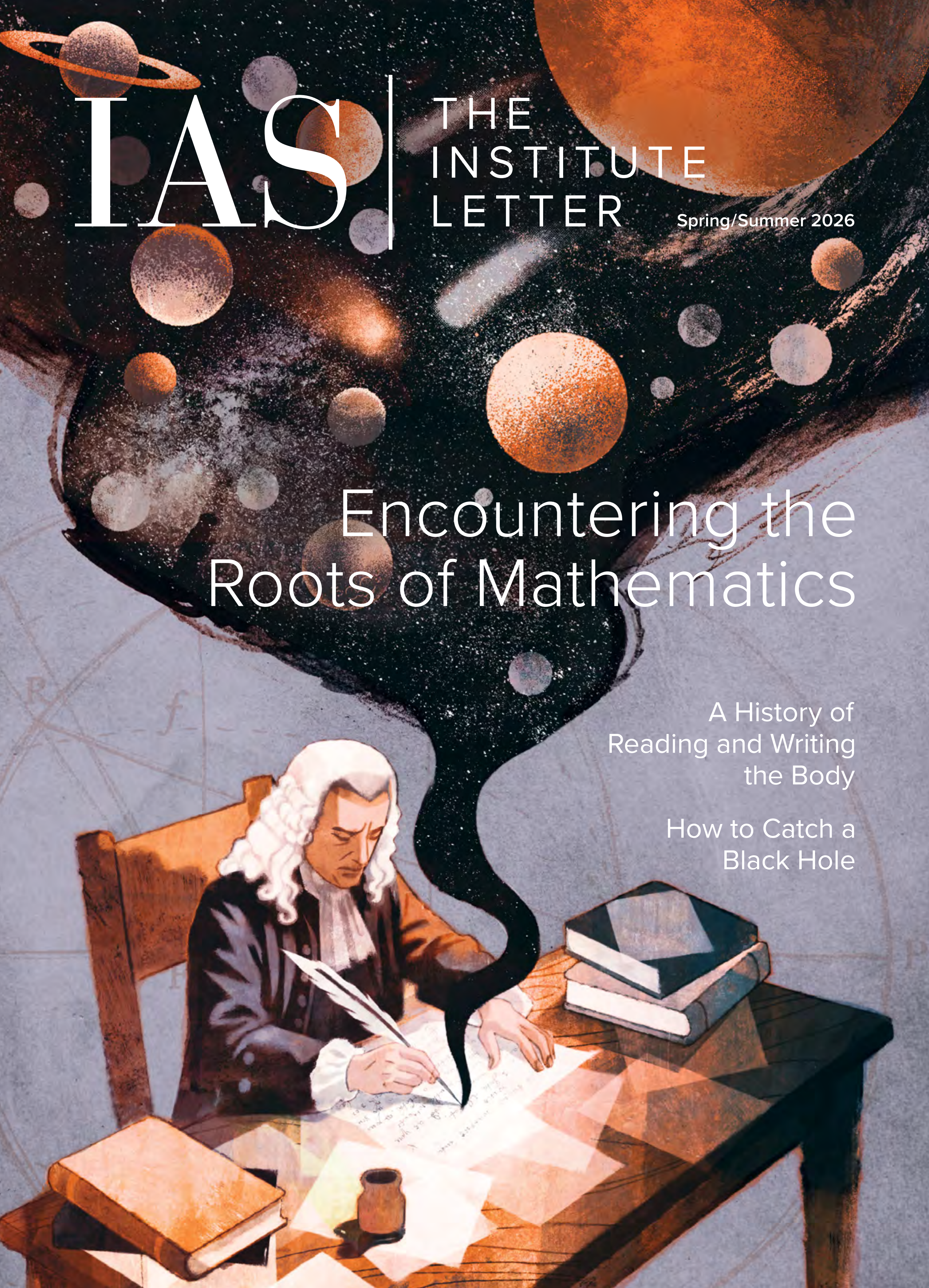
IAS | THE INSTITUTE LETTER

Spring/Summer 2026

Encountering the Roots of Mathematics

A History of Reading and Writing the Body

How to Catch a Black Hole



THREADS OF CONNECTION

Early in 2026, Dominique Borel, daughter of Armand Borel, Professor (1957–2003) in the School of Mathematics, donated a tablecloth of embroidered signatures to the Institute's Shelby White and Leon Levy Archives Center. The Borel family had a tradition of hosting dinner guests and having them sign their names on the cloth, which were later stitched in by Dominique's mother (and Armand's wife), Gabrielle. This cloth not only represents the eclectic group of guests that met at the Borels' to talk and think together, but also embodies the unique network that makes up the Institute's community. Turn to page 32 to learn about some of the many signatures stitched into the cloth.

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Spring/Summer 2026

The Institute for Advanced Study is a leading center for theoretical research and discovery dedicated to advancing the frontiers of knowledge across the sciences and humanities.

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Cover Image
Isaac Newton, digital illustration with hand-drawn textures, depicts the English polymath at work as ink from his pen transforms into planets and deep space, reflecting the moment when scientific discovery expands into a broader understanding of the cosmos. **Kevin Howdeshell** is a Kansas City-based illustrator specializing in narrative-driven work that combines digital processes with hand-drawn textures. He has illustrated more than 30 children's books, including *Pine Cone Regrown* (Sleeping Bear Press), selected for The New York Public Library's Best Children's Books of 2025.

Inside Front Cover, Inside Back Cover, Back Cover
Maria O'Leary

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The Institute for Advanced Study forms a vital synapse in the global collective intellect, a space where disparate sparks of inquiry ignite into borderless discovery.

This intellectual gravity defies even the elements. In January, the Abel Prize Committee pressed through swirling snow and travel chaos, gathering in Simonyi Hall to select the 2026 laureate. Afterward, attendees enjoyed the warmly anticipated Abel Symposium, featuring talks by Karen Uhlenbeck, Distinguished Visiting Professor in the School of Mathematics, and Hong Wang, Member (2019–21) in the School.

In March, that same magnetic pull drew scientific vanguards from Germany, Taiwan, and the U.S. to campus for the kick-off conference of the Max Planck-IAS-NTU Center (MPC) for Particle Physics, Cosmology, and Geometry. Supported by the Institute's Nelson Center for Collaborative Research, this event launched a cross-disciplinary effort to shatter silos and decode the universe's most elusive secrets at all scales.

The Synaptic Institute

Yet the Institute's curiosity does not merely extend to the stars; it is equally devoted to untangling earthly realities. To this end, March also saw acclaimed sociologist and economist Juliet B. Schor deliver the School of Social Science's Lecture on Public Policy. Her talk pierced the digital veil of the "gig economy," exploring whether algorithmic management offers true flexibility or merely a new architecture of exploitation.

The current of ideas flowed further into April, when another conference wove together an international tapestry of scholars to mark the upcoming retirement of Didier Fassin, James D. Wolfensohn Professor in the School of Social Science. Participants engaged with Fassin's transformative contributions—from his groundbreaking work on moral anthropology to his illuminating studies of policing, migration, and public health—highlighting how his scholarship has fundamentally impacted our understanding of power, inequality, and ethical life.

Whether decoding the cosmos or deciphering human morality, the Institute stands as an intellectual junction where these vibrant convenings act as currents, leaping between the disciplines and connecting to form the profound.

Cultivating Enduring Connections

Q&A with Pablo J. Boczkowski

Pablo J. Boczkowski, Member (2023–24) in the School of Social Science, came to IAS to take part in the School's theme year, "PLATFORM." Boczkowski has since returned to his home institution of Northwestern University—there, he serves as the Hamad Bin Khalifa Al-Thani Professor in the School of Communication—but he carried back with him the enduring experiences, and especially relationships, formed during his time at the Institute. This Founders Day, Boczkowski will return to campus to give a book talk on his recent work *The Patina of Distrust: Misinformation in a Context of Generalized Skepticism*, published in October 2025.

Q Describe your favorite walk on campus.

A The trail from the apartment I stayed at (211 von Neumann Drive, I think) until its very end, passing through the campus and continuing.

Q What surprised you most about the Institute?

A The unwavering commitment to the pursuit of knowledge in the most profound and passionate ways.

Q When taking your tea at IAS: inside or outside?

A Outside, whenever possible!

Q What was the most interesting conversation you had at lunch or at teatime?

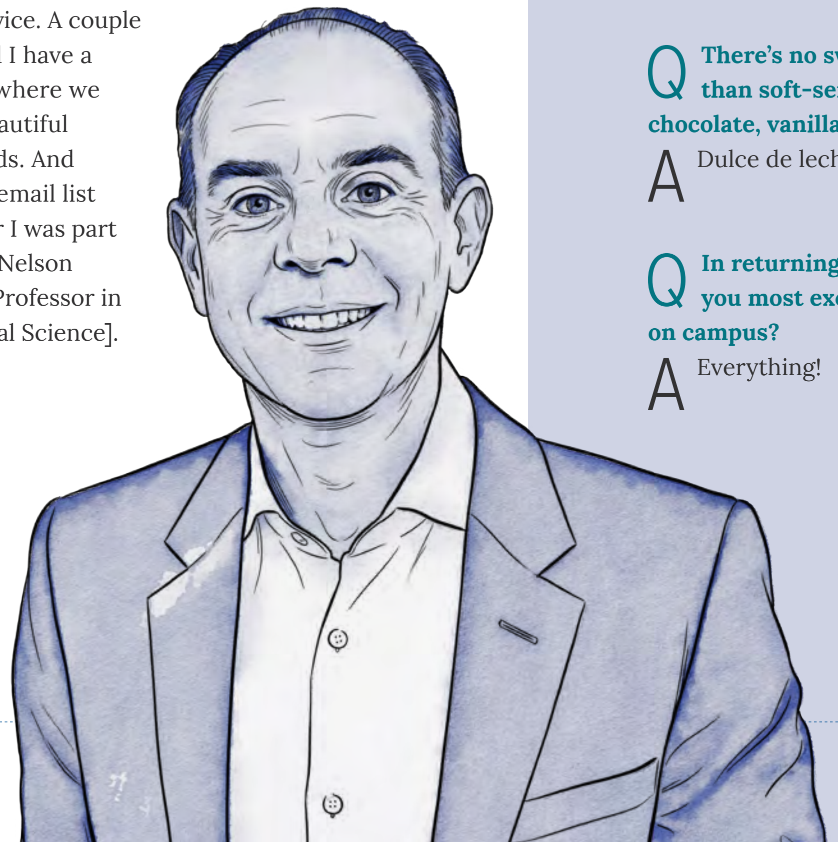
A I had many such conversations; IAS is the ideal place for that. But if I had to choose one, I'd say a chat about the "ills of deregulation" with Wendy Brown [UPS Foundation Professor in the School of Social Science].

Q What's the best question another scholar asked you about your work?

A The book project I worked on during my year at the Institute was entitled "Digital Freud." Technology is central to it, to the point that it moved to the background in some parts of the account. One day, I was telling Didier Fassin [James D. Wolfensohn Professor in the School of Social Science] about the book and he asked me: "Where's technology in your story?" An invaluable reminder that what the author might take for granted, the reader will not!

Q Have you continued any of the relationships you established while you were at the Institute?

A Yes, several of them. I have a few local colleagues that I continue seeing, and with one of them, Natacha Nsabimana [Wolfensohn Family Member (2023–24) in the School of Social Science], we read each other's book manuscripts-in-progress and give feedback. Joan Scott [Professor Emeritus in the School of Social Science] has been truly generous by offering to read my manuscript and providing her always-superb advice. A couple of soccer fans and I have a WhatsApp group where we talk about the "beautiful game" on weekends. And there is an active email list for the theme year I was part of, led by Alondra Nelson [Harold F. Linder Professor in the School of Social Science].



Q If you could bottle one "IAS condition" that helped your thinking (e.g., time, quiet, community, resources), what would it be?

A Aspiration to greatness, hands down. It really empowers you and challenges you to do your very best.

Q You serve on the Board of AMIAS,[1] which works to sustain the Institute's mission of supporting discovery. What motivated you to get involved?

A To stay connected with this gem of an institution and add my two cents in helping it grow and evolve.

Q If you could be on a Founders Day panel with any IAS scholar past or present, who would you choose?

A Clifford Geertz [Professor (1970–2006) in the School of Social Science]. His work was incredibly inspirational for me when I was a student back in Argentina.

Q There's no sweeter Founders Day tradition than soft-serve ice cream! But which flavor: chocolate, vanilla, or swirl?

A Dulce de leche, always, as a dutiful Argentine!

Q In returning for Founders Day, what are you most excited to do once you're back on campus?

A Everything!

[1] The Association of Members of the Institute for Advanced Study (AMIAS) counts all accepted, current, and former IAS scholars—more than 8,000 individuals worldwide—among its membership.

Maria O'Leary

IAS ON Instagram

In anticipation of Founders Day 2026, the Institute's Instagram page recently looked back at one of the highlights of last year's programming: a series of ten-minute book talks delivered by IAS Members past and present.

Topics ranged from the history of South Africa's gold mines and the reception of a Latin novel to the participation of beagles in twentieth-century science—representing a true showcase of the varied and vibrant research that happens at the Institute every day.

This year, a series of brand-new book talks are set to spark even more dialogue at Founders Day.

For the latest campus updates, news, and snippets of daily life, scan the QR code to follow @instituteforadvancedstudy on Instagram.

Discovery in the Doing

The Institute has long been home to unconventional forms of discovery—and thinkers who rely on methods beyond textbooks, notes, or blackboards to uncover new understandings of the world around them. From anthropologists navigating physical ruins to historians tracing the history of techniques of capturing human movement, many IAS scholars rely on an active, often tactile engagement with the world. For these researchers, discovery is not a sudden "eureka" moment: it is a deeply iterative and practice-based pursuit.

This animating force is evident in the arts, too: this spring, the campus has been set alight by a series of musical programming titled "The Art of Collaboration." The slate of events, at turns experimental and classical, includes a number of lecture demonstrations that pair exposition with live performance, modeling how knowledge can emerge through the act of doing.

In this installment of Campus Conversation, scholars from the Institute's Schools of Historical Studies and Social Science discuss what discovery through process means to them. Through reflections on the intersection of their work and craftsmanship, practice, performance, and the arts, these thinkers illuminate the thrilling range of what the pursuit of knowledge can look like—and the many wells from which insight can spring.

Maria O'Leary

"Hands-on research is what I find most exciting about being an anthropologist. Fieldwork is a permanent source of surprises, challenges, and thought-provoking experiences that can change the whole direction of your research. A good example is my fieldwork in northern Argentina for my book Rubble*, which taught me to look at ruins differently: not as dead objects from the past, but as part of the living and contemporary senses of place of the people living around them. The conceptualization of ruins as rubble that I developed in the book emerged from memorable fieldwork experiences that helped me unlearn my own assumptions about what 'a ruin' is."*

– Gastón Gordillo, Wolfensohn Family Member (2025–26), School of Social Science

"Focusing on discovery through process undermines the idea that what we know, or what we can do, results from moments of individual insight. One way that has played out in my work is in the recognition that collaborations between chemists and glassblowers were essential to chemistry's nineteenth-century development. I identified the importance of glassblowing in chemistry by studying print and manuscript sources. But collaborating with a master scientific glassblower, Tracy Drier, transformed my understanding of how working in glass impacted chemistry, opening new historical questions about skill, lab safety, and the interaction between innovation and standardization that is crucial to science. Together, Drier and I have brought scientific glassblowing to notice, not just as a historical craft but as a living tradition that remains essential today."

– Catherine Jackson, Elizabeth and J. Richardson Dilworth Member (2026), School of Historical Studies

"I'm now a historian of science and technology, but I spent my formative years in a ballet studio. Though movement is often thought of as natural or unmediated, my dance training made me viscerally aware of the many methods by which movement patterns are actively created. It also attuned me to why the methods of that construction matter, not just to the individual, but also to society at large."

– Whitney Laemmli, Member (2023–24), School of Historical Studies

"My project, titled 'SEI,' developed with the phenomenal guitarist Kaki King, built on the constraints, creativity, and unique processes that live within collaboration. It became a story about collaboration told through collaboration—exploring the physical tension and possibilities between two guitarists. We wanted our body movement, together and apart, to shape the narrative and dictate the music. Constantly rethinking how to approach and strum the guitar in new ways, we also played sixteen guitars at once like 'athletes,' which created the intense track 'Circuit.' Practicing from opposite corners of the room, back-to-back, we searched for ways to sync sound and motion, allowing every idea to move us forward. From that beautiful openness and freedom emerged our language of 'SEI.' This is a hands-on experience and collaboration grounded in attention to our bodies, dedicated freedom, and attention to synchronicity."

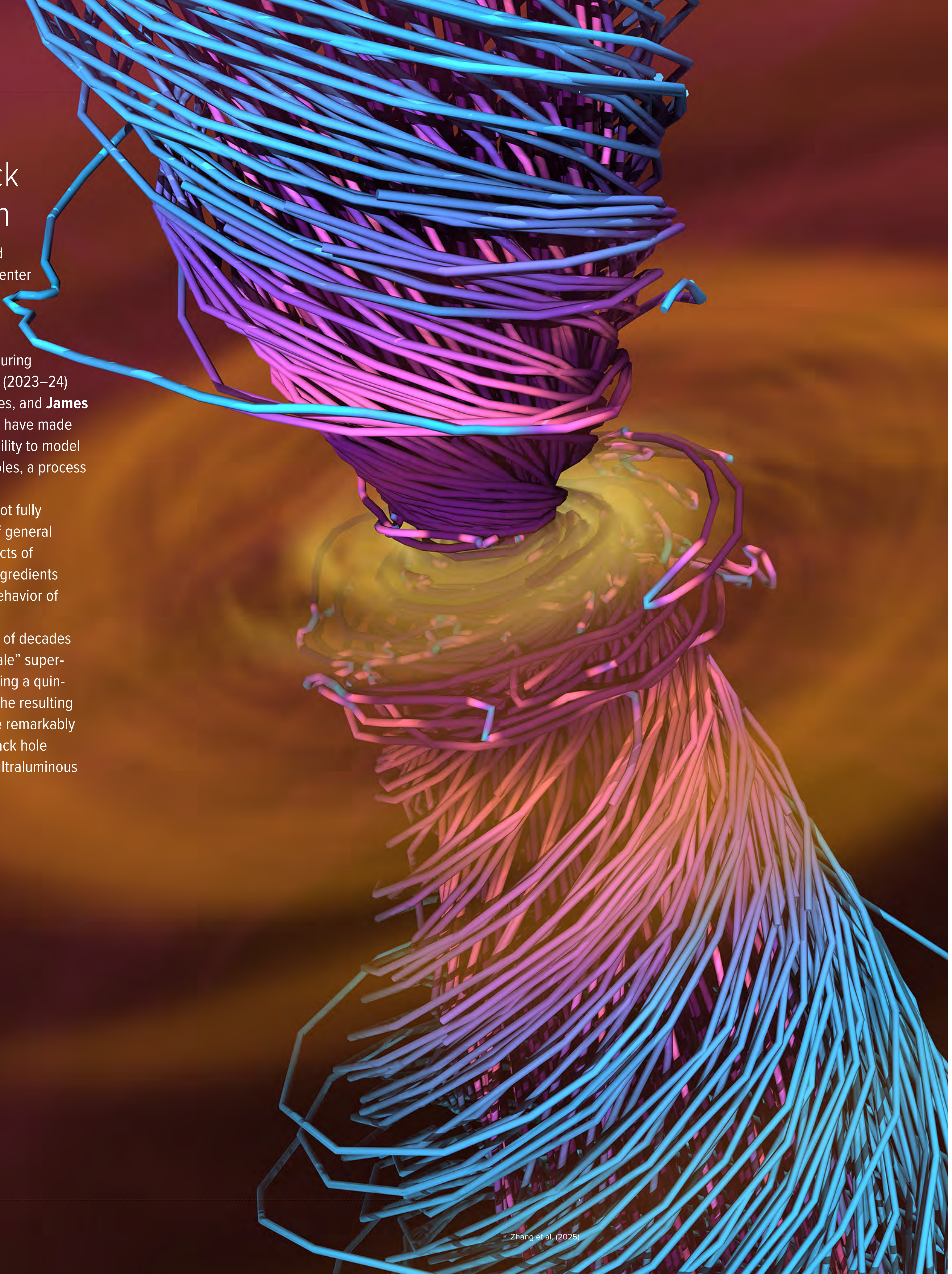
– Tamar Eisenman, Visitor (2025–26), School of Historical Studies

"I research the production process of ancient Greek ceramics through long-term observation in the workshops of contemporary potters and vase painters who recreate ancient Greek shapes.

Timing is central in ceramic production: potters must carefully coordinate the creation of individual components—such as the foot, rim, and handles—to ensure even drying and optimal attachment. This timing depends on form and seasonality. As they move through each stage, the potters consider the drying periods required for clay slips of varying consistencies. Since ceramics production operated on a large scale, effective time management also meant producing one shape in batches and carrying out the same forming or decorating step across multiple pieces rather than completing one vessel from start to finish before beginning another. This technologically and economically driven approach to project organization has significantly influenced my own research perspective, recognizing that ancient potters were not only skilled artists but also savvy entrepreneurs."

– Eleni Hasaki, Hetty Goldman Member (2025), School of Historical Studies

Modeling Black Hole Accretion



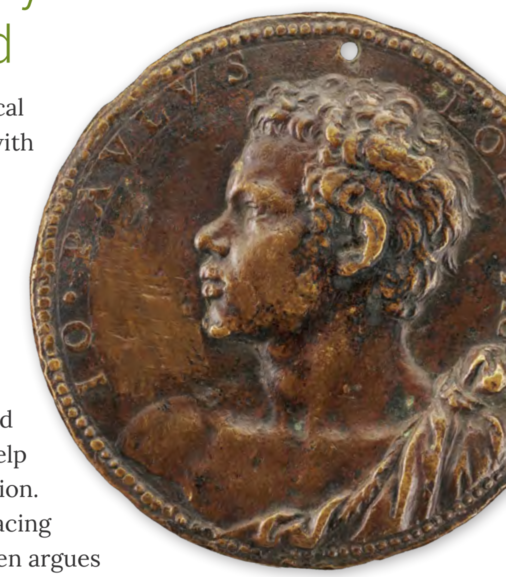
Zhang et al. (2025)

Researchers from IAS and the Flatiron Institute's Center for Computational Astrophysics, including **Lizhong Zhang**, who began working on the project during his first year as an IAS Member (2023–24) in the School of Natural Sciences, and **James Stone**, Professor in the School, have made a major advancement in our ability to model the flow of matter into black holes, a process known as black hole accretion.

Previous simulations did not fully incorporate Einstein's theory of general relativity together with the effects of radiation—essential physical ingredients for realistically capturing the behavior of accreting black hole systems.

The new model, the result of decades of work, employed two "exascale" supercomputers, capable of performing a quintillion operations per second. The resulting simulations can now reproduce remarkably consistent behaviors across black hole systems seen in the sky, from ultraluminous X-ray sources to X-ray binaries.

Disability as Authority in the Early Modern Period



In early modern Europe, as today, physical and mental disabilities were often met with ableism—prejudice that made it difficult for disabled writers to claim credibility and authority. In *Crip Authority: Disability and the Art of Consolation in the Renaissance*, written during her time at IAS, **Elizabeth B. Bearden**, Felix Gilbert Member (2022–23) in the School of Historical Studies, shows how disabled authors resisted this ableism with the help of an ancient, respected genre: consolation.

Consolatory texts comfort people facing hardship, including disability, but Bearden argues that, in the Renaissance, they also operated as a practical rhetorical toolkit. Works by Cicero and Seneca, for instance, provided Renaissance writers with strategies for coping with impairment and societal scorn; they abound in examples of ancient people with disabilities, creating a sense of community with the past. Disabled writers' engagement with consolation transforms disability into a source of "military, spiritual, political, and, most importantly [...] writerly authority," a practice Bearden names "crip authority."

The book treats the Latin, Italian, Iberian, and English traditions. For instance, it opens with the Renaissance poet Petrarch, whose dialogues *Secretum* and *De remediis utriusque fortunae* disclose and provide comfort for mental and physical disability—the *De remediis* being a hugely popular consolation text for audiences from the Americas to the Ottoman Empire. It goes on to discuss "Sor Teresa de Cartagena, a Deaf Spanish nun from a prestigious family of *conversos* (Spanish Jews who converted to Christianity)," who adapted biblical and classical consolation to reframe her disabilities as spiritual advantage and defend herself against ableist accusations of plagiarism. The book ends with the blind painter-theorist Giovanni Paolo Lomazzo's discussion of portrait medals that console or represent blindness to demonstrate how disability reshapes Renaissance aesthetics—especially Mannerism and sensory dimensions of art theory.

By recovering these narratives and their consolatory tactics, Bearden ultimately "crips" the Renaissance itself, placing disability at the center of canonical literary history.

Obverse of a bronze portrait medal depicting Giovanni Paolo Lomazzo, made after 1571. Creative Commons License Zero, Samuel H. Kress Collection. Courtesy National Gallery of Art, Washington, DC (1957.14.1036.a).

The Limits of "Close Enough"

Many important computational problems involve optimization: finding the best schedule, the shortest route, or the most efficient allocation of resources.

A foundational achievement of theoretical computer science—the Probabilistically Checkable Proofs (PCP) Theorem of the early 1990s—showed that for a broad class of such problems, not only is finding an exact solution computationally infeasible (known as NP-hard), but even finding a good approximate solution can be difficult to prove.

In 2002, **Subhash Khot**, Member (2003–04) in the School of Mathematics, proposed the Unique Games Conjecture (UGC), which, if true, shows that, for a vast family of optimization problems, the best-known algorithms are already optimal and good approximate solutions can be considered NP-hard. The conjecture became one of the most important and hotly debated open questions in the field.

This April, Khot and **Irit Dveer Dinur**, Betsey Lombard Overdeck Theory of Computing Professor, alongside their School of Mathematics collaborators **Dor Minzer**, Member (2018–20); **Shmuel Avraham Safra**, Member (2004–05); and **Guy Kindler**, Member (2004–05), won the National Academy of Sciences's Michael and Sheila Held Prize for work which represents the most significant advance toward resolving Khot's conjecture.

In a series of papers culminating in 2018, the recipients proved the 2-to-2 Games Theorem, a closely related variant of the UGC. Beyond providing strong evidence that the full conjecture is true, the theorem has direct consequences for fundamental problems including vertex cover and graph coloring.

Beauty and the Bastion

In a new book completed during his IAS Membership (2023–24) in the School of Historical Studies, **Morgan Ng** reconsiders the Italian Renaissance through unexpected, monumental works of art: urban fortifications. *Form and Fortification: The Art of Military Architecture in Renaissance Italy* shows that ramparts and citadels were not merely instruments of war but laboratories through which sculptors, painters, architects, humanists, and military commanders tested new ideas about geometry, construction, and the shape of the city itself.

Ng maps the exchanges between defense, garden design, hydraulics, and courtly display.

By analyzing drawings, archival manuscripts, printed treatises, and built works—from Michelangelo and Leonardo to Francesco Paciotto—Ng maps the exchanges between defense, garden design, hydraulics, and courtly display. His key notion of "cognate technologies" illuminates how earthworks echoed terraced landscapes, artillery chambers resembled grottoes and tunnels, and fortified corridors evolved into palatial galleries.

The study restores military architecture to the center of Renaissance creativity, revealing how protection and beauty advanced together, and offers a fresh vocabulary for reading walls as both technical and artistic-cultural artifacts.

Archaeology and its Ambitions

During his most recent visit to the Institute, **Daniel J. Sherman**, Member (1993–94; 2016) in the School of Historical Studies, was interested in "unearthing"—in more than one sense of the word—and its politics. *Sensations: French Archaeology between Science and Spectacle, 1890–1940*, published in 2025, is one artifact of that historical digging.

In the book, Sherman examines the impact of French cultural and intellectual forces on archaeology at the precipice between the field's "heroic age" and its professionalization. He ultimately argues that archaeology, as we understand it today, is a legacy of the tension between archaeologists' desire for recognition and for scientific rigor.

Two French controversies ground this argument. The first concerns state-sponsored excavations in Tunisia, for which French directors of antiquities incurred the censure and critique of amateur archaeologists. The second centers on a debate over the authenticity of a purportedly groundbreaking Neolithic discovery in central France. Through detailed accounts of these disputes and the various media narratives that swirled around them, Sherman asks: "In what ways was archaeology legitimated, and for whom?"

"Critical histories" of archaeology are a relatively new phenomenon. In treating archaeology as an object of historiography—the study of how history is interpreted over time—*Sensations* makes a unique intervention, placing archaeology alongside other histories of scientific enterprise.


CE QUE LES SAVANTS ONT TROUVÉ DANS LES FOUILLES DE GLO

NOUS DISONS, EN PAGE 1, QUE LA COMMISSION INTERNATIONALE QUI S'EST RENDUE A GLOZEL POUR ENQUÊTER VIENT DE CONCLURE A L'AUTHENTICITÉ DU GISEMENT. ELLE AVAIT DÉJA FAIT PLUSIEURS DÉCOUVERTES INTÉRESSANTES DIMANCHE. VOICI : 1. MM. AOSCH HIMPERA, PILLAT ET L'ABBÉ SABRET AU TRAVAIL DANS UNE TRANCHÉE. DERRIÈRE EUX, MISS GAROD. — 2. M. PEYRONY EXAMINANT UN CAILLOU. — 3. MISS GAROD FOUILLE LA TERRE. — 4. L'IDOLE BRISÉE. — 5. LE PROFESSEUR FERRER EXAMINANT LE GALET SUR LEQUEL SONT TRACÉS QUELQUES SIGNES ET L'IMAGE D'UN CERVIDÉ

"Ce que les savants ont trouvé dans les fouilles de Glozel," *Excelsior*, 8 November 1927. Photographer unknown. Source: gallica.bnf.fr/Bibliothèque nationale de France.

(Psycho)Analyzing Conspiracy Culture

The book uses thinkers such as Freud, Adorno, and especially Foucault, to examine case studies including election denialism, public health resistance, and the far-right conspiracy theory QAnon.

In *Paranoid Publics: Psychopolitics of Truth*, **Zahid R. Chaudhary**, Member (2023–24) in the School of Social Science, brings psychoanalysis to bear on modern culture's fraught relationship to truth. Chaudhary contends that turning to psychodynamics—namely, the dynamic interplay of desires, compulsions, and the like that motivate individual and collective behavior—can help to unravel "the erosion of what we once took for granted" about truth and facts. Written during Chaudhary's time at the Institute, the book uses thinkers such as Freud, Adorno, and especially Foucault, to examine case studies including election denialism, public health resistance, and the far-right conspiracy theory QAnon.

As Chaudhary sees it, the agreed-upon story about these phenomena among liberals, that attachments to so-called "unreality" arise from political-economic reality, is too simplistic. According to this narrative, increasing inequality and the unfulfilled promise of upward mobility have produced a widespread sense of abandonment among the under-resourced majority, whose anger is then mutated by increasingly myopic and narrow media channels (for example, our ever-personalizing and inflammatory social media algorithms).

Paranoid Publics offers an alternative; that unconscious mental forces like our fears and memories might also inform attitudes about truth, and that the unconscious plays a role in political-economic processes. When wealthy, liberal women subscribers of Gwyneth Paltrow's lifestyle brand "Goop" and insurrection enthusiasts who follow Alex Jones purchase the same pseudo "health supplement," albeit under different names, Chaudhary identifies that the divergent groups of consumers are united by the same paranoid fantasy about a hostile external world. "Both companies offer their consumers psychic release conditioned on a notion of the body as a fortress under threat," he writes.

Rather than dismissing these collective forms of paranoia as mere delusion, Chaudhary challenges readers to ask whether they might "illuminate the social realities that give rise to them"—offering a new framework for under-standing our fractured political landscape.

TapTheForwardAssist, Wikimedia Commons

HOW TO CATCH A BLACK HOLE

BY ABBEY ELLIS

Andy Mummery might have had the talent for professional cricket, but fortunately for the field of astrophysics, he didn't quite have the attention span.

"I got too distracted," he says. "I'd wander off or get bored and try something new, which doesn't work all that well if you're trying to perfect a technique or, you know, catch a ball."

This wandering curiosity, however, is precisely what makes him an excellent scientist, and, in particular, a scientist who has been able to seize all of the opportunities that an IAS Membership has to offer.

Since arriving at the Institute, the John N. Bahcall Fellow (2025–30) in the School of Natural Sciences has not only been awarded two major grants to use the Hubble and James Webb space telescopes to study his astrophysical phenomena of choice, tidal disruption events, but has also branched out into an entirely new area, namely galactic dynamics.

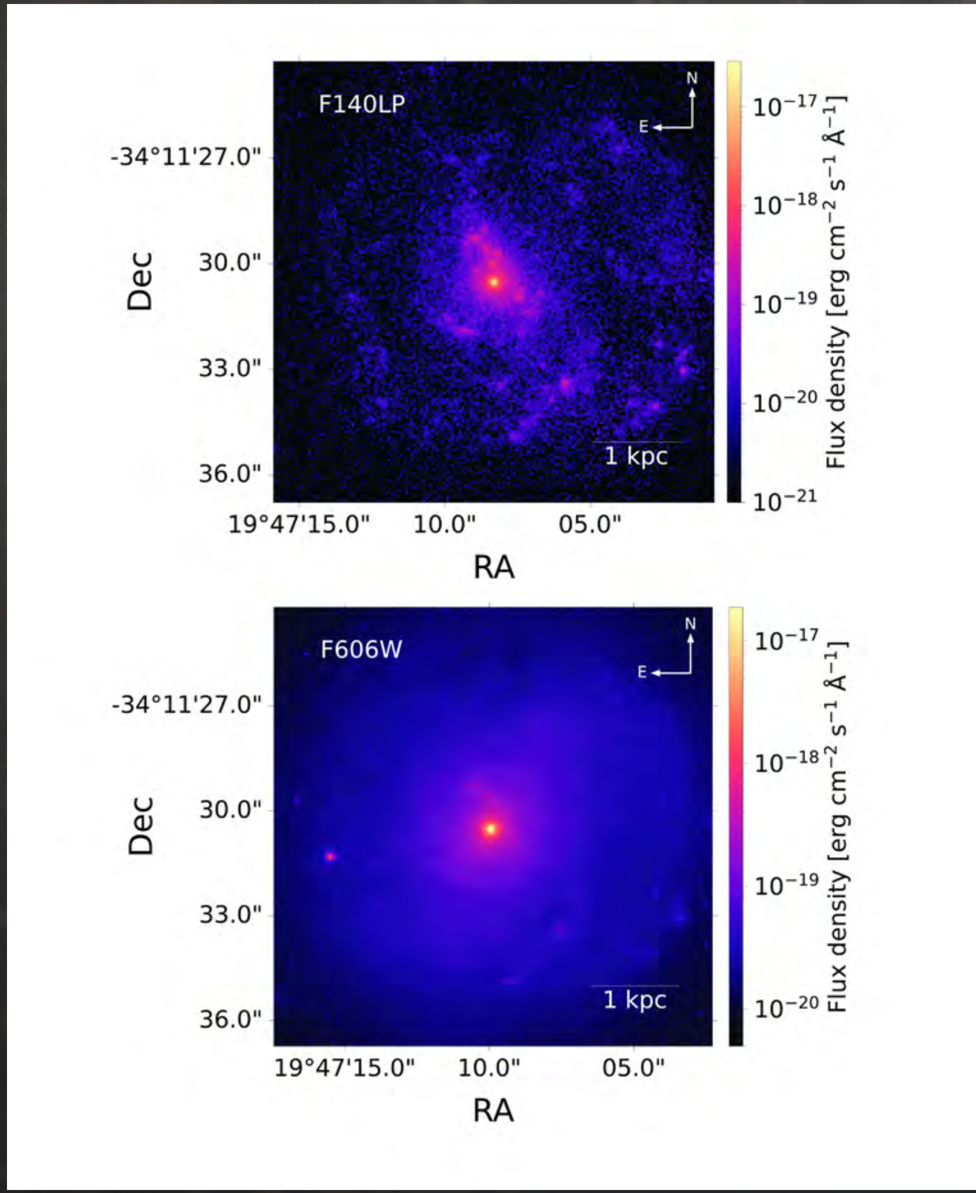
It is a fittingly expansive portfolio for a researcher who admits he has never been interested in small, fundamental scales. "I am just excited by big things generally," he says.

Yet, while Mummery is drawn to the massive *lengthscale* of the cosmos, the primary focus of his research—tidal disruption events, or TDEs—are unique precisely because they occur on a distinctly shorter *timescale* than is usual for astrophysical phenomena.

A tidal disruption event happens when a star wanders too close to a black hole and

Photography by Andrea Kane

Two images of a galaxy known as GSN069 viewed through two different wavelengths of light, as captured by the Hubble Space Telescope. Analysis of this galaxy conducted by Mummery and his colleagues indicated that GSN069 hosts a compact, viscously expanding accretion disk likely formed after a TDE.



Muryel Guolo

gets ripped apart. The shredded star creates an accretion disk of swirling gas moving at extremely high speeds around the black hole. The disk produces a bright flare of light that briefly lights up a formerly dark region of space. While typical supermassive black holes evolve over millions of years—a timeframe Mummery jokingly describes as "not as interesting, because I'm not going to live a million years!"—a TDE shreds a star in about a day, and the resulting luminosity from this process evolves over a period of just months or years. For Mummery, this provides a rare, fleeting window to watch the universe's largest objects actively change within a human lifetime.

TDEs also map onto Mummery's own path through spacetime—the field is effectively the same age as he is—and their scientific appeal is therefore deeply personal. While TDEs as a phenomenon were predicted by theorists in the 1970s, the first class of TDEs was discovered by X-ray telescopes in the 1990s. Mummery himself was born in 1996. In fact, he can literally mark his own date of birth on their luminosity charts.

Since those early days, his coming-of-age as a scientist has mirrored the field's technological explosion. "It's a quirk of when I was born and when the optical surveys took place," he says. "I started my Ph.D. in 2018 when there were fewer than ten known TDEs. We're now at maybe 100 to 200, depending on who you ask. But by the end of my time here at IAS, we should have thousands. There's only one time that this exponential growth in data will happen and being around that is very exciting."

The primary engine driving this incoming explosion of data is the Legacy Survey of Space and Time (LSST), recently switched on at the Vera C. Rubin Observatory in Chile. For Mummery, the sheer volume of information the LSST is poised to capture is staggering. "They're expecting to find one TDE an hour for a decade, which is about 80,000 to 100,000, a huge increase in data," he says. However, this deluge of data brings its own immediate challenges.

"On the first night they switched it on, I think there were about 50,000 alerts of 'something's gone flash in the sky!'" he says. "Loads of them are asteroids. Loads of them are supernovae. There's about one TDE in a galaxy for every 100 supernovae. So it becomes a problem of, sure, the telescope will have seen one TDE an hour, but can I pick it out of this monstrous stream of other data?"

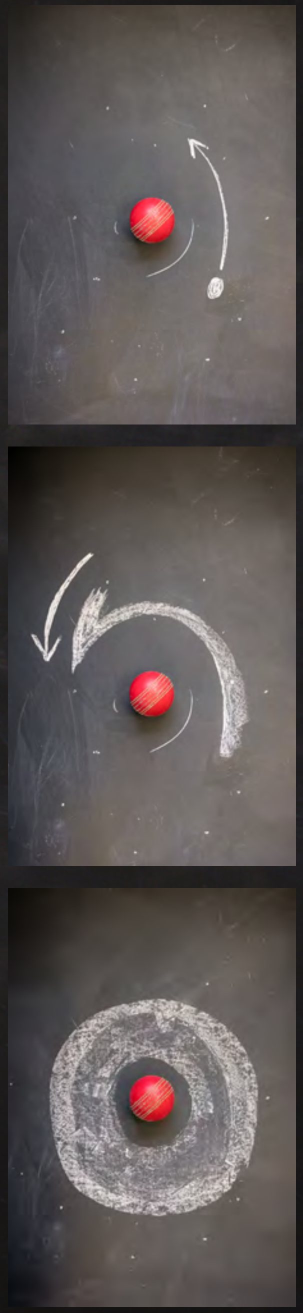
Locating a TDE is what Mummery calls a classic "needle in a haystack" problem, one that he describes himself as "pleased that I don't have to work on!" Happily, other scientists are actively trying to filter the data using machine learning. If they can successfully sift through the noise, the scientific payoff will be revolutionary. Identifying tens of thousands of TDEs might finally allow astrophysicists to answer fundamental questions about the demographics and evolution of black holes.

Currently, scholars know about relatively small stellar-mass black holes in our galaxy, which are tens of times the mass of the sun, and the supermassive giants at the centers of galaxies, which start at around a million solar masses. But as Mummery explains, there is a glaring, unexplained gap in the middle.

"It's like if you looked around at people and you saw babies and adults, you would guess that there were children and teenagers in between, but we don't seem very good at finding them," he says.

TDEs are currently the best way to probe for these hidden "intermediate-mass" black holes.

But how can you tell how massive a black hole is from a TDE? That's where Mummery comes in. His process starts with a fixed set of observational data gathered by telescopes, which record exactly how bright a TDE flare was on specific days across various wavelengths of light, including red, blue, UV, and X-ray. Mummery then uses his pen-and-paper models to make



During a tidal disruption event (TDE), a star wanders too close to a black hole—represented here by a cricket ball. The black hole's gravity pulls the star in and begins stripping away its matter. Over time, the gas from the shredded star forms a swirling accretion disk around the black hole, producing the brilliant flare of light that defines a TDE.

predictions based on variable parameters, calculating how bright the flare should have been on those specific days for a black hole of a certain size. Using sophisticated statistical frameworks, such as Bayesian and Markov Chain Monte Carlo (MCMC) methods, he identifies the differences between his theoretical model and the real-world data. By tweaking the theoretical parameters to make that difference as small as possible, Mummery finds the model that draws a line closest to the observed data points, thereby revealing the mass of the black hole.

If, using these methods, Mummery can use the new data from LSST to map out a continuous spectrum of black hole sizes, it will finally reveal the evolutionary links between the "baby" black holes and the "adults"—perhaps solving the mystery of how supermassive black holes formed in the early universe. "And *that's* why we should care about TDEs," he says.

But Mummery isn't going to stop there. He is also using different instruments, highly targeted observations using the Hubble and James Webb space telescopes, to answer other lingering questions about how TDEs operate.

For a long time, scientists expected a TDE to flare and fade within about a year. However, through their theoretical accretion disk models, Mummery and his colleagues realized that the shredded stellar material struggles to lose its angular momentum, causing the glowing disk to persist much longer than was initially thought. To find out exactly how long they stick around, they were awarded time on the Hubble Space Telescope to check in on the class of TDEs discovered by X-ray telescopes in the 1990s. Because the question is a simple binary—is the disk still glowing 30 years later, yes or no?—the telescope only needs to take a picture.

Meanwhile, his time on the James Webb Space Telescope is dedicated to a different mystery: TDE candidates that appear to flash from the middle of nowhere. For a TDE to occur, a black hole needs a star to rip apart, meaning there should be a cluster of stars present. Yet, with some intermediate-mass black hole candidates, current instruments see nothing but a massive flash seemingly coming "just from the vacuum of space," explains Mummery.

He suspects that these black holes might just be surrounded by a

Finding interesting answers to complex astronomical problems is exactly what prompted Mummery to branch out into a completely different area of astrophysics during his time at IAS: galactic dynamics.

very small number of faint stars, which he hopes James Webb's highly sensitive instruments will finally be able to detect.

"But if the flashes really are coming from the vacuum of space, then it's an even bigger mystery," he notes. For Mummery, coming up empty-handed would be just as thrilling as finding the missing stars. "Whatever we see, it'll be an interesting answer," he says.

Finding interesting answers to complex astronomical problems is exactly what prompted Mummery to branch out into a completely different area of astrophysics during his time at IAS: galactic dynamics.

The shift came about through a new collaboration with his IAS colleague Chris Hamilton, also a John N. Bahcall Fellow (2021–26) in the School of Natural Sciences. As Mummery tells it, "Chris and I are from a similar part of the world. We've been educated at similar places, come from all the same groups, but somehow never really bumped into each other much before I came here."

They quickly bonded over a shared scientific philosophy. Like Mummery, Hamilton is a theorist who prefers to tackle complex astrophysical problems, in Mummery's words, "carefully and properly, using pen and paper," rather than relying on massive numerical simulations.

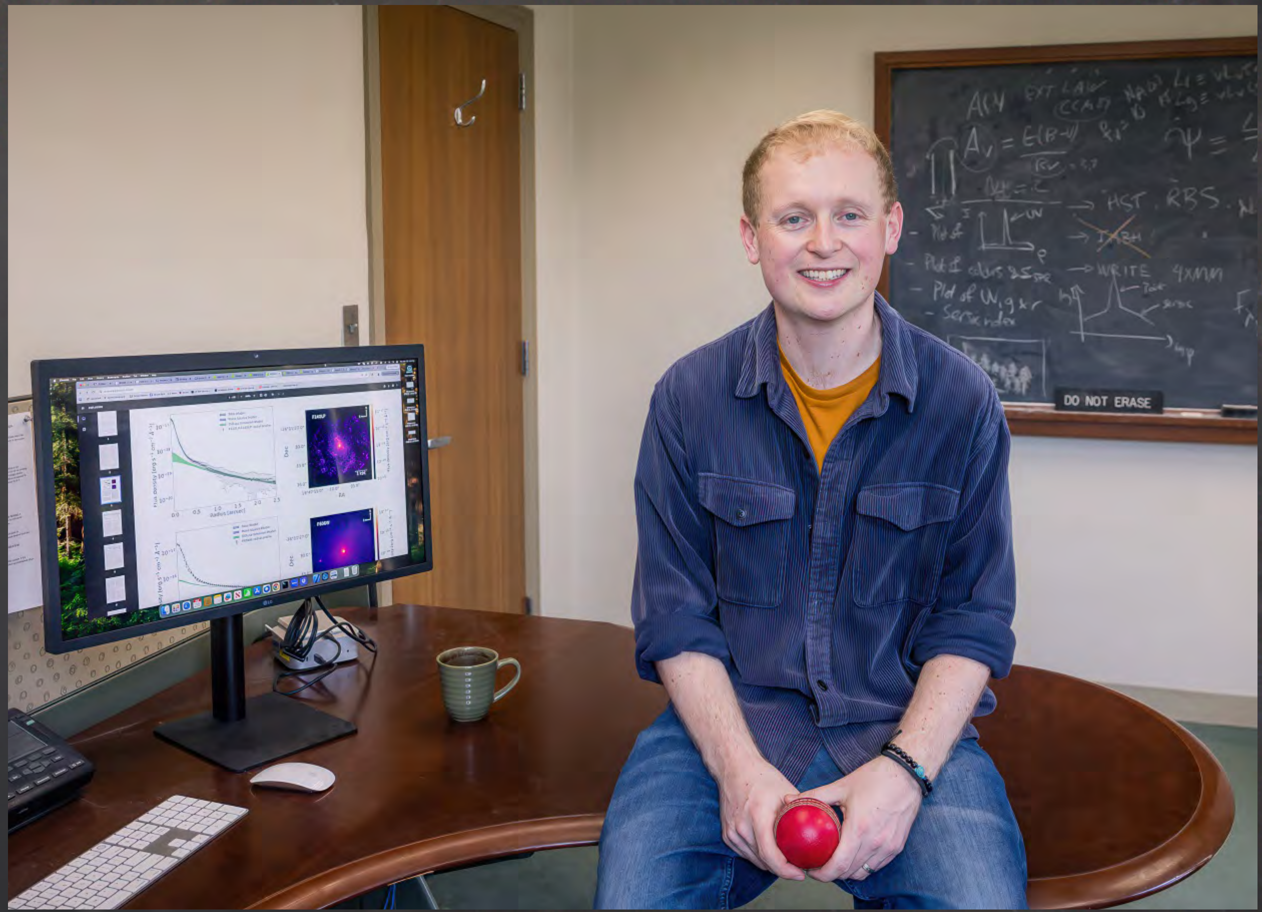
Having seen Mummery successfully build statistical frameworks to fit his theoretical TDE models to telescope observations, Hamilton proposed a collaboration. He wanted to know if Mummery's toolkit could be applied to the wealth of data that has been gathered by the Gaia Space Telescope. In particular, he was searching for the origin of a famous ripple in the motions of stars around the Milky Way.

While a shredded star and the massive structure of a galaxy seem entirely unrelated, the two problems share a remarkably similar structure. In both cases there is a signal, a flash of light in Mummery's case, a galactic ripple in Hamilton's. And, in both cases, the theorists believe they know roughly what is causing that signal. Mummery's are the consequence of a star being torn apart, while Hamilton's hypothesis was that the Milky Way stars were shunted by a large spiral arm of stars and gas a few hundred million years ago, causing the ripple that we still observe today. But neither of them could pin down the *precise* parameters of their systems of interest. Just as Mummery was working to identify the precise mass (as well as the spin) of the black holes that were crucial to the tidal disruption events, Hamilton needed to identify key parameters for his system, such as how tightly wound the galactic spiral was, how long it lived, and exactly when it perturbed the galaxy.

Mummery helped Hamilton to formulate his problem in such a way that the same statistical toolkit used to explore TDEs could be applied to the galactic question. The statistical framework they employed allowed them to search over large numbers of possibilities and find the one that fit the data best.

The result? The pair, who conducted their study alongside Joss Bland-Hawthorn of the Sydney Institute for Astronomy, concluded that short-lived spirals, probably with around two arms, perturbed our galaxy around 400 million years ago. This conclusion is an important piece of the puzzle in deducing the history of our galaxy.

Mummery is optimistic about what's next, especially for TDEs. "I think as a community, we've got to a really good point where we understand the basics. We definitely don't understand everything about these problems, but we don't understand nothing. And



Mummery is optimistic about what's next, especially for TDEs. "I think as a community, we've got to a really good point where we understand the basics. We definitely don't understand everything about these problems, but we don't understand nothing. And we're just about to go into the world of big data."

we're just about to go into the world of big data. And I think we've done really well to get ourselves to a point where we can start to exploit this. I think it's going to be a big few years."

It is a future that will rely heavily on his unique brand of pen-and-paper theory—which is exactly where he intends to stay. While visiting the new LSST observatory in Chile might sound appealing, he jokes that for everyone's sake, he should probably stick to the theory. "I hope they wouldn't let me anywhere near it," he laughs. "I can do data but I can't do experiments. You don't want to be the guy who knocks something over."

Mummery may never have had the attention span to perfect his wicket-taking technique, but as it turns out, his restless curiosity made him perfectly suited to catch something much more elusive: a black hole lighting up in the dark.

Encountering the Roots of Mathematics

BY ALLYN JACKSON

Illustrations by Kevin Howdeshell

In the 2025–26 academic year, the Institute's School of Mathematics hosted an unusual seminar. Titled "Mathematical Folklore," the seminar centered on readings of historical works that originated concepts standing at the heart of mathematics today. The goal was to reach beyond the technical thickets that surround modern mathematics and reconnect with the vital roots that have nourished the field.

The weekly seminar was led by Akshay Venkatesh, Robert and Luisa Fernholz Professor in the School of Mathematics, and Govind Menon, Erik Ellentuck Fellow (2025–26) in the School and professor in the Division of Applied Mathematics at Brown University.

The seminar was born of "the need to revitalize the humanistic part of mathematics, the idea of mathematics as a humanistic discipline," said Venkatesh. That idea "has never vanished, but it's diminished, at least in the outward practice of mathematicians."

As mathematics research has become increasingly specialized and technical, its connection to the elemental stuff of human experience has been obscured. With artificial intelligence poised to accelerate this trend, said Venkatesh, "we really need to look at the human aspect of what we are doing."

ETERNAL QUESTIONS

The seminar provided a forum for mathematicians to encounter fundamental ideas and modes of thought unadulterated by later developments in the field. While the seminar readings required considerable mathematical background, the discussions tended toward the philosophical rather than the technical. Big questions about the nature of thought, intuition, and knowledge arose spontaneously.

In addition to Menon and Venkatesh, the seminar participants included several IAS scholars, from within the School of Mathematics and without. Among them was Alma Steingart, Robbert Dijkgraaf Member (2025–26) in the School of Social Science; also occasionally joining the group was Myles Jackson, Ernst and Elisabeth Albers-Schönberg Professor in the History of Science in the School of Historical Studies. Taking part regularly were three freelance writers: myself, Evelyn Lamb, and Leila Sloman.

But most of the participants were young mathematicians, mainly IAS Members with a sprinkling of graduate students from nearby Princeton University, whose idealism and open-mindedness leavened the discussions. Michael Chapman, Member (2025–26) in the School of Mathematics, initially thought the seminar might be a "pat on the back" affair in which mathematicians gush about how wonderful and important their own field is. Instead, he said, "it was a serious intellectual activity." He was a frequent and active participant.

Readings ranged over original writings from the sixteenth century up to the present, together with profile articles, expository pieces, and correspondence. In their encounters with thinkers of the past, the seminar participants pondered questions about the nature of mathematical knowledge, the sources of mathematical inspiration and intuition, and where the field might go in the future.

“UNLEARNING” NEWTON

[T]he thoughts of pure mathematics are true, not approximate or doubtful; they may not be the most interesting or important of God’s thoughts, but they are the ones that we know exactly. **—Hilda P. Hudson**

An engineering major before he moved into mathematics, Govind Menon has, in some sense, been studying the work of Isaac Newton (1642–1727) for 35 years. But when, in the seminar, he read excerpts from Newton’s *Principia Mathematica*, he found himself “unlearning” what he thought he knew. “I felt I was seeing the material for the first time,” said Menon. He experienced it as an encounter with the thoughts of another human being, a “kindred spirit.” That experience is just what the seminar was intended to foster.

Historians have produced a rich literature examining the life and work of Newton. A tiny sliver of that literature provided enriching background for the seminar readings, as did illuminating comments by Myles Jackson and Alma Steingart. But the mathematicians in the seminar were seeking something complementary to historical knowledge: a mathematical communion with Newton.

One of the readings this spring explored Newton’s derivation of Kepler’s laws of planetary motion. Although Newton developed calculus in the *Principia*, his treatment of Kepler’s laws is based not on calculus but on Euclidean geometry. Assuming centripetal force acting on the planets, he uses ratios, similar triangles, and parallelograms to construct the curved paths of the planets. From this he deduces the “inverse-square law” of gravitation, which describes planetary motion.

The seminar participants noted that, in contrast to modern treatments, one can feel physical reality in Newton’s writings. Students today are taught that the planets move in the way they do because they obey Newton’s inverse-square law. Newton’s derivation goes the opposite way: Kepler’s data about the motion of the planets led Newton to his law. Seminar participants found Newton’s approach to be “clear, simple, straightforward.” By contrast, many modern approaches feel “industrialized,” “ultra-processed,” and unconnected to the primal notions at the core of the field.

Alongside the Newton readings, the seminar explored a thimbleful out of the ocean of writings of Gottfried Wilhelm Leibniz (1646–1716). Leibniz and Newton independently developed calculus around the same time; it was Leibniz who created the better notation, which is still in use today. The contrast between the two thinkers was palpable in the readings. Newton strived for unifying explanations of many different phenomena, whereas Leibniz sought a symbolic, algorithmic approach that he believed could be adapted to solve all kinds of problems.

Leibniz had a dream of building a *calculus ratiocinator*, which would resolve any dispute by using symbols to calculate a rational solution. Perhaps an echo of his dream is present in today’s AI chatbots, whose answers to mathematical queries are starting to become trustworthy and knowledgeable, even insightful.

The theme of religious belief as inspiration arose in the seminar readings of Kepler, Leibniz, Newton, and several others. Although he is not religious, this theme resonated with Asvin G., Member (2025–26) in the School of Mathematics. He said that, in some sense, the greatest challenge in research is believing that there is a possibility of understanding the world, and that belief is not so different from religious belief. “Whenever I think about why I do science, it seems audacious to think that I, as a little individual human, can set out to understand the world and have any hope of succeeding,” he said. “But, also, it seems so beautiful and so magical that I have to try.”

RIEMANN: A NEW CONCEPTION OF GEOMETRY

Experience remains, of course, the sole criterion of physical utility of a mathematical construction. But the creative principle resides in mathematics. In a certain sense, therefore, I hold it true that pure thought can grasp reality, as the ancients dreamed. **—Albert Einstein**

Early last fall, the group read an 1854 lecture by the young Bernhard Riemann (1826–66), which changed the course of mathematics. The lecture, part of Riemann’s habilitation at the University of Göttingen, was delivered before a small audience that included Carl Friedrich Gauss (1777–1855).

Through his extensive investigations of surfaces in three-dimensional space, Gauss had invented what became known as Gaussian curvature, thereby launching the field of differential geometry. His monumental *Theorema Egregium* showed that curvature is intrinsic to the surface; in other words, curvature depends only on measurements done on the surface and is independent of how the surface is placed in the surrounding three-dimensional space.

Riemann’s lecture gave a profound generalization of the *Theorema Egregium*. He conceived of surfaces as abstract geometric objects, or manifolds, independent of any surrounding space, and extended this conception to include manifolds of any dimension. He showed that, once one has a way to do measurements on a manifold, one can define curvature, and that curvature is intrinsic to the manifold. In this conceptual leap, he expanded what geometry could be.

By this time, the primacy of Euclidean geometry as the single true geometry of our world was being questioned. Riemann’s work showed definitively that there is not one geometry, but infinitely many. His ideas propagated across mathematics, blossoming into the area known as Riemannian geometry. This conceptual leap turned out to be exactly what founding IAS Professor (1933–55) Albert Einstein needed to formulate his theory of general relativity.

Riemann’s lecture was not an easy read for the seminar participants, and its challenges were compounded by infelicities of translation from German into English. Nevertheless, the participants could feel the power of the work, calling it “fresh” and “timeless,” with “awe-inspiring” intuition.

Riemann explored fundamental questions about the nature of space and what unites geometry. He mused on how, in a world dominated by the discrete, one can conceive of continuous spaces (he proposed color as an example). He had no “headline theorem,” as is typical in modern mathematics papers, and used very few symbols. His work is ambiguous and philosophical. “What can we learn from this?” asked Asvin G. “What have we lost in becoming more rigorous and more axiomatic?”

Venkatesh mentioned his own "long and tragic relationship with curvature," a notion he'd never understood deeply. In Riemann's work he found a beauty, clarity, and richness lacking in modern treatments that aim at precision and efficient delivery of material. Because it was written in natural language and did not resort to technicalities, the insights in Riemann's work remain accessible more than a century and a half after it was written.

A FRAMEWORK FOR THE FUTURE

I desire to know fervently what math is all about. Like everyone I am much interested in the meaning of existence. **—Norman E. Steenrod**

The seminar spanned a range of themes and thinkers, from the celestial spheres of Kepler and the geometry of Descartes to Einstein, Mach, Maxwell, and Wiener on the theory of atoms and random motion. It further examined the work of John von Neumann, Professor (1933–55) in the School of Mathematics, on the brain; and David Mumford, Member (1962–63, 1981–82) in the School, on "the age of stochasticity."

Some lighter readings, including mathematics popularizations chosen by science writer Evelyn Lamb, focused on more-modest figures, such as amateur mathematician Marjorie Rice. A 1970s homemaker with five children, Rice got hooked on polygonal tilings of the plane through a *Scientific American* article by legendary mathematical expositor Martin Gardner. Rice discovered a host of new tilings that professional mathematicians didn't know about. Working on her kitchen counter in between household tasks, she invented her own ingenious notation that distilled information about properties of polygons and allowed her to organize and analyze them. In her story, the seminar participants found an inspiring example of the mathematical spirit.

For one seminar session, Alma Steingart chose a collection of Depression-era letters exchanged by Norman E. Steenrod and Raymond L. Wilder, Member (1933–34) in the School of Mathematics. When the correspondence began, Steenrod was 22 years old and struggling to scrape together enough money to attend graduate school in mathematics. Wilder had been his undergraduate teacher at the University of Michigan. In June 1934, Steenrod wrote to Wilder:

"I don't like simple and elegant proofs. And I don't think anyone else does. They fool you completely. They have to be memorized thoroughly before they stick. But a straightforward, hammer-and-tongs proof is the kind that appeals and is most easily remembered. For this is the way anyone would go about the proof—not the most elegant way."

These sentiments were something of a surprise, as Steenrod became well known for his highly abstract work in algebraic topology. The seminar participants read some of his papers, including a classic work from the 1940s, in which he and Samuel Eilenberg developed axiomatic homology theory.

The Steenrod–Wilder letters touched many seminar participants. Menon said, "To get to know Steenrod as a person, in his own voice, as he went from raw undergraduate working at a tool shop, to becoming increasingly sophisticated, to becoming a luminary in mathematics, really brought home the importance of looking at original sources."

One session was devoted to artificial intelligence: Constantin Kogler, Member (2025–27) in the School of Mathematics, chose as readings four recent preprints by mathematicians who had used AI tools. One of the papers presented a collection of problems designed to challenge AI and reported on the results, while the other papers discussed problems for which AI either found a solution on its own or had contributed substantially to a solution. The intense and wide-ranging discussion surfaced a host of questions. Will mathematicians gravitate towards problems suited to solution by AI? Will AI influence, or overtake, human mathematical intuition? Will chatbots replace collaborators? Will AI set the course for the mathematics of the future?

Such questions weigh on the mathematical community, especially on its youngest members. No easy answers came out of the seminar. However, in providing mathematicians an opportunity to step back and ponder their field—its origins, its wellsprings, and its meaning—the seminar offered a framework for considering its future.

The seminar might not continue in exactly the form it took this year, but Menon and Venkatesh are thinking about ways to keep its spirit alive. The moment feels urgent. As Menon put it, "We are facing a battle for the soul of our discipline."

A History of Reading and Writing the Body

BY EMMA EATON AND GENEVIEVE LOOBY

"Come up with an improvisation that uses *light weight* and *quick speed* with a *bound movement flow*," Whitney Laemmli, Member (2021–22) in the School of Historical Studies, might have been instructed during her years of formal training in dance. Laemmli didn't recognize this language as the legacy of the Austro-Hungarian expressionist choreographer Rudolph Laban—who had ties to both utopian artist colonies and fascist performances of "Aryan" identity—until she began work on *Making Movement Modern: Science, Politics, and the Body in Motion*, a book she published this spring with the University of Chicago Press.

Written during Laemmli's time at the Institute, *Making Movement Modern* examines the history of a movement visualization technique called "Labanotation." Much like musical notation, Labanotation appears glyphic to an untrained eye, simultaneously imaginative and highly systematic. It takes its name from Laban, who, in 1928, imagined a way to transcribe dance and choreography on paper. Over the next nine decades, this system and its permutations would find their way out of dance studios and into factories, hospitals, military training grounds, and robotics labs.

Tracking Labanotation's strange migration from Weimar-era political rallies to British factory floors and American corporate management, Laemmli's book illustrates how the quest to chart human movement fundamentally reshaped how we view the body: not just as a vessel of expression, but as a technology to be analyzed, optimized, and controlled.

From left to right: Helen Priest Rogers, Judy Bissell, Barbara Hoenig, Irmgard Bartenieff, Maria Nicholson, Lucy Venable, and Els Grelinger of the Dance Notation Bureau.

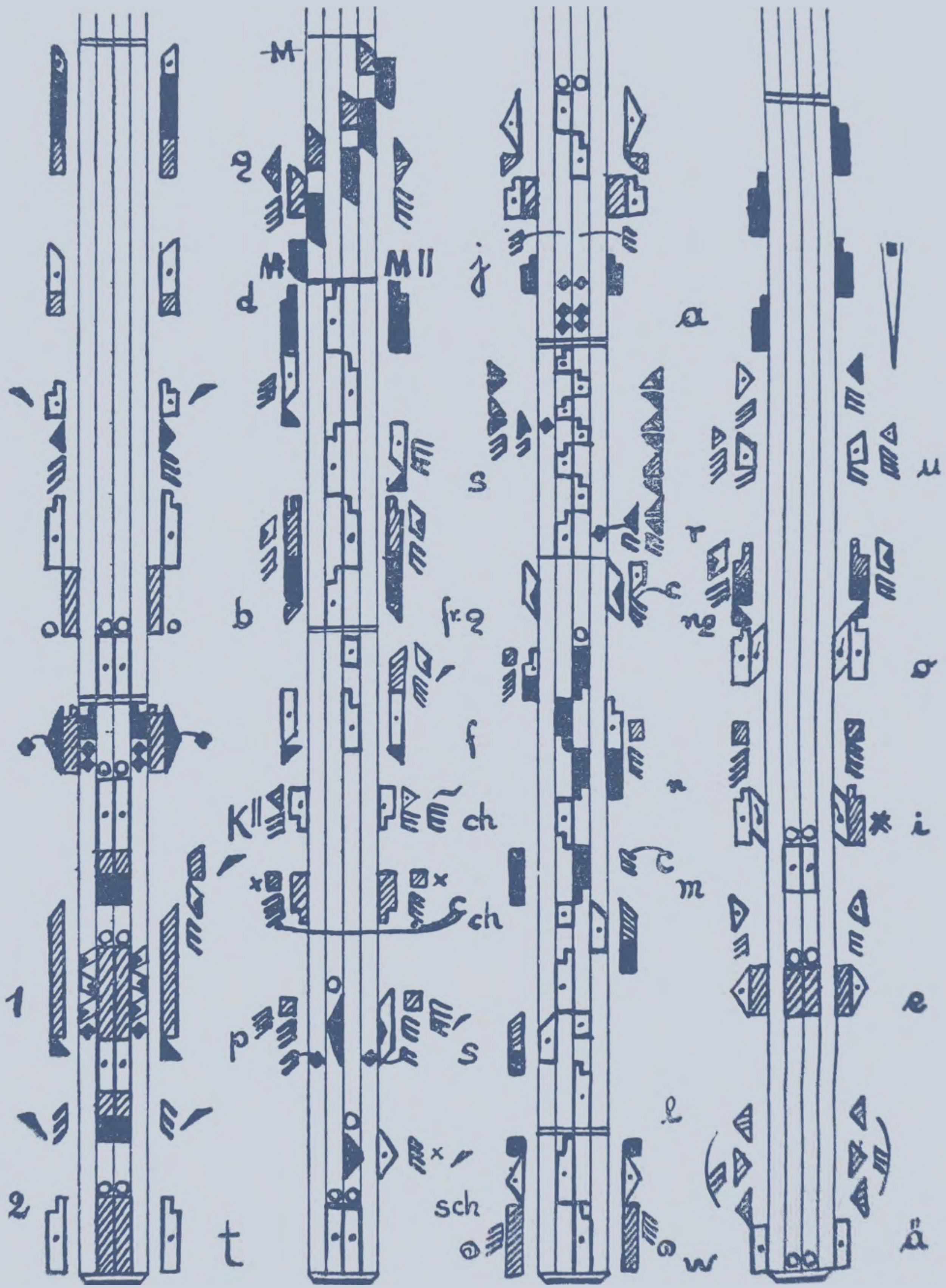
Courtesy of the Dance Notation Bureau and the DNB Collection at the Lawrence and Lee Theatre Research Institute at the Ohio State University.

DANCE AS SOCIAL AND SPIRITUAL TOOL

Parallel to the strange paths the system took after its publication, Laban and Labanotation emerged out of a confluence of sociocultural forces as revealing as they are complex.

Born in 1879, Laban grew up the son of the military governor of Bosnia-Herzegovina and spent his youth at outposts and then military school before rejecting martial movement for artistic movement. Thus began what the book describes as "the distinctive intertwining of the romantic and modern, the artistic and militaristic, that undergirded both Laban's life and [Labanotation's] creation."

The following decades saw Labanotation—and the desire to master human movement it represented—shapeshift across borders and vocations. Soon after the notation system's publication in Weimar Germany, Laban and his new technique were commissioned for use in "movement choirs," a practice in which dozens or hundreds of participants were taught a sequence of motion to be performed in concert. In the German artistic scene of the early twentieth century, new forms of physical exploration (like eurhythmics, bodybuilding, and gestural theater) and cultural phenomena (like cabarets) were flourishing. Premised on unity and collective feeling through simultaneous movement, these choirs made Labanotation into a tool for "stirring the spirit on a mass scale." When, after 1933, all such choirs came under control of the state, their aims—molded by Nazi ideals—became about solidifying a racialized national identity.



When Laban emigrated to England in 1937, his ideas about transcribing movement came with him. However, instead of charting the bodies of dancers, Labanotation was poised as the solution to another kind of body: that of the industrial worker. There, Laemmli describes, the "notation went from a tool for fortifying German national identity to a mediator of British working life."

When it arrived in the United States via the Dance Notation Bureau (DNB), a New York-based organization that aimed to popularize Laban's system, the original philosophical and nationalistic goals of the notation were stripped away. The DNB wanted to turn the fluid, subjective art of dance into pure, objective data. By writing a dance down in standardized symbols, a choreographer in New York could, in theory, send a score to a ballet company in London, and the dancers could recreate the dance's exact movements without ever seeing the original creation. Labanotation's journey across the Atlantic also saw the creation of a new kind of worker, the (overwhelmingly female) dance notator—and a collision between human movement and the information age's preoccupation with data.

Fittingly, this link found its way into the postwar corporate world, in the form of management consulting: the emerging concept of "body language" and Laban-inspired supervision of movement were ideologically joined to sell a system that purported to read and analyze individuals' physical habits. Employees' bodies (more specifically, their "movement profiles") held the key, so the theory went, to their professional abilities and dispositions.

At the same time, Laban-derived methods were applied to access truths about what were considered atypical or dysregulated bodies—those of psychiatric patients, war veterans, and trauma victims. This would become "movement therapy," an incipient field animated by anxieties about how such pathologized bodies might "incubate" negative emotions and experiences.

Laemmli's book illustrates how the quest to chart human movement fundamentally reshaped how we view the body [...] as a technology to be analyzed, optimized, and controlled.

Making Movement Modern outlines, finally, the adoption of the technique by folklorists and anthropologists—especially a project helmed by Alan Lomax[1] titled "Choreometrics"—that aspired to observe, document, and preserve the whole of dance traditions across the globe. This endeavor had both archival and "activist" ambitions, locating in dance fundamental information about culture and identity.

TOWARDS A UNIVERSAL DANCE

Why was Laban—an experimental artist ostensibly attracted to the special authenticity of dance—so interested in rendering "the four-dimensional fleshiness of the moving body" in print, ossifying it into "something written, replicable, and universally valid"?

For one, Laban was preoccupied with affording dance—in particular, the new modernist forms of dance that interested him—a certain authority and permanence. Through Labanotation, dance, formerly ephemeral and dependent on a live audience, could be preserved over time, a form of knowledge like the written word. And all genres of dance would share a common vocabulary. In addition, Laban hoped, dance would become legible to institutions like universities. If human movement could be laid out and examined, it would become something comparable, replicable, able to be studied—something scientific.

[1] Alan Lomax (1915–2002) was an American folklorist, archivist, activist, oral historian, and ethnomusicologist best known for his work collecting field recordings of folk and blues traditions in the U.S. and Europe.

46. Langsamer werdende Beingeste, schnelle Übertragung; schneller
47. Langsame Übertragung, schnelle Gesten; schnelle Übertragung,
48. Gleichmäßige Übertragungen mit rhythmisch verschiedenen Ges

44. Schritt und Armgeste.

43. Gleichmäßig abwechselnd Schritt und Beingeste.

45. Rhythmisch verschiedene Schritte und Armgesten.

"It's been interesting working on this project," says Laemmli, "because on the one hand, I have a lot of critiques of what the effort to capture movement on paper entails and its attendant losses and oversights."

"On the other hand, movement, and dance in particular, is often feminized, racialized, and not taken seriously, and so, I also understand the desire to make movement legible and thus respectable in some way."

Another motive was Laban's belief in a connection between movement and the mind and soul. This idea wasn't Laban's alone: early twentieth-century psychologists and theorists increasingly suggested that physical movement and experience could shape human cognition. Controlling movement, and thus bodies, seemed a way to influence the human spirit, too. A system that prescribed movement uniformly would ensure, Laban theorized, that people would experience the right kinds of emotions, at the right time, in the right setting. This control was, for Laban, about building a community—more specifically, one in which members could feel joy, belonging, or recognition, but in a managed or prescribed way.

"I think part of what makes Laban appealing to so many people," explains Laemmli, "is the way he takes this desire for free-form expression, individuality, and human connectedness, and tries to control it from above. [He is] basically saying, 'you can have your cake and eat it too.'"

Laemmli points out that there is a discourse on dance—particularly modern dance—that casts it as an especially liberated form of movement. But all genres of dance have rules for the bodies of their performers, and organic-seeming motion is often part of a given style or choreography.

For Laban and his followers, the essence of a given dance was in the choreography, not any one dancer's interpretation of it. In this way, they saw dance as both universal and universalizing—it transcended the bodies of individual performers and had the power to unite those bodies.

THE POLITICS OF MOVEMENT RECORDING

Laemmli arrived at the questions that inspired her work early, and outside of academia: she was trained in ballet through college. "I came into graduate school very interested in the history of the body. I'm a dancer myself. It's something that I want to be preserved," she says.

"I don't think the effort to preserve and communicate movement is in itself problematic. I think the problems arise when the people who use it [...] believe in its absolute objectivity, or that nothing will be lost in its capture."

Historians of science are frequently concerned with the term *technology*, especially what fits within it. The discipline has, in the last several decades, "moved from thinking about technology as [...] large machines that go clank" to "anything that organizes realms of human endeavor," says Laemmli. Bureaucratic systems like the U.S. electoral college are technology; the cotton gin and the highway are technology; indeed all "ways of doing things that are in some sense codified" fit the definition.

And as a "technology like any other," Labanotation and Laban-based systems have "certain affordances, and certain flaws, and also certain politics." For Laemmli, keeping these politics in mind is the crucial thing.

"There are people working in dance, disability arts, and other forms of notation now who are interested in how we might use multiple modes of recording at the same time to highlight each system's particular strengths and weaknesses." These initiatives are even more important in the context of the other, less critically informed ways in which movement recording is being used today, such as computer-generated animations based on limited, Western movement repertories. *Making Movement Modern*'s epilogue addresses these modern versions of movement capture and control directly. And, as Laemmli writes, taking movement seriously also means recognizing the ways in which it can be used for both good and ill—how ecstatic forms of embodiment have also functioned as tools of social control.

BODIES, BODIES, BODIES

Laemmli is not yet finished with the physical body and our epistemic relationship to it. Her next project is likely to be a history of scientific and cultural "ideas about emotion and memory as embodied," especially "embodied in places other than the brain." *The Body Keeps the Score* by Bessel van der Kolk, which popularized the notion of trauma being "stored" in the body, is one instance in this history. But there are other figures Laemmli hopes to investigate: American biologist and animal psychologist James McConnell, for instance, who hypothesized a chemical basis for memory based on evidence gathered from so-called "cannibal worms."

Though the project is "still incipient," Laemmli knows her overarching research questions. How have people understood how the body is impacted by the world around it? What does the body retain that the mind is or is not aware of? And how and why has it felt important to study these phenomena?

For *Making Movement Modern* and this upcoming research both, Laemmli describes taking inspiration from sound studies, a highly interdisciplinary field concerned with the politics and history of "sound" as a concept. Crucially, scholars of sound center that which we might take for granted—listening, noise, and the like—and treat it as a site of academic inquiry. For thinkers across anthropology, architecture, science, history, and musicology, sound has become something worthy of theoretical and analytic study. "Sound studies have shown us how much really interesting work can arise when you turn your attention to a new object," Laemmli enthuses.

Movement as an object is young as far as academic studies go. Laemmli expects this to change: "Everyone has a body." And the moving human body, at turns problematic, manipulable, expressive, and utilitarian, is shaped by tides of power and history—just as the historical record is shaped by bodies in motion.

Tablecloth of Signatures

In 1952, mathematician Armand Borel arrived on campus for a two-year stay as a Member at the Institute. Borel, who in 1957 would become Faculty in the School of Mathematics, brought with him his wife, Gabrielle Aline Pittet-Borel. The couple met when Armand was completing graduate work at the ETH Zürich and Gabrielle, a classically trained artist, was drawing weather maps at a meteorological institute. Their two children, Anne and Dominique, grew up in Princeton following Armand's appointment to the Faculty.

As her oral history—housed in the Institute's Shelby White and Leon Levy Archives Center—attests, Gabrielle, known locally as Gaby, was a frequent entertainer who enjoyed the company of an eclectic mix of guests. During the family's time at IAS, she initiated a unique tradition: dinner guests would sign their names on her tablecloth, autographs which Gaby then immortalized by embroidering them onto the fabric. The signatories include well-known figures of the math world, like Member (1956–57; 1961–64) in the School of Mathematics John Nash and Professor Emeritus in the School, Peter Sarnak, alongside other stalwarts of the Institute community, such as Herman Joachim, who still works in the Institute's mailroom today. With names of those hailing from as far as Ukraine and as close as Orange, New Jersey, the tablecloth represents a truly international group.

The tablecloth, beautifully "of-the-period," also reflects not only the cosmopolitan nature of the Borels' personal circles, but that of the larger Institute, too. As an artifact, it attests to the intimacy of an environment that welcomes scholars from across the globe, while hinting at what is perhaps the most ephemeral aspect of the Institute's legacy: conversation.

Such exchanges can be particularly difficult to capture and preserve for future generations. Fortunately, this textile—generously donated to the Archives Center by Dominique Borel in early 2026—helps to fill one of the largest gaps within the Institute's historical record. Through its intricate embroidery, the piece embodies the network of dialogue and engagement characteristic of IAS and its unique community.

Natascha Artin Brunswick (signed Natascha Brunswick) was born in St. Petersburg in 1909 before her family fled the Russian Empire in the aftermath of the October Revolution. She studied mathematics at the University of Hamburg, where she met and married mathematics professor Emil Artin. During this time, she also pursued a keen interest in the arts and took courses in art history from Erwin Panofsky, Professor (1935–68) in the School of Historical Studies, and Aby Warburg. In 1937, the family fled to the U.S., eventually arriving in Princeton. There, Brunswick worked closely with Richard Courant at New York University and became both the technical editor for its journal *Communications on Pure and Applied Mathematics* and the translation editor of *Theory of Probability and its Applications*. The Artins divorced in 1958, but Brunswick remained in Princeton and remained dedicated to her mathematical work, which she continued until her retirement in 1989. Today, she is remembered for both her mathematics and her artwork.

Israel Moiseevich Gelfand (signed I. Gelfand) was born in Okny, Ukraine in 1913. Gelfand began postgraduate study at Moscow State University at the age of 19 under the mathematician Andrey Kolmogorov and received his Ph.D. in 1935. From 1943 until 1989, Gelfand conducted research at Moscow State University, where he became widely known for his work in group theory, mathematical analysis, and representation theory. Over the course of his career, Gelfand was awarded the Order of Lenin, the Wolf Prize, the Wigner Medal, and the Kyoto Prize. On the eve of his 76th birthday, Gelfand immigrated to the U.S., where he began to give his famed seminars at Rutgers University. Gelfand settled in Highland Park, New Jersey, where he remained in close contact with

Maria O'Leary

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several IAS mathematicians. He passed away in New Brunswick at the age of 96.

John Willard Milnor (signed Jack Milnor) was born in Orange, New Jersey in 1931. He attended Princeton University as an undergraduate and, at only 19, proved the Fáry-Milnor theorem, setting the stage for a prolific mathematical career. In 1956, two short years after receiving his Ph.D., he proved the existence of 7-dimensional spheres with nonstandard differentiable structure, opening the pathway to the field of differential topology. Milnor worked at Princeton University for several years and, from 1970–90, served on the Faculty of the School of Mathematics. Milnor has been widely lauded for his work: his honors include a Fields Medal, a National Medal of Sciences, a Wolf Prize, and an Abel Prize. His name appears alongside that of his wife, Dusa McDuff.

Dusa McDuff was born Margaret Dusa Waddington in London in 1945. She completed her undergraduate studies at the University of Edinburgh before moving to Girton College, Cambridge to study functional analysis under the tutelage of George A. Reid. Later, she taught at the University of York, where she worked with Graeme Segal, Member (1969–70) in the School of Mathematics. In 1976, she joined IAS as a Member, working with Segal on the Atiyah-Segal completion theorem. Around this time, McDuff met John Milnor, who was then based at Princeton University. The two married in 1984. Today, they both continue their research. In 2025, McDuff was awarded the American Mathematical Society's Leroy P. Steele Prize for Lifetime Achievement.

Morton White was born in New York City in 1917. At the age of fifteen, he enrolled in the City College of New York. He received his bachelor's degree in philosophy, and then went on to obtain a Ph.D. in the subject from Columbia University in 1942. He took on his first position as an Assistant Professor at the University of Pennsylvania in 1946, before moving to Harvard University in 1948. While at Harvard, White visited the Institute as a Member (1953–54; 1962–63; 1968) in the School of Historical Studies. These visits sparked a deep affection in White, who later wrote, "From the moment I first came to the Institute in 1953, I longed to be there forever." Indeed, he returned as Faculty in 1970. Though White was a philosopher by training, his time at the Institute allowed him to form interdisciplinary ties, including with such Faculty as Kurt Gödel, then-Professor Emeritus in the School of Mathematics.

Old and New in the Mathematics - Natural Sciences Library

From Computer Vision to Pure Math

Maria O'Leary

How does a computer "see"? This question, which arose as a practical engineering challenge for computer scientists, has, through decades of scholarly work, evolved to open up elegant problems in pure mathematics. Three pivotal books found in the stacks of the Institute's Mathematics - Natural Sciences Library, the oldest dating from the 1990s and the newest encapsulating the latest pioneering research from IAS Faculty, trace this fascinating intellectual trajectory.

When we look at a digital photograph, whether it's of a person, a tree, or a banana, our brains effortlessly distinguish the subject from the background, even when the image is distorted by "noise" stemming from a photographer's shaking hand or poor lighting.

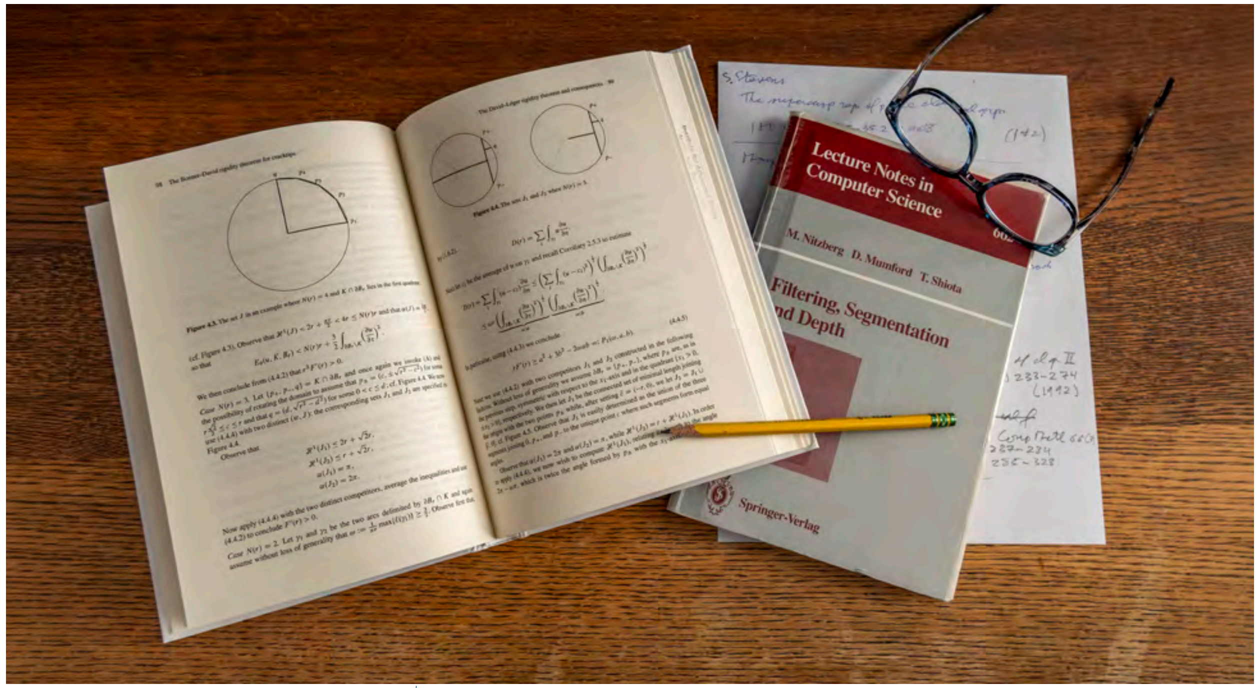
To a computer, however, the same image is merely a grid of numbers representing brightness or color. If one asks a computer to use a standard mathematical filter, such as a Gaussian blur, to remove noise, the result will likely destroy and blur out the important "edges" that mark the subject of the image, and important detail from the photograph will be lost.

Enter Fields Medal-winning mathematician and Member (1962–63, 1981–82) in the School of Mathematics, David Mumford. In the 1980s, Mumford and his colleague Jayant Shah proposed a mathematical formula to solve this "image segmentation" problem. Their Mumford–Shah functional forced the computer to create a simplified version of the image, which is smooth almost everywhere, but contains important "cracks" or "breaks" where the

evidence for an edge is strong. It works by balancing three key priorities:

- Fidelity: The simplified image should stay close to the original.
- Smoothness: Within regions, the image should vary gradually, removing noise.
- Economy: The boundaries (or edges) between regions should be as short and simple as possible.

The functional allows a computer to clean up a noisy image without losing the critical information found at important boundaries. A copy of Mumford's 1993 book, *Filtering, Segmentation and Depth*, which contains the discussion of the functional, is held in the Institute's Mathematics - Natural Sciences Library.



Mumford's book is joined on the shelves by a second title, *Functions of Bounded Variation and Free Discontinuity Problems* by Luigi Ambrosio, Nicola Fusco, and Diego Pallara, published in the year 2000. It took the Mumford–Shah functional from an intuitive tool and placed it into a rigorous mathematical discipline.

To understand the contributions of this text, it helps to think of the Mumford–Shah functional as something of a mathematical orphan. It offered a window into a new kind of geometry, but it lacked a formal home in the world of rigorous analysis.

That is because calculus traditionally studies smooth functions, namely curves that change gradually. But an image on a computer has sharp edges where, for example, a dark shadow meets a bright wall. The color values jump instantly from one number to another.

Ambrosio et al. provided an entirely new mathematical language to describe surfaces that were smooth in some places, but could crack or break in others. They also proved that within the conditions of a space called "Special Functions of Bounded Variation," these surfaces could crack or break optimally. A surface that is optimally cracked allows just enough breaks to account for the sharp change in the image, while keeping the length of those cracks as short and clean as possible.

Ambrosio's former Ph.D. student and current IBM von Neumann Professor in the School of Mathematics, Camillo De Lellis, then took up the mantle. His most recent book, *The Regularity Theory for the Mumford–Shah Functional on the Plane*, co-authored with Matteo Focardi, provides a comprehensive journey through the existing literature on the functional, revisiting classic results and incorporating new advancements. Most notably, it tackles the most persistent problem left by Mumford and Shah: the so-called Regularity Conjecture.

While Ambrosio and his collaborators proved that an "optimal breaking" of the surfaces of an image is always mathematically possible, the precise nature and shape of those breaks and cracks remained a mystery. Without a proof of so-called "regularity," the edges of the breaks could theoretically be infinitely jagged, never smoothing out no matter how closely you zoom in. However, the Mumford–Shah Regularity Conjecture proposes that the most efficient way to simplify a complex image should result in clean, predictable geometry. This has yet to be proven in its full generality, but significant progress has been made.

In their publication, De Lellis and Focardi synthesize decades of research to show that, on a two-dimensional plane, cracks and breaks are indeed forced into a state of elegant geometric order. Specifically, they show that these edges can only meet in two ways: at "triple junctions," where three lines meet at perfect 120-degree angles, or at "crack tips," where a line simply terminates.[1] This 120-degree junction is the same configuration seen in soap bubbles; it is nature's most efficient way for regions to meet. Ultimately, De Lellis and Focardi's book shows that even when a mathematical object is allowed to be messy, efficiency forces it into a state of geometric order.[2]

Taken together, these three books on the Mathematics - Natural Sciences Library shelves, encompassing many years of inquiry, show how hidden order can be teased out of noise.

[1] The foundational results synthesized by De Lellis and Focardi include the work of Guy David, who provided significant progress on the regularity conjecture. The book further details key contributions from mathematicians such as Luigi Ambrosio, John Andersson, Alexis Bonnet, Nicola Fusco, Jean-Christophe Leger, Hayk Mikayelyan, and Diego Pallara, as well as those of De Lellis and Focardi themselves.

[2] The definitive analysis of these structures, particularly the behavior of "crack tips," builds upon joint research conducted by De Lellis and Focardi alongside Silvia Ghinassi, Visitor (2019–21) in the School of Mathematics.

Taken together, these three books on the Mathematics - Natural Sciences Library shelves, encompassing many years of inquiry, show how hidden order can be teased out of noise.

DIRECTOR

David Nirenberg, IAS Director and Leon Levy Professor, was named an inaugural Distinguished Visitor in the Arts and Humanities at Johns Hopkins University. He also presented the special 60th Anniversary Tanner Lecture at Clare Hall College, University of Cambridge. In addition, he co-authored *The Co-production of Judaism, Christianity, and Islam: Artefacts, Rituals, Communities, Narratives, Doctrines, Concepts*.

FACULTY

Wendy Brown, UPS Foundation Professor in the School of Social Science, delivered the plenary lecture at the American Political Science Association Annual Meeting in Vancouver, British Columbia. She was also awarded a Distinguished Scholar Residency at the Gate 27 Policy and Arts Project in Istanbul, Turkey.

Nicola Di Cosmo, Luce Foundation Professor in East Asian Studies in the School of Historical Studies, was named the 2026 recipient of the Onon Prize by the University of Cambridge. He also published two books: *The Great Wall of China as a Climate Frontier: Climatic and Historical Perspectives on the Ordos Region* and *Venice and the Mongols: The Eurasian Exchange That Transformed the Medieval World*.

Irit Dveer Dinur, Betsey Lombard Overdeck Theory of Computing Professor in the School of Mathematics, was announced as the recipient of the National Academy of Sciences's 2026 Michael and Sheila Held Prize, together with her four IAS collaborators: **Dor Minzer**, Member (2018–20); **Subhash Khot**, Member (2003–04); **Shmuel Avraham Safra**, Member (2004–05); and **Guy Kindler**, Member (2004–05).

Didier Fassin, James D. Wolfensohn Professor in the School of Social Science, published *Leçons de ténèbres. Ce que la violence dit du monde*, which is being translated into English, Italian, and Arabic. He also delivered the Huxley Memorial Lecture on the subject of "The Moral Question." In addition, he organized an international conference on "Politics and Poetics on the Ruins of Gaza" at the Collège de France in Paris.

Myles W. Jackson, Ernst and Elisabeth Albers-Schönberg Professor in the History of Science in the School of Historical Studies, was inducted into the Saxon Academy of Sciences and Humanities in Leipzig, as part of the Physics and Mathematics class. He was also granted a renewal of his Reimar Lüst Research Prize from the Alexander von Humboldt Foundation.

Alondra Nelson, Harold F. Linder Professor in the School of Social Science, was recognized with the 2026 Miles Conrad Award by the National Information Standards Organization for "distinguished lifetime achievement in moving us toward a world where all can benefit from the unfettered exchange of information." She also co-authored, with the Marquand House Collective, a book titled *Auditing AI*.

Sabine Schmidtke, Professor in the School of Historical Studies, published a book titled *Scholar of Islam, Victim of the Holocaust: The Tragic Story of Hedwig Klein*.

EMERITI

Yve-Alain Bois, Professor Emeritus in the School of Historical Studies, opened an exhibition of Matisse's *Stations of the Cross*, originally curated for the Matisse Museum in Nice, at the Baltimore Museum of Art. He also published a revised edition of his 1998 book *Matisse and Picasso*.

MEMBERS

James Beattie, Member (2026–30) in the School of Natural Sciences, was named a NASA Hubble Fellow.

Roman Bezrukavnikov, frequent Member in the School of Mathematics, received the National Academy of Sciences's 2026 Maryam Mirzakhani Prize in Mathematics "for his seminal contributions to geometric representation theory."

Manjul Bharğava, Member (2001–02) in the School of Mathematics, was announced as the first President of the National Museum of Mathematics (MoMath).

Pablo J. Boczkowski, Member (2023–24) in the School of Social Science, received the 2025 RAICES Prize in Social Sciences and Humanities by the Secretary of Innovation, Science, and Technology of Argentina.

Rishad Choudhury, Member (2020) in the School of Historical Studies, was presented with a Bernard S. Cohn Book Prize by the Association for Asian Studies.

Emilie Connolly, Member (2024–25) in the School of Historical Studies, won a 2026 Bancroft Prize in American History and Diplomacy for her book *Vested Interests: Trusteeship and Native Dispossession in the United States*.

Molly J. Crockett, Member (2025–26) in the School of Social Science, was awarded the 2026 Troland Research Award by the National Academy of Sciences for "significantly advanc[ing] our understanding of moral cognition."

Legalizing the Revolution: India and the Constitution of the Postcolony by **Sandipto Dasgupta**, Elizabeth and J. Richardson Dilworth Member (2024–25) in the School of Historical Studies and Member (2024–25) in the School of Social Science, was awarded the International Society of Public Law Book Prize. His book also received a Bernard S. Cohn Book Prize from the Association for Asian Studies.

Vesselin Dimitrov, Member (2017–18, 2022–23) in the School of Mathematics, was awarded the 2025 Salem Prize for fundamental contributions to Diophantine geometry and number theory.

Gerd Faltings, Member (1988, 1992–93) in the School of Mathematics, was awarded the 2026 Abel Prize.

Peniel Emmaus Joseph, Friends of the Institute for Advanced Study Member (2025–26) in the School of Social Science, was officially presented with the 2025 Texas Writer Award at Texas Book Festival.

Prophetic Maharaja: Loss, Sovereignty, and the Sikh Tradition in Colonial South Asia by **Rajbir Judge**, Member (2024–25) in the School of Social Science, was awarded Best First Book in the History of Religions by the American Academy of Religion.

Beth Lew-Williams, Visitor (2015–16) in the School of Social Science, received a 2026 Bancroft Prize in American History and Diplomacy for her book *John Doe Chinaman: A Forgotten History of Chinese Life Under American Racial Law*.

Marcus Guy Plested, Member (2010–11) and Visitor (2016) in the School of Historical Studies, was appointed

Five IAS Scholars Honored by American Astronomical Society

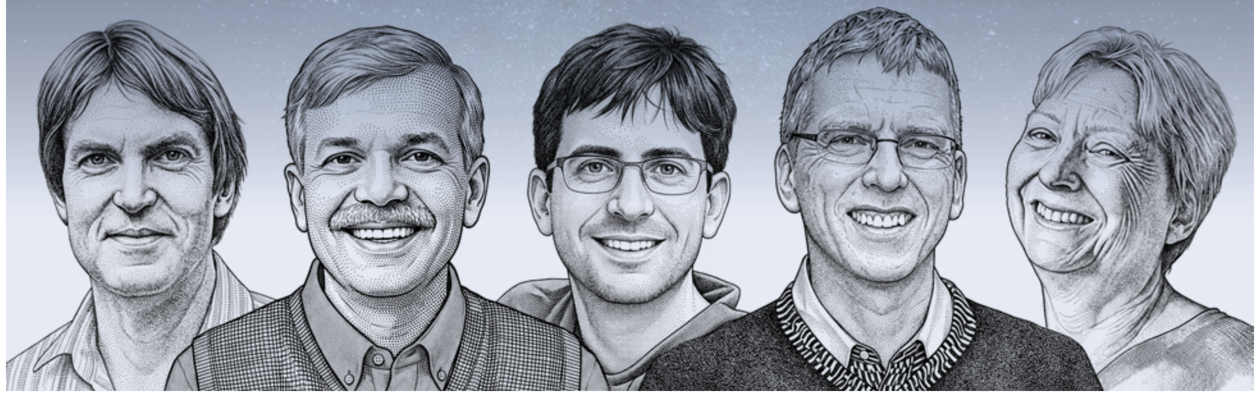
Five past scholars from the School of Natural Sciences were named as recipients of the American Astronomical Society's 2026 awards and prizes, recognizing their "outstanding achievements in research and education."

Lars Hernquist, Member (1987–90), received the 2026 Henry Norris Russell Lectureship for his "pioneering theories, numerical techniques, and simulations," as well as his work "training and mentoring generations of early career astronomers."

Kailash Sahu, Member (2022–23), was awarded the Beatrice M. Tinsley Prize, which recognizes "an outstanding research contribution to astronomy or astrophysics, of an exceptionally creative or innovative character."

The Buchalter Cosmology Prizes, awarded for "new ideas or discoveries that have the potential to produce breakthrough advances in our understanding of the origin, structure, and evolution of the universe" were awarded to **Matthew McQuinn**, Junior Visiting Professor and John N. Bahcall Fellow (2016–17); **Clifford Burgess**, Member (1985–86, 2000–01); and **Anne Davis**, Member (1982–83).

McQuinn won first prize, alongside four collaborators, for the paper "Kiloparsec-scale turbulence driven by reionization may grow intergalactic magnetic fields." Burgess and Davis received second prize, alongside their collaborators, for the paper "A Minimal Axio-dilation Dark Sector."



to the 1643 Chair of Divinity at the University of St Andrews.

George Sterman, Member (1978–79, 1985–86) in the School of Natural Sciences, was awarded an honorary doctorate by ETH Zürich for "his groundbreaking theoretical research in particle physics."

Rashid Sunyaev, Distinguished Visiting Professor (2010–24) in the School of Natural Sciences, won the 2026 Fritz Zwicky Prize for Astrophysics and Cosmology.

Charles Thorn, frequent Member in the School of Natural Sciences, received the 2026 Dannie Heineman Prize for Mathematical Physics.

Hong Wang, Member (2019–21) in the School of Mathematics, was awarded the 2025 Salem Prize. She also received the 2025 Ostrowski Prize for "her influential work in harmonic analysis, solving central problems in the field like the Kakeya set conjecture."

INSTITUTE

Mario Draghi, IAS Trustee since 1998, was announced as the 2026 laureate of the International Charlemagne Prize of Aachen. He also received the 2026 SIEPR Prize from the Stanford Institute for Economic Policy Research.

American Mathematical Society Recognizes IAS Scholars

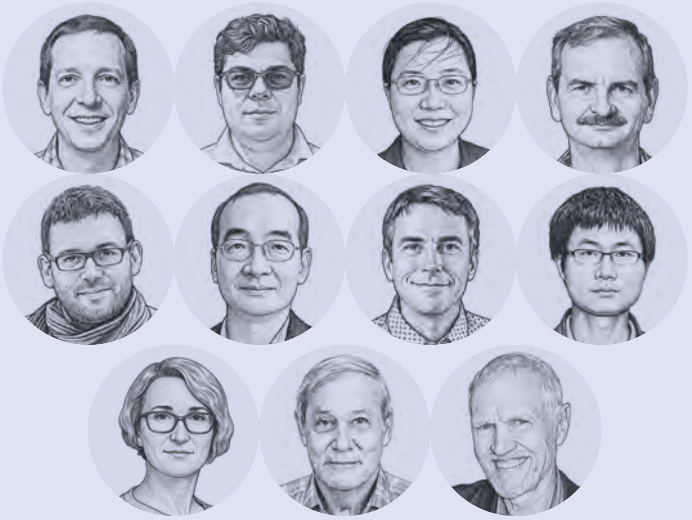
Many scholars affiliated with the Institute's School of Mathematics were named among the recipients of the American Mathematical Society's 2026 awards, recognizing contributions to the mathematical sciences and the mathematics community.

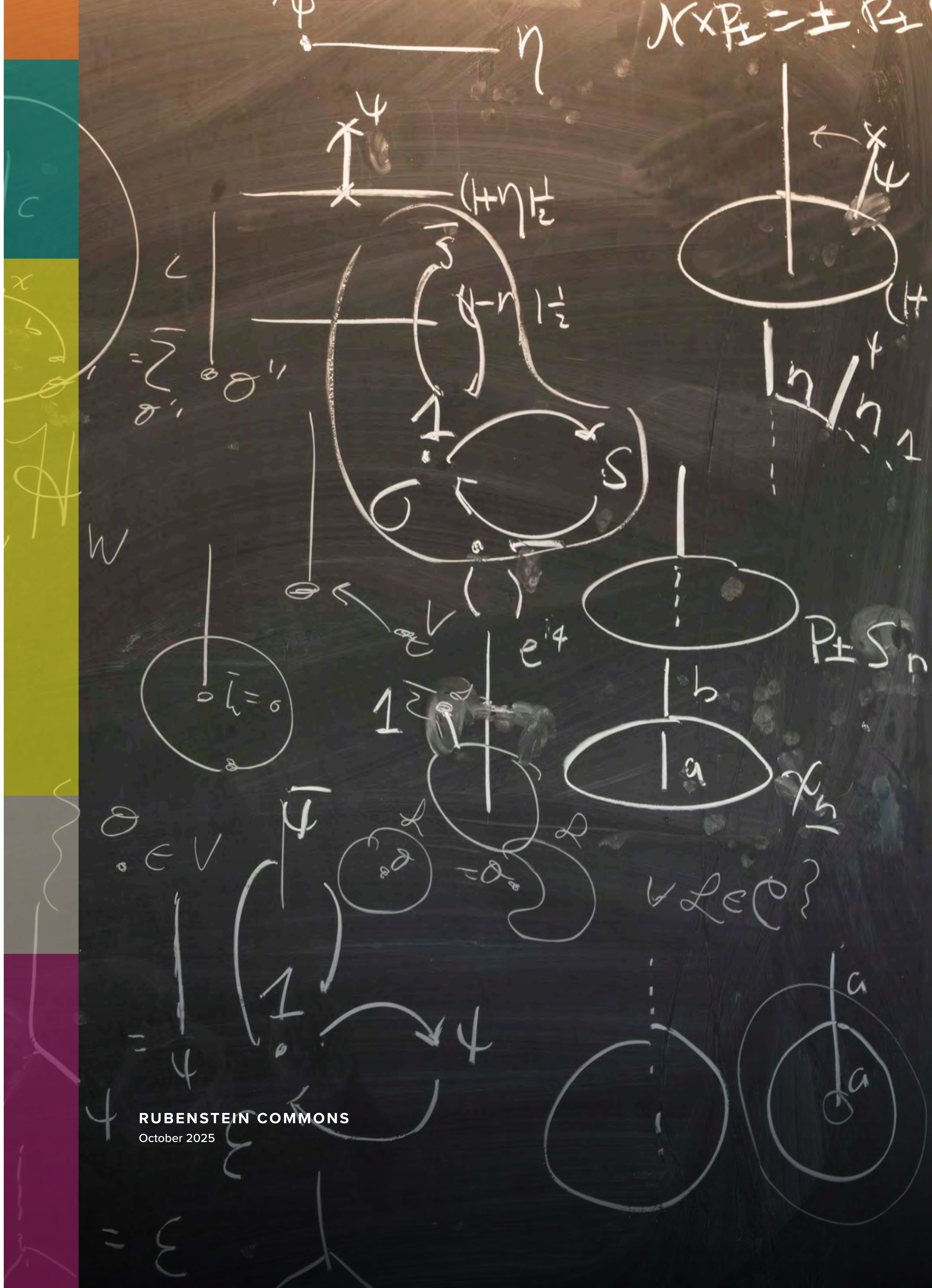
Frank Calegari, von Neumann Fellow (2010–11); **Vesselin Dimitrov**, Member (2017–18, 2022–23); and **Yunqing Tang**, Member (2016–17), received the 2026 AMS Frank Nelson Cole Prize for Number Theory for a "striking original proof" that resolved a long-standing conjecture.

László Erdős, AMIAS Member (2013–14); **Benjamin Schlein**, Member (2014); and **Horng-Tzer Yau**, frequent IAS scholar, were awarded the 2026 Steele Prize for Seminal Contribution to Research for a series of papers on random matrices.

Tasho Kaletha, Veblen Research Instructor (2010–13) and von Neumann Fellow (2020), and **Zhiwei Yun**, Member (2009–10) and Visitor (2009), received the 2026 Chevalley Prize in Lie Theory.

Monica Vișan, Member (2006–08), received the inaugural Edmond and Nancy Tomastik Prize in Differential Equations; **Glenn H. Stevens**, Member (1985), received the 2026 Award for Impact on Teaching and Learning of Mathematics; and **H. Blaine Lawson**, Member (1972–73), received the 2026 Leroy P. Steele Prize for Lifetime Achievement.





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