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UPDATE



IN THIS ISSUE

- > Network communities 2
- > Wealth & inequality 2
- > SFI in the news 2
- > Achievements 3
- > Flack to rejoin SFI faculty 3
- > Societal universalities 3
- > Research news briefs 3
- > Primate disease 4
- > Mitchell leads Education 4
- > New ASU-SFI center 5
- > Social seismology 5
- > Protecting indigenous people 6
- > Life's underlying architecture 6
- > Mayan numeracy 6
- > Hampton Sides: Miller Scholar 7
- > New SFI Board members 7
- > Donor Profile 8
- > Education program deadlines 8
- > Upcoming events 8

RESEARCH NEWS

Two sabbaticals dedicated to better power grid science

A British power plant operator watches a popular sitcom in his control center. As soon as the show ends, he will need to dial in more power from plants from France to Scotland to meet a surge in demand from a million viewers who suddenly turn on their tea kettles.

"In energy, the interaction between physics and social systems is quite pronounced," says Paul Hines, a professor of engineering and computer science at the University of Vermont. He is spending his sabbatical at SFI with his colleague Seth Blumsack, who teaches energy policy and economics at Penn State University.
> [more on page 7](#)

RESEARCH NEWS

Why modeling in evolutionary biology matters

Despite their important role as "proof-of-concept" tests in evolutionary research, mathematical models are commonly misunderstood in the biology research community.

In a recent article in *PLoS Biology*, SFI Omidyar Fellow Caitlin Stern and former Omidyar Fellow Jeremy Van Cleve explore the role of mathematical modeling in evolutionary biology.

Abstract mathematical models, they argue, test the logical validity of verbal hypotheses. These hypotheses have long
> [more on page 2](#)

State of the Institute 2015

Q&A with President Jerry Sabloff

Continuing an *Update* New Year's tradition, Institute President Jerry Sabloff offered his thoughts on SFI in 2014 and its outlook for 2015 and beyond.

Update: During 2014, SFI's 30th anniversary year, we looked back on the Institute's history and its contributions to science, but we also spent a good deal of time looking forward, imagining the next 30 years. What

do you see as the biggest opportunities and the biggest challenges in SFI's future?

Jerry Sabloff: I believe, and I think everybody in this building believes, that the biggest opportunity in the general sense is that complex, nonlinear thinking can help scientists and our policy makers and planners solve some of the biggest challenges we face in this country and the world. I think it's clear

that when we try to solve really difficult problems, one-dimensional, near-term, linear thinking is only going to result in more of the same disappointing results we've seen in the past. And even though concepts like Black Swan and Long Tail and other complexity-related ideas are now more commonplace in the vernacular, in practice we still aren't seeing really deep complex systems thinking
> [more on page 4](#)

PEOPLE

David Krakauer selected as SFI's next president

David Krakauer, an evolutionary theorist and director of the Wisconsin Institute for Discovery (WID) at the University of Wisconsin-Madison, has been selected as the Santa Fe Institute's next president.

Krakauer served as the WID's first permanent director and has led WID since fall 2011. He plans to join SFI on August 1, 2015.

"I feel both energized and privileged to be returning to SFI," Krakauer says. "I am convinced that the social, technological, research, and educational landscapes of the 21st century need an institute like SFI. It is the one place I know where collective brain power is limited only by the questions that it dares to ask."

Krakauer spent nine years at SFI as a faculty member and chair of faculty prior to leading WID, a major transdisciplinary research center at UW-Madison. He will take the reins from retiring SFI President Jerry Sabloff, who has led SFI since 2009, to become SFI's seventh president.

"David was selected following a rigorous 18-month presidential search that included some of the top scientists and science administrators in the country," says Michael Mauboussin, Chairman of SFI's Board of Trustees, which made the selection. "He distinguished himself as having the right leadership experience, the needed breadth and rigor, and an abundance
> [more on page 4](#)



On the Santa Fe Radio Café on December 10, SFI Omidyar Fellow Sam Scarpino explains how mathematical epidemiologists can help slow the spread of the Ebola virus by mapping its patterns of transmission.

On the Santa Fe Radio Café on December 2, author and SFI Journalism Fellow Laurence Gonzales explains why failure is inherent to the functioning of complex machines such as airliners, space shuttles, and nuclear power plants.

In the *Santa Fe New Mexican* on November 24, SFI Omidyar Fellow Sam Scarpino describes how SFI scientists, working with public health officials, are using mathematical models to explore the interacting

factors contributing to the Ebola outbreak in West Africa.

On the Santa Fe Radio Café on November 12, Ginger Rhodes and Richard Rhodes examine the association of violence with mental illness and make an argument for early intervention, in a preview of their SFI Community Lecture.

The *Atlantic's* CityLab on November 4 covers research by SFI's Cities & Urbanization team to explore the relationships among a city's quantifiable features and its population.

In a November 4 op-ed in *Nature*, SFI Omidyar Fellow Sam Scarpino is among 24 co-authors offering a rebuttal to recent

assertions that epidemiological models used to estimate the trajectory of the Ebola outbreak in West Africa missed the mark. The authors note that the modeling forecasts themselves encourage public health interventions, which can change the course of the outbreak.

In *New Scientist* on November 1, SFI's Geoffrey West and three co-authors advocate a revised view that treats an economy much as biologists think about an ecosystem, rife with interdependencies and evolutionary dynamics that give rise to imbalances that underlie observed market crashes and bubbles.

In the *Santa Fe New Mexican* on October 27, SFI External Professor Andreas Wagner

addresses a question that has confounded theoretical biologists: how do evolutionary innovations arise in the first place?

SFI's Sam Bowles explains why some incentives go wrong in an October 22 article in *The Guardian* that examines the record of various cash incentive schemes, including a proposed program that would pay British doctors to diagnose dementia patients.

Offering previews of his SFI Community Lecture in the *Santa Fe New Mexican* on October 12 and on the Santa Fe Radio Café on October 14, SFI Professor Sid Redner draws on sports statistics to bust common myths about scoring streaks, "hot hands," and infamous team curses. ■

Nonlinearities

From the editor

News and more news. From the announcement of a new SFI president and resident professor to SFI's first major collaboration with a university, this eight-page issue is pushing maximum density. Plus, as he has done every January, Jerry Sabloff treats us to a deep dive into SFI's status and future. And, of course, there is plenty of good Institute-style science herein. Lots of change afoot.



I refuse to be happy about one recent change, though. Ginger Richardson retired from SFI on December 31 after 29 years, or roughly 97 percent of SFI's history.

Ginger is more than the person who ran education, or my former boss, or SFI's first employee. Ginger helped build an entirely new way of delivering science education, a "re-imagining" as Jerry calls it in his page 1 interview. (For more, see her essay in the most recent issue of the *SFI Bulletin*: bit.ly/1HqOjXN.) With just the right balances of confidence and humility, humor and focus, vision and inclusion, Ginger is an enduring, omnipresent force acting on all of us, pulling towards excellence. She is also a fantastic friend and amateur therapist and I miss her. SFI misses her. She's already working on a new creation. I'm glad for her, but we're all still adjusting. Bah!

Radical science? Or relevant? Seeing Sam Bowles here at SFI is always a treat. If you don't know him, he's an SFI professor and economist whose research delves into the origins and drivers of wealth inequality and the co-evolution of institutions and behavior. He's made a career of science-truthing mainstream economic theory. When social issues stemming from inequality flare up, as they have recently with shouting in the streets, Sam typically is there to share some of what science tells us about inequality and its multigenerational persistence. He does it with a disarming smile. See the article on this page about his forthcoming, related workshop. ■

– John German, jdg@santafe.edu

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The *SFI Update* is published bimonthly by the Institute to keep its community informed. Please send comments or questions to John German at jdg@santafe.edu.



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RESEARCH NEWS

Finding communities in networks

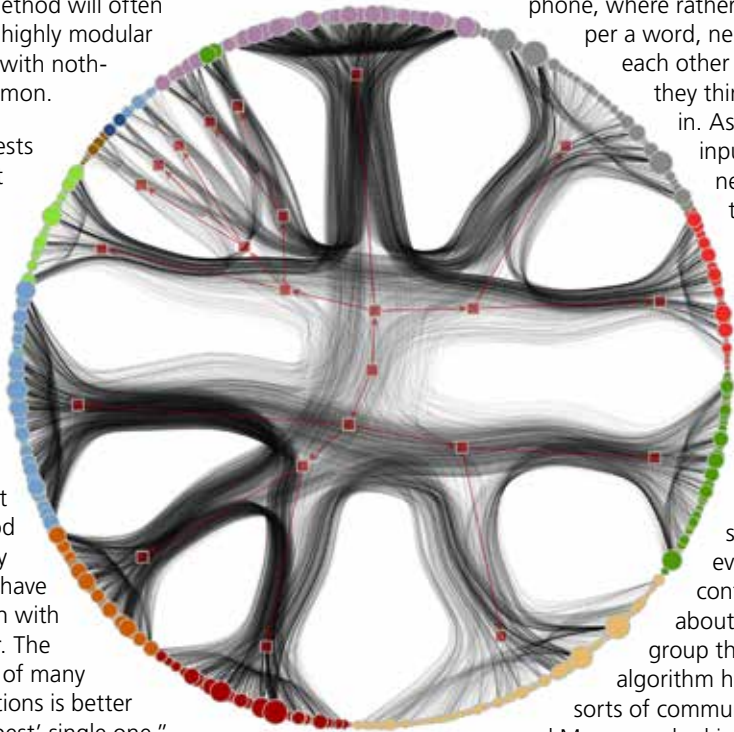
A key challenge for network scientists is figuring out how networks break down into communities. Robustly identifying those communities in large, complex datasets could be essential to understanding how a network functions, but it's proved difficult.

Now, two SFI researchers have found a better way using methods borrowed from statistical physics.

The problem, SFI Postdoctoral Fellow Pan Zhang and SFI Professor Cris Moore argue in a recent paper in *PNAS*, is that finding communities is almost too easy. In one popular approach, researchers begin by breaking a network into a set of proposed communities and computing the set's modularity – or how dense within-community links are compared with between-community links. In theory, the highest-modularity set reflects the network's true community structure.

But that method will often find many highly modular structures with nothing in common.

That suggests "you don't want the 'best' community structure," Moore says. "Instead, you want to understand what all the good community structures have in common with each other. The consensus of many good solutions is better than the 'best' single one."



A hierarchical division of the political blogosphere network during the 2004 U.S. presidential election, a dataset commonly used for evaluating community-detection methods. The authors' algorithm first finds two large communities corresponding to liberals and conservatives but further splits these communities into subcommunities, eventually finding a hierarchy five levels deep with a total of 14 subgroups. (Image: Pan Zhang and Cris Moore)

> Modeling in biology continued from page 1

been used in evolutionary biology to describe processes that operate across varied species and long timescales; Darwin's theory of natural selection is the best-known example.

The authors posit that mathematically framing a verbal model helps clarify the initial assumptions and offers an opportunity for critical analysis of the model's logical results. They also maintain that a rigorous analysis by a mathematical model can test a verbal hypothesis just as well as an elegant experiment.

The paper describes significant contribu-

tions mathematical models have made to understanding sex and speciation, and also addresses common questions about proof-of-concept models, such as how can they be "empirically tested."

But they couldn't stop there, because they needed an efficient way to find such community structures.

For that, they turned to the cavity method, originally designed to find lowest-energy states in spin glasses, one of the thorniest challenges in statistical physics.

The method, known in computer science as belief propagation, is something like an elaborate version of the party game Telephone, where rather than whisper a word, neighbors tell each other what group they think they're in. As players get input from their neighbors, their own beliefs about what group they're in change. Once – and if – that settles down so that everybody's confident about which group they're in, the algorithm has found the sorts of communities Zhang and Moore are looking for. ■

RESEARCH NEWS

Inheriting riches or rags: Wealth transfer and inequality

Getting rich and keeping your family wealthy depends on more than wise investing. Conversely, poor families face historical and poverty-induced restrictions to gaining wealth. Such constraints are among the drivers of increasing and sustained wealth inequality today, says SFI Professor Sam Bowles, head of SFI's Behavioral Sciences Program.

Human societal structures influence the heritability of wealth, and some aspects of wealth matter more than others depending on the type of economy, he says. Among foragers, for example, material things are not very heritable: objects tend to be shared, and thus matter far less than an individual's physical strength and ability to hunt.

"Types of wealth differ markedly in how they are passed from one generation to the next," says Bowles, adding that wealth in this context is defined as anything that helps someone make a living. "Cows and land are highly correlated between generations. A dad with many cattle tends to have sons with many cattle, whereas a father who hunts well can have sons indifferent to hunting."

To investigate the drivers of disparity, Bowles and Monique Borgerhoff Mulder, a professor of anthropology at UC Davis, began in 2008 to hold the annual Dynamics of Wealth Inequality workshop at SFI. Some 30 researchers – among them ethnographers, historians, economists, and statisticians – meet annually to examine inequity and how it spans generations, and share their insights from recent research.

In addition to the highly interdisciplinary group of attendees, another unusual feature of the workshop is its investigative approach. Most socioeconomic studies quantify research using big datasets that cover broad factors about a society in general, such as level of policing and percentage of food from hunting. In contrast, "we're the first to collect large cross-cultural data, where the units are families," says Bowles.

"We believe that, rather than studying the rise of inequality in the past, it's better to emphasize the dynamic setting and see how things change, not just how things are, to give insight into today's capitalism and what's to be done with modern injustice," he says.

This year's workshop, funded by the National Science Foundation, will consider the relationship between polygyny (a form of marriage in which a man is permitted more than one wife) and wealth inequality, and, conversely, the impact of such inequality on family structure. ■



The American Physical Society has named SFI Professor Cris Moore a fellow for his fundamental contributions at the interface between non-linear physics, statistical physics, and computer science, including complex network analysis, phase transitions in NP-complete problems, and the computational complexity of physical simulation. The number of fellows elected in a given year is less than one-half of one percent of the APS membership.

SFI Science Board member and External Professor Stephanie Forrest has been named a fellow of the Institute of Electrical and Electronics Engineers (IEEE) for 2015 for her



Stephanie Forrest



Mark Newman

contributions to computer security systems based on biological principles. The number of fellows selected in a given year is less than one-tenth of one percent of the IEEE voting membership.

Three members of SFI’s external faculty have been named fellows of the American Association for the Advancement of Science (AAAS) for 2014. External Professors Mark Newman and John Harte were honored for their distinguished contributions



John Harte



Aviv Bergman

to physics, and External Professor Aviv Bergman was honored for his contributions to the biological sciences.

SIAM, the Society for Industrial and Applied Mathematics, will award its 2015 SIAM Prize to SFI External Professor Carlos Castillo-Chavez. Each year, the award is given to an applied mathematician who has made “distinguished contributions to applied mathematics on the national level.” Castillo-Chavez researches prob-



Carlos Castillo-Chavez



Clio Andris

lems at the interface of mathematical, natural, and social sciences.

Clio Andris, a former SFI postdoctoral fellow, has joined the Department of Geography at Penn State University as an assistant professor. With expertise in social networks, urban planning, GIS, and spatial analysis, Andris studies interpersonal relationships in geographic space. ■

Flack to rejoin SFI’s resident faculty

Jessica Flack will rejoin SFI’s resident faculty on August 1, 2015 as a professor.

Flack, an evolutionary biologist specializing in collective behavior and natural computation, spent five years at SFI on the resident faculty and three years before that as an SFI postdoctoral fellow prior to leaving for the University of Wisconsin-Madison in 2011. Since then, she ran, as co-director, UW-Madison’s Center for Complexity and Collective Computation (C4).



components often with multiple goal states and only partially aligned interests – are governed by laws derived from strategic interactions at the microscopic level, or reflect contingent events

leading to irreducible complexity. This question motivates most of my work.”

The research draws from many fields – evolutionary theory, information theory, behavior and cognitive science, theoretical computer science, and statistical mechanics – and so is perfectly suited to SFI, Flack says.

“SFI is one of the few places where philosophy is transmuted into rigorous, quantitative science in real time,” she says. “Intellectualism, irreverence, creativity, and a willingness to engage the hard, awesome topics go hand in hand at the Institute. This is the kind of environment I love, and it’s where I believe I can do my best work.”

While at the University of Wisconsin, Flack built C4 from the ground up. The Center’s focus is on the information processing, regulatory, and computational principles underlying the emergence of societies of cells and organisms in the history of life on earth.

Flack’s transition to Santa Fe prompts moving C4 to New Mexico, where it will become the Collective Computation Group. ■

What all societies have in common

Before humans came together in cities and villages they did so, for hundreds of thousands of years, in bands of hunter-gatherers.

The transition to urbanism has long been a research focus at SFI. Now several Institute collaborators and researchers have formed a long-term working group to identify and measure the commonalities across various forms of human agglomeration.

The group, Universals in Human Social Organization, “seeks to identify and formally describe regularities across the enormous diversity of social organizations and systems and to explain their origins and continuity,” says Jose Lobo, a professor of urban economics at Arizona State University.

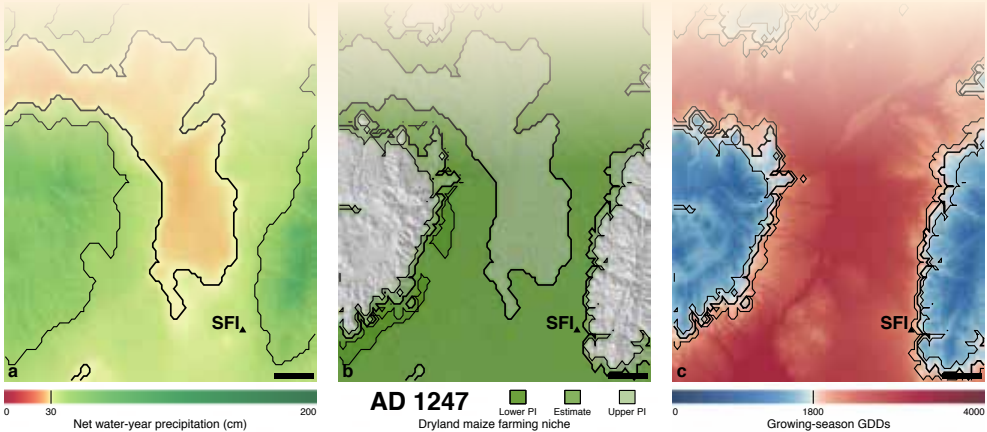
The effort has roots stretching back a decade. As SFI Distinguished Professor Geoffrey West explains, it grew in tandem with SFI’s scaling in biology work, which in turn led to two connected branches: the study of cities, and the study of social invariants in human societies ranging from modern societies to hunter-gatherer groups. The new effort builds

on both branches, with a focus so far on hunter-gatherers.

The group began meeting weekly last summer and plans to continue at least through spring 2015. Its combined expertise in physics, human ecology, anthropology, and urban economics creates a multidisciplinary perspective in building empirically-based mathematical models for the study of common human social dynamics.

Further, explains group co-founder Marcus Hamilton, “given the increased understanding of ecological structure over the last couple of decades, through quantitative theory building and empirical data analysis, we are now in a prime position to ask the same deep questions in anthropology.”

Hamilton is particularly interested in exploring how the uniqueness of humanity evolved. “In what ways are humans truly a unique primate, or mammal, or even organism in the history of life on this planet,” he asks, “and what evolutionary and ecological pathways did we evolve along that other species didn’t. And why?” ■



Rain-fed maize agricultural niche in A.D. 1247 in the Southwestern U.S. Left: Net precipitation. Center: Agricultural niche. Right: Growing season degree days. (Image: Kyle Bocinsky)

Did climate change cause the Anasazi to leave?

In *Nature Communications*, SFI External Professor Tim Kohler and colleague Kyle Bocinsky examine the role localized climate change might have played in the depopulation of southwestern Colorado in the 13th century. The researchers used tree-ring chronologies to inform a model of precipitation and temperature that calculated the effects of regional climate change on maize crops. Their research suggests that some 40,000 Ancestral Pueblo farmers migrated from the area in response to a drought that would have disrupted the stability of their year-to-year agricultural yield.

Digital technologies and human social dynamics

A special issue of the *Proceedings of the IEEE*, guest-edited by SFI External Professors Jessica Flack and Raissa D’Souza, examines how digital technologies and the increased social connectivity they enable are changing our social networks and dynamics. Inside the issue, SFI Professor Luis Bettencourt argues that “the dynamics of informational networks in complex systems are the physical manifestations of processes of evolution, inference, and learning, from natural ecosystems to cities and online environments.” He presents a framework for understanding how networks transition from initially static and information-poor states toward dynamic, diverse, and interconnected ones.

Which predictive method best suits a given system?

In a new paper for *Physical Review E*, SFI External Professor Liz Bradley and colleagues Joshua Garland and Ryan James quantify predictability, with a strategy for determining which predictive method best suits a given system. The authors use techniques from information theory to construct a strategy for evaluating whether a given time-series prediction method fits a given set of data. They demonstrate their strategy on a variety of synthetic and real-world datasets. Bradley says the paper was nucleated at SFI.

How multicellular life emerged and persisted

In *Science*, SFI Omidyar Fellow Eric Libby and co-author William Ratcliff explore how early multicellular life might have persisted amidst the evolutionary tug-of-war between single-celled and multi-celled living arrangements, “as cell-level selection can easily overwhelm the generally slower process of group-level selection,” they write. “One solution to stabilizing multicellularity is the evolution of traits that increase cell-level fitness in a group context, but come at a cost to free-living fitness...Accumulation of [such] traits would ratchet cells into a group lifestyle, ultimately preventing unicellular reversion.” One such trait, they suggest, is elevated rates of programmed cell death, called apoptosis, that in experiments allow large clusters of cells to break apart into smaller, more manageable formations.

Studying ecosystem responses via trait spectrum

To better predict the effects of climate change on ecosystems, SFI External Professor Brian Enquist and co-authors argue in *PNAS* that – rather than classifying plants, animals, and bacteria as separate species – a “functional biogeography” approach that models living things along a continuous spectrum of their traits might bring new insights.

Paper makes case for ‘blue-skies’ eco research

In *Trends in Ecology & Evolution*, SFI External Professor Michael Hochberg and collaborators advocate for more fundamental ecological research motivated by curiosity rather than by immediate applications and offer several ways to promote basic research in the future. The paper’s co-authors include SFI VP for Science Jennifer Dunne and SFI Science Board member Robert May, among others. ■

Modeling primate societies sheds new light on spread of disease

Scientists usually study primates for their physiological and social similarities to humans. This month, mathematical modelers and primatologists are coming together at SFI to discuss monkeys and gorillas, not so much because of their likenesses with humans, but because of how much we know about some of them.

“The overarching goal is to understand how primate contact patterns affect disease risk, and then to leverage that to develop a richer theory of disease,” says SFI Omidyar Fellow Sam Scarpino, who is co-organizing the mid-January working group with Margaret Crofoot of UC Davis and Damien Caillaud of the Dian Fossey Gorilla Fund International.

Among the questions the researchers have is how groups of primates that seem too small to sustain disease outbreaks can nonetheless become conduits for epidemics. Scarpino and colleagues are working with two high quality, long-term datasets: one that tracks capuchin monkeys on an island in the Panama Canal, and another that records contacts for mountain gorillas in Central Africa.

“Our working hypothesis is that intergroup contact rates are what’s really essential for the types of diseases that can cause epidemics and

be maintained endemically,” Scarpino says. To study the problem, the researchers create network models of contacts in and among primate groups to quantify how the networks change in time. Then, they search for observable structural changes in the networks that correspond to changes in disease risk.

How the number or the variety of contacts for a given primate individual affect its risk of contracting a disease is difficult to measure in traditional disease models, and Scarpino’s group employs some novel network techniques developed at SFI to meet the challenge.

“SFI’s rich history in applied network theory, animal cognition, group dynamics, and sociality make it ideal for this kind of interdisciplinary work,” Scarpino says. “You can make more progress in a week-long working group than you can make in a year of emailing.”

“What we learn about these primates will help us understand what types of changes are most important to disease risk,” he adds, “and develop a richer theory of disease that will translate to humans as well.” ■



Mountain gorillas, courtesy of the Dian Fossey Gorilla Fund International

> *State of the Institute* continued from page 1

consistently applied to our biggest challenges. So I think one huge opportunity for the Institute is to continue to bring that kind of thinking into the mainstream and to show how it can be applied in a practical way to decision making. I think we’ve had some success, but we can do a lot more.

Then I think there’s the whole area of complexity education. We’ve had tremendous success over the last 30 years, most of it under the outstanding leadership of Ginger Richardson, who just retired. The program now offers entry points for people interested in learning about complex systems science at just about every level of education, from 6th grade through adult learning, and these programs continue to be increasingly impactful. We’ve seen this with – through Irene Lee’s great efforts – the expansion of the GUTS programs into local classrooms, and now into classrooms nationwide, and also with – through Melanie Mitchell’s vision and effort – the growth of the Complexity Explorer’s MOOC course offerings from one to five courses. So in terms of opportunity, I think the Institute has begun to redefine science education. I also think, given the enormity of the challenges our society faces, it is almost a moral obligation for SFI to serve as a role model and pioneer in complexity education.

Another – and this is both an opportunity and a challenge – is SFI’s environment. The opportunity is that as you see universities, and in particular large research universities, becoming more bureaucratic, more bound by all kinds of rules and constraints, we can offer scientists a nonbureaucratic place to do research in a highly intellectually stimulating environment. So the opportunity is we should be able to attract the really top scientists at both the postdoctoral and faculty levels. The challenge is making that happen, because the universities obviously have tremendously more resources than we have. So we have to figure out how to get people, who I think are tempted by this incredible environment, to see how coming to SFI would help their careers and their research, even when we can’t offer the same in terms of salaries and resources that the universities can offer.

The other big challenge is clearly the Institute’s fiscal status. That was the situation the day I arrived, and it remains so today. We’re on better footing now than we were a few years ago, but our finances are still much too tight, and there are just too many factors we do not control that can impact our budget. One is the economy and how that influences private donations. Another is the whole area of federal grants, with the NSF and DARPA and others facing significant

constraints on their grant funding. It’s not that we’re not competing well; we’re competing as well as, if not much better than, many research universities. But the mean size of grants is coming down across the board, not only for government grants but for grants from the private foundations. In that sense we’re in the same boat as other nonprofits, and what it suggests is we really have to build on private philanthropy. So that’s a major challenge that’s going to continue for the foreseeable future. Related to that is the challenge of meeting the goal the Board of Trustees set last year of raising \$100 million in endowments over the next ten years. That, of course, would vastly improve the financial security of the Institute, both in terms of year-to-year budgets and also by providing a cushion for when we have budgetary crises caused by external factors.

Update: After six years at SFI’s helm, including a three-year extension as president, you’re stepping down this summer. What do you see as the Institute’s major accomplishments since 2009, and how has SFI changed?

Sabloff: Right. I came out on a three-year contract, with the understanding that if the Board wanted, and I wanted, to stay for a three-year extension, I would; and they did ask, and I did stay. So it wasn’t exactly unplanned, but it was seen as the best

course of action all around given all the uncertainties the Institute was facing.

I think our major accomplishment, which I’ve said many times before, has been keeping SFI thriving through the recession. I said to the Board at last May’s meeting that my SFI epitaph will read: “He kept the doors open.” [Laughs] You know, on one hand, that’s not the stuff of headlines. But on the other, obviously it’s important that we’re here, that we’re still thriving, and that we’re on a significant upward trajectory in a number of ways, and that in terms of science we’re back to pre-October 2008 levels of activity. That’s probably one, two, and three on the list of SFI’s accomplishments given the economic climate over the last six or seven years.

Related to that is the strengthening of the Institute’s assets, with one major step being the acquisition of the Thaw property in Tesuque, which in the short-term doesn’t directly impact the budget, but in the long-term is a major asset that will really strengthen SFI’s financial position. Another achievement is, with the timely advice of the Board’s Finance Committee, paying off the mortgage on the Cowan Campus. Another is obtaining the funding from George Cowan when I first arrived to establish the Cowan Chair, which has brought in major scientific figures like Mahzarin Banaji of Harvard, > [more on page 5](#)

> *New president* continued from page 1

of energy that will help keep the Institute on the forefront of exciting, risky, and transdisciplinary scientific research.”

“I’ve always felt that SFI has a very special quality,” says Krakauer. “When people walk in, the feeling is often expressed as, ‘Wow, what is this place?’ It is clearly something very different. The question to me is, what is the secret sauce that makes SFI so successful? The people? The culture? The conversation? The place? The history? And how can we get more of it...how can we get a ridiculous quantity of it?”

The most challenging problems of the modern world are “complex,” he notes, in part because they involve interconnected social, biological, physical, and technological systems that adapt to changes in each other.

“There is no ready-made model we can use to net these adaptive Leviathans. We need new theories and new techniques – and we need to experiment with very wide-ranging ideas and very creative, open-minded people.”

Perhaps most important, he says, “there is often an underlying formal structure shared by many of these systems. We’re interested in their energetic and informational properties, and what we can say about them mathematically and computationally. We search for theory because it is the role of theory to simplify problems.

“SFI is not about looking straight at an old problem or seeking an immediate answer to an existing question,” he says. “SFI is about circling a phenomenon, considering all the angles and unique perspectives to see a > [more on page 6](#)

PEOPLE

Mitchell to head SFI education programs



David Krakauer’s arrival at SFI in August 2015, he says.

Mitchell, a professor of computer science at Portland State University, will spend a week at SFI every five or six weeks begin-

SFI External Professor Melanie Mitchell will lead SFI’s education and outreach programs until a permanent vice president can be named, says SFI President Jerry Sabloff. That will likely occur following

ning January 20. She has had a long association with SFI’s education programs, including her recent development of the Complexity Explorer and a series of five massive open online courses (MOOCs) offered through complexityexplorer.org.

Ginger Richardson, former McKinnon Family Vice President for Education and Outreach, retired December 31 after 29 years at SFI.

“Education and outreach are fundamental to SFI’s mission and to its success,” Mitchell says. “I’m looking forward to continuing Ginger’s work in strengthening SFI’s many education programs and in linking these programs more closely with ongoing science at the Institute.” ■

ASU-SFI agreement establishes new Center for Biosocial Complex Systems

SFI and Arizona State University are launching a research and education collaboration that focuses on problems at the intersections of complex biological and social systems.

The new ASU-SFI Center for Biosocial Complex Systems will build a deeper theoretical understanding of the interconnections be-



ASU President Michael Crow

tween these systems and apply that knowledge to questions in both science and policy.

“The synergy of two intellectual powerhouses such as SFI and ASU can accelerate how our community

and nation tackles questions such as disease patterns and healthcare delivery,” says ASU President Michael Crow. “We can generate tools to better understand how decision-making systems work when scaled up, to the level of the urban megalopolis.”

The collaboration pairs researchers from ASU, a leader in sustainability research, and SFI. This is SFI’s first formal collaboration with a university.

SFI President Jerry Sabloff says he hopes it leads to additional partnerships. “This new ASU-SFI collaborative venture has immense potential for the advancement of complexity science at both institutions,” he says.

Crow and Sabloff are to formally establish the Center during a January 16 signing ceremony in Tempe, Arizona.

Two areas of focus for the partnership are the

dynamics of innovation, and urbanization and scaling in cities. As cities grow they face new dilemmas and challenges, especially as they strive to be more sustainable. Phoenix is one such city, and ASU hopes to gain insights that are useful both locally and globally.

ASU will provide support for faculty and postdoc hiring to support joint research and education activities at both institutions. Sponsored activities include workshops, working groups, graduate and postdoctoral fellowships, faculty appointments, faculty exchange visits, seminar series, and other joint projects and proposals between ASU and SFI.

The partnership is the latest in more than 200 new transdisciplinary schools and initiatives developed at ASU since President Crow joined the university in 2002, according to ASU’s announcement.

ASU President’s Professor Manfred Laubichler

and ASU Foundation Professor Sander van der Leeuw will serve as the Center’s directors, reporting to ASU Provost Rob Page. All three hold joint appointments as SFI external professors. The two directors plus SFI Vice President for Science Jennifer Dunne and Sabloff will serve as the Center’s steering committee.

“This is a great opportunity for both institutions, and will help to expand the scope, vision, and reach of complex systems research,” says Dunne. “For SFI, it is a new model for collaboration that might pave the way for partnerships with other academic and research institutions in the future.”

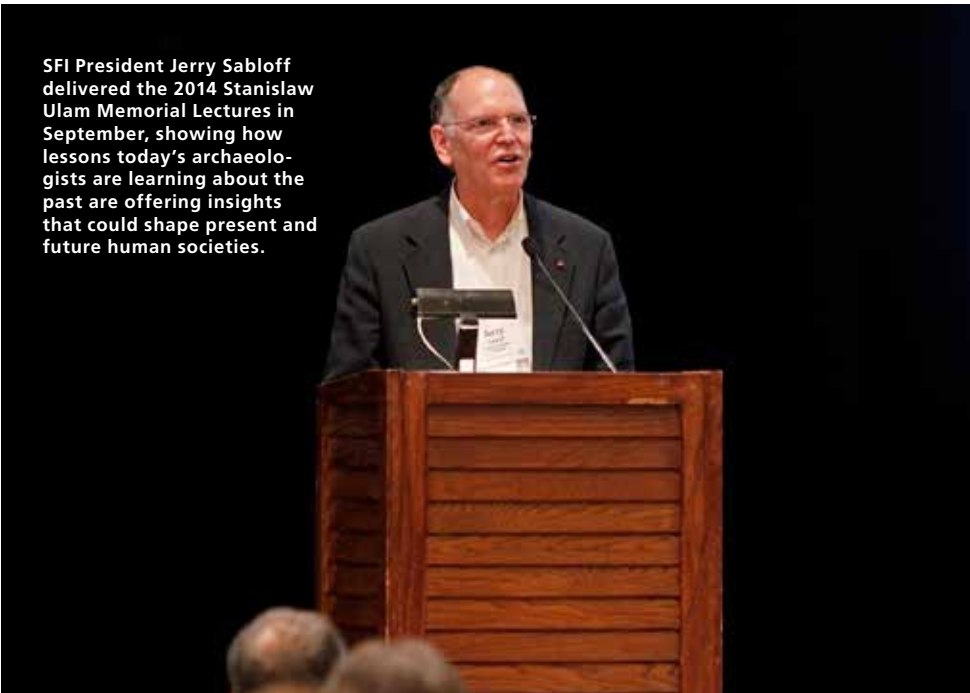
The collaboration supported an October 2014 workshop on the origins of novelty in biological, social, and technological systems, co-organized by Dunne, Laubichler, SFI External Professor Andreas Wagner (ETH Zurich), and frequent SFI collaborator Jose Lobo (ASU). ■

> State of the Institute continued from page 4

Robert Boyd of Arizona State University, Ricardo Hausmann of Harvard, and now Mirta Galesic of the Max Planck Institute, who just joined us this month.

In addition, we were able to restructure the Omidyar Fellowship so that this incredibly successful program will support somewhere around a dozen postdoctoral fellows at any given time. This restructuring lessens the year-to-year unrestricted budgetary expenses of managing the program and, perhaps most important, it means we will secure, by the

excellence, particularly in complex systems. At Sander’s urging, I first visited with President Crow in Tempe in 2012, and then he came to Santa Fe in 2013 to give one of our community lectures. Paula and I had dinner with him and his wife during that visit, which eventually grew into this agreement – after lots of hard work by Jen, ASU Professor and SFI External Professor Manfred Laubichler, Sander, and their ASU colleagues. We’ve already hosted a great workshop together in October on the origins of innovation across systems of many kinds and



SFI President Jerry Sabloff delivered the 2014 Stanislaw Ulam Memorial Lectures in September, showing how lessons today’s archaeologists are learning about the past are offering insights that could shape present and future human societies.

end of 2015, the full \$7.5 million pledge by Pierre and Pam Omidyar, which will allow the program to function at this strong level for at least another 25 or 30 years. Also, I think, securing the large “Principles of Complexity” grant from the John Templeton Foundation, which we just finished and which helped mobilize the whole building – faculty, postdocs, and visitors – on our core mission of developing a general understanding of complex systems, was an important accomplishment.

Finally, a major accomplishment is the agreement we are signing on January 16 with Arizona State University to establish a joint ASU-SFI Center for Biosocial Complexity – fulfilling a long-term vision of SFI External Professor Sander van der Leeuw. [See “ASU-SFI agreement establishes new Center for Biosocial Complexity” above.] This is clearly a major experiment that both [VP for Science] Jen Dunne and I think has huge potential if it’s successful, not only for what it will do in terms of exciting research through our collaboration with ASU, but also for the potential it has in serving as a model for agreements with other research universities in the future. We generally have not entered into these kinds of agreements with universities before, but we think this one has particular promise because of the similarities of our interests with ASU’s. ASU President Michael Crow has been among the most innovative university presidents in the world in terms of establishing new centers of

scales, and the Center’s first postdocs have been appointed. We’re talking with ASU about faculty exchanges and other arrangements that are mutually beneficial, so this is just a great arrangement for both institutions. President Crow has long been interested in SFI, and now ASU Provost Rob Page, a former SFI external professor who we’ve recently re-appointed, is excited about the Center, too, and wants to explore new ideas for collaboration. So I strongly believe that this new partnership really will enhance the capabilities of both institutions and lead to some exciting joint research. There’s much more to come.

Update: Has the Institute changed in any fundamental ways since 2009?

Sabloff: I don’t think it has changed fundamentally, but there have been a few significant changes. One of the obvious ones is we’ve added and strengthened SFI’s work in the social sciences, in particular archaeology and anthropology. That strength can be seen in the “Emergence of Early States” project that was funded by the Templeton Foundation, in which we took a broad comparative look at the formation of states. That project involved the participation of a range of faculty including Paula Sabloff, Henry Wright, Tim Kohler, and Peter Peregrine; postdocs like Marcus Hamilton, Scott Ortman, Charles Perreault, and Paul Hooper; and Research Associate Eric Ruxley, among others. In addition, of course, the exciting

RESEARCH NEWS

Social seismology...Twitter style

When an earthquake hits, it makes more than seismic waves. Extreme events such as earthquakes, tsunamis, and terrorist attacks produce waves of immediate online social interactions that offer insights into the event itself and to broader questions of how communities of people respond to disaster.

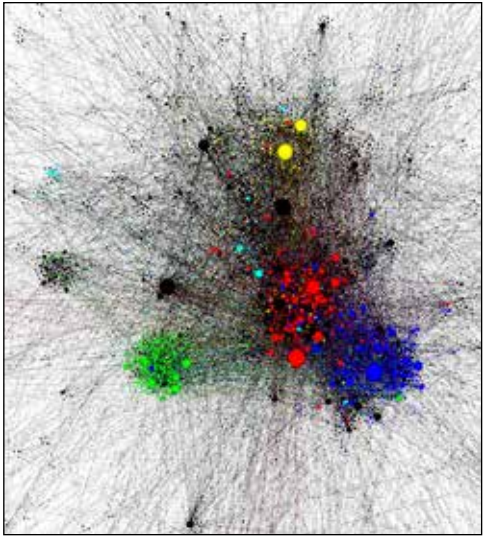
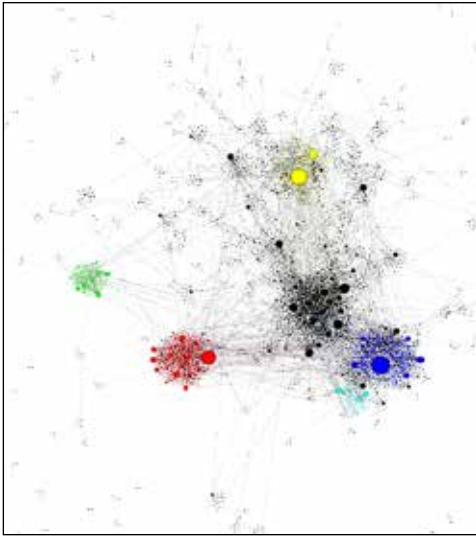
In a paper in *Nature Scientific Reports*, SFI Postdoctoral Fellow Christa Brelsford and co-author Xin Lu (National University of Defense Technology, China) analyze interactions among communities of Twitter users preceding and following the 2011 earthquake and tsunami in Japan.

The authors find that among Japanese-speaking Twitter users, the disaster created more new connections and more changes in online communities than it did globally, and (not surprisingly) it produced worldwide increases

in earthquake-related Tweets.

In addition to their findings, the authors describe a novel framework for investigating the dynamics of communities in social networks that can be used to study any kind of social change.

“Although we would never wish living through a natural disaster on anyone, when disasters do occur, we can learn a lot about how social systems adapt and change during stressful periods by looking at how people’s interaction patterns change,” says Brelsford, herself a survivor of the 2010 earthquake in Haiti. “Communication on Twitter can be accessed from both before and after an unexpected event, providing an accurate and detailed record of how interaction patterns change and how that influences whole communities.” ■



Japanese-language Twitter communities before (left) and after the 2011 earthquake (Images: Christa Brelsford & Xin Lu)

research of Sam Bowles and his colleagues in cultural evolution and human behavior has been growing more productive year by year. So I think that’s been a significant change. In fact, I was gratified when Murray Gell-Mann mentioned to me a couple of years ago that he’d always hoped the Institute would one day have this sort of social science research in a fuller historical dimension. These interests have always been there, but the Templeton-funded project really connected those longstanding interests and helped take them further.

At the same time – and this is not new – we’ve been able to strengthen research in pure math, computer science, and physics that the Institute has always held at its core. We’ve been able to have Cris Moore and Luis Bettencourt join us full time, and we’ve added scientists like Sid Redner and Nihat Ay and postdocs like Josh Grochow, Yoav Kallus, and Pan Zhang. The other area where SFI has been an innovator is in network studies and the implications of network thinking, and we’ve been able to significantly strengthen our efforts in this area as well.

These are not fundamental changes, but they are areas where we’ve added and strengthened our portfolio over the last several years.

Update: The Board of Trustees recently announced the selection of David Krakauer as the Institute’s incoming president. What are your thoughts about his selection?

Sabloff: Like everyone in the building, I’m excited about David returning to head the Institute. [See “David Krakauer selected as SFI’s next president” beginning on page 1.] He has a close familiarity with SFI. He has an ambitious vision, and combined with his administrative experience running the Wisconsin Institute for Discovery, he is an excellent choice with all the right attributes. His charisma and energy are going to attract a great deal of interest from scientists and supporters and the public alike at a time when the Institute will be taking up the Board’s challenge of raising a large endowment. So in my view he’s the right leader at the right time. The Board and Walter Fontana did an excellent job of vetting David against a

> more on page 6

Can remote sensing help protect indigenous people?

Among the last uncontacted indigenous people in the world are roughly 70 Amazonian tribes who live in isolation, deep in the forests of Brazil and Peru. These tribes present a dire conservation challenge, as they face deforestation and encroachment from the civilized world.

Where and how they move, how many people they represent, and their daily means of subsistence are not well known to governments, and this basic demographic information is essential for developing policies to protect them.

In a paper published in *Royal Society Open*

Science, SFI-ASU Postdoctoral Fellow Marcus Hamilton and colleagues at the University of Missouri at Columbia and the University of New Mexico use satellite tracking and imagery to understand the demographics and movements of people in five indigenous groups in the forests of Brazil. Theirs is the first attempt to scientifically study isolated Amazonian tribes from space.

The study offers the five tribes' population estimates and their living areas and weighs the challenges and benefits of using remote-sensing technology to study uncontacted people. The researchers compare their data

with those obtained from overflights, which can be costly and invasive compared to remote sensing.

"We are probably the last generation to see indigenous subsistence cultures existing in this way, and one of the key pieces of ecological knowledge we need about these groups is how they utilize their landscapes on a daily basis," Hamilton says. "These data are very hard to get at without making potentially harmful contact, but if we use current technology to track populations as they move across the landscape, we can find the best way to preserve the habitat." ■

Life's underlying architecture shapes creation of proteins

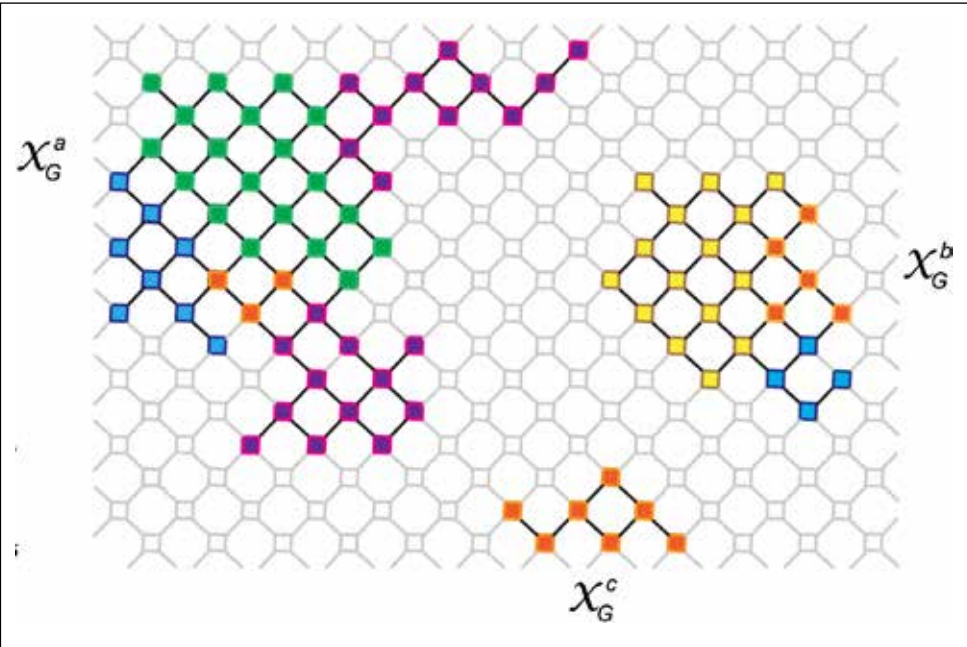
Understanding how nature maps sequences of amino acids onto the physical structures of the proteins they form is an old problem in biology, and a solution could open new doors to understanding the earliest forms of life – and even help engineer useful new proteins.

In a recent paper in *PLOS Computational Biology*, SFI Omidyar Fellow Evandro Ferrada argues that the key to this problem doesn't lie simply in decoding nature's chosen map. Instead, it's in the underlying architecture that shapes and constrains such maps in the first place.

"This is a problem with a very long tradition," Ferrada says, and it has very broad implications. A better knowledge of the biological architecture underlying sequence-structure maps, for example, could help evolutionary biologists reveal the "primordial" amino acids present at the dawn of life.

But first, researchers need to grasp the architecture. According to Ferrada, efforts until now have been somewhat piecemeal, though they do point to the interactions between a protein's amino acid sequences as playing a central role.

To investigate, Ferrada randomly generated a range of possible interactions, called potential energy functions, to see how they shape what sets of proteins are viable, how



In this simplified, two-dimensional network caricature of the sequence space for amino acid sequences, sequences are represented as nodes (squares), and edges connect sequences that differ by one mutation. Degenerate (nonviable) sequences are the open squares; colored squares represent sequences with biologically promising architectures. (Image: Evandro Ferrada)

diverse the sets are, and how robust a set of proteins is to mutations.

The most interesting result: Ferrada was able to predict what kinds of interactions are most likely to result in biologically promising architectures.

In the future, Ferrada's techniques could help others identify not just which proteins were present at earlier stages of the evolution of life, but also what constraints those put on life as we know it – or as we might someday engineer it. ■

How the Maya used numbers to manage

The ancient Maya didn't merely dabble in numbers, they wrestled with big numbers – some so significant they gave them names. And they applied those big numbers – sometimes in the form of bar-dot notations on stelae – to everything from tribute and commerce to divination.

A mid-February working group at SFI, Maya Materialization of Time: History and Prophecy in Long-term Perspective, will explore how the Maya used numeracy for more than just calendars and codexes.

The meeting, originally inspired by SFI Trustee Jerry Murdoch, who wanted to know how the Mayan study of the stars affected their civilization, picks up where two previous SFI working groups left off. Those two meetings examined Maya E Groups and the origins of Maya complexity and identified time keeping and calendar reckoning as important reasons for the establishment of ceremonial centers.

"Numbers are fundamental to complexity,

period," says Maya iconographer and Washington University professor David Freidel, who is organizing the 2015 working group. "And big-number information is vital for harnessing social energy – which the Maya did.

"I thought, let's revisit Mayan numeracy. We have things to say about it."

Why is the question vital today? "We're in the middle of a [big data] revolution in which numeracy has gone completely viral," stresses Freidel. By looking at big numbers as a way the Maya managed society, he says, we might find useful parallels for modern times.

Freidel and the group will also be looking for patterns leading to complexity, and how the Maya concept of time affected their decision-making.

"The materialization of time," Freidel says, "is about how you materialize your sense of the future based on your sense of the past. It's the same today." ■

> **New president**
continued from page 4

thing in a completely new light. That's what people admire, what I admire, about SFI. That's the spirit in which SFI does its best, most compelling, most important work. And then, of course, we use data, math, and computation to make sure we're on the right trajectory and orbiting the right intellectual star."

Krakauer received degrees in biology and computer science at the University of London and earned his D.Phil. in evolutionary theory from Oxford University, where he remained as a postdoctoral fellow and later as a Wellcome Research Fellow. He also spent three years at the Institute for Advanced Studies at Princeton University before joining SFI in 2002.

At WID, he sought to re-imagine the standard, siloed university research model in favor of a more collaborative, freeform mash-up of disciplines.

His own research focuses on the evolutionary history of information processing mechanisms. The research spans multiple levels of organization, seeking analogous patterns and principles in genetics, cell biology, microbiology, organism behavior, and society.

The big question motivating his research, Krakauer says, is "to understand the origin of intelligence in the universe – where does adaptive matter come from and how does it evolve to game the world around it?" ■

> **State of the Institute**
continued from page 5

truly talented field of candidates. We'll all be working with David during the next several months to make sure we have a smooth transition.

In addition, having Jessica Flack rejoin us as a resident professor, with her expertise in the emergence of multi-scale organization in biological and social systems, is also going to add a great deal of depth to SFI's research portfolio and play a major role in ensuring a very bright future for SFI. [See "Flack to rejoin SFI's resident faculty" on page 3.]

Update: SFI said goodbye to one of its longest serving and most successful leaders, Ginger Richardson, who pioneered and led SFI's education and outreach programs for nearly three decades. What is the status of education at SFI at this turning point, and where do you see it headed?

Sabloff: I think SFI's education program is a very strong enterprise with a great future. We owe Ginger our deep gratitude for really building this program from scratch. If you look at the program, from the community lectures to the K-12 programs to the summer schools and MOOCs, it's an amazing re-imagining of science education. Not only did she build this program into what it is now, but she rose to the challenge of making much of it financially self-sustaining. I think the recent generous gift from Ian and Sonnett McKinnon that endows certain aspects of the program, from administrative costs to a variety of program expenses, and which resulted in renaming the position that leads the program the "McKinnon Family Vice President for Education and Outreach," is in part a recognition of Ginger's success. We're also grateful to Melanie Mitchell for stepping in to serve in that role and keep the program strong until a new vice president is named. [See "Mitchell to head SFI education programs" on page 4.]

I also should note that the Institute has lost another long-term leader. Rich Murray has stepped down as head of our Finance office. Fortunately he has been very ably replaced by Marcella Austin, who now heads both Finance and Accounting.

In addition, SFI Professor Paula Sabloff will be retiring this summer when I do. She has had a very productive time at SFI, publishing two highly praised books on Mongolia, as well as being an important part of the Early States project, among other accomplishments.

Update: SFI's science has apparently rebounded, with more science activities – visitors, workshops and working groups, and collaborations – than we've seen since the 2008 financial crisis forced us to curtail some expenditures. Where does SFI science stand today, and how has that been accomplished?

Sabloff: I think it has rebounded to pre-economic-crisis levels, but we could do even more with greater financial resources, and we are looking at different ways to make that possible. Building on the strong work of her predecessors David Krakauer and Doug Erwin, Jen Dunne as VP for Science has done an outstanding job of strengthening the science programs with meager finances and making the most of the resources we have, and also, after losing several faculty members through normal rotation and attrition, finding creative ways to add great new faculty like Sid Redner, Michael Lachmann, Mirta Galesic, and Nihat Ay, who hold great promise for SFI. That our six top Omidyar Fellow candidates accepted our offers last year is a testament to the opportunity that SFI represents.

The SFI Journalism Fellowship sponsored by Bill Miller, now in its second year, has brought in some really top-notch journalists and has been a great addition to the intellectual environment – in particular serving as a reminder of how the general public often views scientists and scientific issues, and I think this perspective helps make us all better science communicators and advocates. And then the Miller Scholars have really added significant excitement to the lunchtime and teatime discussions, and I



Drawing of the lunar table inscribed on a wall, circa 814 A.D., Xultun, Petén, Guatemala. (Drawing by David Stuart, courtesy William Saturno, Boston University and the National Geographic Society)

Author Hampton Sides selected as 2015 SFI Miller Scholar

Hampton Sides, a best-selling narrative historian, is an SFI Miller Scholar for 2015. He will be in residence at the Institute for four months this fall and plans to drop in at other times during the year.

The Miller Distinguished Scholarship is the most prestigious visiting position at SFI, awarded to highly accomplished, creative thinkers who make profound contributions to our understandings of society, science, and culture.

Scholars are internally nominated and may have backgrounds in the humanities, arts, or sciences. Miller Scholars are free to devote their time at SFI to scholarship on any topic. They are encouraged to interact and collaborate with resident and visiting scientists, with the goal of catalyzing and crystallizing research at SFI.

Sides is known for his gripping nonfiction adventure stories set in war and his depictions of epic expeditions of discovery and exploration. He is the author of the best-selling histories *Ghost Soldiers*, *Blood and Thunder*, *Hellhound on His Trail*, and, most recently, *In the Kingdom of Ice*, which has received

favorable reviews in *The New York Times*, *The Washington Post*, *The Wall Street Journal*, and other news media.

His journalistic works have been anthologized and have twice been named finalists for the National Magazine Awards.

He is an editor-at-large at *Outside* magazine and a frequent contributor to *National Geographic*. He also is a partner of Atalaya Productions, an independent film company that develops nonfiction and historical stories for the screen.

Sides divides his time between Santa Fe and Colorado Springs, where he teaches narrative nonfiction and serves as Journalist in Residence at The Colorado College.

He will be the fifth Miller Scholar since SFI Board of Trustees Chair Emeritus Bill Miller conceived and underwrote the appointment in 2010. The previous Miller Scholars are philosopher of science Daniel Dennett (2010), quantum physicist Seth Lloyd (2010-2011), actor-director-playwright Sam Shepard (2010-2011), and philosopher-author Rebecca Goldstein (2011-2012). ■



Hampton Sides holds a woolly mammoth tusk on Wrangel Island, a Russian preserve off the northeast coast of Siberia where Sides was researching his most recent book and an article for *National Geographic*. (Image: Sergey Gorshkov)

> Power grid science continued from page 1

Together, Blumsack and Hines study the interconnected social and physical variables that influence whether people get electric energy services when and where they need them.

Electric power networks share many traits with other complex adaptive systems. The sizes of large blackouts, for example, follow power-law distributions. That the output of a power grid can be diminished by adding new transmission lines resembles an emergent phenomenon observed in the study of street traffic. Further, the potential for local changes to ripple across the grid at multiple temporal and spatial scales is a classic complex system phenomenon.

There is still much to learn, though. Hines and Blumsack observe, for example, that as more consumers install solar panels on their homes, power sources are becoming less centralized – and more complex. They predict that electrical utilities will soon face a rapid and extreme change in the patterns of demand for their product.

“For these networks to continue to perform in the way that we want them to, they’re going to have to become much more adaptive,” Blumsack says.

One way is to change consumer behavior. Hines and Blumsack are analyzing data from incentive programs to assess whether new pricing schemes can mitigate demand spikes during peak hours, as in the British sitcom example. They also are working on a way of



Paul Hines (left) and Seth Blumsack are spending their sabbaticals at SFI studying the social and physical interactions relating to energy supply systems.

understanding a network that connects its topological structure to its behavior.

In collaboration with SFI Professor Cris Moore, Hines organized two past SFI workshops on power grid modeling and plans a third this spring. The two also co-authored an opinion piece for *PNAS* on the need for transdisciplinary electric power grid science.

Among other pursuits, Blumsack hopes to collaborate with SFI VP for Science Jennifer Dunne to explore the power grid and the rivers that feed it from an ecological perspective.

“There are people here [at SFI] who have really creative ways of thinking about networks, to tease out the things you want to know about,” says Blumsack. “I think [we will be] sponging off of that creativity as much as possible.” ■

Barbier, Feldstein elected to SFI’s Board

SFI’s Board of Trustees has welcomed two new members: Remi Barbier and Andrew Feldstein were elected to the Board at the Institute’s Annual Business Network and Trustees Symposium in November 2014.

“Andrew and Remi have shown exemplary leadership, initiative, and insight in their professional careers,” says Michael Mauboussin, the Board’s chairman. “Their guidance will no doubt contribute to SFI’s future success as a leading research institute for complexity science.”



Remi Barbier

Remi Barbier is founder, chairman, and CEO of Pain Therapeutics, Inc., a firm developing novel drugs in pain management and oncology, which he founded in 1998. Previously, he helped in the founding and/or growth of Exelixis Inc., ArQule, and EnzyMed and served as a top executive of Xoma Corporation, Mendel Biotechnology, Inc., and Poetic Genetics, Inc. He is a trustee of the Carnegie Institute of Washington and is on

the advisory board of the California Institute for Quantitative Biosciences.



Andrew Feldstein

Andrew Feldstein is CEO and co-CIO of BlueMountain Capital Management. He spent more than a decade at J.P. Morgan where he was a managing director and headed several divisions. He is a member of the board of directors of PNC Financial Services Group Inc.; a trustee of Third Way, a prominent centrist think tank; and a member of the Harvard Law School Leadership Council.

Also in November, SFI bid farewell to three longstanding trustees: Dan Lynch, Henry Lichstein, and Stewart Greenfield retired from the Board, with SFI’s gratitude for their many contributions.

SFI’s Board of Trustees, which has the fiduciary responsibility for the Institute, oversees SFI’s operations through its biannual meetings and its active committees that offer advice and support to SFI’s leadership. ■

> State of the Institute continued from page 6

know Jen has lined up two great new Miller Scholars for this coming year including well-known author Hampton Sides. [See “Author Hampton Sides selected as 2015 SFI Miller Scholar” above.] So the quality of the incoming contributors has really been a bright spot over the last 12 months or so.

Update: What is being done to help make the Institute more fiscally stable?

Sabloff: The most important is our effort to successfully complete our \$30 million 30th anniversary campaign this year and to begin to raise \$100 million in endowments over ten years, which the trustees have challenged us with, and to not rely so heavily on the trustees for donations. However, we do need to rely on our trustees more than ever for access to the people in their social and professional circles and look to them to open doors to

other potential donors and their friends who are excited about complexity science. Through the efforts of [VP for Advancement] Nancy Deutsch and her team, the Board’s Advancement Committee, and the full Board, we are seeing these doors opening to a greater extent than ever before. [See “Barbier, Feldstein elected to SFI’s Board” above.]

Another important effort is to increase the number of Business Network members from where we are now, at around 40 members, to 50 or 60. The BNet, under [VP for Administration and Director of the Business Network] Chris Wood’s leadership, has been extremely valuable in terms of giving us a venue for interacting with people who want to apply complex systems thinking to real-world problems. It also plays an important role in SFI’s fiscal health, and adding a dozen or so members would

be highly impactful. This is a priority for Chris and Casey Cox.

And then the breakfasts and other events Nancy and her team have been holding in places like New York and Palo Alto and Austin – talks by our scientists often hosted by trustees – are very important in terms of getting people energized about complexity and SFI, and we hope to expand those events into other cities.

These activities all have impacts in planting the seeds for fiscal health, and so the question is how do we use these activities to position ourselves to be more resilient in those times when we face new fiscal challenges.

Update: What are your post-SFI plans?

Sabloff: My number one plan is to have

more time to write. Clearly the demands of this job have made it difficult to take on some of the writing projects I have been planning. But I also don’t want to spend all my time behind a computer, so I plan to continue to serve on some of the academic advisory boards I’m on and possibly do some consulting. I’m also looking forward to sleeping through the night and not lying awake thinking about all the challenges of running this place. We’re staying in Santa Fe, which we love, and both Paula and I will become external professors on August 1, so we’ll be around SFI regularly. So I have a general idea of what my retirement will be like, but nothing specific. This is the second time I am retiring [Jerry retired from the University of Pennsylvania in 2009 and is the Christopher H. Browne Distinguished Professor of Anthropology Emeritus there], so we’ll just have to see what happens. Who knows?! ■



Margaret and David Alexander: SFI ‘gives back to the world’



The SFI library at the heart of the main campus sees daily visits from researchers seeking all manner of information related to complex

systems. SFI Librarian Margaret Alexander helps them find what they need and keeps it all in order.

Like many Institute employees and spouses, she and her husband David are SFI donors, too.

The couple gives to SFI, she says, because SFI gives back to the community – and to the world.

“When I first moved to Santa Fe, I marveled that we had national labs spending millions in our state, and yet it seemed so poor, and education seemed so troubled,” she says. “I asked: ‘Is there anything happening because of the science they are working on?’ Then I found out about the Santa Fe Institute, and

I started as a volunteer in 1989.”

As donors, Margaret and David are most passionate about SFI’s Omidyar Challenge Campaign. Gifts made through the campaign are matched by Pierre and Pam Omidyar and help bring promising, early-career postdoctoral researchers to the Institute to pursue creative, independent research.

“It’s exciting to interact with these young people who are so kind and so interesting and so concerned about their work,” she says.

She and David also give back to the community through their active engagement on local boards and commissions. ■

Facts about the Omidyar Challenge Campaign

- Gifts are matched dollar for dollar by Pierre and Pam Omidyar.
- Since 2007, the Omidyar Fellowship has supported the appointments of 31 creative early-career researchers at SFI.
- To support the Campaign, visit www.santafe.edu/omidyargive or call 505.946.3678.



In *Reality Mining: Using Big Data to Engineer a Better World* (MIT Press, 2014), Jana CEO and former SFI Omidyar Fellow Nathan Eagle argues that the data generated through everyday web browsing, commuting, mobile phone use, and credit card transactions can be used to inform infrastructure development and fuel projects that improve the human condition at both the global and community levels – especially for emerging markets and underserved regions. ■



White House ceremony honors New Mexico teachers

At a December 8 White House ceremony celebrating Computer Science Education Week, four New Mexico teachers were recognized for teaching computer science and imparting lifelong skills to New Mexico students. All four are part of the New Mexico Computer Science for All program led by SFI Learning Lab Director Irene Lee and collaborators from the University of New Mexico. Here, Elisa Cundiff of Las Cruces High School poses with Havi Partovi of code.org during the event.



MY STORY

Caitlin Stern
SFI Omidyar Fellow



“I grew up in a Southeast Alaskan community in which potlucks were frequent and people co-owned expensive equipment such as wood-splitters and snow-blowers. This background contributed to my strong interest in how the social environment in which people or other animals live affects the extent to which they cooperate with each other, and the evolution of cooperative behavior over time. Social environments are in turn the product of decisions individuals make about where to live, and my research also addresses the evolution of these decisions. I am tremendously excited to be conducting this research in another highly cooperative community: SFI.”

Don’t miss these application deadlines

- **Graduate students & postdocs** - Complex Systems Summer School, June 7 - July 3, 2015 in Santa Fe. Apply by January 13, 2015.
- **Undergraduate students** - Research Experiences for Undergraduates summer internship program, June 7 - August 15, 2015 in Santa Fe. Apply by February 7, 2015.
- **Graduate students** - Graduate Workshop in Computational Social Science, Modeling, and Complexity, June 21 - July 3, 2015 in Santa Fe. Apply by February 14, 2015.
- **High school students** - Summer Complexity and Modeling Program (CAMP), July 12 - 24, 2015 in Groton, Massachusetts. Apply by April 21, 2015.

More information at www.santafe.edu/education



Upcoming community events

SFI Community Lecture, Wednesday, January 14, 7:30 p.m., James A. Little Theater (1060 Cerrillos Road) – Eating Our Words: What the Language of Food Says About Us. The words we use to talk about food offer surprising insights about history, economics, psychology, and even evolution. Daniel Jurafsky explores the relationship between food and language around the globe, from the origins of America’s national condiment as a Chinese fermented fish sauce to the reason crispy food brands tend to have different vowels than their creamy counterparts. Jurafsky will also look at the stunningly complex language of restaurant menus and reviews and what they tell us about our culture and society. Jurafsky, a 2002 MacArthur Fellow, is professor and chair of linguistics and professor of computer science at Stanford University. He recently published *The Language of Food: A Linguist Reads the Menu*.

SFI Community Lecture, Wednesday, February 18, 7:30 p.m., James A. Little Theater (1060 Cerrillos Road) – Touching a Nerve: The Self as Brain. What shapes our personalities? How do we account for near-death experiences? And how does our self-identity change when we accept that everything we think and feel stems not from an immaterial spirit but from electrical and chemical activity in our brains? Neurophilosopher Patricia Churchland grounds the philosophy of mind in the essential ingredients of biology, offering lucid explanations of the neural workings that underlie identity. She then explores how the latest research into consciousness, memory, and free will can help us reexamine enduring philosophical, ethical, and spiritual questions. Churchland was a 1991 MacArthur Fellow and currently teaches at UC San Diego and at the Salk Institute. She is author of *Touching a Nerve: The Self as Brain*.

SFI’s 2015 Community Lectures are made possible through the generous support of Thornburg Investment Management. Lectures are free and open to the public, but seating is limited. To watch a lecture as it happens, visit SFI’s YouTube page; participate in the discussion live on Twitter at #sfilive.

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UPDATE

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