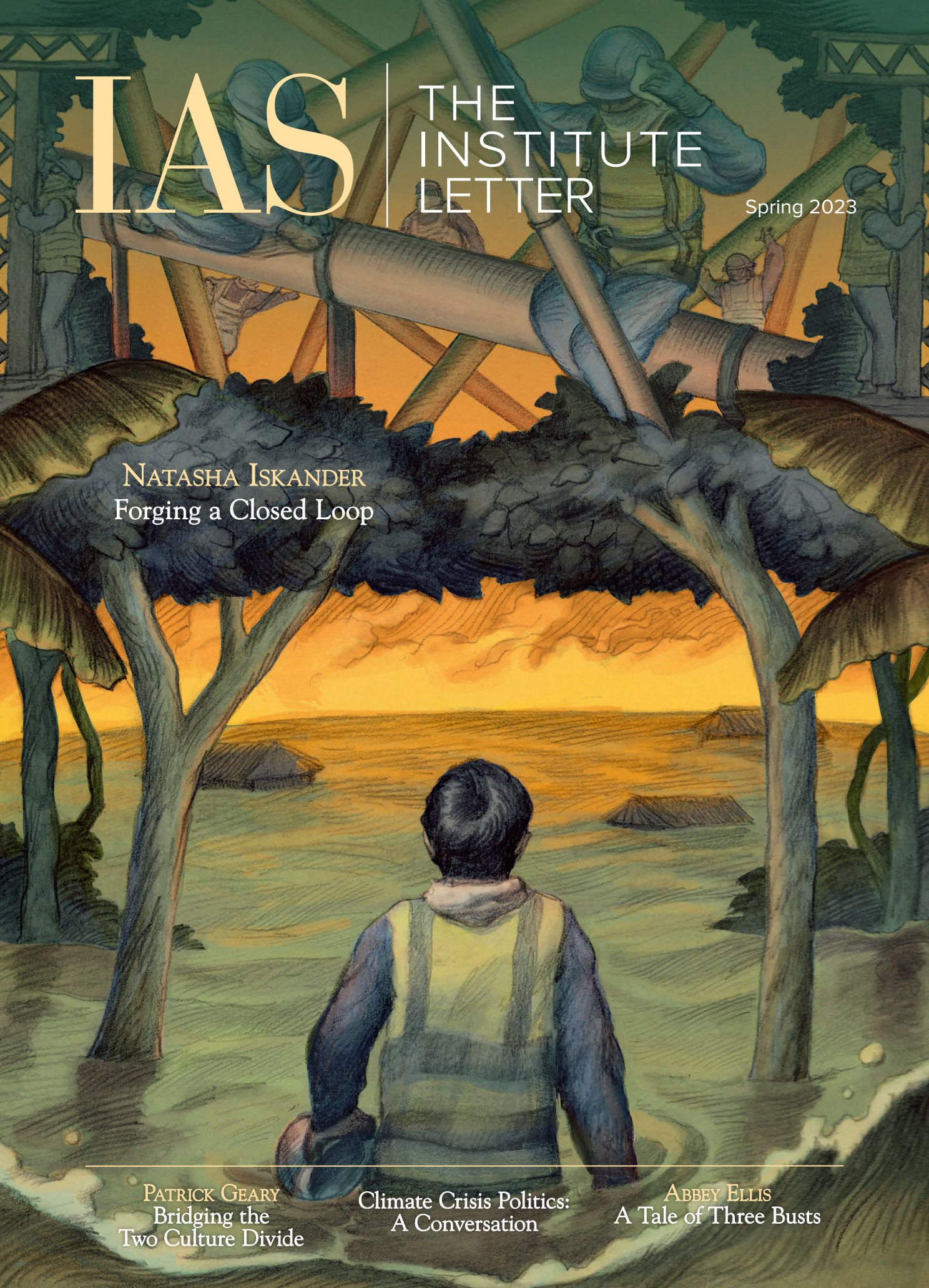

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Spring 2023

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NASA, ESA, AND J. LOTZ (STSCI)

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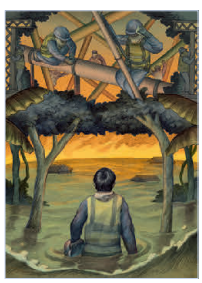
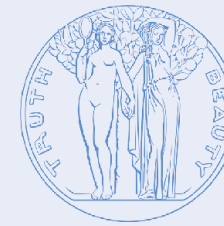


COVER IMAGE

Visualization of migrant workers, recruited from areas of climate damage, who were involved in the construction of venues and stadia for the 2022 FIFA World Cup in Qatar. **Julie Benbassat** is an illustrator and painter whose work delights in the eccentricities of the natural world and highlights the bridge between the cute and the horrific. She has done work for *NPR*, the *New York Times*, and the National Park Service, among others.



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A History of Collaboration and Community Engagement

Throughout its history, the Institute has brought to its campus researchers from around the world, offering them a place to think and collaborate without restraint. This pursuit of both scholarship and community is invigorated when people from outside the Institute share in campus activities, events, and newly cultivated ideas. Recently, the Institute has been fortunate to welcome luminaries such as mezzo-soprano Joyce DiDonato in conversation with Director and Leon Levy Professor David Nirenberg; and Daniel H. Weiss, art historian, author, and president and CEO of the Metropolitan Museum of Art in New York, who discussed, with Nirenberg, the state of culture and higher education in the world today.

In addition to such events, the Institute will continue to engage communities beyond our campus. IAS will host a Science Journalism Workshop from July 10–15, 2023. The program will be led by Natalie Wolchover, Senior Editor at *Quanta Magazine* and past IAS Director's Visitor (2017), alongside author Siobhan Roberts, a regular contributor to the *New York Times* and a frequent IAS Director's Visitor since 2007. Confirmed guest instructors include Christie Aschwanden, Graham Farmelo, Sabrina Imbler, John Rennie, Ashley Smart, Gideon Lewis-Kraus, and George Musser, with more to be announced.

These opportunities to convene across the spheres of science and society is a continuation of the Institute's history as a place that assembles intellects, providing them a place to do their best work, and supporting the dissemination of knowledge. To learn more about the Institute and for opportunities to connect through our public events, please visit www.ias.edu/events. ■

DAN KOMODA

Daniel H. Weiss signs his book *Why the Museum Matters* for Members in Fuld Hall.

IAS ON Instagram

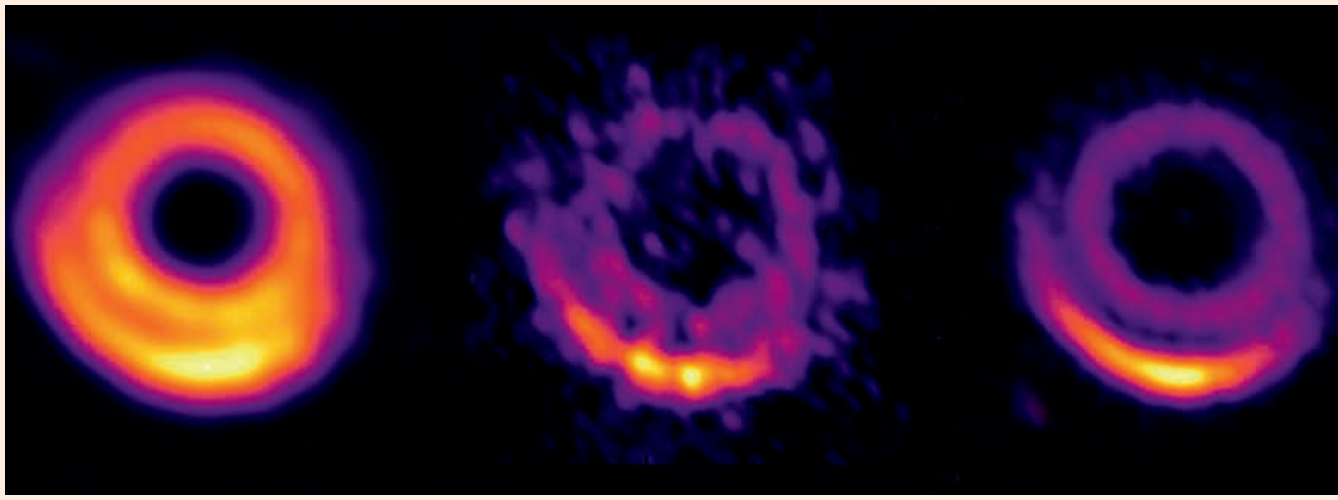
instituteforadvancedstudy

MARIA O'LEARY

MARIA O'LEARY

In front of a capacity crowd, multi-Grammy winning mezzo-soprano Joyce DiDonato joined IAS Director and Leon Levy Professor David Nirenberg for a conversation exploring how DiDonato brings her voice and the musical traditions in which she works to pressing issues of the age. Their dialogue was followed by two operatic master classes led by DiDonato, with Canadian American Molly Netter and Cree-Métis baritone Jonathon Adams.

For the latest news, research, and campus updates, follow IAS on Instagram: @instituteforadvancedstudy.



PAOLO CAZZOLETTI

Observations at different wavelengths and resolutions of a horseshoe and a ring-shaped structure in the dust around HD 135344B.

Astronomers Use "Little Hurricanes" to Weigh and Date Planets Around Young Stars

Little "hurricanes" that form in the discs of gas and dust around young stars can be used to study certain aspects of planet formation, even for smaller planets which orbit their star at large distances and are out of reach for most telescopes.

Researchers from the University of Cambridge and the Institute for Advanced Study have developed a technique that uses observations of these hurricanes by the Atacama Large Millimeter/submillimetre Array (ALMA) to place some limits on the mass and age of planets in a young star system.

Pancake-like clouds of gases, dust, and ice surrounding young stars—known as protoplanetary discs—are where the process of planet formation begins. Through a process known as core accretion, gravity causes particles in the disc to stick to each other, eventually forming larger solid bodies such as asteroids or planets. As young planets form, they start to carve gaps in the protoplanetary disc, like grooves on a vinyl record.

Even a relatively small planet—as small as one-tenth the mass of Jupiter according to some recent calculations—may be capable of creating such gaps. As these 'super-Neptune' planets can orbit their star at a distance greater than Pluto orbits the Sun, traditional methods of exoplanet detection cannot be used.

In addition to the grooves, observations from ALMA have shown other distinct structures in protoplanetary discs, such as banana- or peanut-shaped arcs and clumps. It had been thought that at least some of these structures were also driven by planets.

"Something must be causing these structures to form," said lead author, Professor Roman Rafikov from Cambridge's Department of Applied Mathematics and Theoretical Physics and the Institute for Advanced Study in Princeton, New Jersey. "One of the possible mechanisms for producing these structures—and certainly the most intriguing one—is that dust particles that we see as arcs and clumps are concentrated in the centers of fluid vortices: essentially little hurricanes that can be triggered by a particular instability at the edges of the gaps carved in protoplanetary discs by planets."

Working with his Ph.D. student Nicolas Cimerman, Rafikov used this interpretation to develop a method to constrain a planet's mass or age if a vortex is observed in a protoplanetary disc. Their results have been accepted for publication in two separate papers in the *Monthly Notices of the Royal Astronomical Society*.[1,2]

"It's extremely difficult to study smaller planets that are far away from their star by directly imaging them: it would be like trying to spot a firefly in front of a lighthouse," said Rafikov. "We need other, different methods to learn about these planets."

To develop their method, the two researchers first theoretically calculated the length of time it would take for a vortex to be produced in the disc by a planet. They then used these calculations to constrain the properties of planets in discs with vortices, basically setting lower limits on the planet's mass or age. They call these techniques 'vortex weighing' and 'vortex dating' of planets.

1 Roman R. Rafikov and Nicolas P. Cimerman. 'Vortex weighing and dating of planets in protoplanetary discs.' *Monthly Notices of the Royal Astronomical Society* (2022). DOI: 10.1093/mnras/stac3692

2 Nicolas P. Cimerman and Roman R. Rafikov. 'Emergence of vortices at the edges of planet-driven gaps in protoplanetary discs.' *Monthly Notices of the Royal Astronomical Society* (2022). DOI: 10.1093/mnras/stac3507

When a growing planet becomes massive enough, it starts pushing material from the disc away, creating the tell-tale gap in the disc. When this happens, material on the outside of the gap becomes denser than material on the inside of the gap. As the gap gets deeper and the differences in density become large, an instability can be triggered. This instability perturbs the disc and can eventually produce a vortex.

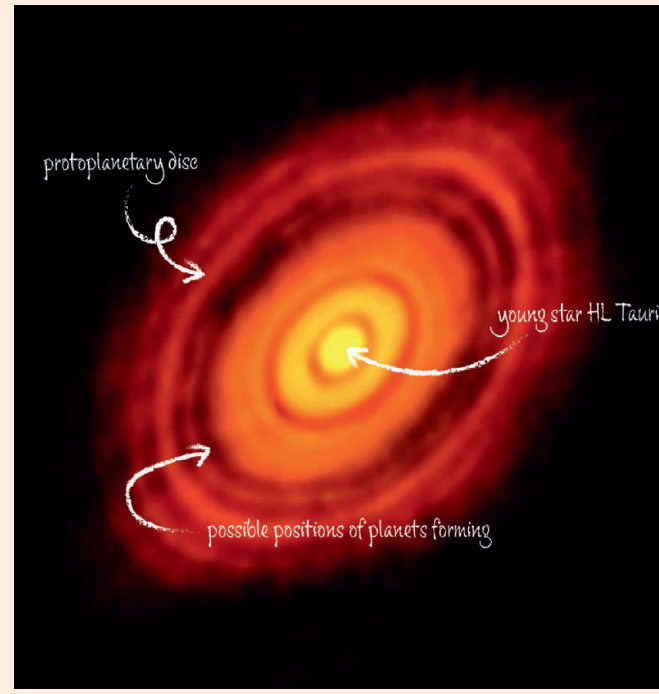
"Over time, multiple vortices can merge together, evolving into one big structure that looks like the arcs we've observed with ALMA," said Cimerman. Since the vortices need time to form, the researchers say their method is like a clock that can help determine the mass and age of the planet.

"More massive planets produce vortices earlier in their development due to their stronger gravity, so we can use the vortices to place some constraints on the mass of the planet, even if we can't see the planet directly," said Rafikov.

Using various data points such as spectra, luminosity, and motion, astronomers can determine the approximate age of a star. With this information, the researchers calculated the lowest possible mass of a planet that could have been in orbit around the star since the protoplanetary disc formed and was able to produce a vortex that could be seen by ALMA. This helped them put a lower limit on the mass of the planet without observing it directly.

By applying this technique to several known protoplanetary discs with prominent arcs, suggestive of vortices, the researchers found that the putative planets creating these vortices must have masses of at least several tens of Earth masses, in the super-Neptune range.

"In my daily work, I often focus on the technical aspects of performing the simulations," said Cimerman. "It's exciting when things come together and we can use our theoretical findings to learn something about real systems."



ALMA (ESO/NAOJ/NRAO)

This is the sharpest image ever taken by ALMA — sharper than is routinely achieved in visible light with the NASA/ESA Hubble Space Telescope. It shows the protoplanetary disc surrounding the young star HL Tauri. These new ALMA observations reveal substructures within the disc that have never been seen before and even show the possible positions of planets forming in the dark patches within the system.

"Our constraints can be combined with the limits provided by other methods to improve our understanding of planetary characteristics and planet formation pathways in these systems," said Rafikov. "By studying planet formation in other star systems, we may learn more about how our own solar system evolved."

The research was supported in part by the Science and Technology Facilities Council (STFC), part of UK Research and Innovation (UKRI). ■

IMAGE PROVIDED BY EIKO IKEGAMI

Samurais and Second Life:
Explorations in Virtuality and Community

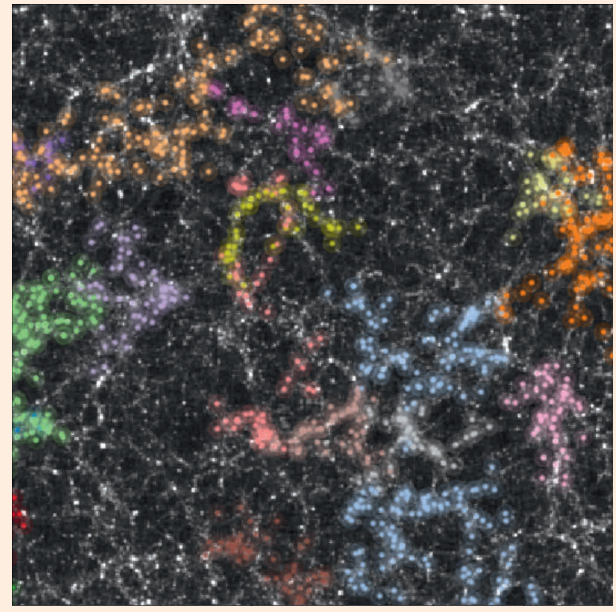
In 2007, Eiko Ikegami, Visitor in the Program for Interdisciplinary Studies, created an avatar in the 3D world of Second Life, built a house, and began her research on internet-based 3D communities—specifically the autistic community. Before this project, Ikegami's work was focused on historical investigations of the development of Japan, including her book *Bonds of Civility*, which details how aesthetic social networks like poetry circles enabled the spread of information and ideas, established practices for how to interact in a social setting, and, eventually, undermined the rigidly hierarchical feudal system of the Japanese Edo period. What do these topics have in common? The answer is, of course, networks, but also virtuality—in her definition, the desire to communicate one's 'inner images.' Visit the Institute's website to read more about Ikegami's research and how these themes appear in her next proposed research project: Virtual Moon Village.

Pinpoint Simulations Provide Perspective on Universe Structure

The universe is peppered with galaxies, which, on large scales, exhibit a filamentary pattern, referred to as the cosmic web. This heterogeneous distribution of cosmic material is in some ways like blueberries in a muffin where material clusters in certain areas but may be lacking in others.

Based on a series of simulations, researchers have begun to probe the heterogeneous structure of the universe by treating the distribution of galaxies as a collection of points—like the individual particles of matter that make up a material—rather than as a continuous distribution. This technique has enabled the application of mathematics developed for materials science to quantify the relative disorder of the universe, enabling a better understanding of its fundamental structure.

"What we found was that the distribution of galaxies in the universe is quite different from the physical properties of conventional materials, having its own unique signature," explained Oliver Philcox, a co-author of the study.



PHILCOX & TORQUATO; THE QUIJOTE SIMULATIONS

This figure shows a section of the universe (black and white), with dark matter halos indicated by points and their associated large-scale topological structures indicated by colors.

This work, now published in *Physical Review X*, was conducted by Salvatore Torquato, frequent Member and Visitor at the Institute for Advanced Study and Lewis Bernard Professor of Natural Sciences based in Princeton University's departments of chemistry and physics; and Oliver Philcox, a visiting Ph.D. student at the Institute from September 2020 to August 2022, now a Junior Fellow in the Simons Society of Fellows, hosted at Columbia University.

The pair analyzed public simulation data generated by Princeton University and the Flatiron Institute. Each of the 1,000 simulations consists of a billion dark matter "particles," whose clusters, formed by gravitational evolution, serve as a proxy for galaxies.

One of the main results of the paper concerns the correlations of pairs of galaxies that are topologically connected to one another by means of the pair-connectedness function. Based on this—and the array of other descriptors that arise in the theory of heterogeneous media—the research team showed that on the largest scales (on the order of several hundred megaparsecs), the universe approaches hyperuniformity, while on smaller scales (up to 10 megaparsecs) it becomes almost antihyperuniform and strongly inhomogeneous.

"The perceived shift between order and disorder depends largely on scale," stated Torquato. "The pointillist technique of Georges Seurat in the painting *A Sunday on La Grande Jatte* produces a similar visual effect; the work appears disordered when viewed up-close and highly ordered from afar. In terms of the universe, the degree of order and disorder is more subtle, as with a Rorschach inkblot test that can be interpreted in an infinite number of ways."

Statistical tools, specifically nearest-neighbor distributions, clustering diagnostics, Poisson distributions, percolation thresholds, and the pair-connectedness function, allowed the researchers to develop a consistent and objective framework for measuring order. Therefore, their findings, while made in a cosmological context, translate to a number of other dynamical, physical systems.

This interdisciplinary work, combining the techniques of cosmology and condensed matter physics, has future implications for both fields. Beyond the distribution of galaxies, many other features of the universe can be explored with these tools, including cosmic voids and the ionized hydrogen bubbles that formed during the reionization phase of the universe. Conversely, the novel phenomena discovered about the universe may also provide insight into various material systems on Earth. The team recognizes that more work will be needed before these techniques can be applied to real data, but this work provides a strong proof-of-concept with significant potential. ■

Astrophysicists Show How to "Weigh" Galaxy Clusters with Artificial Intelligence

Scholars from the Institute for Advanced Study have used a machine learning algorithm known as "symbolic regression" to generate new equations that help solve a fundamental problem in astrophysics: inferring the mass of galaxy clusters.

Galaxy clusters are the most massive objects in the universe: a single cluster contains anything from a hundred to many thousands of galaxies, alongside collections of plasma, hot X-ray emitting gas, and dark matter. These components are held together by the cluster's own gravity. Understanding such galaxy clusters is crucial to pinning down the origin and continuing evolution of our universe.

Perhaps the most crucial quantity determining the properties of a galaxy cluster is its total mass. But measuring this quantity is difficult—galaxies cannot be "weighed" by placing them on a scale. The problem is further complicated by the fact that the dark matter that makes up much of a cluster's mass is invisible. Instead, scientists infer the mass of a cluster from other observable quantities.

Previously, scholars considered a cluster's mass to be roughly proportional to another, more easily measurable quantity called the "integrated electron pressure" (or the Sunyaev-Zel'dovich flux, often abbreviated to Y_{SZ}). The theoretical foundations of the Sunyaev-Zel'dovich flux were laid in the early 1970s by Rashid Sunyaev, current Distinguished Visiting Professor in the Institute's School of Natural Sciences, and his collaborator Yakov B. Zel'dovich.

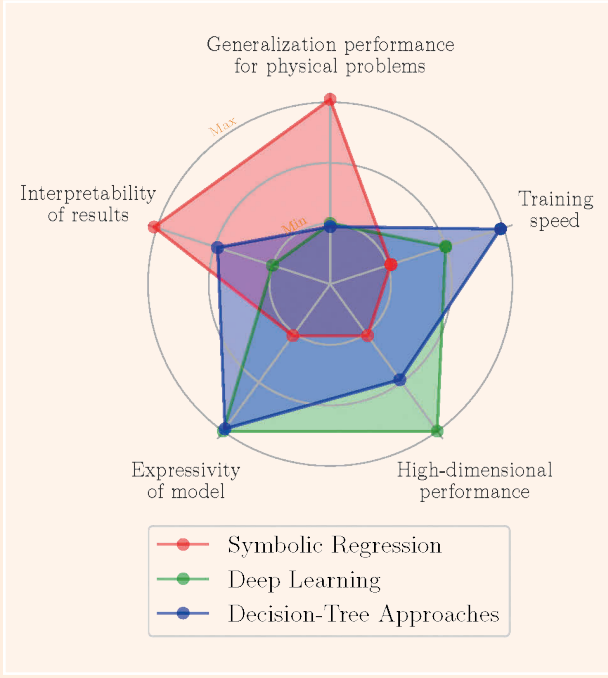


FIGURE PROVIDED BY DIGVIJAY WADEKAR

The trade-offs between different machine learning techniques. Symbolic regression is much less powerful than deep neural networks on high-dimensional datasets, but it is much more interpretable as it provides mathematical equations as output.

However, the integrated electron pressure is not a reliable proxy for mass because it can behave inconsistently across different galaxy clusters. The outskirts of clusters tend to exhibit very similar Y_{SZ}, but their cores are much more variable. The Y_{SZ}/mass equivalence was problematic in that it gave equal weight to all parts of the cluster. As a result, a lot of "scatter" was observed, meaning that the error bars on the mass inferences were large.

Digvijay Wadekar, current Member in the Institute's School of Natural Sciences, has worked with collaborators across ten different institutions to develop an AI program to improve the understanding of the relationship between the mass and the Y_{SZ}. Their work was recently published in *Proceedings of the National Academy of Sciences*.

Wadekar and his collaborators "fed" their AI program with state-of-the-art cosmological simulations that have been developed by groups at the Harvard & Smithsonian Center for Astrophysics, and at the Flatiron Institute's Center for Computational Astrophysics (CCA) in New York. Their program searched for and identified additional variables that might make inferring the mass from the Y_{SZ} more accurate.

AI is useful for identifying new parameter combinations that could be overlooked by human analysts. While it is easy for human analysts to identify two significant parameters in a data set, AI is better able to parse through high volumes often revealing unexpected influencing factors.

More specifically, the AI method that Wadekar and his collaborators employed is known as symbolic regression. "Right now, a lot of the machine learning community focuses on deep neural networks," Wadekar explained. "These are very powerful but the drawback is that they are almost like a black box. We cannot understand what goes on in them. In physics, if something is giving good results, we want to know why it is doing so. Symbolic regression is beneficial because it searches a given dataset and generates simple, mathematical expressions in the form of simple equations that you can understand. It provides an easily interpretable model."

Their symbolic regression program (called PySR) handed them a new equation, which was able to better predict the mass of the galaxy cluster by augmenting

Y_{SZ} with information about the cluster's gas concentration. Wadekar and his collaborators then worked backward from this AI-generated equation and tried to find a physical explanation for it. They realized that gas concentration is in fact correlated with the noisy areas of clusters where mass inferences are less reliable. Their new equation therefore improved mass inferences by providing a way for these noisy areas of the cluster to be "down-weighted." In a sense, the galaxy cluster can be compared to a spherical doughnut. The new equation extracts the jelly at the center of the doughnut (that introduces larger errors), and concentrates on the doughy outskirts for more reliable mass inferences.

The new equations can provide observational astronomers engaged in upcoming galaxy cluster surveys with better insights into the mass of the objects that they observe. "There are quite a few surveys targeting galaxy clusters which are planned in the near future," Wadekar stated. "Examples include the Simons Observatory (SO), the Stage 4 CMB experiment (CMB-S4), and an X-ray survey called eROSITA. The new equations can help us in maximizing the scientific return from these surveys."

He also hopes that this publication will be just the tip of the iceberg when it comes to using symbolic regression in astrophysics. "We think that symbolic regression is highly applicable to answering many astrophysical questions," Wadekar added. "In a lot of cases in astronomy, people make a linear fit between two parameters and ignore everything else. But nowadays, with these tools, you can go further. Symbolic regression and other artificial intelligence tools can help us go beyond existing two parameter power laws in a variety of different ways, ranging from investigating small astrophysical systems like exoplanets to galaxy clusters, the biggest things in the universe." ■

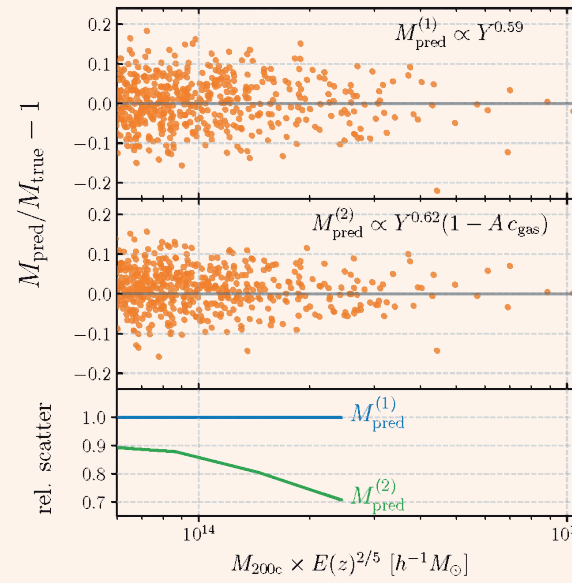


FIGURE PROVIDED BY DIGVIJAY WADEKAR

The performance of the new equation from symbolic regression is shown in the middle panel, whereas that of the traditional method is shown in the top. The lower panel explicitly quantifies the reduction in the scatter.

M87 Black Hole Gets a New Look

A group of researchers, from the EHT collaboration—which captured the first horizon-scale image of a black hole in 2019 (M87) (left image), and did so again in 2022 (Sgr A*)—has produced a groundbreaking new image, achieving, for the first time, the full resolution of the array (right image). With PRIMO, a machine learning technique, developed by School of Natural Sciences Member Lia Medeiros, along with Dimitrios Psaltis (Georgia Tech), Tod Lauer (NOIRLab), and Feryal Özel (Georgia Tech), the team offers a new approach to the difficult task of constructing images from EHT observations. The result is that the bright ring of accreting gas in the new image is now smaller by about a factor of two, providing a powerful constraint for theoretical models and tests of gravity. This work was published in *The Astrophysical Journal Letters* on April 13, 2023.

MEDEIROS ET AL.

Q&A with K-Sue Park

IMAGE PROVIDED BY K-SUE PARK

The scholarship of K-Sue Park, a Roger W. Ferguson, Jr., and Annette L. Nazareth Member in the School of Social Science, examines the development of American property law and the creation of the American real estate market through the histories of colonization and enslavement.

Her publications have appeared in the *Harvard Law Review,* the *Yale Law Journal, The University of Chicago Law Review, The History of the Present, Law & Social Inquiry,* and the *New York Times*. In 2015, her article, "Money, Mortgages, and the Conquest of America," won the American Bar Foundation's graduate student paper competition and the Association for Law, Culture and the Humanities' Austin Sarat Award, and was selected for the Law and Humanities Junior Scholar Workshop. She currently serves as an Associate Professor in Law at Georgetown University Law Center.

How do you describe your work to friends and family?
I write about histories of colonization and enslavement, which are parts of this country's history that have long been ignored. Specifically, I ask how these histories shaped the legal institutions and practices that we have, including ones that we take totally for granted.

What motivates you as a researcher?
What motivates me most as a researcher is the communities with which I've worked or been privileged to get to know, whose own histories are strongly linked to those I write about and who are very aware of how they have been erased from national narratives. My goal is to write for them, in conversation with them, by explaining how these histories produced various aspects of our legal system. At the same time, I try to introduce these histories to people who are not familiar with them, but the goal is to bring them to a table that I didn't set—that has been there a long time.

Where is your favorite place to think?
I think best while walking. I usually don't take a pen, so I have to come up with mantras to remember the ideas I have while out.

What is your favorite part about your career and work?
My favorite part about my writing is helping to find language for things that many people already know, especially people from communities that have not traditionally had control over the main narratives of U.S. legal scholarship. Bringing their perspectives and understandings into these discourses centers and vindicates what they know; and sometimes, I hope, the material I've dug out of the library and out of archives can even supplement or build on that knowledge.

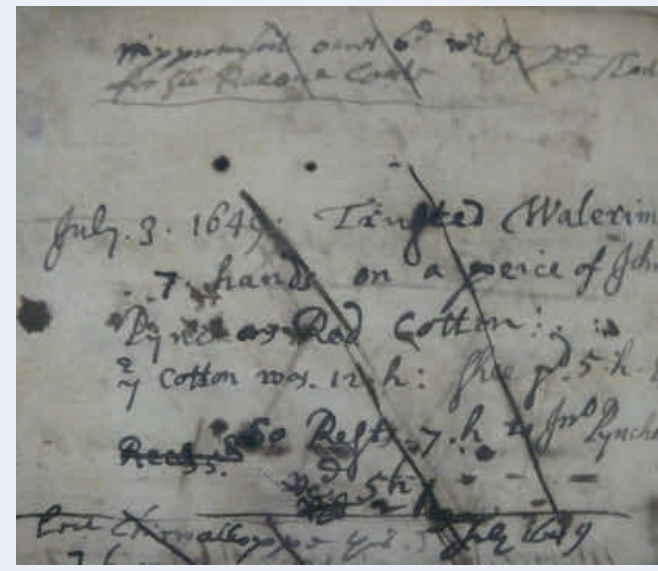


IMAGE PROVIDED BY K-SUE PARK

A copy of John Pynchon's account books in the Forbes Library in Northampton, MA

Bridging the Two Culture Divide

How HistoGenes is Bringing Together Disciplines and New Approaches

BY PATRICK J. GEARY

The ability to recover and sequence DNA from ancient samples, known as the field of paleogenomics, has undergone major advances. These advances are not only revolutionizing the study of paleolithic hominids, the dispersal of populations across the globe, and knowledge of prehistoric population changes and migrations, but are also allowing scholars to answer questions about much more recent history, previously inaccessible using solely traditional historical and archaeological sources. Paleogenomics techniques allow scholars to put aside the broad-brush approach of the past and tackle the challenge of producing a nuanced historical account even—and especially—in areas with great social complexity and no written record.

To meet the challenge of producing such a fine-grained understanding of historical phenomena (and to realize the full potential of paleogenomics), scientists and humanists must learn to work in close collaboration in order to integrate genomic data, written sources, and archaeological material. An international, interdisciplinary team of geneticists, archaeologists, historians, and anthropologists—funded by the European Research Council and operating under the label HistoGenes—is working on the largest project of its type ever undertaken, combining ancient DNA analysis with archaeological and historical approaches.[1] By developing new methods and practices, and using many working groups to analyze data from a wide variety of sub-regions, this interdisciplinary team is well-positioned to meet such a challenge.[2] Three years into this seven-year project, exciting preliminary results are beginning to emerge.

Using Conventional Methods in Complex Regions

Most historically directed paleogenomic projects have consisted of transects—that is, studies that take ancient DNA samples from a wide variety of locations over centuries to understand broad-scale changes in human population demography. For recent periods, historians are skeptical of such broad-brush approaches that assume that a few samples from a location are representative of a whole population. Historians are also concerned when geneticists attempt to assign names of historically documented peoples to the clusters that emerge from these studies, and even more so when ideologues attempt to draw a direct line between these genetic clusters and contemporary populations. Too often, such studies have been carried out without detailed collaboration and consultation with historians and archaeologists, and rely on outdated nineteenth-century historical paradigms that assumed historically recorded "peoples" shared a common ancestry, language, and culture—controversially put, an essence—that clearly distinguished one from another and that could be traced from the moment of their appearance in the historical record to the present day.

All of these challenges are particularly acute in the study of the period from c. 400–900 C.E., when medieval Europe emerged after the dissolution of the Western Roman Empire in a process that involved migrations, demographic change, and the rise of post-Roman Christian kingdoms in the West and non-Roman "barbarian" societies in the East. One of the most complex regions affected by these changes was the Carpathian Basin, the area that stretches roughly from the Vienna Woods to Belgrade, where at least six different models of social and political organization coexisted, merged, or replaced each other. These included the Christian Roman Empire with its series of cities, forts, trade routes, and agricultural organization; barbarian militaries with their elites who replaced Roman governance and partially integrated into the Roman system; post-Roman rural populations that continued to live and work the land; Steppe warriors including the Huns and Avars whose empires relied on plunder and tribute from their neighbors as well as the agricultural produce of their farmers; radically decentralized Slavic groups who gradually built entirely new social and political structures; and finally, the expanding Frankish empire that conquered much of the region in the late eighth and ninth centuries.

The extraordinary complexity of this region across

1 The principal investigators include Walter Pohl of the Austrian Academy of Sciences; Tivadar Vida, head of the Institute for Archaeological Sciences at the Eötvös Loránd University in Budapest; Johannes Krause, Director of the Max Planck Institute for Evolutionary Anthropology in Leipzig; and at the Institute for Advanced Study, Patrick Geary, Professor Emeritus in the School of Historical Studies. Further collaborators include scholars and scientists from Austria, Hungary, the U.S., Romania, Serbia, Slovenia, Slovakia, the Czech Republic, and Germany. This project is funded by the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement n° 856453 ERC-2019-SyG),

2 The HistoGenes team has formed working groups to analyze data from sub-regions including eastern Austria around present-day Vienna; the Little Hungarian Plain in northwest Hungary and southern Czechia, the western end of the Lake Balaton, the complex post-Roman settlement around the Roman site Keszthely, two large seventh-century cemeteries at Rákóczifalva in central Hungary, and a complex of sites in present-day Slovenia that extend from the fourth to the tenth centuries, among others.

these centuries is difficult to assess because although they were identified by their neighbors with a bewildering list of names including Huns, Goths, Gepids, Heruls, Sciri, Suebians, Longobards, Bulgars, Avars, Slavs, and Byzantine captives, none of these populations, with the exception of a few Byzantine and Carolingian texts, left any written record. We do have extensive archaeological material, including some 70,000 well-excavated graves from the region, but these alone cannot tell us about population continuity, the make-up of newly arrived groups, social organization, and integration at the local or regional level, or how these men and women understood themselves and their world.

Methods to Meet the Challenges

The HistoGenes team is in the process of analyzing over 6,000 burials from dozens of cemeteries in the Carpathian Basin, capturing more than one million markers from across the genome from each of the individual burials, while subjecting each grave to detailed archaeological and osteological analysis. Unlike transect studies that sample numerous cemeteries, the team is sequencing, whenever possible, entire cemeteries in order to capture the entire diversity of even the smallest local populations. Then, they employ the methods of principle component analysis (PCA), admixture, and network analysis to sketch a thorough and nuanced understanding of a complex history.

When first looking at the genomic data produced, they perform a preliminary, unsupervised survey of the diversity of these communities using the technique of PCA, a statistical procedure that identifies patterns in a complex multidimensional data set. It does this by converting a set of possibly correlated variables into a set of those components that account for as much of the variance within the set as possible. Thus, the first component accounts for the greatest variance, the second for the second greatest, etc. In theory, any number of resulting components from PCA can be examined. However, in population genetics, PCA is typically used to create a visual representation of genetic distance and relationships separating populations by plotting the first and second principal components for each sample. The result is to show, via a two-dimensional image, the relative distance separating all of the samples.

Previous studies have shown that when PCA is applied to modern European individuals, the resulting two-dimensional image replicates, to a remarkable extent, a map of Europe, demonstrating that geographical distance is the strongest indicator of genetic identity (a phenomenon known as isolation-by-distance). Ancient samples can also be projected onto modern background PCA maps in order to visualize the

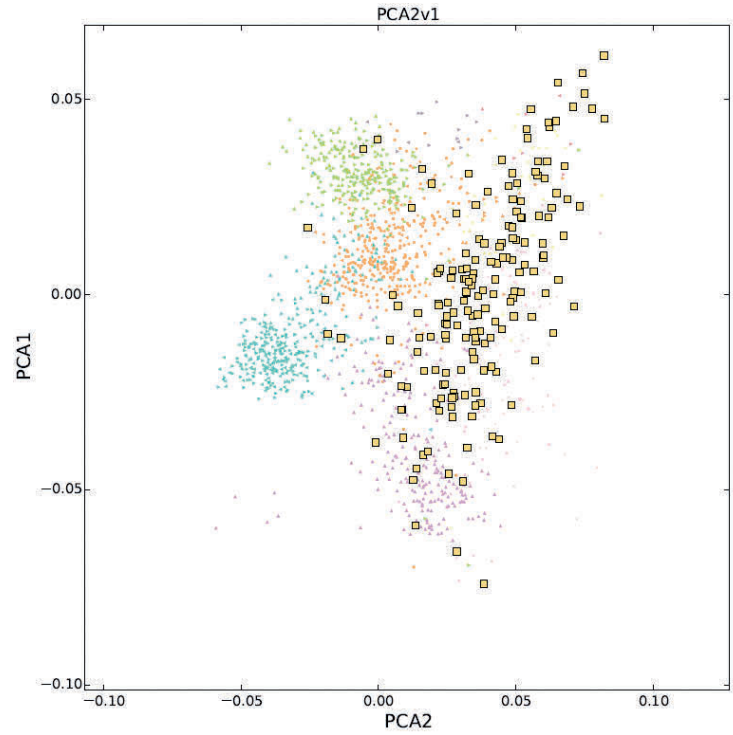


FIGURE PROVIDED BY PATRICK GEARY

A principal component plot indicating where individuals buried in a seventh-century Pannonian cemetery position themselves (yellow squares) when compared with a modern European population plot

diversity of the genetic backgrounds within an individual cemetery or group of cemeteries. A significant advance, moreover, has been that, as more and more penecontemporary ancient DNA samples become available, it is possible to dispense with these modern background PCA maps and place the populations with greater accuracy relative to the genetic diversity of Eurasia in late antiquity and the Early Middle Ages. The use of PCA, for example, has made it possible to demonstrate that in the late sixth to early seventh century, a considerable, rapid migration from central and eastern Asia into the Carpathian Basin took place. This confirmed the origins of the core of the Steppe nomadic Avars who ruled the region for over two centuries.[3]

The second method employed (this one supervised), admixture analysis, compares the relative percentages of genetic ancestry in individuals to representative "reference" populations from Europe, Asia, and Africa. The reference populations used for this analysis, taken from the 1000 Genomes Project, are of course nominal, since they are themselves composites—no individuals are ever pure anything. However, it can be helpful in a general comparative sense to see the relative ancestral composition of individuals buried at the sites under investigation.

3 Guido Alberto Gnecchi-Ruscone et. al. "Ancient genomes reveal origin and rapid trans-Eurasian migration of 7th century Avar elites," *Cell*, vol 185 (2022): 1-12. https://doi.org/10.1016/j.cell.2022.03.007

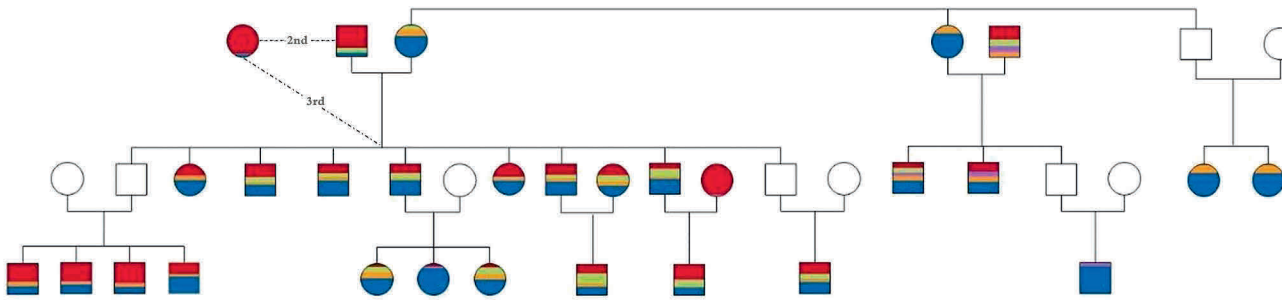


FIGURE PROVIDED BY PATRICK GEARY

A preliminary reconstruction of a three-generation pedigree within a seventh-century Pannonian cemetery. Squares are male; circles are female. The colors indicate the model-based clustering analysis admixture plot percentages: Red, Central Italy; Green, Iberian Peninsula; Violet, East Asia; Blue, Northwestern Europe; Orange, Finland/Scandinavia.

Since HistoGenes works to sequence whole cemeteries, the project can also look at the biological relationships among individuals buried in the same cemetery or between nearby cemeteries. With modern DNA, this is a simple procedure; for ancient DNA, plagued as it is by low quality sequence data due to DNA degradation, this is problematic. A key member of the HistoGenes team, Krishna Veeramah of Stony Brook University, has developed a statistical tool that accounts for this uncertainty and accurately calculates the kinship coefficient that can infer relationships down to approximately fifth degree relatives (depending on the quality of the underlying data), that is, to third cousins.[4] Using this tool, and in collaboration with archaeologists and anthropologists, the project can work out pedigrees, sometimes over as many as seven generations, and determine when, if at all, they begin to merge. Marriage strategies can also be recognized by determining the origins of spouses. By plotting the location of burials of closely related individuals within cemeteries, the project can also gain some insight into the importance of these biological ties within these local communities.

Finally, by examining long contiguous blocks of DNA that are transmitted across generations, the researchers can now start to infer more distant relationships between individuals from different sites and regions. Network analysis of these blocks, termed tracts of identity by descent, help to depict the regional social bonds and distant origins of the inhabitants of the region across centuries.

Findings and the Future

Thus far, these results are very preliminary. However, the enormous variation within this region can already be seen, not only at the macro level, but even within small areas of a few square miles and within a half century. In some cases, the genetic diversity within twenty square miles is as great as in all of modern Europe. Clearly, this is a complex society. However, this does not mean that all of these groups intermarried rapidly. In some nearby cemeteries where the material culture suggests a homogeneous population, one community with a marked Asian ancestry continued for generations to choose wives from other more distant communities with a similar ancestry while avoiding marriage with their nearby, more-western neighbors.

Other cultural practices were also identified, such as evidence of levirate marriages—the custom found in various societies in which the widow of a man is remarried to one of his close kin, a brother, uncle, or even her own step son. This practice, which serves both as a way of keeping property given to a bride at marriage within the husband's kindred and of supporting a widow, is still followed in Steppe societies of Central Asia, and suggests that in the Avar empire certain Steppe cultural traditions survived for generations.

During the remaining four years of the project, the HistoGenes team expects to complete these regional studies and to establish connections among them and with other, more distant populations, thereby creating a dynamic image of the relationship between biology, culture, and mobility in this region. Ultimately, this is made possible by bringing humanists and scientists together as equal partners in a common endeavor, offering a model for both future collaborations and the future of understanding humanity in all its complexity. ■

Patrick Geary is Professor Emeritus in the School of Historical Studies, Distinguished Professor Emeritus at UCLA and former President of the Medieval Academy of America. He has written widely on western European social and cultural history in the first millennium, on the history of memory, language, and gender, as well as ethnicity, identity, and the misuse of the past by contemporary ideologues. He is co-Principal Investigator of HistoGenes.

4 M. Lipatov, K. Sanjeev, R. Patro, K. R. Veeramah, Maximum Likelihood Estimation of Biological Relatedness from Low Coverage Sequencing Data. *bioRxiv*, 023374 (2015).

Q&A with Sophie Lund Schrøder

MARIA O'LEARY

Sophie Lund Schrøder is an astrophysicist who uses numerical methods and analytic modeling to study high-energy astrophysical phenomena, especially the evolution of stellar binaries. She gained her Ph.D. from the Niels Bohr Institute at the University of Copenhagen and has now joined IAS as a Friends of the Institute for Advanced Study Member in the School of Natural Sciences. In 2021, she worked as part of a team of scholars to explain the formation of heavy neutron star binary systems, interpreting results from gravitational wave observatories that had previously puzzled scientists.

How do you describe your work to friends and family?
I work on binary stars which are two stars orbiting each other in circles, similar to how the moon orbits Earth. The most well known example of a binary star system is the two suns that Luke Skywalker looks at from Tatooine in Star Wars.

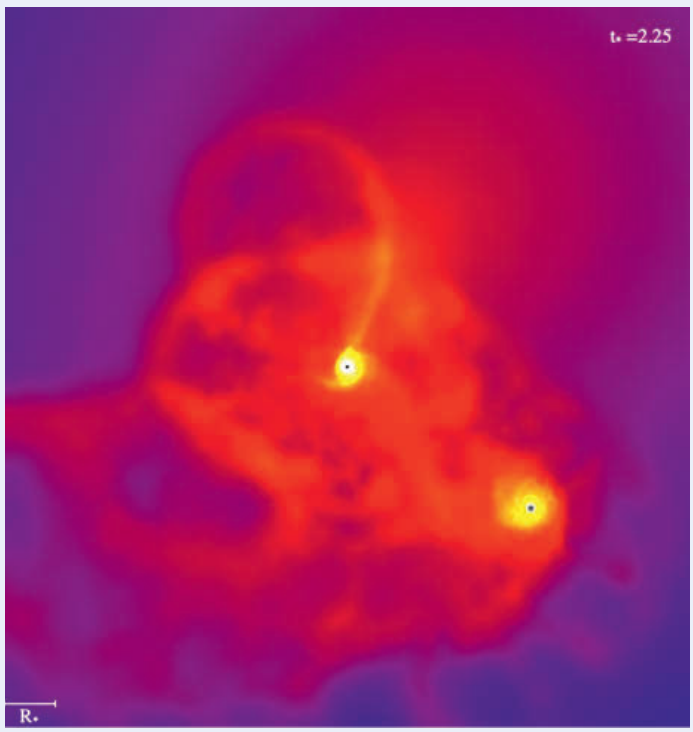


IMAGE PROVIDED BY SOPHIE LUND SCHRØDER

What motivates you as a researcher?
Interacting with other scientists and hearing how their projects are going. I really like talking with other people to learn how their research fits together with my projects.

Where is your favorite place to think?
In groups with others. Or when I have to do difficult math, in my office alone so I can work it through slowly.

What other activities or pastimes do you enjoy?
I like cooking, exercising, visiting new places, and going for long walks listening to audiobooks.

What is your favorite part about your career and work?
I love traveling and getting to meet and interact with other scientists during visits or at conferences. I also really enjoy when a puzzle is solved, like when a difficult mathematical description of a physics problem simplifies to something that can easily be understood.

The aftermath of a star (center) exploding in a supernova, with a close by orbiting companion black hole. Large amounts of gas are ejected by the exploding star, but gravity causes about half of the gas to fall back onto the binary system, and the gas gets re-accreted by both the supernova remnant and the companion black hole.

CLIMATE CRISIS POLITICS

During the 2022–23 academic year, the School of Social Science hosted a special theme seminar on Climate Crisis Politics, meant to investigate how the challenges of climate crisis and its surrounding politics generate novel questions. Members Lynne Huffer and Andreas Folkers, and Distinguished Visiting Professor Timothy Mitchell—co-leader of the special theme year—spoke with us about the important and varied work of the seminar Members, the meaning of the term 'climate crisis politics,' and on what it looks like to live in and beyond climate crisis.

This interview has been edited for length and clarity.

The words climate, crisis, and politics can combine in a variety of ways, and those conjunctions have a very broad reach in meaning. Which conjunction do you find most important or relevant to your own work?

TM: It's the three words together. And it's precisely bringing them together that's important—for my work, and probably for the group as a whole. We're not trying to study the climate crisis from the point of view of climate science. We're not trying to solve the crisis—I think it's probably too late for that. But we are trying to think about the kinds of conceptions and the kinds of vocabulary that will help us mitigate it, live with it, live with one another, and live on the planet differently.

AF: I have some minor reservations against the 'crisis' element. The notion with which we speak about climate crisis—and, I think, the idea behind giving the seminar this title—was a decision by a couple of journalists and influential climate scientists to show the urgency of the issue. I still think it is a good choice to feature 'crisis' in the seminar title—for that reason. But the traditional notion of crisis is that certain types of events escalate to a certain point and then resolve, or not, whereas the climate crisis is characterized by

the fact that even if we achieve limiting global warming to five degrees Celsius, it would still be a long secular change of both nature and society. To think about climate change as a chronic crisis with a long adaption period is something new for the social sciences.

LH: And I would add that another reservation some people have about the word 'crisis' is that it suggests that the effects of the changes in the climate are new. And, for many people (some of whom are marginalized and not seen by mainstream media), they are not new. The word 'crisis' suggests newness, and it makes one ask the question: "crisis for whom?" For my own work, where I think about extinction and the question of ethics in relation to extinction, I would also want to add two things: first, a capacious understanding of climate that includes the problem of mass species extinction; second, to connect the question of politics with ethical questions about "how we are to live" in a very everyday sense. Sometimes I think people perceive politics as being on the level of government or international meetings, but, as someone trained in feminist theory, I think one of the things feminism has brought to the understanding of politics is the way it permeates every aspect of our lives and how it has to do with questions of power. I think it's useful to think about politics' relation to climate in this way.

Have you found surprising intersections between climate crisis politics and other disciplines or subdisciplines?

LH: I'm a philosopher, so I've done theory and I'm trained in literary studies. One of the things that has been surprising in my own work, taking on the problem of mass species extinction, is that I've become something of an expert in the history of paleontology. And that's definitely unexpected!

AF: I don't think I can name a single area because, as social scientists, I think we have to be prepared to be surprised by the effects of the climate emergency. Sociology formed around social questions in the late nineteenth century with the emergence of industrialization and capitalism, problems of poverty, public health, and others. As a sociologist, I think what the climate crisis is doing is changing the way we have traditionally thought of societies and the fundamental concepts we are employing. Therefore, it's really important to expect surprises.

TM: Several of us in the group are influenced by the field of science and technology studies (STS). And what I think that reflects, as Andreas was just saying, is that older forms of social science often worked with a very well-defined conception of what the object of that science was: society, economy, government, and the political system. Lynne just mentioned the way in which feminist theories sort of exploded and expanded those forms. I think that's an example—and there are others—of the ways in which none of us are working within the limits of one of the conventional disciplines of social science. And I think, with climate politics, that's absolutely essential. Climate politics challenges the very conception that there's some sort of bounded thing called the social world, or society, that you can study—or that you ought to study—separately from questions of ecology or questions of energy and its use. Again and again, you're moving outside of what might have been historically the more conventional focus on certain kinds of social actors or political actors.

LH: What Tim is saying is interesting because how we think about nature is completely different. In traditional social contract theory, you come into society by making a contract that brings you out of the state of nature. But current scholarship is very much about how human relations are inextricably tied to this thing that we call nature—the natural world. It's no longer "Man versus Nature." It's natureculture, all as one thing.

Which other fundamental theories are challenged by climate crisis politics?

AF: You can say, at the most fundamental level, we're talking about questions of social ontology. What is an actor? What is a social entity? What is the object we are studying? What is social action? Who has agency? Who doesn't have agency? There are a lot of debates that have asked these questions through, roughly, the millennium. Then there are the political questions—the general diagnosis of what kind of society

we're in. One of the concepts that I am struggling with is the concept of modernity, and this is the question of my book project. How do we have to rethink modernity, which is always presented to us as 'the new,' if it only became possible by going to the old—fossils—to fuel this sense of newness, of movement, of dynamic? And how is modernity undermined by the fact that we are now stuck with the fossil residuals of the past: the CO_2 in the atmosphere, the plastic waste in the ocean, and the chemical pollution all over? What does it mean to be modern?

TM: One of the things I'm thinking about is connected with that; it's how we conceptualize and live in relation to the future. One way of thinking about the problem of climate politics would seem to be our inability to act in relation to the future, that we suffer from some kind of presentism. Part of my interest is that we actually have a variety of ways of relating to the future, but those ways are inadequate because they are very specific to specific kinds of ends. I am particularly interested in that from the aspect of finance, and the particular ways of not just calculating the value of the future but of extracting that future value in the present. Living off the future in the present has come to define both the nature of capitalism and the way capitalism works. So, reframing what capitalism is and capitalism's relation to modernity has been at the center of some of the work I have been doing this year.

LH: My primary field is philosophy, so one of the things I have been thinking about for many years is ethics. Traditionally, ethics begins with a moral subject—a human subject. And I think one of the things that climate crisis politics forces us to do is de-center the human subject as a moral agent. And that's super tricky; what kind of ethics is that? But I think it's necessary. There's a tradition in philosophy of anti-humanism that goes back at least until the middle of the twentieth century, but I think that climate crisis and extinction reframe it in really interesting ways.

How has climate crisis politics challenged traditional methodologies?

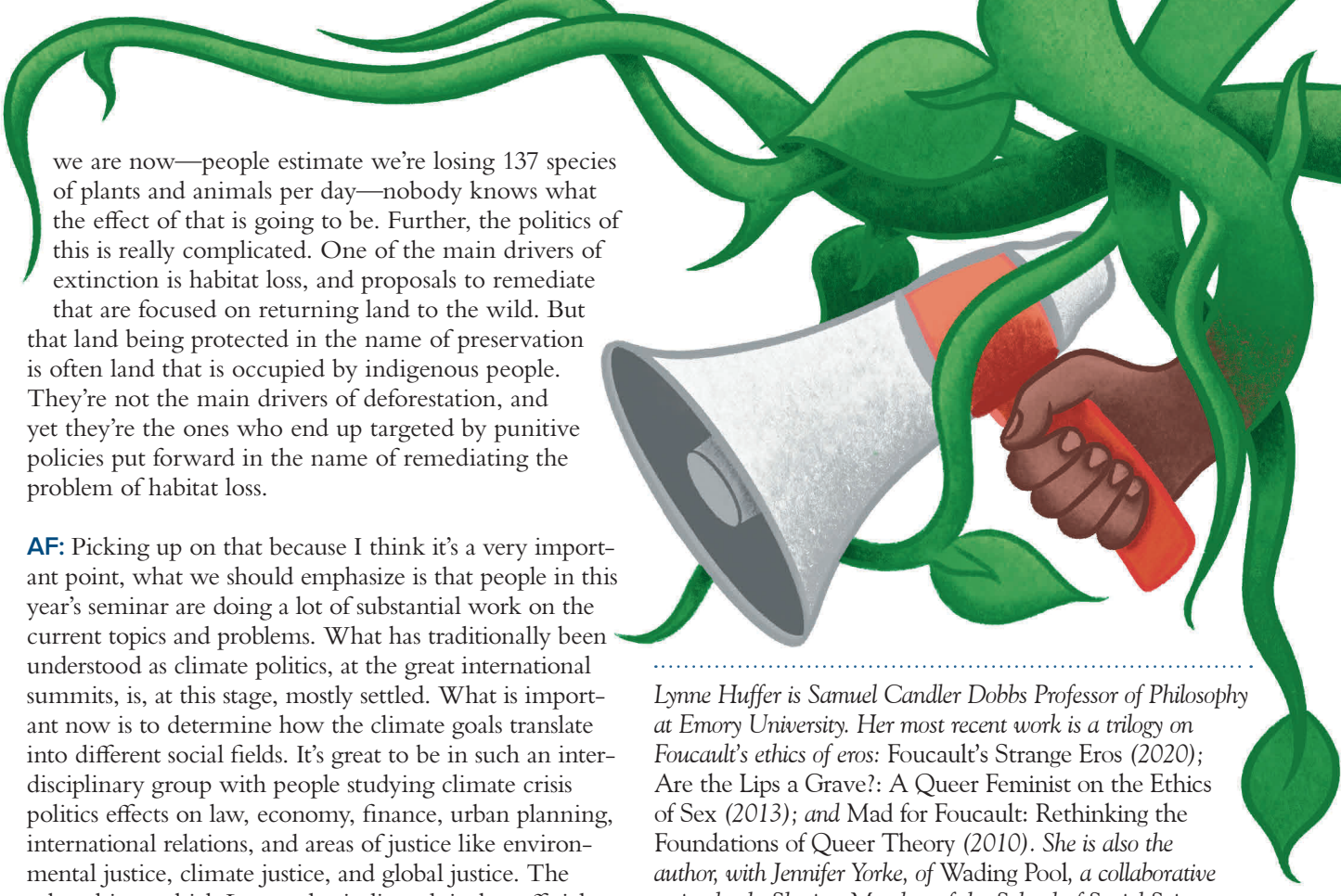
LH: My methodologies are influenced by philosophers of various kinds, but one method I take really seriously is the genealogical method, specifically in the sense defined by [Michel] Foucault, which has to do with looking at discontinuities and not being able to determine causes. Assumptions we make about causality are put into question. I think that ties in really well with how I'm looking at the fossil record, because the fossil record is radically incomplete. It's mostly blanks. One writer describes it as speech marks without quotations—which I love. And so, one thing I'm doing methodologically, again as somebody in the humanities, is I'm experimenting with the form of my work by trying to replicate that fragmentation of our knowing and that fragmentation of the archive. My project is written as a rearrangement of fragments. It's not just chaos—it still tells us stuff—but it's also really paying attention to the gaps and silences and to the places where we just cannot know. My method is trying to open up a space for thinking differently about how we can know and what we can know, as well as change our ethical attitude to one that makes us more right-sized in relation to the universe.

AF: Picking up on what Lynne said, I think what is clear is when we say we can no longer separate nature and society, this brings a huge challenge not only to the social sciences but also to the natural sciences. I recently re-read an old text by Wilhelm Windelband, and he makes a distinction not between natural scientists and social scientists but a distinction between two separate approaches: one is historical, an event science that reconstructs history, and the other is a law science where you try to explain certain processes through the fundamental laws that govern it. What I think is interesting is that this distinction no longer maps on to the 'social sciences versus natural sciences' distinction because in both instances we have these moments—in no longer separating nature and society, but viewing it as natureculture—where we have to think about historical processes as eventful. I'm always thinking about this idea of natural history, and I think it's a problem that we all have to grapple with.

TM: For the reasons we've been talking about, with the inadequacies of the conventional disciplines and divisions of the social sciences for dealing with what we're up against, inevitably new methods are necessary. Instead of singling out one, I believe it's more about a kind of openness, similar to what Andreas already mentioned. As opposed to a more conventional approach which sort of assumes it knows who the actors are—certain classes or social groups, political organizations, or states (depending on what level the actors are taken to be)—and then examines the interactions between them, I think starting with an openness and a curiosity about the very question of agency and the possibilities of action is necessary, and is itself a methodological principle.

When thinking about climate crisis politics, what other important considerations should we keep in mind?

LH: As somebody who works on extinction, I think that some people aren't aware of the extent of the problem of extinction. It's somewhat invisible. Sometimes, ironically, it's made invisible by the prominence of climate crisis and all the media attention that's given to that. People think of extinction as just about these animals: we don't notice if they're there or not. But really it has to do with the stability of the earth system, the integrity of the biosphere. It forms the foundations of everything that we do, the bonds that hold everything together. And when we're in a mass-species-extinction event as



we are now—people estimate we're losing 137 species of plants and animals per day—nobody knows what the effect of that is going to be. Further, the politics of this is really complicated. One of the main drivers of extinction is habitat loss, and proposals to remediate that are focused on returning land to the wild. But that land being protected in the name of preservation is often land that is occupied by indigenous people. They're not the main drivers of deforestation, and yet they're the ones who end up targeted by punitive policies put forward in the name of remediating the problem of habitat loss.

AF: Picking up on that because I think it's a very important point, what we should emphasize is that people in this year's seminar are doing a lot of substantial work on the current topics and problems. What has traditionally been understood as climate politics, at the great international summits, is, at this stage, mostly settled. What is important now is to determine how the climate goals translate into different social fields. It's great to be in such an interdisciplinary group with people studying climate crisis politics effects on law, economy, finance, urban planning, international relations, and areas of justice like environmental justice, climate justice, and global justice. The other thing, which Lynne also indicated, is that official climate politics often has a negative impact on a series of other fields, like biodiversity and indigenous groups. The dominance of economic tools on climate politics don't address the global inequalities between polluting countries and the countries to whom most of the climate effects are happening. It is very important for us to critically engage with the proposals already made and examine how they are aggravating existing inequalities—and determine how we can think about these things differently.

TM: I think alongside that question of justice, and as a part of this question of politics, there is a concern with the fact that some people are going to benefit, at least within the short to medium term, from forms of climate catastrophe. There will be money to be made; there will be forms of great impoverishment that will benefit others. And so, the question of justice and injustice isn't just about how you reach out and help other people. It's realizing that, particularly in the more privileged kinds of places in which we live, there will be beneficiaries. One of the extraordinary political challenges will be arguments about limits to freedom. Thinking not only about the ways this is already the case, but also what we're up against in the future, about how a crisis can be mobilized, as it often has been in history, as an argument against freedom—against various forms of very fragile political rights—is an important aspect which some of the seminar members are working on. ■

Lynne Huffer is Samuel Candler Dobbs Professor of Philosophy at Emory University. Her most recent work is a trilogy on Foucault's ethics of eros: Foucault's Strange Eros *(2020);* Are the Lips a Grave?: A Queer Feminist on the Ethics of Sex *(2013); and* Mad for Foucault: Rethinking the Foundations of Queer Theory *(2010). She is also the author, with Jennifer Yorke, of* Wading Pool, *a collaborative artists book. She is a Member of the School of Social Science, where she is completing an experimental book project, "The Ethics of Extinction: 99 Anthropocene Fragments."*

Andreas Folkers is a postdoc in sociology. His work investigates the bio- and technopolitics of contemporary societies from a perspective that combines the analytical sensibilities of STS with approaches in (critical) social theory. He has published a monograph on his Ph.D. work on disaster preparedness, and numerous articles in journals such as Theory, Culture & Society, EPD: Society and Space, Economy and Society, European Journal of Social Theory, Security Dialogue, *and* Social Studies of Science. *As a Member of the School of Social Science, he is writing a book tentatively titled "Fossil Modernity: A Natural History of the Present" on the rise, fall, and afterlives of the cataclysmic ligature between modern societies and fossil fuels.*

Timothy Mitchell is the William B. Ransford Professor of Middle Eastern Studies in the Department of Middle Eastern, South Asian, and African Studies at Columbia University. His areas of research include the place of colonialism in the making of modernity, the material and technical politics of the Middle East, and the role of economics and other forms of expert knowledge in the government of collective life. His books include Colonising Egypt; Rule of Experts: Egypt, Techno-Politics, Modernity; *and* Carbon Democracy: Political Power in the Age of Oil. *During the 2022–23 academic year, he is a Distinguished Visiting Professor in the School of Social Science.*

Forging a Closed Loop

The intersection of climate change, migrant labor, and the conditions of work at the World Cup in Qatar

BY NATASHA ISKANDER

Throughout the weeks of late November and early December, the scholarly community at IAS was pulled away from our research by the muscular grace of the beautiful game. In the newly opened Rubenstein Commons, we gathered to watch the 2022 FIFA World Cup, held for the first time in the Arab world, in the small but emergent country of Qatar. We huddled over our morning coffee as we watched Saudi Arabia trounce Argentina; during afternoon games, we sprinted out to Fuld Hall at half-time to collect the tea and cookies that would console us when our team lost. We watched Morocco rise from its ranks as the underdog and let ourselves be inspired by the heart with which it played. We watched as Richarlison of the Brazilian team executed a miraculous backward kick into a soaring and unexpected goal, and we watched as Messi ambled across the pitch in the middle of even the most heated games. We cheered in all the languages spoken at the Institute and we felt the sense of community that bound us, for a short time, to the billions around the world who also tuned in to watch the games.

We also marveled at the beautiful stadia in which the games took place: the Al Wakrah stadium with its fluid organic curves; the Education City stadium covered in reflective panels that glimmered in the colors of the Doha sky; the Lusail stadium, made of what seemed ethereal filigree of light. Qatar's Supreme Committee for Delivery and Legacy, the organizer of this year's tournament, claimed that these gorgeous stadia were also the emblems of "the first carbon-neutral World Cup in history,"[1] and games so pathbreaking in their environmental stewardship that they would redefine how large-scale sporting events were organized around the world. Numerous environmental organizations, from Greenpeace[2] to Carbon Market Watch,[3] called out this boast as greenwashing and pointed to the funny accounting that had to be deployed in order to turn the games—and the air-conditioned stadiums, grass pitch (flown in and kept alive on desalinated water), daily shuttle flights for spectators from neighboring countries, and massive build out of infrastructure required to host them—into an event that leaves no mark on the climate.

Lost in these debates, however, was a deeper, more troubling story about climate change—a story I witnessed firsthand. In the decade leading up to the World Cup, for examination of labor migration and the structures of production that they interpolated, I conducted research in Qatar on the working conditions for migrant workers in the construction industry. I spent a year shadowing workers on construction sites, interviewing them about their work and spending time with them at their labor camps. I also interviewed

1 Gilbert, Ben. "Will Qatar Really Produce 'the First Carbon-Neutral World Cup in History'?" *The Guardian*, October 12, 2022, https://www.theguardian.com/football/2022/oct/12/qatar-carbon-neutral-world-cup-history.

2 "Will the World Cup in Qatar be Carbon Neutral?" *Aljazeera*, October 19, 2022, https://www.aljazeera.com/sports/2022/10/19/host-qatars-world-cup-carbon-neutral-claims-under-fire

3 "FIFA 2022 World Cup's 'carbon neutral' claim is far-fetched and spurious." *Carbon Market Watch*, June 7, 2022, https://carbonmarketwatch.org/2022/06/07/fifa-2022-world-cups-carbon-neutral-claim-is-far-fetched-and-spurious/

managers, engineers, architects, and consultants. I spoke with government and with representatives of Qatar's Supreme Committee for Delivery and Legacy. And as part of this research, I traveled to many of the countries that migrants were from, especially Nepal, India, and the Philippines.

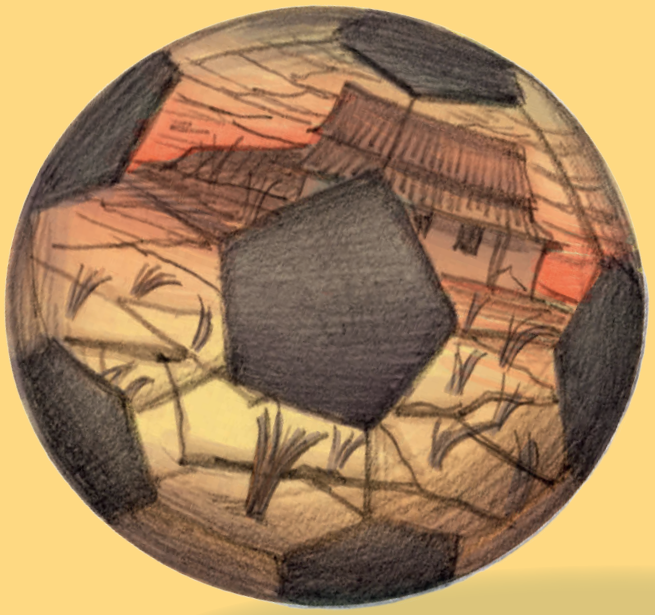
Through this research, I discovered a story of how the business and government interests that built these games turned climate change and climate migration into profit. It is a story that runs through the recruitment of more than one million migrant construction workers, and through the ways that climate change has impacted the communities they were from. It is a story demonstrating the link between climate change and the conditions of work and migration—and the role global companies can have in shaping this link; thus, it is a story that has implications for how we understand and address the growing relationship between climate change and labor mobility.

Sourcing a Specific Kind of Laborer

Staring down the hard deadline of World Cup kickoff, the global construction companies operating in Qatar needed to recruit thousands and thousands of low-paid workers quickly, sometimes within weeks. But they also needed to be sure that those workers could learn—and learn fast. Qatar's construction projects (the stadia on our TV screens the most photogenic among them) were at the technological cutting edge, and companies needed workers who could quickly master advanced construction techniques and become the expert scaffolders, welders, and carpenters that the building designs, sketched out by the world's star architects, required. The workers construction companies recruited—from South Asia, the Middle East and sub-Saharan Africa—all arrived without relevant construction experience. To bridge this gap, companies turned their construction sites into vast and accelerated training systems. They designed their entire workflows to promote learning. All building practices, absolutely every single task, doubled as on-the-job training. Companies viewed their detailed and accelerated training systems as proprietary and used them to compete for bids in the Qatari market. But the training systems were only as good as workers' ability to learn the advanced construction techniques needed on Qatar's project sites.

In my interviews with construction companies, I asked their managers and the staff of their human resource departments how they met the challenge of recruiting the hundreds of thousands of teachable laborers they needed for their advanced construction projects. Much to my surprise, almost all of them had developed a similar strategy: to find the workers they needed, construction companies in Qatar sought out places around the world that climate damage had made newly poor. They looked for communities that had once been well-off and that had benefited from investments in education, health, and housing, until torrential monsoon rains or a violent typhoon drowned them out, until slow-moving drought strangled them, or until sea level rise and salt water intrusion poisoned their parched fields. In those climate-impoverished places, they explained, they could source migrants who had the educational foundations that equipped them to learn quickly. There, they could find hundreds and thousands of workers who could connect to the intensive training systems companies used and master the technical skills needed to build the sophisticated and futuristic structures that Qatar had commissioned.

They could recruit these workers, with their all-important foundations for learning, at the low wage of $200 a month (the standard in Qatar until 2021, when it instituted a minimum wage of $275 a month). An additional boon was that migrants and their families in those climate-damaged places still had resources from better days to pay recruitment fees for a visa to Qatar (which ran several hundred, sometimes even thousands, of dollars): their underwater fields could still be mortgaged; their storm-wrecked homes could still be sold.



The Intersection of Global Companies and Climate Change

The global construction companies operating in Qatar were not merely opportunistic in their use of climate damage as a resource for worker recruitment. They actively mentored recruitment agencies in countries that were bearing the brunt of climate change, from Nepal to Bangladesh to Ethiopia, working with them to target places where climate disasters were causing dislocation. As a result, recruitment agencies for Qatar, like those

that I visited in Nepal, were quickly becoming specialists in analyzing the potential of different climate pressures to yield workers for export, pulling together highly granular information about the socio-economic consequences of environmental damage. The information they produced was often more complete and more detailed than scientific data available on the ways climate change was transforming the socio-economic practices in those ecologies.

To be sure, in recruiting from climate-damaged areas, companies operating in Qatar offered migrants and their families jobs that paid cash at a time when they badly needed it to rebuild their lives. But in using environmental damage as a resource for recruitment, Qatari recruitment practices drew a closed loop that linked climate change to the conditions of work and migration: Qatar's construction industry, bankrolled by the country's massive fossil fuel revenues and emitting large amounts of carbon in the building process, was boosting its profits by recruiting migrant workers, at low wages, from places damaged by the climate change that the industry helped accelerate.

That closed loop was also drawn on and through the bodies of workers. The migrants recruited from climate-damaged ecologies were tasked with working in Qatar's extreme heat. As the media coverage (which ran like a deep bass under the celebratory projection of the games) made clear, the migrant workers that built the World Cup did so at steep cost to their health. They suffered anomalously high rates of injury and death as a result of the physically-taxing work they did in temperatures that were often life-threatening to a body at rest. In addition to the many deaths that the Qatari government attributed to the nebulous category of "natural causes," many of the men returned to their communities with silent damage to their kidneys and heart that would only blossom years later. Nepal now faces an epidemic of chronic kidney disease, and incidences of kidney damage are concentrated in the communities that have sent workers to countries, like Qatar, where the heat is dangerous. Communities like Janakpur and Dhanusa are also seeing high numbers of men with chronic kidney disease, which in many cases will become fatal. The medical care required, including lifelong dialysis, is expensive and can tip families into debt far greater than the wages that the migrant could have earned as a construction worker abroad.

The media coverage of the World Cup was striated with stories about the injuries that workers sustained at work, and Qatar was singled out for its exploitative labor practices. But Qatar is not an outlier. The conditions that migrant workers have faced in Qatar are not meaningfully different than those they face in other economies around the world, and Qatar's labor and migration laws are in many respects more protective of worker rights than those in the United States or the United Kingdom.

In the connection its companies are building between climate damage and migrant worker recruitment, however, Qatar is certainly a harbinger of things to come. Global companies, like those operating in Qatar, will inevitably capitalize on the opportunities that climate damage offers them, and they will shape the significance of climate change for the communities and ecologies it affects. Climate change is often represented as a faceless force, one that we have set in motion through our reliance on fossil fuels but that we cannot control. The story of climate damage and migrant recruitment that unfolded in Qatar's drive to build the World Cup highlights instead that climate change has a face, and that its consequences are made through specific economic and organizational practices. What climate change will mean for equity, access, and justice will depend on our attention to the way climate change is made through our actions. ■

Natasha Iskander is the James Weldon Johnson Professor of Urban Planning and Public Policy at New York University's Wagner School of Public Service. She is currently a Member at IAS (2022–23) in the School of Social Science. Her most recent book is Does Skill Make Us Human? Migrant Workers in 21st Century Qatar and Beyond *(Princeton University Press, 2021).*

A Tale of Three Busts

How Gianlorenzo Bernini brought an art historian to the Institute, and how that art historian returned the favor

BY ABBEY ELLIS

The Beginning: A Discovery of Busts

Our story begins in Rome on a Saturday in September of 1966. Art historian Irving Lavin returned home to the apartment he shared with wife Marilyn Aronberg Lavin after a day's research at the San Giovanni dei Fiorentini, a sixteenth-century church located at the north end of the city's Via Giulia.

In a state of excitement, Irving asked Marilyn: "How would you like a date two Saturdays from now to discover some Berninis?" A distinguished art historian in her own right, Marilyn accepted his offer with enthusiasm.

That day, Irving had been working in the archive of the San Giovanni dei Fiorentini, adjacent to the sacristy. He was consulting a nineteenth-century card catalog of the archive as part of his investigations into Italian architect Francesco Borromini, who designed the apse of the church and is also buried there.

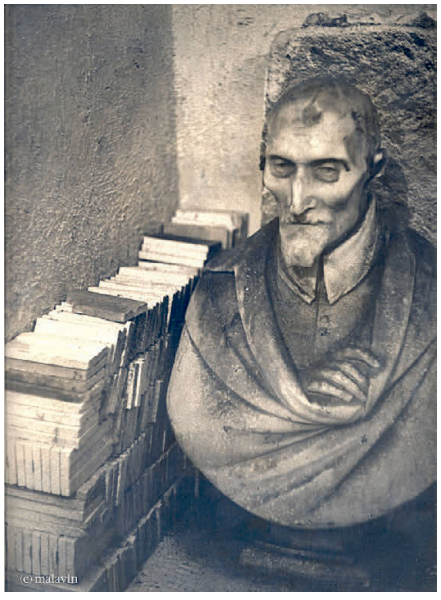
When thumbing through the catalog cards under the letter 'B', Irving unexpectedly came across two cards with a familiar title name: that of Gianlorenzo Bernini (1598–1680). The famous sculptor and architect had changed the face of Rome, but had no known connection with this particular church. Irving had been researching Bernini since his days as a graduate student, writing his doctoral thesis on the Baroque artist while at Harvard.

Each card named a marble bust by Bernini and identified the sitter. Upon further inspection of the archive, Irving found that the two busts had been housed not in the church of San Giovanni dei Fiorentini but within the now-destroyed Confraternità della Pietá Hospital across the street. Thanks to his unrivalled familiarity with Bernini's output, Irving realized that the names of the men represented in these busts had never been mentioned in published inventories of any sort.

Two weeks later, Irving and Marilyn, armed with a Brownie camera and a flashlight, returned to the church to learn more from its archivist. He was unable to provide any more information on the busts, but the sacristan recommended that they check the basement.

The pair descended into a dingy corridor where they came across the first bust. It was dusty, dirty, and carelessly situated alongside a pile of bricks and old candle wax. On the bust, a pencil inscription revealed the name of the person represented: Antonio Coppola, a doctor and benefactor of the Confraternità della Pietá. Around the corner, the other bust referenced in the card catalog, that of Florentine nobleman Antonio Cepparelli, was also discovered.

How had these works of art come to be in the church basement? In 1937, Mussolini had torn down the hospital as part of his construction of a new bridge from the Vatican to Rome. Everything of value in the Confraternità della Pietá, including the busts, was taken across the road and stored in the bowels of the church.



MARILYN LAVIN

The discovery of two new works by Bernini garnered mass media attention. The *New York Times* covered the story, and Marilyn's Brownie camera snapshot of the bust of Coppola was reproduced in *Life* magazine. The discovery of the busts of Coppola and Cepparelli in Rome was a watershed moment, securing Irving's promotion from Associate Professor to full Professor at New York University. And, alongside his notable win of no less than three Arthur Kingsley Porter Prizes for outstanding scholarship published in *The Art Bulletin* in the 1960s and 1970s, Marilyn views the first Bernini discovery as a key factor in securing Irving's appointment to the IAS Faculty in 1973.

A Mysterious Bernini

But this was not Irving's only discovery of a Bernini. In 1967, an unexpected glimpse began an Odyssean journey to trace another bust, culminating in Irving making a new attribution to Bernini.

As a newly appointed Professor at the Institute of Fine Arts in New York, Irving had delivered a public lecture. Afterwards, he again returned home to Marilyn in a state of agitation, recounting how an audience member had approached him at the end of the talk and thrust a photograph of a bust under his nose. Irving had taken a brief look at it and pronounced it to be of little

significance, a "mere copy." However, upon reflection he was regretful that he had not paid closer attention, realizing that even copies could possess value. He tried to find the man who had approached him but never succeeded in doing so.

Fifteen years later, after Irving had been appointed as Faculty in the Institute's School of Historical Studies, he received a call from the Sotheby's New York auction house; they were asking for his opinion on a bust that was going up for sale. When looking at the associated catalog, Irving immediately recognized the bust as the one he had been shown at the lecture years before!

The piece is certainly striking. With its head of white Carrara marble, bust of black Belgian marble, and pedestal of grey marble, it was out of the ordinary. The sitter, an elderly man with a long moustache and beard, wears a shirt with a buttoned jerkin, and a cape over the shoulder.

Irving decided not to offer his scholarly opinion on the bust but to instead make an offer at the auction. Three weeks after the gavel fell, it was delivered to his and Marilyn's home on the Institute campus. It stood on a column in the corner of their living room for 40 years, from 1982 to 2022. Its arrival saw the beginning of a decades-long investigation, conducted jointly by Irving and Marilyn, to find documentation for the bust and discern its maker. When recounting this process, Marilyn laughingly refers to Irving as "a terrier—he knows how to do a search!"

ANDREA KANE

The couple's dogged work ultimately bore fruit. In 2018, they jointly published an article in art historical journal *Artibus et Historiae*, in which they made their case for identifying the black-and-white bust as having been made by the young Bernini. Yet the only documentation that they could find for a long time was that inscribed into the bust itself: the word "Farinacio," which named the man represented as Prospero Farinacci (1544–1618).

Farinacci was a prominent lawyer in sixteenth-century Rome. Marilyn describes him as "a man of many colors." In his youth, he was involved in a knife fight which resulted in the loss of one eye. Later, he worked as a lawyer to the Vatican, taking care of everything from bookkeeping to accusations of heresy for two Popes. He also garnered a reputation for his defense of a young noblewoman, Beatrice Cenci. Beatrice had committed patricide after being subjected to years of abuse and sexual assault at her father's hand. Farinacci defended her in a public court in 1599 but lost; she was beheaded after the trial. In the nineteenth-century, her tragic story was revived and was the subject of many literary and musical works, most notably Percy Bysshe Shelley's verse drama *The Cenci: A Tragedy in Five Acts*.

No stranger to scandal in his own private life, Farinacci was also known for fathering a bastard son with a prostitute. After banishing the mother from

COURTESY OF MARILYN LAVIN

A painting of Castel Sant'Angelo by John Wenger, which hangs over the Lavins' fireplace. The Castel Sant'Angelo was the location of Farinacci's legal offices in sixteenth-century Rome, and is where his bust resides today.

Rome on pain of death, he took custody of the child, named Ludovico, and placed him with a nurse. Once he reached the appropriate age, Ludovico was sent to train as a priest at the monastery at the church of San Silvestro al Quirinale, where Farinacci was buried after his death in 1618. Ludovico, in an unprecedented turn of events, inherited Farinacci's estate.

Where the bust of Farinacci was originally displayed remains an open question, but one theory is that it once stood in the library of the San Silvestro al Quirinale, of which Farinacci was a patron. Not only did he educate his son there, but Farinacci also donated his own personal library to the church. Farinacci's will also mentions leaving 100 scudi to Michele Ghislieri the church's librarian and Prospero's spiritual advisor, for the cost of completing two of his unfinished manuscripts and preparing them for publication. The books were published, but Marilyn finds 100 scudi an excessively large sum to be offered for this task. Her theory is that the remaining money was used to pay for a bust of Farinacci, which was placed in the library in his memory. The major clue that suggests that this bust fulfilled such a commemorative function is the inscription giving Farinacci's name, which is written in the dative case in Latin, meaning that it reads "for Farinacci," perhaps denoting a memorial. Had the library of the San Silvestro al Quirinale not also been destroyed, we might have a record that could confirm or deny this conjecture, but alas. Marilyn likes to imagine the bust of Farinacci as a welcoming figure for scholars entering the library, where they would do good works for the church.

In Search of a History

Tracing Farinacci as a historical figure was relatively straightforward, but uncovering the provenance of the bust was much more difficult. Despite Irving and Marilyn's best efforts, not a whisper of the bust could be found that gave its location in the seventeenth- or eighteenth-centuries. But thanks to meticulous internet searches conducted by Irving's Academic Assistant, Uta Nitsche Joseph, a photograph was unearthed which showed the Farinacci bust on display in a sculpture gallery at the Art Museum of Detroit. This image was the key to unlocking the bust's history.

The bust had been donated to the Museum in 1902 by Sibyle L. Baldwin, the widow of the former Governor of the State of Michigan, Henry P. Baldwin. The bust was part of a larger bequest of statues that were given on the condition that a new room was constructed for their display, to be named after the Baldwin family.

In 1924, Baldwin's daughter, Katherine

Phelps Bliss, visited the Detroit Museum to inspect their display. To her horror, she found that her mother's bequest had been placed in storage and was in poor condition. Furious, she demanded that the sculptures be transported to her Manhattan apartment. The bill of lading—a document that details the items shipped—is extant, which mentions the bust of Farinacci.

Uncovering this part of the bust's history led Irving and Marilyn to further documents that tracked its journey to the U.S. It had travelled from Italy in a group of objects purchased by a young man named Lewis Cass Jr., who served as ambassador to the Holy See in 1849. Irving searched the Palazzo Braschi, where customs records are kept, and found two pieces of parchment that granted permission for Cass to bring thirteen statues back from Italy, including that of Farinacci. Cass gave his sculptures to his father, Lewis Cass Sr., the then governor of Michigan, and they were displayed in the governor's house. It is thought that the next governor, the aforementioned Henry P. Baldwin, took on the collection when he inherited the house from Cass in 1868.

Jumping forward in time to 1929, the bust changed hands again when the fortunes of Katherine Phelps Bliss suffered owing to the Wall Street Crash. She was forced to downsize her Manhattan apartment and sell the sculpture. It then came into the hands of Bertram Isard, a private collector based in Philadelphia; after his death, Isard's wife offered it for sale at Sotheby's in 1982. This was when Irving came across it.

In the bust of Farinacci, Irving noted youthful hints of the style of composing portrait sculptures that Bernini would go on to produce for the rest of his life. That Bernini was the author of the work also became probable through the sheer quality of the carving. Irving and Marilyn's 2018 publication on the subject highlights the "bold drill work executed with great bravura," in particular that of the perforated locks of the beard, which extend as much as an inch and a half below Farinacci's chin.

Part of the Family

The Farinacci bust was not only a segment of Irving's career: it was almost part of the family. His daughter, Amelia, reflected on Farinacci's presence in their living room: "I've had a lot of conversations with him over the years. It was like having a grandfather or a spooky presence

ANDREA KANE

in the corner!" She described walking downstairs in the early hours of the morning and coming across the bust: "If you can't sleep and you open the curtains, the moon can be very bright. And with those sunken cheeks, depending on the light, he was either friendly or very ominous!"

During their search for the bust's history, having Farinacci watching over them each day as they conducted their research was not a source of frustration to Irving and Marilyn. Instead, they found it helpful. Marilyn describes frequently coming to look at him: "I'd say, 'Oh my goodness, I don't remember that exact detail—here's what I'm looking for' and so on. As art historians, we are so used to shuffling through books, looking for a good photograph to inspect. Having the bust right there was really out of the ordinary."

When trying to resolve what she would do with the bust after Irving's passing, Marilyn decided not to sell it. Instead, she resolved to "put it where it's supposed to be. The people on the Grand Tour were interested in taking things away and putting them in American museums. But nobody has given anything back."

To realize her goal, she connected with an organization called LoveItaly, and with the American Friends of LoveItaly, which is dedicated to sustaining Italy's cultural heritage by facilitating select restoration projects of artworks and architecture. Tracy Roberts, the non-profit organization's Vice President said that they had never received a gift like the Farinacci bust. As a result, Marilyn and Tracy tirelessly worked to secure the sculpture's return to Rome.

In October 2022, the bust was professionally packed at Marilyn's home and eventually shipped to the Castel Sant'Angelo in Rome, where it is now displayed in a Renaissance -era room with mural paintings on the ceilings and walls. This position also returns Farinacci to the locale where his legal offices were once held. Laughing, Marilyn refers to this position as a "stroke of genius!" The bust was officially received in a ceremony in the Castel Sant'Angelo on March 20, 2023.

Ships in the Night

After organizing this new placement for the Farinacci bust with LoveItaly, Marilyn realized that it had already been sitting for years adjacent to the Castel Sant'Angelo, in the form of a painting by artist John Wenger, displayed in her living room. The painting shows, in modernist form, a classic view of the River Tiber, with

MAXIMILIANO MASSARONI

the Castel on the right side of the composition.

This was not the only coincidence linking Irving, Marilyn, and Farinacci. When the couple were graduate students, working on Irving's Ph.D., they lived two doors down from the entrance to San Silvestro al Quirinale where Farinacci was buried. With a smile, Marilyn remembered, "It had a bell tower that was always waking us up and we would shake our fists!"

With the publication "Bernini's Bust of Prospero Farinacci," Irving's career had come full circle—from the first Bernini discovery to the last. During his tenure at the Institute, Irving's work on Bernini continued. His monumental study 'Bernini and the Unity of the Visual Arts,' published in 1980, was the first to tackle exhaustively the artist's oeuvre. It remains the starting point for many scholars working on Bernini to this day. Not limiting himself to investigations of Bernini, Irving also published extensively on everything from late antique architecture to twentieth century art during his time at the Institute, to great critical acclaim. After an illustrious career spanning over five decades, in which he played an integral part of life in the School of Historical Studies, he passed away aged 91 in 2019.

The legacy of Irving Lavin and Marilyn Aronberg Lavin lives on at IAS in the form of a fund that allays publication costs for Members working in art history. At the age of 97, Marilyn continues her academic work, preparing a number of Irving's unfinished manuscripts for publication alongside publishing her own scholarship. The pair's long history of collaboration is still going strong. ■

"Well, Doc, You're In" Freeman Dyson's Journey through the Universe

Edited by David Kaiser

An Excerpt from "That Secret Club of Heretics and Rebels" by Amanda Gefter

No night is too dark for climbing," the guidebook said.

That was good news, since the wartime blackout was still in full effect.[1] Dyson and Sankey consulted the night climbers' guidebook before setting out in the darkness to attempt its climbs. First, they conquered the Gateway Column at the Wren Library. Then they managed the Senate House. Finally, they decided to tackle the New Court clock tower at St. John's.[2]

The New Court clock tower was profoundly ornate but clockless—just four empty faces stared blankly where the clocks should have been. No one knew exactly why. The climb, according to the guidebook, was fifty feet up from the ground to the roof of the building, followed by another forty feet up the tower. Dyson and Sankey studied Whipplesnaith's instructions:

> *To reach the roof … go up the Drain-pipe Chimney, halfway along the outer west wall. Two drain-pipes run from the ground to the battlements in the lee of a buttress set at an angle to the main wall. The right-hand pipe is loose in two places, and should not be trusted too far.*[3]

They shimmied up the left-hand pipe, two improbable silhouettes in the moonlight, as the ground dropped away beneath them. It was easy enough not to be scared—not when a stray bomb could drop out of the sky at any moment anyway. It was a reality Dyson knew too well: he'd stood helpless and watched the student union building, hit by a lost German bomber, burn to the ground.[4]

1 Whipplesnaith, *The Night Climbers of Cambridge* (Cambridge: Oleander Press, 2007 [1937]), 19.

2 Williams, "Cambridge Night Climbing History."

3 Whipplesnaith, *Night Climbers*, 97.

4 Dyson, *Maker of Patterns*, 23.

The pipe runs up past four windows on the left, at the top and bottom of which a stone foot-hold can be found.[5]

They kept climbing. There were bright things ahead. Soon Dyson and Sankey would sit down together and write their own guidebook: *The Night Climbers of Winchester.* It would be their own contribution to the secret rebel club.[6]

The pipe ends three feet short of the battlements. There is no bowl; it just stops dead. The last few inches pass through a ledge, and so one can grasp the top with confidence. A stretch on to the battlement, and one is safely on the roof.[7]

Dyson would go on to have a remarkably bright career. So would the rest of the Winchester gang of four—James Lighthill in fluid dynamics, Christopher Longuet-Higgins in theoretical chemistry, Michael Longuet-Higgins in oceanography. They'd all be elected fellows of the Royal Society.

The two buttresses on either side appear to offer the possibility of chimney-ing. However, they diverge too much and one slips.[8]

The two small figures stood on the rooftop, the tower looming over them. Dyson's great act of rebellion in the moment was to nurture the seed of an overwhelming optimism—a seed that would blossom into the belief that we live in the most interesting of possible universes, that we can overcome all of it: the limits of our biology, the claustrophobia of our planet, the absoluteness of elsewhere, the heat death of the universe.

One can now reach a ledge to the front and above one's head. A scramble lands one on a sort of terrace, a yard wide and two yards long.[9]

They scrambled.

A clockless circle of stone provides the necessary holds. Thus for the first twelve feet.

5 Whipplesnaith, *Night Climbers*, 97.
6 Williams, "Cambridge Night Climbing History."
7 Whipplesnaith, *Night Climbers*, 97.
8 Whipplesnaith, *Night Climbers*, 101.
9 Whipplesnaith, *Night Climbers*, 101.

Some futures would be darker, though—they could sense it. Like Frank Thompson's. Dyson's poetic idol at Winchester, Thompson would parachute into German-occupied Yugoslavia, attempting to link up with a resistance movement in Bulgaria. He'd be captured there and, according to newspaper reports, held trial, where spectators would gape in amazement when he refused a translator, not knowing that he was a founding member of the Winchester College Obscure Languages Club. He would answer his accusers in flawless Bulgarian: "I am ready to die for freedom." And he did.[10]

The next twelve feet are the most difficult part of the climb.… Pillars rear up at the outside corners and are joined to the Tower by an arch of sloping stone, festooned on the upper side with ornamentations that should not be trusted too far.[11]

As for Dyson, he'd soon be sent to High Wycombe for Bomber Command, where the same familiar numbers that had danced around his crib would come to mean other things.

For a climber is a man standing on the edge of an abyss.[12]

Dyson and Sankey perched on the edge. Just two years from now, Sankey would be killed in the battle of Arnhem.[13]

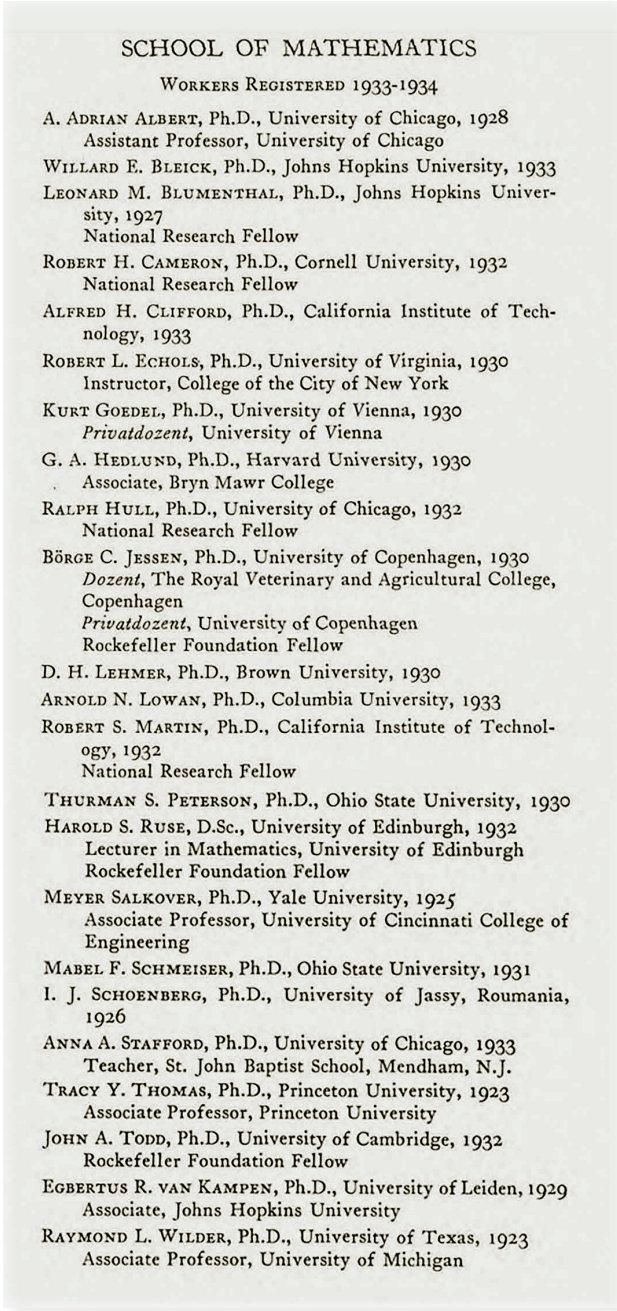
From now on it is merely a wriggle to get on to the arch, and the rest of the way is practically a stone ladder to the pinnacle.[14]

They clung to the crowning spire, triumphant, because what they understood implicitly was what Dyson would someday try to tell the Oersted crowd: that *this* was their education. The books. The secret club. Each other. The Trinity College clock rang out, exultant in the dutiful dark, bells to count the final moments of a childhood. In a minute they'd start the climb back down. For now, they listened to the chimes, and Dyson thought: what a beautiful sound. ■

Excerpted from *"Well, Doc, You're In" Freeman Dyson's Journey through the Universe* edited by David Kaiser. Reprinted with permission from the MIT Press, Copyright 2023.

10 Dyson, *Disturbing the Universe*, 38.
11 Whipplesnaith, *Night Climbers, 101.*
12 Whipplesnaith, *Night Climbers, 221.*
13 Neuenschwander, *Dear Professor Dyson, 201.*
14 Whipplesnaith, *Night Climbers, 103.*

Losing Track and Finding Traces of the Institute's Lesser-Known Histories



SCHOOL OF MATHEMATICS

WORKERS REGISTERED 1933-1934

A. ADRIAN ALBERT, Ph.D., University of Chicago, 1928
Assistant Professor, University of Chicago

WILLARD E. BLEICK, Ph.D., Johns Hopkins University, 1933

LEONARD M. BLUMENTHAL, Ph.D., Johns Hopkins University, 1927
National Research Fellow

ROBERT H. CAMERON, Ph.D., Cornell University, 1932
National Research Fellow

ALFRED H. CLIFFORD, Ph.D., California Institute of Technology, 1933

ROBERT L. ECHOLS, Ph.D., University of Virginia, 1930
Instructor, College of the City of New York

KURT GOEDEL, Ph.D., University of Vienna, 1930
Privatdozent, University of Vienna

G. A. HEDLUND, Ph.D., Harvard University, 1930
Associate, Bryn Mawr College

RALPH HULL, Ph.D., University of Chicago, 1932
National Research Fellow

BÖRGE C. JESSEN, Ph.D., University of Copenhagen, 1930
Dozent, The Royal Veterinary and Agricultural College, Copenhagen
Privatdozent, University of Copenhagen
Rockefeller Foundation Fellow

D. H. LEHMER, Ph.D., Brown University, 1930

ARNOLD N. LOWAN, Ph.D., Columbia University, 1933

ROBERT S. MARTIN, Ph.D., California Institute of Technology, 1932
National Research Fellow

THURMAN S. PETERSON, Ph.D., Ohio State University, 1930

HAROLD S. RUSE, D.Sc., University of Edinburgh, 1932
Lecturer in Mathematics, University of Edinburgh
Rockefeller Foundation Fellow

MEYER SALKOVER, Ph.D., Yale University, 1925
Associate Professor, University of Cincinnati College of Engineering

MABEL F. SCHMEISER, Ph.D., Ohio State University, 1931

I. J. SCHOENBERG, Ph.D., University of Jassy, Roumania, 1926

ANNA A. STAFFORD, Ph.D., University of Chicago, 1933
Teacher, St. John Baptist School, Mendham, N.J.

TRACY Y. THOMAS, Ph.D., Princeton University, 1923
Associate Professor, Princeton University

JOHN A. TODD, Ph.D., University of Cambridge, 1932
Rockefeller Foundation Fellow

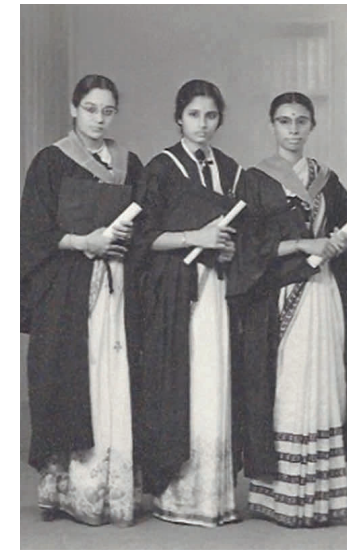
EGBERTUS R. VAN KAMPEN, Ph.D., University of Leiden, 1929
Associate, Johns Hopkins University

RAYMOND L. WILDER, Ph.D., University of Texas, 1923
Associate Professor, University of Michigan

SHELBY WHITE AND LEON LEVY ARCHIVES CENTER

BY CAITLIN RIZZO

The Institute for Advanced Study welcomed its first class of Members (then known as "Workers") in 1933. In the 90 years since, the Institute has welcomed over 8,000 Members comprising scholars from nearly every part of the globe. For many of these scholars, the Shelby White and Leon Levy Archives Center holds some of the only extant archival records documenting their life and work. The Archives Center answers hundreds of requests a year related to household names like Albert Einstein, T. S. Eliot, and J. Robert Oppenheimer; however, just as frequently, it receives requests for information regarding scholars with lesser-known histories and is often one of the few places where researchers can turn to find the remaining traces of those scholars' stories. The Archives Center has assisted with major efforts to track these "lost" scholars ranging from Patrizia Guarnieri's publication *Intellectuals Displaced from Fascist Italy: Migrants, Exiles and Refugees Fleeing for Political and Racial Reasons* to *Scientific American* and PRX's podcast *Lost Women of Science*.



(Left to right) Amba Raghavan, Dr. Radha Gourishankar, Dr. Bhamathi Sudarshan; Presidency College, Chennai, India in the early 1950's; from Levy's blog post "My Hidden Figures"

Over the past year, the Archives Center has taken steps to learn more about the Institute's earliest female-identifying members, like Mabel Schmeiser Barnes and Anna Stafford Henriques. Most recently, archivists spent a significant amount of time researching one of the earliest women of color at the IAS: Thayyoor K. Radha. Radha joined the School of Mathematics/Natural Sciences in 1965 under then Director J. Robert Oppenheimer during a period of significant growth for the Institute. Radha earned distinction as a scholar at the University of Madras, studying under another former Member Alladi Ramakrishnan (School of Mathematics/Natural Sciences, 1957–58). Radha's story is deeply intertwined with Ramakrishnan's experience at the Institute.

Having come to IAS under the invitation of Oppenheimer (after completing his own work under Homi Bhabha), Ramakrishnan returned to his home institution inspired to create an opportunity for young Indian scholars to experience the seminars that changed the course of his career during his time in the United

States. When Ramakrishnan returned to India, he founded the Institute of Mathematical Science (MATSCIENCE) in present-day Chennai, where he advised Radha first as a doctoral student and then as a fellow. Ramakrishnan's acceptance of Indian women into his program surprised even the most distinguished members of Indian society. In his memoir, former Minister C. Subramaniam recalls the shock expressed by Prime Minister Jawaharlali Nehru, when visiting MATSCIENCE, at discovering not only the enthusiasm of the students but "in particular… four girls among the students."[1]

PHOTO BY JOE PLUEZER, MABEL S. BARNES: PEOPLE FILES, SPECIAL COLLECTIONS AND COLLEGE ARCHIVES, OCCIDENTAL COLLEGE, LOS ANGELES, CA

SHELBY WHITE AND LEON LEVY ARCHIVES CENTER

Above, Mabel Schmeiser Barnes (undated); right, Anna Stafford Henriques (undated); the first two women admitted to the Institute for Advanced Study. They appear in the 1933–34 list of Members for the School of Mathematics (far left).

Of the four girls, Radha seemed perhaps the most impressive at that critical moment in time. In 1963, *The Straits Times* (published in Singapore where Radha's sister had settled) printed an article explaining the young Radha's accomplishments, along with the nuclear scientist's image above a caption that read "Miss Radha… too busy to think of marriage." Indeed, in the years between 1963 and 1966, Radha's career as a physicist featured incredible success. In 1963, Radha held a post-doctoral fellowship at Stanford University under physicist Leonard I. Schiff (now famous for his *Quantum Mechanics*). In 1964, Radha co-authored "Slow Neutron-Deuteron Capture and the Structure of 3H and 3He" with Schiff and N. T. Meister for the *Physical Review*, and Schiff presented on the work at the International Conference of High Energy Physics and Nuclear Structure. After Radha returned to the University of Madras for her fellowship, she co-authored several papers with another female fellow R. Thunga, before applying to the Institute and being accepted in 1965. In this period, Radha's name was featured on lectures across the United States—she was invited as far as UCLA by another former IAS Member (and a major advocate for women in science) Nina Byers (IAS School of Mathematics/Natural Sciences, 1964–65).

Today, few scholars recognize Radha's name. Part of the difficulty lies in the traditional structures of twentieth-century society. Radha's name is virtually undiscoverable after 1966 when she married Vembu Gourishankar, a professor in the Department of Electrical Engineering at the University of Alberta, and changed her name to Radha Gourishankar. It is only through the hard work of female mathematicians that there is an answer to what became of Dr. T. K. Radha after marriage. Professor Rachel Levy's viral blog Grandma Got STEM featured Radha, along with three fellow physicists, in a 2018 post titled "My 'Hidden Figures.'" Levy's blog captures the amazing work of women that often goes under celebrated in comparison to academic achievements. Following her marriage and the birth of her children and grandchildren, Gourishankar's scholarship turned toward service: teaching programming and caring for the sick.

Unfortunately, more often than not, the most marginalized scholars in academia can be the hardest to rediscover. Even for archivists, the work of uncovering marginalized communities in the archives can be especially challenging. Institutional records often leave little trace of identity—for better or worse, an individual's race, ethnicity, gender, sexuality, ability, political affiliations, and economic class rarely feature in the archival descriptions created to help researchers identify their records. When these identity markers do appear, they are not without the troubled politics of their historical era.

But in recovering Radha Gourishankar's lost history—and the legacies of other lost predecessors—scholars can unearth important insight into the historic landscape of their own scholarship, as Levy explains in her blog. These forgotten histories reveal the social constructs that shaped knowledge in the twentieth century. For Institute archivists, they illustrate the ways that Institute scholars impact one another. Across time and place, even some of the least-known of the Members play a critical part of the intellectual ecosystem of the Institute. ■

1 Bindu A. Bambah, "Women in High Energy Physics in Post Independent India," *Physics News: Bulletin of the Indian Physics Association* January–June 2021, Vol. 51, No. 1–2.

News of the Institute Community

Faculty

ANGELOS CHANIOTIS, Professor in the School of Historical Studies, has been appointed a member of the National Council of Research, Technology, and Innovation in Greece.

MYLES JACKSON, Albers-Schönberg Professor in the History of Science from the School of Historical Studies, has been elected to the German National Academy of Science and Engineering.

ALONDRA NELSON, Harold F. Linder Professor in the School of Social Science, has been appointed a distinguished senior fellow at the Center for American Progress.

Emeriti

YVE-ALAIN BOIS, Professor Emeritus in the School of Historical Studies, has published *An Oblique Autobiography*, a collection of essays and reminiscences, with no place press.

CAROLINE WALKER BYNUM, Professor Emerita in the School of Historical Studies, has been awarded the 2022 Distinguished Scholar Award from the American Catholic Historical Association.

JOAN WALLACH SCOTT, Professor Emerita in the School of Social Science, has been awarded an honorary doctorate from Université Paris 8.

Members

LUIS CAFFARELLI, past Faculty (1986–96) and Member (2009) in the School of Mathematics, has been awarded the 2023 Abel Prize.

ESHAN CHATTOPADHYAY, Member (2016–18) in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

CLAY CORDOVA, Member (2015–19) in the School of Natural Sciences, has been elected a 2023 Sloan Research Fellow.

INGRID DAUBECHIES, Member (1999) in the School of Mathematics, has won the 2023 Wolf Prize in Mathematics.

DAVID SIMMONS-DUFFIN, Member (2012–17) in the School of Natural Sciences, was awarded a 2023 New Horizons in Physics Prize.

PETER B. KRONHEIMER, Member (1987–89) in the School of Mathematics, and **TOMASZ MROWKA**, Member (2003–04) in the School of Mathematics, have been awarded the 2023 Steele Prize for Seminal Contribution to Research for their 1993 paper "Gauge theory for embedded surfaces."

JOEL LEBOWITZ, Member (1980–81, 2001–02, 2006, 2013–14) in the School of Mathematics, was awarded a 2022 ICTP Dirac Medal.

JENNIFER LEE, Member in the School of Social Science, has been elected as a 2023 Samuel Stouffer Fellow of the American Academy of Political and Social Science.

ELLIOTT H. LIEB, Member (1982, 1989) in the School of Mathematics, was awarded a 2022 ICTP Dirac Medal.

LIA MEDEIROS, Member in the School of Natural Sciences, has been named an Einstein Fellow of the NASA Hubble Fellowship Program.

PAUL MINTER, Veblen Research Instructor in the School of Mathematics, has been elected a 2023 Clay Research Fellow.

BHARGAV NARAYANAN, Visitor (2020–21) in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

TEJASWI VENUMADHAV NERELLA, Member (2015–20) in the School of Natural Sciences, has been elected a 2023 Sloan Research Fellow.

K-SUE PARK, Member in the School of Social Science, has been awarded an Emerson Collective Fellowship.

DAVID RUELLE, Member (1962–64, 1970–71) in the School of Natural Sciences, was awarded a 2022 ICTP Dirac Medal.

SUSHANT SACHDEVA, Visitor (2019) in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

WILL SAWIN, Visitor in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

RASHID SUNYAEV, Distinguished Visiting Professor in the School of Natural Sciences, has been awarded the Max Planck Medal by the German Physical Society.

YUNQING TANG, Member (2016–17) in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

TERENCE TAO, Member in the School of Mathematics, has been awarded La Grande Medaille for 2022.

ANNA WIENHARD, Member in the School of Mathematics, has been awarded the Hector Foundation's Science Award.

EDWARD WRIGHT, Member (2000–01) in the School of Natural Sciences, has been elected a 2023 Fellow for the American Astronomical Society.

JONATHAN JULIAN ZHU, Visitor (2018–19) in the School of Mathematics, has been elected a 2023 Sloan Research Fellow.

Institute

STEPHEN ACKLEY-ORTIZ was appointed as the Institute's Chief Development Officer on August 8, 2022.

ALEXANDRA DAY was appointed as the Institute's first Associate Director of Strategic Initiatives, Programming, and Partnerships on February 15, 2023.

Seven IAS Scholars Win 2023 Guggenheim Fellowships

Seven scholars across all four Schools—Mathematics, Natural Sciences, Historical Studies, and Social Science—have won 2023 Guggenheim Fellowships, one of the most remarkable honors for mid-career researchers, artists, and writers.

Winners from the School of Historical Studies include current Member **ELIZABETH BEARDEN**, who is working at IAS on her third monograph, "Crip Authority: Disability and the Art of Consolation in the Renaissance." Her last book, *Monstrous Kinds: Body, Space and Narrative in Renaissance Representations of Disability*, won a Tobin Siebers Prize. Also from the School, past Member (2016–17) **ROLAND BETANCOURT**, an expert on the Byzantine Empire, received a Fellowship. At IAS, Betancourt explored classical and late-antique foundations of Byzantine thought on time.

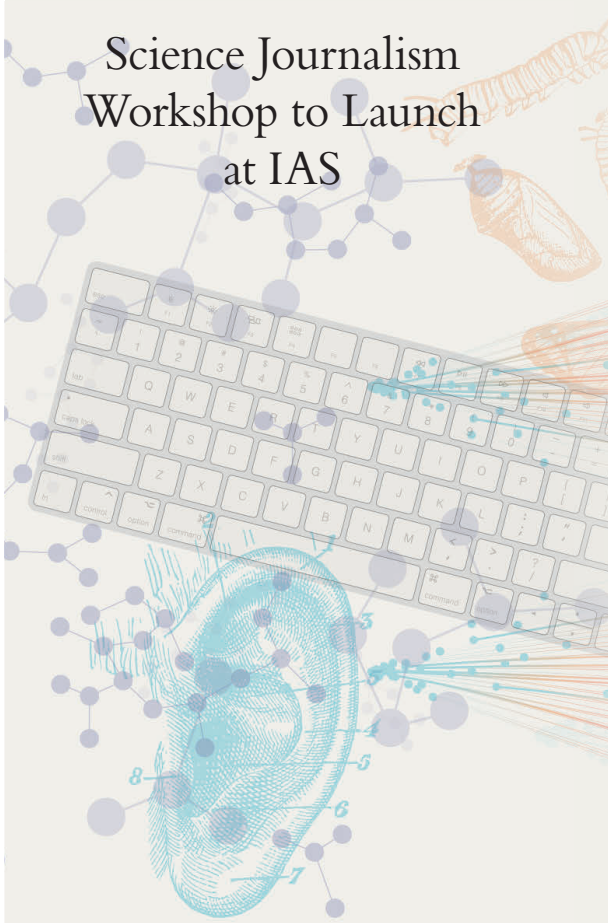
From the School of Social Science, past Members **LUCAS BESSIRE** (2012–13) and **DAVID SCOTT** (2006–07) won Fellowships. In 2021, Bessire published *Running Out: In Search of Water on the High Plains*, making him a finalist for the National Book Award. Scott is currently finishing his fourth book, tentatively titled "Irreparable Evil: New World Slavery in Moral History," while also working on a biography of Stuart Hall.

Winners in the School of Mathematics are past Members **VENKATESAN GURUSWAMI** (2007–08) and **LILLIAN B. PIERCE** (2009–10), who was recently a 2017–18 von Neumann Fellow. Guruswami explores a broad array of topics in theoretical computer science, while Pierce studies the intersection between harmonic analysis and analytic number theory.

Past Member in the School of Natural Sciences **HIROSI OOGURI** (1988–89), who was also a Visiting Professor in 2015, won a Fellowship in the subject of physics. Ooguri works on quantum field theory, quantum gravity, and string theory. In 2019, he was awarded a Medal of Honor from the Emperor of Japan.

Together, they join a diverse class of 171 Fellows whose achievements span numerous fields in the humanities, sciences, and visual and literary arts. The Fellowship is granted by the John Simon Guggenheim Memorial Foundation, founded in 1925, which offers funding to exceptional individuals in any field of knowledge or artform.

Science Journalism Workshop to Launch at IAS



We live in a world where science, innovation, and technology impact our daily lives in increasingly profound ways. But if both science and the society in which it is intimately embedded are to flourish, it is necessary for the latest groundbreaking developments to be made accessible and intelligible to the average citizen. Science journalists play a significant role in the global circulation of this scientific scholarship, generated at institutions such as the Institute for Advanced Study.

To provide the opportunity for prospective and early career science journalists to hone their skills in an intensive, immersive environment, IAS will host a new Science Journalism Workshop from July 10–15, 2023. During the week-long program, two or three instructional sessions will be held each day, led by the program directors and a roster of guest instructors who will join the group for one day each.

The instructional sessions will cover a range of subjects, including structuring stories, pitching, interviewing, the logistics of freelancing, scientific biography/profile writing, developing a beat, and covering controversial topics. In the afternoons, time will be dedicated to workshopping participants' writing in group sessions. Throughout the week, attendees and instructors will convene for meals and other social activities. Participants will also have the chance to meet and network with world-leading IAS scientists.

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