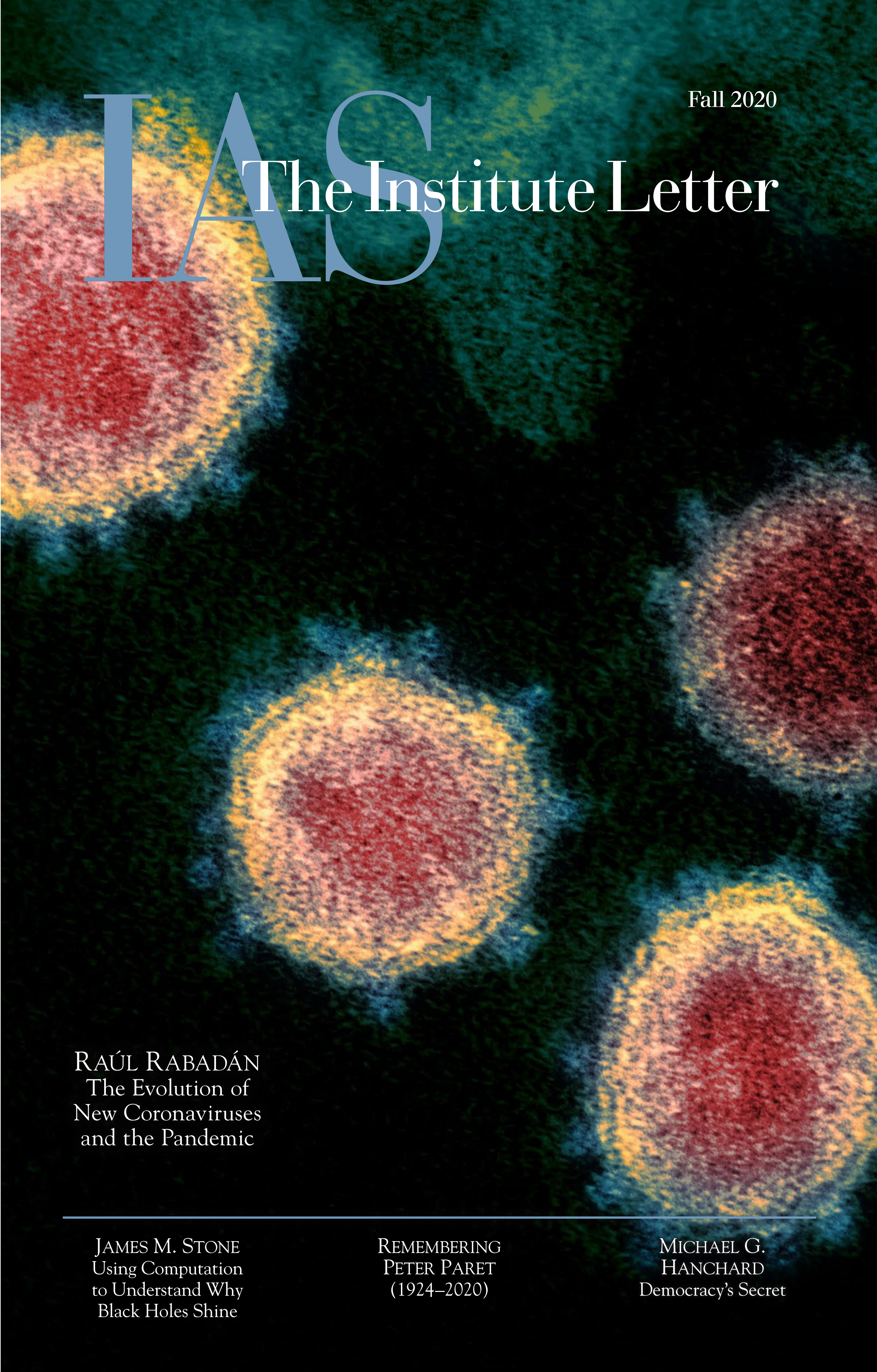

IAS

Fall 2020

The Institute Letter

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New Coronaviruses
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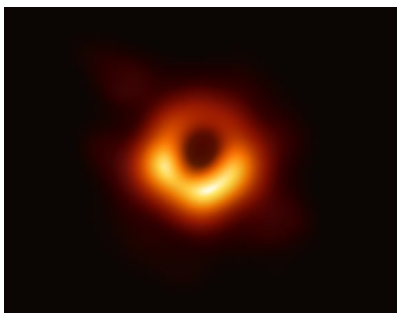
Using Computation to Understand Why Black Holes Shine

Building a picture of the plasma falling into M87's black hole



EVENT HORIZON TELESCOPE COLLABORATION

The first image of a black hole from Event Horizon Telescope observations of the center of the galaxy M87

BY JAMES M. STONE

The following article is based on a virtual talk given to the Trustees and Friends of the Institute.

Let me begin at the beginning with the basic question of: what is a black hole? In perhaps the simplest terms, a black hole is a collapsed object in which matter is so dense that not even light can escape from its surface. The term black hole was actually coined by John Wheeler, who at the time was a professor in the physics department here at Princeton University, and it's really a very appropriate term.

Remarkably, black holes were once thought to be only a theoretical construct of general relativity. The solutions to Einstein's equations that predict black holes were quite surprising at first, and were thought to be a quirk of the mathematics of general relativity. What's even more amazing is that today we know for certain that black holes actually exist in nature, in fact this year's Nobel Prize was awarded for the certain proof that there is a black hole at the center of our own Milky Way galaxy (as I'll describe in a minute). In 2017, the Nobel Prize was awarded for the discovery of gravitational waves produced

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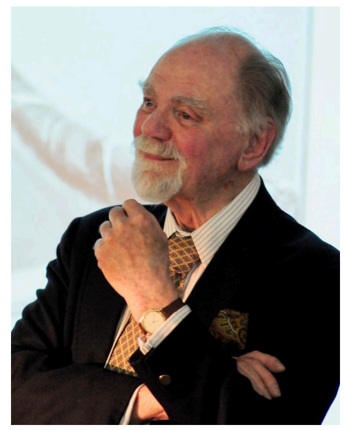
Peter Paret (1924–2020)

Eminent military historian and intellectual beacon



BENTLEY DREZNER

Peter Paret

Peter Paret, Professor Emeritus in the School of Historical Studies, passed away peacefully at age 96 at his Salt Lake City home on September 11, 2020. A German-born American and acclaimed cultural and intellectual historian, Paret studied the modern historiography of war from eighteenth- to twentieth-century Europe, as well as the relationship of art, society, and politics.

Paret first joined the Institute's School of Historical Studies as a Member for the 1966–67 academic year and returned in 1986 to become the Andrew W. Mellon Professor in the Humanities. Paret became a Professor Emeritus in 1997 and remained active and productive through his retirement.

"The combination of engagement and detachment with which Peter approached historical questions, and the shrewdness and energy with which he always argued his case, made him a vigorous contributor to intellectual life at the Institute, and cemented his legacy as one of the leading historians of the twentieth century," stated Robbert Dijkgraaf, IAS Director and Leon Levy Professor. "His legacy as an educator, author, and innovator will continue to inform the field for generations to come."

Paret was born in Berlin on April 13, 1924, the son of Hans Paret and Suzanne Aimée Cassirer. Following his parents' divorce, Paret joined his

(Continued on page 9)

Democracy's Secret

How racism and discrimination have been central to democracies from the classical period to today

BY MICHAEL G. HANCHARD

I am very happy to be back, albeit in virtual space, at the Institute. I completed my entire manuscript for *The Spectre of Race: How Discrimination Haunts Western Democracy* (Princeton University Press, 2018) at IAS, and have great memories of productivity there in a supportive community of scholars. I will combine some of the book's key points about racial hierarchy and democratic politics (actual political systems, not the political party in the U.S.) with an analysis of racial hierarchy in the contemporary United States and in other places across the globe. One of the key takeaway points is to look at democracy not simply as a concept and a set of ideals, but also as a *practice*: a particular combination of institutions, law, norms, and actors.

One of the key questions *Spectre* explores is how the practice of democracy produces and is affected by political inequality. Democracy and inequality have had a complementary relationship through the formation of political institutions that encourage and maintain hierarchies of difference along the lines of presumed racial and ethnonational distinction, nationality, and, of course, gender. The three countries I spent the most time analyzing for *Spectre* are Great Britain, the United States, and France. These three are often referred to as the longest-standing continuous democratic polities.

AP PHOTO/JOHN MINCHILLO

Protesters march on the Brooklyn Bridge, Thursday, June 4, 2020, in New York, under a U.S. flag with the words "I can't breathe." Protests followed the death of George Floyd, who died after being suffocated by Minneapolis police officers on May 25, 2020.

The economies and polities of these societies, however, utilized enslaved and poorly paid labor to provide citizens with material freedom to exercise citizenship. In *The Promise of Politics*, Hannah Arendt describes the role slaves played in classical Athens and other democratic forms to provide the

(Continued on page 4)

News of the Institute Community

Suzanne Conklin Akbari, Professor in the School of Historical Studies, has coedited *The Oxford Handbook of Chaucer* (Oxford University Press, 2020).

Didier Fassin, James D. Wolfensohn Professor in the School of Social Science, has authored *De l'inégalité des vies* (Collège de France, 2020).

Alondra Nelson, Harold F. Linder Professor in the School of Social Science, has been awarded the 2020 Morison Prize in Science, Technology, and Society. Nelson also has been elected to the National Academy of Medicine. Additionally, Nelson's book *The Social Life of DNA* has been awarded Honorable Mention for the 2020 Diana Forsythe Prize.

Sabine Schmidtke, Professor in the School of Historical Studies, has coedited *Jewish-Muslim Intellectual History Entangled: Textual Materials from the Firkovitch Collection, Saint Petersburg* (University of Cambridge, 2020). Schmidtke has also coedited, with George A. Kiraz, Research Associate in the School, *Scribal Habits in Near Eastern Manuscript Traditions* (Gorgias Press, 2020).

Matias Zaldarriaga has been named Richard Black Professor in the School of Natural Sciences.

A Hebrew translation of *Empires in Collision in Late Antiquity* by Glen W. Bowersock, Professor Emeritus in the School of Historical Studies, has been published in Israel under the imprint of the Historical Society of Israel.

Caroline Walker Bynum, Professor Emerita in the School of Historical Studies, has authored *Dissimilar Similitudes: Devotional Objects in Late Medieval Europe* (Princeton University Press, 2020).

Joan Wallach Scott, Professor Emerita in the School of Social Science, has authored *On the Judgment of History* (Columbia University Press, 2020).

Danielle S. Allen, Professor (2007–15) in the School of Social Science, has been awarded the 2020 John W. Kluge Prize for Achievement in the Study of Humanity by the Library of Congress.

Ahmed Almheiri, Long-term Member in the School of Natural Sciences, Rouven Essig, Visitor (2011–12) in the School, Tracy Slatyer, Junior Visiting Professor (2018–19) and Member (2010–13) in the School, and Tomer Volansky, Member (2017–19, 2007–10) in the School, have been awarded 2021 New Horizons in Physics Prizes.

Khaled Fahmy, Member in the School of Historical Studies, and Kathleen Coleman, Member (2017–18) in the School, have been elected to the British Academy as Corresponding Fellows.

Xuhua He, Member in the School of Mathematics, and Subo Dong, Member (2009–13) in the School of Natural Sciences, have been awarded 2020 XPLORER Prizes by the Tencent Foundation.

Jan Michael Ziolkowski, Member in the School of Historical Studies, has been elected an External Member of the Finnish Academy of Science and Letters.

Alexander Beilinson, Member (1994, 1996–97) and Visitor (1997–98) in the School of Mathematics, and David Kazhdan, Distinguished Visiting Professor (Math–NS 1996–97) and Visitor (1976, 1986, Math–NS 1988) in the School, have been jointly awarded the 2020 Shaw Prize in Mathematical Sciences.

Bhargav Bhatt, Member (2012–14) and Visitor (2020) in the School of Mathematics, and Aleksandr Logunov, Member (2017–18) in the School have been awarded 2021 New Horizons in Mathematics Prizes.

Roger Blandford, Member (1974–75, 1998) in the School of Natural Sciences, has been awarded the 2020 Shaw Prize in Astronomy.

Shai Evra, Member (2018–20) in the School of Mathematics, has been awarded the SASTRA Ramanujan Prize.

Martin Hairer, Member (2014) in the School of Mathematics, has been awarded the 2021 Breakthrough Prize in Mathematics.

Dor Yosef Minzer, Member (2018–20) in the School of Mathematics, has been awarded the 2019 Doctoral Dissertation Award from the Association for Computing Machinery.

Roger Penrose, Visitor (1980) in the School of Mathematics, has been awarded the 2020 Nobel Prize in Physics by the Royal Swedish Academy of Sciences.

David Radice, Member (2016–19) in the School of Natural Sciences, has been named recipient of Department of Energy Early Career Award.

James C. Scott, Member (1986–87) in the School of Social Science, has been awarded the 2020 Albert O. Hirshman Prize.

Katepalli Sreenivasan, Member (2018–19) in the School of Mathematics, has been awarded the Charles Russ Richards Memorial Award, the Fluid Dynamics Prize, the G.I. Taylor Medal, and the Theodore von Karman Medal.

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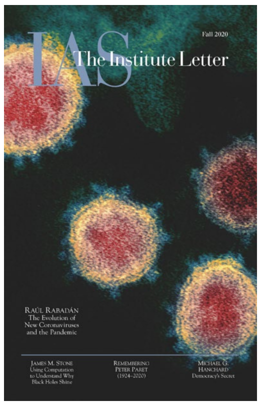
Questions and comments regarding the *Institute Letter* should be directed to Amy Ramsey, Assistant Director, Communications, at aramsey@ias.edu.

Issues of the *Institute Letter* and other Institute publications are available online at www.ias.edu/publications.

Articles from issues of the *Institute Letter* are available online at www.ias.edu/ideas.

To receive monthly updates on Institute events, videos, and other news by email, subscribe to *IAS eNews* at www.ias.edu/enews.



COVER IMAGE

This transmission electron microscope image shows SARS-CoV-2, the virus that causes Covid-19, isolated from a patient in the U.S. Virus particles are shown emerging from the surface of cells cultured in the lab. The spikes on the outer edge of the virus particles give coronaviruses their name, crown-like.

Image captured and colorized at NIAD's Rocky Mountain Laboratories in Hamilton, Montana

Q&A with Natalie Paquette

The interplay between physical exploration and mathematical structures

Natalie Paquette, Member in the School of Natural Sciences, is a mathematical physicist whose research interests span string theory and quantum field theory.

Natalie Paquette

What question within your field do you most want to answer and why?

In the back of my mind, I hope to have a more complete description of M-theory (the "parent" theory of quantum gravity that encompasses the various string theories) and how to understand, e.g., the emergence of spacetime in that theory. I feel I have a solid understanding of something when I know how it should be formulated mathematically, or at least how I would begin to explain it to a mathematician, so my personal predilection is to approach questions that way. But I always hope to stay engaged broadly with outstanding questions in theoretical physics, and hope that some of the questions I end up answering, and the means I use to answer those questions, will surprise me.

Why IAS?

I think just being in proximity to, or collaborating with, great thinkers can have salutary effects on one's own thinking.… It's also essential for me to have a lot of intellectual stimulation outside of physics, and I'm excited to learn from, and interact with, the scholars across all schools and subjects at the IAS.

Can you describe a high point and/or low point in your academic career and explain how this may have influenced your work?

Rather than focusing on one or two clear high points, I like to think about the many bright spots in my day when I feel that I finally learn or understand something properly, get a satisfying answer to a computation, or become excited about a new idea. Experiencing those bright spots has just reinforced my conviction to work on the topics and ideas that I like and make me happy, irrespective of trends or sociology. As it happens, the low points reinforce the same lesson. ■

The Institute Welcomes Scholars for the 2020–21 Academic Year

Bold ideas, creative methods, and novel means of collaboration

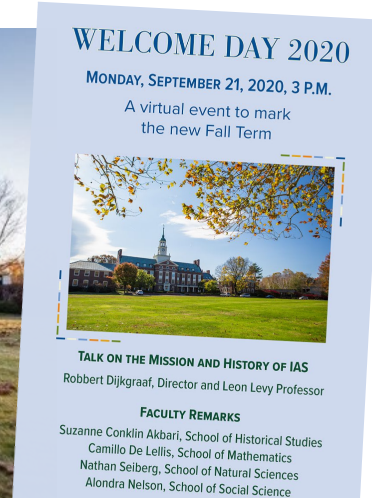
Virtual "Welcome Day," held on September 21, 2020, marked the formal start of the Institute for Advanced Study 2020–21 academic year. This year, 241 leading scholars and scientists, representing over 100 academic institutions in over twenty countries, will work alongside the Institute's twenty-five permanent Faculty. This year's class is comprised of scholars both in-residence and working remotely through a virtual interface that will enable enhanced communication and collaboration.

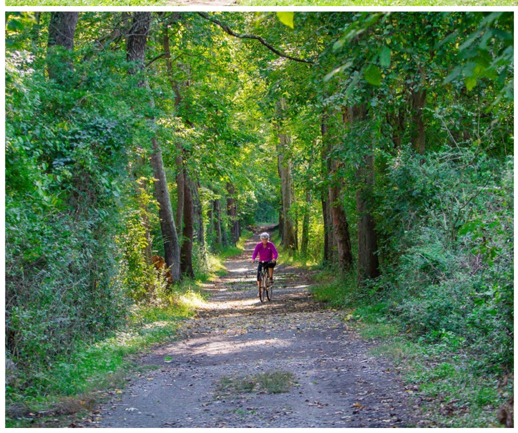
During a digital presentation reflecting on the Institute's long history, Robbert Dijkgraaf, Director and Leon Levy Professor, remarked, "In addition to the groundbreaking research that takes place on campus, the Institute's footprint will be enlarged this year through a number of interactive digital channels that will reinforce and leverage the creativity of our global community of scholars."

The expansion of virtual outreach enables collaboration and access to Institute scholarship in novel and exciting ways. A range of academic seminars and public events will now be available to audiences around the world in real-time.

Research at IAS is conducted across four Schools—Historical Studies, Mathematics, Natural Sciences, and Social Science—to push the boundaries of human knowledge through interdisciplinary collaboration and intellectual risk-taking. This research in turn has the goal of developing new insights to benefit society, technology, and scholarship.

Despite a year of many unknowns, it is precisely these types of uncertainties that motivate scholars to study, explore, and contribute to achieving a more prosperous and informed society. ■





ANDREA KANE

Scholarship continues apace at IAS, albeit socially distanced. Charles Simonyi Professor Edward Witten gives a physics seminar in the birch garden.

Q&A with Carissa Harris

Studying the roots of our sexual culture and our expectations for gendered behavior

Carissa M. Harris, Member in the School of Historical Studies, is an Associate Professor at Temple University. In the 2020–21 academic year, Harris is exploring how anger became feminized in the late medieval English popular imagination, focusing particularly on the figure of the wrathful shrew.

How do you describe your work to friends and family?
I study gender and sexuality in the Middle Ages, and I'm especially interested in drawing connections between past and present. I focus on rape, consent, reproductive justice, and gendered violence, in my academic work as well as my volunteer and public-facing work.

What question within your field do you most want to answer and why?
Where did the roots of our current sexual culture and our expectations for gendered behavior come from? How did carryovers from the Middle Ages shape ideas about race and gender in America that we're still grappling with today?

Why IAS?
I appreciate the regular seminars and IAS's sense of community. I'm especially excited to work with IAS's Suzanne Conklin Akbari, who's an incredibly well-respected and generous medievalist scholar.

Can you describe a high point and/or low point in your academic career and explain how this may have influenced your work?
It was very validating to win the Society for Medieval Feminist Scholarship's award for my first book [*Obscene Pedagogies: Transgressive Talk and Sexual Education in Late Medieval Britain* (Cornell University Press, 2018)]. That book was a scary book to write because I broke all sorts of rules for how you should approach medievalist academic writing, and I was worried that people wouldn't understand what I was trying to do and that the reviews would be terrible and I wouldn't get tenure. In the end, I felt affirmed in my choice to go with my gut, and I plan to follow my weird scholarly instincts in the future.

HAYLEE FINN

Carissa Harris

What is one of your interests or passions outside of academia? Has this had a bearing on your work?
Before the pandemic, I attended spin class religiously. It was useful for my work because I'd go into class with an issue or point I wanted to think through from whatever I was writing that day. I'd spend the hour-long class devoting my mental energy to working out the issue and emerge with new insights, which I'd then frantically text to myself on my phone as I walked home. I also used to imagine mowing down Chaucer with my spin bike during sprints because I have a love-hate relationship with him.

Where is your favorite place to think?
Pre-pandemic, I'd visit a cidery near my house every Thursday night, sit by the window, and drink two ciders while brainstorming and writing in my notebook.

What is your hope for the future?
I want to finish my book on medieval women's anger that I'm writing this year at the IAS, and I hope to write a more public-facing book after that. ■

material preconditions for citizens to engage in politics, free from economic and material constraints. Leaders in classical Athens first came up with the idea, which was transformed into law, that its citizens—exclusively male—literally emerged from the soil. This served as a barrier preventing women and foreigners from becoming citizens in classical Athens. In more contemporary versions of democracy, the governments of France, Britain, and the United States created and maintained laws to prohibit or limit the enslaved, the formerly enslaved, and the popular classes from membership in their democracies.

DEMOCRACY—NOT JUST ELECTORAL BUT ECONOMIC AND SOCIAL DEMOCRACY—IS SOMETHING THAT HAS BEEN AND CONTINUES TO BE FOUGHT OVER.

Along with the nexus of democracy and inequality, another key theme of *Spectre* is a tendency across democracies for some political activists and their constituencies to assume that nation-states have been and somehow require homogeneous populations—those often being religious or ethnonational or presumably racial—to function effectively in polities, particularly democratic polities. This sentiment has found its expression in many right-wing movements, not just in the U.S. but across the EU, Russia, and other places, notwithstanding the fact that no nation-state in the contemporary world began as a homogeneous society. This tendency is highlighted by the 2017 confrontation between antifascist, anti-racist organizations and individuals, on the one hand, and pro-fascist, neo-Nazi, and other white supremacist groups on the other in Charlottesville, Virginia and other cities across the United States.

One of the core desires that many contemporary right-wing advocates have articulated is to create an *ethnos* filled with Aryans, or some other kind of white people, in spite of the fact that true Aryans came from what is now referred to as the Indian subcontinent, and white people, much like blacks or Latinos, are neither an ethnicity or race, just arbitrary classifications of people. This false assumption, however, has had dire political consequences in the form of restrictive immigration policies, forced assimilation policies, segregation, and—as in the case of the Third Reich, but also at times in the U.S.—expulsions and liquidation of populations.

ANDREW WALLNER @AND_REW_AND_YOU

An 8-minute and 46-second die-in on the Burnside Bridge in Portland, Oregon, June 2, 2020, paid tribute to George Floyd.

Woodrow Wilson, the twenty-eighth president of the United States, held views on nationality, statehood, and identity that are clearly informed by this ideology. I utilize Wilson in light of the recent decision by Princeton University to remove his name from a residential college.

Wilson's views on the relationship between race and democracy can be found in his unpublished manuscript on modern democracy titled *The Modern Democratic State*, an earlier draft and foundation for his book, *The State*. At the outset, Wilson details "several all-important conditions" for the successful operation of democratic institutions. Number one on Wilson's list is "the homogeneity of race and community of thought and purpose among the people." Thus, homogeneity produces political stability, but also democracy.

This point is articulated in several passages in the manuscript. He makes clear that even though U.S. Negros (the bright and more ambitious among them) have the capacity for self-government, they should never, under any circumstances, rule over the Saxon race. Such beliefs, which Wilson shared with other staunch segregationists during the era of Reconstruction, were part and parcel of what came to be known as Euro-Aryanism.

Wilson strongly believed that Aryans were fundamentally a state-making people and central to the history of state formation and democracy:

> For purposes of widest comparison in tracing the development of government, it would, of course, be desirable to include in a study of early society not only those Aryan and Semitic races, which have played the chief parts in the history of the European world, but also every primitive tribe, whether Hottentot or Iroquois, Finn, or Turk.

This is a direct quote from the manuscript *The Modern Democratic State*. Again, we have this theme of population homogeneity linked to political stability and, ultimately, to democracy. Population homogeneity within a nation-state, however, like the categories of the foreigner and the citizen, is a political artifact. We do not find such artifacts ready-made in the world.

As the sociologist Rogers Brubaker has reminded us, all polities create barriers to membership. All nation-states, by design, favor the few over the many. Why should democracy, particularly contemporary liberal democracies, be any different? Democracies have always maintained a sharp distinction between members of their societies, the people who live within them; and members of the polities, the people who are authorized to formally participate in the political process. To maintain barriers between members of polities and members of society, law and coercion have often been combined not only to ensure that populations invested with civic benefits and privileges remain privileged, but to also ensure that marginalized populations remain at the periphery. When democracies create barriers to civic membership, they have to justify those barriers. Moments of geopolitical crisis, such as those experienced by Athenians during the Greco-Persian Wars, reveal popular and fundamental anxieties about being overrun by certain, but not all, foreigners.

For well over two centuries since, citizenship has often been associated with ethnonationally, religiously, and chromatically privileged groups, not with the enactment of behaviors associated with citizenship. This tendency is clearly evident in President Donald Trump's evocations of caravans surging from Central America, carrying dangerous criminals into the United States. In what sociologists used to refer to as coded language before racist speech went mainstream, Trump was sending a message that implicitly and explicitly denounced certain—not all—immigrants from entering the United States.

What does all this tell us about the practice of democracy? Certainly, racial and ethnonational hierarchy is not the only way in which we can track the emergence of exclusionary citizenship criteria. But an examination of ethnonational and racist hierarchies provides opportunities to examine the emergence and development of institutionalized racism in the form of what I call *racial regimes*. The existence of racial and ethnonational regimes and democratic polities enables scholars and citizens to consider broader, more abstract questions about the entanglements of citizen, society, and power.

Under what conditions does democracy require barriers to membership? Could it be that under the most practical conditions for the elaboration of democratic and republican ideals (not the political parties), a subordinated laboring population with limited or non-existent political rights is necessary for the function of democracy for the few? This is, in many ways, the legacy bequeathed to us. What else is voter repression but an effort to secure the victory of one political party over another, and in the case of the United States, the expression of anxiety on the Republican Party that if it loses the election on Nov. 3 or sometime afterwards, black and brown peoples, by virtue of demography and political will, may overtake whites in both demographic and political terms? As the presidential campaign in the U.S. comes to a close, Trump is increasingly providing his constituency with desperate language about the collapse of the United States and "all that it stands for" should the Democrats win.

If we take a look at how democracies function when challenged to extend the franchise and other aspects of democratic practice to a population that was once excluded, barriers to political and civic membership have not fallen due to some *telos* intrinsic to democratic politics. Those barriers have been pushed aside because of challenges made by the excluded. Examples are civil rights movements, feminist and abolitionist movements, suffragist movements, and so on, which managed the incorporation of the formerly excluded into democratic polities. This is, in some sense, what we're seeing today. The dynamic relationship between movements seeking radical change and those that want to preserve the status quo reminds us that democracy—not just electoral but economic and social democracy—is something that has been and continues to be fought over.

The question is, how will it be fought over? I think we can take some cues from other times and places in an effort to contextualize the current crisis of democracy. I think this moment, particularly in the United States, holds seemingly disparate elements that are reminiscent of Reconstruction after the fall of the South at the end of the Civil War and the interwar years in Europe, from the end of World War I through the rise of fascist states like Germany and Italy.

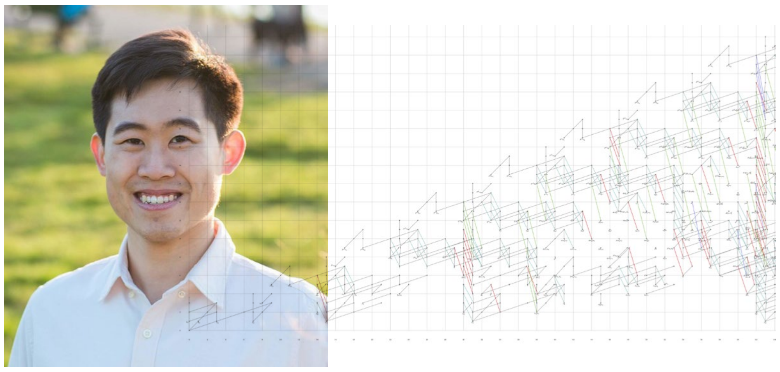
With respect to Reconstruction, traces of white supremacist reaction to the presence of black people as representatives of state are evident in the visceral reaction to President Barack Obama's legacy regarding healthcare. It's been clear that Trump, Mitch McConnell, and other members of the Republican party want no less than to erase the Obama presidency from the political history of the United States, as many

(Continued on page 5)

Q&A with Allen Yuan

Exploring conceptually satisfying and computationally tractable questions in algebraic topology

Allen Yuan, Visitor in the School of Mathematics, is a recent graduate from Massachusetts Institute of Technology who is studying problems in homotopy theory and algebraic topology.



Allen Yuan, with the Adams spectral sequence, which computes stable homotopy groups of spheres

How do you describe your work to friends and family?
I like to give a simple-sounding fact that turns out to be justifiable with algebraic topology: for instance, "if I throw a map of the United States on the ground, then one point on the map will land exactly on the place it represents." If you think about trying to explain this, there's something tantalizing and fundamental, yet flexible and hard to put your finger on about it. I think this kind of feeling captures what my work is like.

What question within your field do you most want to answer and why?
Algebraic topology aims to study spaces—things such as donuts and spheres of various dimensions, up to continuous deformation—by attaching algebraic invariants to them. A foundational idea in the field, due to [Daniel] Quillen, is that if one works over the field of rational numbers, these spaces can be modeled by algebraic structures known as Lie algebras. Recently, these ideas have been generalized by Gijs Heuts to work over a certain sequence of "generalized fields," known as Morava K-theories, which "fill the gap" between the rational numbers and the integers.

In some sense, these Lie algebra models over Morava K-theories are the pieces of a puzzle that should assemble into a complete picture of a space, but the question of how these puzzle pieces fit together remains a mystery. I'm excited about this question because it could answer a fundamental question in algebraic topology ("what is a space, algebraically?") in a way which is both conceptually satisfying and computationally tractable.

Why IAS?
Beyond its incredible and diverse faculty in mathematics, the IAS brings together an unparalleled number of mathematicians from a broad range of fields each year. I find that much of the most interesting mathematics results from interactions between different fields of math, and so it seemed to me that the IAS would be an ideal place to explore these interactions. I'm especially excited by the special year in representation theory happening at the School of Mathematics, and I think it will be an invaluable learning opportunity for me.

Can you describe a high point and/or low point in your academic career and explain how this may have influenced your work?
One high point for me was when I first learned of the question that eventually became the subject of my thesis. I had asked my advisor, Jacob Lurie, a very naive question, and he responded by telling me about a somewhat related but much more interesting question that I could think about. I remember feeling excited and enthralled by the simplicity of the problem, and spending all my time working on it, despite being constantly stuck. In the end, the fallout from this problem has shaped my research to this day, as much of the work I've done is either directly or indirectly motivated by it.

What is your hope for the future?
Restricting the scope of this question to math research in particular, I hope that the subject can move forward from the pandemic stronger than ever. A particular issue in some fields of math, algebraic topology included, is that there are high barriers to entry; it's difficult to get into research if you're not in particular places talking to particular people. During the pandemic, I've been heartened and excited by all the new ways of learning and interacting that are being adopted out of necessity, such as virtual seminars and conferences. My hope is that the materials produced from these can be harnessed to make mathematics more accessible in the future. ■

HANCHARD *(Continued from page 4)*

southerners did with Reconstruction. Trump's implicit and at times explicit support of white nationalist and other organizations' use of force against citizens and civic groups will make the period between Nov. 3 and the announcement of the ultimate victor a period of national reckoning. Paramilitary groups' increasing intimations of violence may turn into a civil war, not civil war in the classic sense, but in the form of skirmishes in different parts of the country involving paramilitary groups, citizens who oppose them, and segments of the armed forces who would ostensibly show up to keep the peace by restoring "order." There are Black, Latino, Indigenous members of the armed forces who support Black Lives matter and allied groups, as well as soldiers who are opposed to such groups. Will this lead to dissension amongst the armed forces? I really hope this scenario does not become a dystopic reality.

In the present day, Black Lives Matter and allied social movements represent the long-standing tension between democratic and coercive institutions, built within the same democracy to manage inclusion, exclusion, and hierarchy at the same time. In the United States and in so many other cases, coercive apparatuses—the police, the military, and the technological tools of surveillance—have served this function by targeting and marginalizing excluded populations. Jim Crow was a central feature of southern politics after the Civil War that served this essential function, with the support of groups like the Klan and the Regulators, but also, lest we forget, average citizens participating on juries and in mob violence.

This year, we've witnessed vigilante groups that not only had the support of the police but also state, municipal, and sometimes federal courts. At any number of protests, whether in Charlottesville, Virginia; Lafayette Park in Washington, D.C.; or Philadelphia, where I reside, there is audio-visual evidence of police officers with very cozy relationships with vigilante groups during street protests. Police officers have often stood watch as anti-racist protestors got pummeled.

Once a democratic polity loses any moral, ethical, or political compass, the most vulnerable suffer first and, if not first, the most. The stubborn persistence of Covid-19 throughout the world has put the precarity of marginalized populations front and center. When one hears Republican Lieutenant Governor Dan Patrick of Texas opine during the Covid-19 pandemic that the elderly and the poor, those who were more likely to have compromised immune systems, needed to serve as martyrs for the purportedly healthiest segment of the population, we creep into advocacy for eugenics.

Under such conditions, where does civil society begin and the state end? Once these lines get blurred, vigilante groups act as if they represent the people's will and, by extension, state power, with direct ties to police departments, district attorney's offices, and members of the armed forces who remain committed to white supremacy. It is also important to remember that black and brown populations have been living under authoritarian situations for quite some time. Those who protest these authoritarian conditions have had to risk imprisonment, severe beatings, unemployment and character assassination, or their very lives. In the current moment, one key difference between a nation-state such as the United States and Brazil (led by authoritarian populist Jair Bolsonaro) is that many of the U.S. military elite and bureaucrats of several branches of government have expressed their disapproval of Trump's leadership. In Brazil, the military's presence in present-day government and civil society is equal to, and in some areas, exceeds, the military's presence during the most recent era of military dictatorship in Brazil (1964–86). As during the U.S. civil rights movement of the 1950s and 1960s, portions of the U.S. armed forces may be called upon to protect United States citizens from vigilante groups, and in so doing help salvage what is left of an already limited U.S. democracy from destruction from within.

A glimpse of democracy's secret reveals its juggling act to preserve egalitarian and unequal orders simultaneously. If many of us are fighting for or hoping for democracy's salvation, what form of democracy will we seek to create or at minimum maintain? The old models have run their course. It's time for many of us to acknowledge that democracy must be made anew. ■

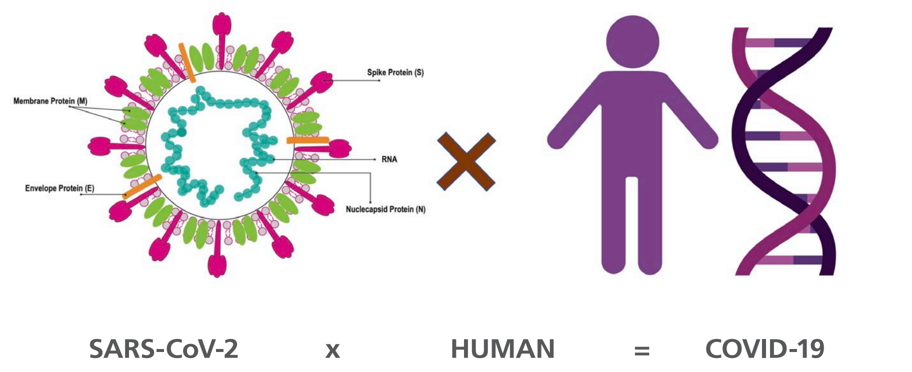
Michael G. Hanchard is a member of the board of trustees of AMIAS, the Association of Members of the Institute for Advanced Study, and a past Member (2014–15) in the School of Social Sciences. Hanchard is the Gustav C. Kuemmerle Professor of Africana Studies at the University of Pennsylvania and director of the Marginalized Populations project. His research interests include comparative politics and political theory, nationalism, xenophobia, and national governments that lack representation. This article consists of excerpts from an IAS talk given June 30, 2020, and his most recent book, The Spectre of Race: How Discrimination Haunts Western Democracy *(Princeton University Press, 2018).* Spectre *was recognized with the* Times Higher Education*'s Best Books of 2018 and the American Political Science Association's 2019 Ralph J. Bunche Award.*

The Origins and Evolution of Coronaviruses and the Pandemic

A tale of mutations, recombination, spike proteins, and bats

BY RAÚL RABADÁN

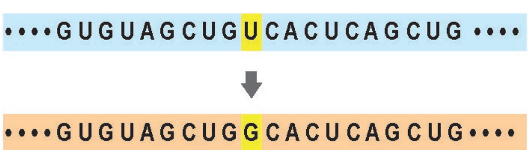
An enormous amount of research on the Covid-19 pandemic is underway. Scientists are trying to understand where the virus is coming from, if related viruses able to create new pandemics are circulating in animal species, how the virus causes disease, and how we can leverage our knowledge to find new therapies, including vaccines. Covid-19 is an infectious disease and, as such, it has to be understood as consisting of two components. The first is the infectious agent, a coronavirus, named SARS-CoV-2. The second component is us, the humans, our human genetics, and our human immune history. In order to understand the disease, we have to understand these two parts and their interaction. Here I will be talking about the virus, what we know about its origin, and how it is evolving.



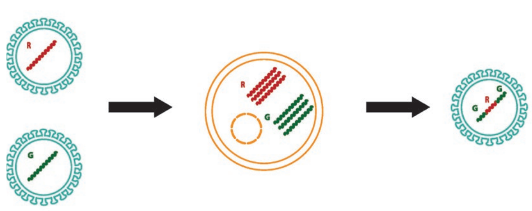
The main theory we have for the emergence of this virus and its evolution is through two mechanisms: mutations and recombination. Mutations refer to mistakes that happen in the viral genome when they are replicating. There is a general rule in life that organisms with very short genomes (like viruses) make many more errors than organisms that have very long genomes (like humans). Mutations in human genomes are very rare because we have a large machinery for correcting errors. Failure to correct these mistakes is one of the common causes of cancer. But viruses accumulate mutations at a much faster pace. The flu, for example, adds one mutation to its genome every week or two. SARS-CoV-2, the virus that causes Covid-19, makes one mistake every two weeks. Mutations accumulate as viruses replicate, creating a diversity of viruses.

SARS-CoV-2 is a member of the vast family of betacoronaviruses, which are found mostly in bats. Bats are frequently found co-infected with a cocktail of different viruses. Groups of researchers have been going around the world collecting samples from bats and sequencing them. The coronaviruses sampled in the last few years provide a background to understand the origins of the new virus.

SARS-CoV-2 genome was sequenced in the beginning of January, 2020. Its entire genome—written as As, Cs, Gs, and Us—is around 30,000 letters long, roughly a ten-page text. Sequencing samples from other persons, bats, and so on produces many small books with ten pages each. To understand the relationship between these genomes we need to organize the information, and a common tool is the phylogenetic tree. Genomes that are very similar—for example, TCGA and TCGC, which have in common a triplet TCG—are placed on the same branch. By gathering many genomes, the information can be organized into a large tree structure. Researchers can plot the evolution of a virus by using mutations to reconstruct who is infecting whom and how the virus is moving and evolving in the population. For instance, there have been many introductions of SARS-CoV-2 to the United States, from Asia, from Europe, that can be traced by following how mutations accumulate during infection and transmission.



Mutation



Recombination

The second mechanism for change in viruses is recombination. If two viruses co-infect the same cell, they produce new genetic combinations called chimeras. Imagine a red virus and a green virus, each with a different genome, that co-infect the same cell. One enters the cell to produce copies of red viral genomes, and the other enters and makes green viral genomes. The chimera produced could be green, red, and green, for instance. This new virus genome is very different from its parents. A child and a parent virus can be very similar in sections of their genome, but differ in some other parts. This recombination process happens pervasively in coronaviruses.

While mutations create small local changes in genomes, recombinations are associated with the acquisition of new genomic material. In general, mixing genomic material at random is rarely successful, but sometimes it enables the virus to acquire new abilities, such as the capacity to infect new hosts. The new coronavirus, SARS-CoV-2, acquired the ability to enter and infect human cells by adapting the spike protein to bind to a particular human protein, ACE2. The same mechanism was used by the SARS-CoV virus in 2002. The viruses responsible for the outbreaks in 2002, and now in 2020, are related in the one particular region that codes for the spike gene that allows the virus to enter into a cell. This potentially indicates that there has been a recombination.

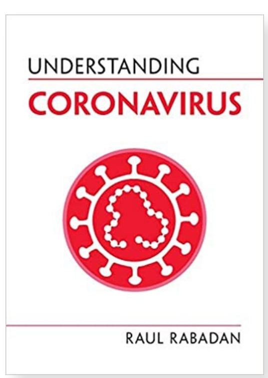
Additional sequencing has found that the closest relative of SARS-CoV-2 is a virus found in horseshoe bats in the south of China in July 2013. What happened from then to now is unknown, but by looking at recombinations and mutations, we can reconstruct the virus and its history. It is like a puzzle: we have many related viral genomes and we need to figure out exactly how those pieces of information came together to generate the pandemic virus.

This virus probably emerged following a two-hit scenario. First, viruses can exchange genetic material through recombination. Recombination enables some viruses to pick up genes that allow them to imperfectly bind to human proteins and infect human cells. We think this happened at least twenty years ago. Since then, there have been further mutations that induce refinements to the ability of the viruses to bind to particular human proteins.

There are many similarities between the SARS outbreak and the current Covid-19 pandemic, and it is very instructive to compare the scientific literature in the years that followed the SARS outbreak to current scientific papers on Covid-19. These two viruses are genetically very, very similar. And the diseases are also similar: immune deregulation, severe respiratory disease, severity increasing with age and more severe in males, etc. We are moving very fast with our investigation into SARS-CoV-2 because of the many things we have learned about the SARS virus.

There are still many missing pieces that we do not understand, but we have a significant amount of information. We now have more than 100,000 SARS-CoV-2 genomes from all corners of the world and we are collecting a significant amount of information on the infected individuals. With the right tools and original ideas, we can elucidate how this virus changes, how it causes disease, and how we can prevent it. Hopefully science will help us to be better prepared in the future. ■

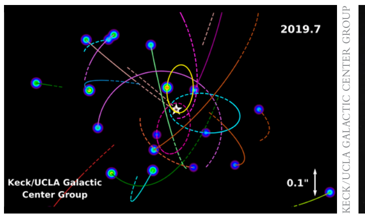
Raúl Rabadán, Member (2003–09) in the School of Natural Sciences, came to IAS as a particle physicist to work with the theoretical physics group. After becoming intrigued by the biology talks going on in Bloomberg Hall, he started to collaborate in systems biology research with Professor Emeritus Arnold Levine in the Simons Center for Systems Biology. At IAS, he began studying viruses and evolutionary biology, and pioneered innovations to follow the evolution of viral and cancer chromosomes. He is the Gerald and Janet Carrus Professor in the Departments of Systems Biology, Biomedical Informatics and Surgery at Columbia University; founding Director of the Program for Mathematical Genomics; and Director of the Center for Topology of Cancer Evolution and Heterogeneity. This article is an expanded version of a virtual IAS talk given in June that includes excerpts from Rabadán's book Understanding Coronavirus *(Cambridge University Press, 2020). Rabadán is a coauthor of* Topological Data Analysis for Genomics and Evolution: Topology in Biology *(Cambridge University Press, 2020) on applying topology, a branch of mathematics, to genomes, cancer, and viruses. This work grew out of a program that originated at IAS.*

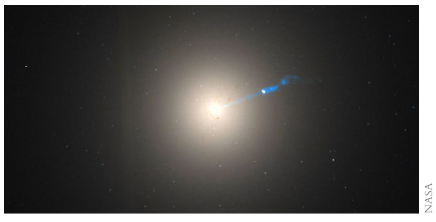


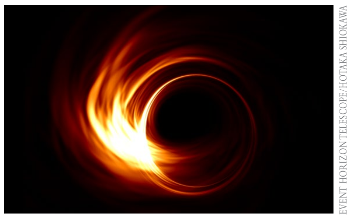
by merging black holes. So they are no longer just a mathematical quirk in general relativity.

How do we know there is a black hole at the center of the Milky Way? Just as we can use Kepler's laws of motion to measure the mass of the sun by the orbits of its planets, we can measure the mass of a black hole by the orbits of the stars going around it. Recording the positions of stars at the center of the Galaxy over the last couple of decades (Fig. 1) has shown that they are zipping around some unseen point mass that contains 4.1-million-solar masses of matter, but is smaller than the Earth's orbit around the Sun. We know of no object other than a black hole that could be so small with that much mass. Most astronomers consider this pretty direct evidence of a black hole at the center of the Milky Way.

Are there black holes at the center of other galaxies? If you look closely at an optical image of the M87 galaxy (Fig. 2), you can see this kind of smudge of blue light coming out of the center. Back when the first high-quality photographic images of this galaxy were made in 1919, it was noted that this "curious straight ray" was coming from the center of this galaxy, M87. Nowadays, using radio telescopes, we've discovered that this straight ray of light is actually a narrow jet of matter flowing out of the center of M87 at very close to the speed of light. We think the only kind of object that can create such powerful relativistic jets are black holes. So that's indirect evidence of a black hole at the center of M87.







From left to right: Fig. 1. Orbits of stars very close to the black hole at the center of the Milky Way. Fig. 2. Optical image of the M87 galaxy. Fig. 3. Computational model of plasma accreting into a black hole.

But of course, direct proof of the black hole at the center of M87 has recently come from the Event Horizon Telescope (EHT). It is a collection of radio telescopes that work together to make an image with the same resolution as a single telescope the size of the entire Earth. And with such high resolution, we've actually resolved that shadow of the event horizon of the black hole in M87 (page 1). One of the members in the Astrophysics group at the IAS, Lia Medieros, has been very involved in the work of the EHT and the production of this image.

The black hole in the M87 galaxy is not dark in the EHT image, because what we're observing is not the black hole per se, but hot plasma that's falling into the black hole (Fig. 3). When accreting plasma—a gas of charged particles, electrons, and protons—falls into the black hole and gets compressed, it heats up, just like how when you pump up a bicycle tire it gets warm from adiabatic compression. In addition, as the plasma falls in it releases gravitational energy, and this energy gets turned into heat. As the electrons in the plasma get hot, they start to emit photons (light), which is what we see in the EHT image.

Where does computation come into this story? Computational methods are absolutely crucial for this work in two ways. The first is for reducing the actual data itself. As you can imagine, the EHT is a complicated instrument which generates terabytes of data. Reducing this data and producing the image that you see is a challenging computational problem in data science. Secondly, in order to produce and interpret the image and to measure things like the mass and spin of the black hole, then models of the plasma flowing into the black hole are needed. Generating those models requires very sophisticated computational methods.

Methods for computing theoretical models of the plasma flow into black holes is in fact one of my main areas of research. How are such computations performed? The mathematical equations that describe the time evolution of basic properties of the plasma like density, momentum, and energy are a well-known set of differential equations. If you have some regions of space in which you want to model the plasma dynamics, you break that space up into discrete cells. You might have millions or billions of these cells in a single calculation. In each cell, you store the mass, energy, momentum, all of the conserved quantities. Then you update these quantities according to an approximation to the underlying differential equations that you can solve on a computer. This approximation tells you how to update the mass, momentum, and energy in every cell, which gives you the time evolution of the plasma.

And this is where algorithms come into play. The accuracy of the numerical methods used to find approximate solutions to the underlying differential equations is measured by something called the rate of convergence. This rate measures how quickly the error in the solution decreases as you add more cells. If the error drops by a factor of two when you double the number of cells, the method is called first-order. If it drops by four when you double the number, the method is called second-order, and so on. So higher methods are more accurate. For some problems you would need a resolution that is one hundred times higher per dimension to get the same accuracy with a second-order algorithm as you would need for a fourth-order algorithm. And because of the way the cost of the calculations increases with resolution, one hundred times more cells per dimension is a hundred million times more expensive. But higher-order methods are also more complicated, and harder to program on a computer, which is why they have only recently begun to become popular.

In fact, the increase in computer power over the last few decades is not enough to beat the increase in accuracy you get from using better, that is to say higher-order, algorithms. So that's why algorithms always win. They always lead to a much bigger increase in accuracy than just making the computer faster. Smart algorithms allow calculations that could have never been done even on the world's fastest computer today. And that's why developing new algorithms is so important for so many problems in science in general, not just astrophysics.

Let's return to talking about making images of black holes from the plasma that they are accreting. In the case of our own black hole at the center of the Milky Way, the first question you might ask is, where does all this plasma come from? We know for the case of the black hole in our own galaxy, it comes from the stars near the galactic center. Some of the stars that orbit very close to the galactic center have very powerful outflows, winds just like the sun has a wind. But these stars have much more powerful winds than the sun. The outflows from all of these different stars collide with each other, and when they collide that produces shock waves that fill the region around the black hole with shocked gas from the stellar winds. You can actually see this material in X-ray images of the galactic center as a bright bubble of hot plasma formed by winds from all these stars. The black hole at the center of the galaxy is accreting this X-ray–emitting plasma formed by these stellar winds.

Using the same numerical methods we use to model the accretion of plasma into the black hole itself, we can actually model the dynamics of the winds emanating from these stars directly, and follow the shocks formed as the winds collide with each other. That allows us to understand how the stars feed plasma into the black hole at the center.

Finally, there's one more interesting ingredient that has to be included in modeling the EHT image, which is how light emitted by plasma is affected by the gravitational field of the black hole. Near a black hole, light no longer travels on straight lines, but light rays are bent by the curvature of spacetime. To make this more concrete, if you imagine a thin disc of plasma orbiting around a point mass in non-relativistic Newtonian gravity, you would see the familiar image on the left (Fig. 4). It looks a lot like how Saturn's rings look to an observer from Earth. In relativity, however, this thin disc looks like the right image. Near the black hole spacetime is curved, so that photons travel on curved paths on their way to you. Photons emitted from the back of the disc are bent over the top of the black hole, and then focused towards the direction we are viewing from. This means the back side of the disc appears to be located just above the top of the black hole. Incorporating these relativistic effects is incredibly important because it makes the image of a disc around a black hole look completely different compared to a disc around a normal star.

Fig. 4. Appearance of a thin disc around a point mass in Newtonian gravity (left) and in general relativity (right). The latter demonstrates how light rays are bent in GR.

Going forward, we're going to learn a lot of plasma physics from the current and future observations. EHT is a wonderful experiment to understand general relativity and black holes, but I think it's also a much more interesting experiment to understand plasma astrophysics in the relativistic regime, because the plasma is what we actually see. There are many more physical effects to be included in future models. For example, the temperature of the ions and electrons in the plasma are probably different, and that changes the image. The radiation produced by the plasma also affects its dynamics, and therefore that can change the image compared to a model that does not include radiation. All of these things need to be incorporated in future models. We know the equations to solve, we just need to write the software and do the modeling properly. It's going to keep us busy for many years in the future. Ultimately, we hope to learn a lot more about black holes, and how they affect their environment, from both future observations and future numerical models. ■

James M. Stone, Professor in the School of Natural Sciences, is one of the world's leading experts in computational astrophysics. His expertise is in the development of novel numerical algorithms for plasma dynamics, and the application of these methods to study a variety of problems in astrophysics. His novel approaches have shaped the field of astrophysics and contributed greatly to our understanding of the universe.

Simulating Reality: Where Games and Science Meet

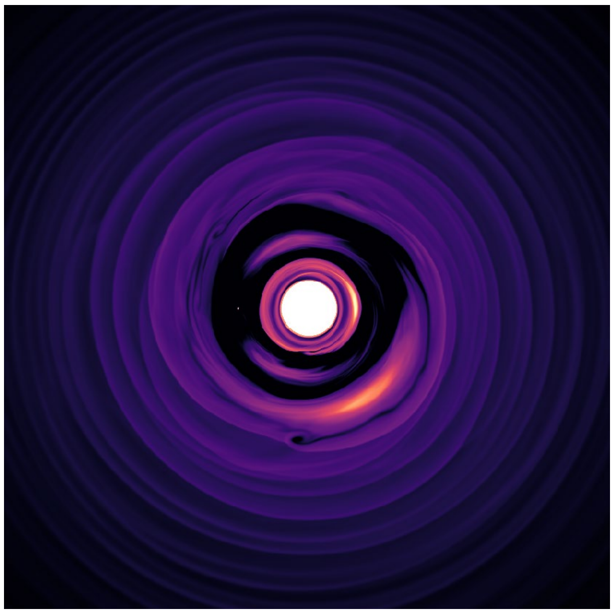
How game developers and scientists ended up reaching for the same goal

BY JEFFREY FUNG

What do you think about when you hear the word *simulation*? A quick search on Google indicates that a popular thought is whether we live in a simulation, i.e., *The Matrix*. The idea has been around for decades, but recently, it has been rekindled by advancements in virtual reality (VR) technology. It is arguably true that VR technology is precisely the path that will one day lead us to the "Matrix"—an entirely simulated world. What, then, has changed since the year 1999 (when *The Matrix* was first released) that made a sci-fi concept appear realistic today?

To simulate reality, we need two things: first, a very powerful computer. If you purchase a home computer today, you may notice that sometimes, there is an expensive component that you would not find twenty years ago. It typically costs more than your CPU, motherboard, RAM, or hard drives—sometimes even all of them combined. It is called a GPU, or Graphics Processing Unit, the reincarnated version of what was once called a display card.

You can think of a GPU as a second brain in your computer. The main brain, the CPU, does most of the complicated tasks, such as communicating between different devices, organizing task schedules, and shuffling data. Meanwhile, the GPU does one thing only—it crunches numbers. This simplicity is inherited from when it was still a display card, but now, instead of just calculating the color of your monitor's pixels, it does much, much more.



JEFFREY FUNG

A simulated snapshot of a massive, gas-giant planet stirring a protoplanetary disk. Brighter colors indicate higher dust concentrations. The gravitational interaction between the planet and the disk is rich and complex, but derived from fundamental equations that also regulate the motion of water and air on Earth.

This takes me to the second ingredient in simulating reality: the knowledge of how reality works. What is "real"? What seems real or natural to you? How leaves fall from a gust of wind, a lamp illuminates a room, or water flows in a kitchen sink, must all follow particular patterns in order to seem natural. These patterns are dictated by natural laws and can be computed given those laws. If that sounds like physics to you, that's because it is.

As it turns out, the fastest, most efficient way to make a virtual world seem real is to simulate reality using the laws of physics. Some decades ago, the gaming industry realized this, and became motivated to solve physical equations as fast as possible. Back then, only supercomputers, which are clusters of many CPUs connected together, could solve these equations sufficiently fast. Clearly, they could not expect gamers to have these kinds of resources. No, they needed an average person in an average household to have access to the kind of computational power that state-of-the-art science used. Millions of dollars in research and development later, they found the answer in GPUs.

BEHIND EVERY IMMERSIVE GAMING EXPERIENCE ARE GPUS PERFORMING THE INCREDIBLE FEAT OF SOLVING THE LAWS OF PHYSICS IN REAL TIME.

From this point on, the line between "virtual" and "reality" started to blur, and so did the line between games and scientific simulations. From gas dynamics (explosions), mechanical motion (gun shots), to ray tracing (cinematic graphics), behind every immersive gaming experience are GPUs performing the incredible feat of solving the laws of physics in real time.

As a computational astrophysicist, I could not be happier about this somewhat accidental alignment between myself and the gaming industry. I, too, simulate reality. I, too, want to solve physical equations as fast as possible. So, piggybacking on this computational paradigm shift, I write my programs to run on GPUs. Though the questions I ask relate to how planets form.

You may know that about 99.9 percent of the mass in the solar system is in the Sun; in other words, planets are formed from the leftover material of star formation. When a star forms, some material avoids falling onto the star, and instead becomes a surrounding disk, in a fashion similar to Saturn's rings, but larger by about a million times (literally). Because planets arise from these disks, we name them protoplanetary disks. In my research, I simulate the interaction between forming planets and their natal disks. These simulations offer insights into how planets form and grow, and also how protoplanetary disks are modified by the presence of planets. The latter is useful for spotting planet formation in action, which may appear as gaps, spiral structures, or other asymmetries in the disks.

To say I simulate protoplanetary disks is a jargony way of saying I simulate gas orbiting a thing with gravity (the star). Fluid in space and fluid on Earth are governed by the same type of equations. In fact, fluid in space is the same as fluid in games. Then, as one might expect, GPUs perform well with my kind of simulations. Over the years, I have developed a GPU-based simulation program specially designed for protoplanetary disks, which I named PEnGUIn (a very forced acronym. Don't ask.) In its latest version, it is able to simulate the motion of gas, representing hydrogen and helium gas in protoplanetary disks, and solids, representing icy or rocky particles, simultaneously.

Most of my simulations are run on desktop computers not unlike the one you may have at home (okay, I have a $3000 GPU in mine, but otherwise it is still a regular desktop.) Even with my rather "homemade" equipment, my collaborators and I managed to publish some cutting-edge simulations. In a paper titled "Circumplanetary Disk Dynamics in the Isothermal and Adiabatic Limits," we pushed the resolution of our simulations higher than ever before and were ultimately able to confirm the formation of circumplanetary disks—mini disks that form out of the material in the protoplanetary disk but encircle planets as small as the Earth.

Moons and satellites are expected to form out of circumplanetary disks. The giant planets in our solar system, Jupiter, Saturn, Uranus, and Neptune, all host extensive satellite systems, and so they likely harbored circumplanetary disks in their early days. The smaller planets, Mercury, Venus, Earth, and Mars, have far fewer satellites, and so it was believed that they never had circumplanetary disks because their gravity is too weak. In our work, we showed that instead of the planet's mass, the more decisive factor is thermodynamics. Gas that cools faster is more likely to form circumplanetary disks. Perhaps the giant planets had circumplanetary disks not because they are massive, but because they are further away from the Sun where the gas is less dense, leading to faster cooling.

As much as I (and many other scientists) have benefited from technology developed by the gaming industry, the relationship between games and science is more of a symbiosis. Scientists are the ones who uncover the laws of physics, and sometimes the ones who develop novel, more efficient algorithms to simulate them. For instance, in a paper titled "A Staggered Semi-Analytic Method for Simulating Dust Grains Subject to Gas Drag," we found a way to save a lot of time when simulating particles that experience strong gas drag. This and a number of other innovations are also included in PEnGUIn, many of which I came up with during the six-month lockdown we had. Perhaps some of these algorithms will one day be pulling the strings behind a waterfall or a cloud in your virtual world.

Enough rambling. If there is a message here, maybe it is that there is a lot of science in games, and a lot of games in science. Or the message is that you don't need to worry about *The Matrix* because to build it, you need the scientists too, not just the machines. Or, maybe the real message is that you should watch *The Matrix* if you haven't already. ■

Jeffrey Fung, Member in the School of Natural Sciences since 2019, is a postdoctoral researcher at the Institute for Advanced Study. He studies the dynamics of protoplanetary disks with a particular interest in disk-planet interaction. Fung is the author of the GPU hydrodynamics code PEnGUIn and many articles published in the Astrophysical Journal, *the* Astronomical Journal, *and the* Monthly Notices of the Royal Astronomical Society.

Q&A with Diana Graizbord

Exploring the nature of expertise, the politics of knowledge and ignorance, and what constitutes policy evidence

Diana Graizbord, Member in the School of Social Science, is an Assistant Professor of Sociology and Latin American and Caribbean Studies at the University of Georgia. At IAS she is writing her first book, "Indications of Democracy: Expertise and the Politics of Accountability."

OSCAR SOSA LÓPEZ

NNA LEBER, ATHENS, GA, 2019

Left: Diana Graizbord
Right: "On following": a mockup from *Ethnography Decoded*

How do you describe your work to friends and family?

The book I'm writing now tries to answer the questions of why certain social policies are deemed successful and others failures, and how social policy goals and the metrics and methods by which policies are evaluated are produced in the first place. To do so, I study the work of monitoring and evaluation experts working within the Mexican state.

I don't have the space to do it here but as an ethnographer, when describing my work to friends and family, I try to enliven my research through stories describing the exciting and everyday work done by the bureaucrats and social scientists who have, over the years, graciously put up with my many persistent questions and observations.

Why IAS?

The Institute's commitment to curiosity-driven research and its proven dedication to protecting and promoting independent and creative inquiry is so unique and important. I'm completely humbled to be in a place that has produced so much important scholarship. I'm excited to get to know and work with the Faculty and other Members, so many of whose work has inspired and informed my own, and I'm thrilled to able to focus on my research and writing.

Can you describe a high point and/or low point in your academic career and explain how this may have influenced your work?

Before graduate school, I worked for several years in policy think-tanks doing applied research, mostly monitoring and evaluation. I loved this work; it felt important and straightforward and I was helping to identify and promote policies that worked! I entered my Ph.D. program with the hopes of gaining the necessary technical skills and credentials to eventually return to policy research. But, in my first year of graduate school, I started reading work in critical development and Science and Technology Studies. It sounds dramatic, but this scholarship threw me into a professional and personal crisis! While it was thrilling to see the work I had previously done described and critiqued, it filled me with doubt and uncertainty. Now, of course, I see this as an important intellectual turning point for which I am very grateful. It was then that I realized that I didn't want to be a policy expert but a sociologist of policy expertise.

What is one of your interests or passions outside of academia? Has this had a bearing on your work?

I studied literature, writing, and film as an undergraduate and though I never pursued these creative fields professionally I have always had a passion for creative, visual storytelling forms. Recently I've found a way to fold these interests into my academic work. I'm currently working with a collaborator on the early stages of a graphic novel about ethnography, tentatively titled "Ethnography Decoded." The book uses comics—an engaging, creative, visual and textual medium—as a way to illustrate a set of key tensions that shape ethnographic research and render ethnographic methodologies more accessible and teachable.

Where is your favorite place to think?

Our work as academic scholars can be quite solitary and while I enjoy that aspect to a certain extent, I find that I do my best thinking alongside collaborators, colleagues, and friends. My favorite place to think is wherever collaborative exchanges take place. I enjoy the energy, freedom, and playfulness that come from thinking together and find these moments generative and inspiring. I'm very much looking forward to thinking with my new friends and colleagues here at the IAS. ■

PARET *(Continued from page 1)*

mother and sister living in Vienna in 1933. They emigrated to the United States in 1937, settling in San Francisco. In 1942, Paret enrolled at the University of California, Berkeley. The following year, he was drafted for World War II and served in combat intelligence and operations until he was discharged in 1946. He reentered Berkeley as a sophomore and graduated in 1949. Paret began his graduate studies in history at King's College, University of London, in 1956, and completed his dissertation under Sir Michael Eliot Howard, graduating with a Ph.D. in 1960.

Paret's publications span more than sixty years from the late 1950s to his most recent publication, "From Discovery of a Clausewitz Manuscript to Its Interpretation," which appeared in the *Journal of Military History* in July 2020. Throughout his career Paret looked beyond the pure military narrative, expanding the study of conflict into the greater context of society. He saw subjects as seemingly diverse as the military, politics, culture, and the arts as all interconnected.

His first book, *Guerrillas in the 1960s* (Praeger, 1961), with John W. Shy, argues that "Basically, the problem [of guerrilla warfare] is political; to attempt to understand it as a purely military one is the most dangerous kind of oversimplification." In *Yorck and the Era of Prussian Reform* (Princeton University Press, 1966), Paret presents a well-rounded view of the Napoleonic wars, noting, "The great achievements are easily identified; the specifics of doctrine, administration, and execution that led to them and form part of their substance prove more elusive." It was a recurring theme that Paret considered alternative angles with the effect of challenging the scholarly consensus.

"Peter Paret was an historian of modern Europe who began as an authority on war and on Clausewitz in particular, but his interests and competence ranged far beyond that, notably in art history," stated Glen Bowersock, Professor Emeritus at the IAS, "His literary sensibilities and meticulously crafted prose enshrine the quality of his elegant mind. I will always cherish my discussions with him about Theodor Fontane."

Having written several articles on the life and work of Carl von Clausewitz, Paret published a biography, *Clausewitz and the State* (Oxford University Press, 1976), which is now in its third expanded edition and has been translated into Spanish, Japanese, and German. Although Clausewitz is traditionally viewed as a frustrated, embittered bureaucrat, Paret states that his life "demonstrates a unity of motives and effort, a harmonizing of inner needs and achievements, a mastery of reality through understanding."

Recommended Viewing: View the public lecture "An Artist of and Against His Time: Ernst Barlach" given by Peter Paret in 2009 on Barlach, conceptions of war and of its uses, and the interaction of the arts with politics and ideology at www.ias.edu/paret-barlach.

In later work, Paret moved toward the use of visual art and sculpture as a historical source, focusing on the works of Adolph Menzel and Ernst Barlach. In *Art as History: Episodes in the Culture and Politics of Nineteenth-Century Germany* (Princeton University Press, 1988) he argued forcefully that "Works of art and literature, whether they address the past or not, reflect facets of the times in which they originate … are among society's most determined efforts to understand itself, and through their insights, errors, and obfuscations we hear the clear voice of the past."

Prior to joining the Institute Faculty in 1986, Paret held academic appointments at the University of California, Davis (1962–1969) and Stanford University (1969–1986). Paret has received four honorary degrees and has been elected to numerous learned societies, including the American Academy of Arts and Sciences, the American Philosophical Society, and the German Clausewitz Society. Paret's numerous awards include the Pritzker Military Museum & Library's Literature Award for Lifetime Achievement in Military Writing (2017); Germany's Order of Merit, Great Cross (2013) and Cross (2000); The Historical Society's Jack Miller Center Prize (2010); the American Philosophical Society's Thomas Jefferson Medal (1993); the Society for Military History's Samuel Eliot Morison Prize (1993); and the Moncado Prize (1970).

Peter Paret was predeceased by his beloved wife Isabel née Harris, a clinical psychologist, in 2018, and is survived by children Suzanne Aimée Paret and Paul (Monty) Paret; and four grandchildren. ■