



# Update

March/April 2009



## INSIDE SFI

### Geoffrey West: Institute's thinking valued, impact growing



SFI President and Distinguished Professor Geoffrey West talked with the *Update* on January 28 about the outlook for the Institute in 2009.

**Update:** You did a lot of traveling this last year – China, Dubai, Ireland, Argentina, to name a few. What impressions did your travels leave you with?

**Geoffrey:** I have done a lot of traveling. It has been a combination of my own work

and, as always, promoting the Institute. I was in Dubai for a world thought leaders forum for major players in Middle Eastern business. Among the other speakers were the likes of Rudolph Giuliani, Mohamed El-Baradei, the head of the World Bank, the explorer and adventurer Sir Ranulf Fiennes, and so on. It was the third year of this event, but I thought it was interesting and quite surprising that I was the first scientist they've invited to speak. I think that's a recognition of SFI's scientific reputation and its

perceived relationship to the major questions facing society and the world today.

One thing that stood out for me was the extraordinary contrast between Dubai as a sort of fantasy land versus the enormous challenges facing the planet. You would never know there might be serious global challenges or shortages of anything anywhere in the world. Unabashed growth and conspicuous consumption permeate the culture of the [more on page 2](#)

## RESEARCH NEWS

### Do this, don't do that: Evolution, complexity, and the law

The complex system of behavioral rights, obligations, and limits we know today as our legal system probably began in early human societies as an unwritten and simple set of guides based on group moral consensus.



Engraving by D.H. Friston showing a scene from the Gilbert and Sullivan comic opera "Trial by Jury" shortly after its premier at the Royalty Theatre, 1875 (Image: Wikimedia Commons)

As society evolved – including its need to fairly manage property rights, debt, inheritance, trade, authority, punishment, and myriad other social constructs – laws evolved too.

"In this sense, the law represents a prototypical complex adaptive system, evolving alongside other institutions to ensure that society remains stable despite increasing population size," says Jenna Bednar, University of Michigan associate professor of political science.

Jenna is co-organizing a March working group with SFI Research Fellow Jessica Flack and SFI Faculty Chair David Krakauer to explore how key concepts from the sciences of complexity – scaling theory, social niche construction, game theory, conflict resolution, agent-based modeling, and more – might help explain and even reshape the global system of law.

In particular, says David, "legal systems represent a special case of culturally evolved robustness mechanisms, and as such, can be analyzed using many of the methods we have been developing in our study of biological systems. In this meeting one of our explicit objectives is to determine the range of utility of robustness principles."

He says law provides a good example of what Jessica has been calling mechanisms for the separation of decision-making time scales – a nested hierarchy of decision making rules that change at slower and slower time scales to ensure that key high level features remain insensitive to noise at the lowest levels.

During the three-day meeting, representatives from all branches of complexity science, [more on page 4](#)

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## RESEARCH NEWS

### Working group: Unraveling societal inequalities

Sometime around 13,000 years ago, rather suddenly and in many parts of the world, sharp differences in social status and economic advantage began to appear in human society.

The archaeological footprints of these beginning steps towards the hierarchical ancient states and the extremes of wealth and poverty of early capitalism are found in elaborate burials, skeletons indicating growing inequality in human stature, personal storage of grain, and other evidence of the accumulation and inheritance of wealth.

"This revolutionary transformation of social structure rivals the rise of capitalism itself in importance for how people would live and [more on page 2](#)

## INSIDE SFI

### SFI receives New Year gift from John Chisholm

Longtime SFI friend, advocate, and Business Network member John Chisholm delivered an unexpected surprise for the New Year: a gift of \$100,000, providing an important boost to end-of-year contributions.

In early 2008 John sold his second company, CustomerSat, to MarketTools, a leading on-line market research provider, and has sought to make meaningful donations to institutions that reflect his scientific interests.

A pioneer in online marketing, he first discovered SFI in the late 1980s when researching complexity theory. In 1992 he founded his first company, Decisive Technology, now part of Google. He founded CustomerSat, a leader in enterprise feedback management, in 1997.

In 2003 he joined the Institute's Business Network and has actively participated in [more on page 2](#)

## LIT BITS

Random matrix ensembles of time-lagged correlation matrices: Derivation of eigenvalue spectra and analysis of financial time-series; Biely, C.; **Thurner, Stefan [SFI External Professor]**; *Quantitative Finance* 8 (7), 2008, pp. 705-722

The Neolithic demographic transition in the U.S. Southwest; **Kohler, Tim [SFI External Professor]**; Glaude, M.P.; Bocquet-Appel, J.P.; Kemp, B.M.; *American Antiquity* 73 (4), October 2008, pp. 645-669

An end to endless forms: Epistasis, phenotype distribution bias, and nonuniform evolution; **Borenstein, Elhanan [SFI Postdoctoral Fellow]**; **Krakauer, David [SFI Faculty Chair]**; *PLOS Computational Biology* 4 (10), October 2008, pp. 211-223

The effect of genetic robustness on evolvability in digital organisms; **Elena, Santiago [SFI External Professor]**; Sanjuan, R.; *BMC Evolutionary Biology* 8, October 14, 2008, pp. 15-23

Autonomous security for autonomous systems; Karlin, J.; **Forrest, Stephanie [SFI External Professor]**; Rexford, J.; *Computer Networks* 52 (15 SP ISS), October 23, 2008, pp. 2908-2923

Distant horizontal gene transfer is rare for multiple families of prokaryotic insertion sequences; **Wagner, Andreas [SFI External Professor]**; de la Chau, N.; *Molecular Genetics and Genomics* 280 (5), November 2008, pp. 397-408

Neutrality and robustness in evo-devo: Emergence of lateral inhibition; Munteanu, A.; **Solé, Ricard [SFI External Professor]**; *PLOS Computational Biology* 4 (11), November 2008, pp. 249-262

The physics of networks; **Newman, Mark [SFI External Professor]**; *Physics Today* 61 (11), November 2008, pp. 33-38

Brachistochrones with loose ends; **Mertens, Stephan [SFI External Professor]**; Mingramm,

S.; *European Journal of Physics* 29 (6), November 2008, pp. 1191-1199

RNAalifold: Improved consensus structure prediction for RNA alignments; Bernhart, S.H.; Hofacker, I.L.; Will, S.; Gruber, A.R.; **Stadler, Peter [SFI External Professor]**; *BMC Bioinformatics* 9, November 11, 2008, pp. 1-13

Physicists on Wall Street and other essays on science and society; Bernstein, J.; **Farmer, Doyne [SFI Professor]**; *Nature* 456 (7219), November 13, 2008, pp. 173-174

Linking global turnover of species and environments; **Buckley, Lauren [SFI Postdoctoral Fellow]**; Jetz, W.; *Proceedings of the National Academy of Sciences* 105 (46), November 18, 2008, pp. 17836-17841

Selfish metabolism; **Morowitz, Harold [SFI Science Board Chair Emeritus]**; **Smith, Eric [SFI**

**Professor]**; Shinivasan, V.; *Complexity* 14 (2), November-December 2008, pp. 7-9

Being human: Conflict, altruism's midwife; **Bowles, Sam [SFI Professor]**; *Nature* 456 (7220), November 20, 2008, pp. 326-327

Neutralism and selectionism: A network-based reconciliation; **Wagner, Andreas [SFI External Professor]**; *Nature Reviews Genetics* 9 (12), December 2008, pp. 965-974

Defeating pathogen drug resistance: Guidance from evolutionary theory; **Pepper, John [SFI External Professor]**; *Evolution* 62 (12), December 2008, pp. 3185-3191

The pleiotropic cost of host-specialization in tobacco etch potyvirus; Agudelo-Romero, P.; de la Iglesia, F.; **Elena, Santiago [SFI External Professor]**; *Infection Genetics and Evolution* 8 (6), December 2008, pp. 806-814

## PEOPLE

### Tsallis heads Brazilian institute



A new Brazilian institute dedicated to the study of complex systems, the first of its kind for Brazil, will be headed by SFI External Professor Constantino Tsallis.

Creation of the INCT of Sistemas Complexos (National Institute of Science and Technology for Complex Systems) was announced November 27, 2008, by Brazilian President Luiz Inácio Lula da Silva.

Constantino says the center's establishment acknowledges the convergence of many fields around the principles of statistical physics and the growth of computational power that allows for investigations of increasingly complex problems.

It is headquartered at the Brazilian Center for Physical Research (CBPF) in Rio de Janeiro, with collaborators from scientific institutions across the country.

"Although the format of this institute is not the same as that of SFI, the goals are very similar," he says. "Naturally, it will be easy to develop common and fruitful activities with SFI." ■

## INSIDE SFI

### SFI welcomes two new trustees

The Institute recently welcomed two new members to SFI's Board of Trustees.



Mari Kooi is CEO of Wolf Asset Management International LLC, an investment management and advisory group of companies that specializes in alternative investment activity. She is former president of Cargill Asset Management, where she developed a number of new products for clients and started the first hedge fund in the marketplace supported by a bank syndicate and commercial paper program. She has served on several nonprofit boards including the Minnesota Museum of American Art.



Jordan Greenhall is co-founder, former CEO, and current chairman of the Board of DivX Inc., the San Diego company behind the digital data compression application DivX that enables high quality video transmission over the Internet. Before DivX, Jordan was vice president at MP3.com, where he developed and implemented the company's business and content development model. He also sits on the board of directors of Eyespot, a service devoted to simple video uploading, organizing, and sharing. ■

### > SFI's 2009 outlook continued from page 1

city. It is a very interesting and truly extraordinary experiment that we ought to be studying! On the other end of the spectrum was Dublin. I was there to talk about complexity and my own work in a public lecture at the Irish Royal Society. Ireland went through an economic miracle in the 1990s but now is suffering tremendously from the global economic crisis. There is a climate of fear developing and a consciousness of the fragility of the social infrastructure, and, in contrast to Dubai, all the questions about long-term sustainability and stability are staring you in the face.

To me these experiences reinforce the need for the kind of thinking that goes on at SFI, and even more important, the need to provide an environment for bringing people together to start to think seriously about these issues.

**Update:** You've announced that you are stepping down. We have a new U.S. president with a different approach to science. The mortgage crisis has become a global financial meltdown. And the Institute is dealing with its own financial difficulties. What will be the net effect of all this on SFI?

**Geoffrey:** The great irony of what has happened to SFI because of the market meltdown is this: What has been one of the greatest strengths of SFI – the diversity of our revenue sources – has made us uncomfortably vulnerable to the downturn. By design, a significant portion of our support comes from private sources, and this strategy has given us the freedom to pursue research that is often very difficult to support in conven-



Dubai, United Arab Emirates

tional academic settings or through federal agencies. We explore questions that are typically a bit more risky, a bit more speculative, and promote thinking broadly about some of the big questions. The freedom to do so has unquestionably been one of the major ingredients of our success.

However, in these unusual circumstances, we are more vulnerable than most research organizations that rely primarily on government funding. Many of our donors are tied very strongly to the financial market, and as they suffer, we suffer. As the end of 2008 approached some of our donors delayed their end-of-year gifts, and by the end of January it was clear that this shortfall for 2008 will result in a potentially serious cash flow problem in 2009.

This put us in a precarious position. We've acted as quickly as possible to understand the problem and to work out various possible scenarios. In an anticipatory move

last August as the mortgage crisis began looking serious, our finance committee acted quickly to formulate a 10 percent budget cut, which we enacted in early October. Its major components were a salary freeze, a halt of capital construction and renovation, and cutting back on any extra expenditures.

By January it became clear that we needed to take additional measures to avoid putting the Institute seriously at risk. So we began planning for a second 10 percent cut for 2009.

To put the situation in perspective, our effective budget is approximately \$11.5 million, of which about 50 percent is from funds committed for specific projects – if we don't do the work, we don't receive the funding. So only about \$6 million is what could be considered discretionary spending. We've already made the first 10 percent overall cut – about \$1 million – and we are now initiating a second 10 percent cut –

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### > Social inequalities continued from page 1

how institutions would subsequently evolve," says SFI Professor Sam Bowles.

In February Sam convened a three-day SFI working group that brought together a dozen archeologists, anthropologists, economists, and political scientists to discuss competing explanations of this permanent alteration of human social structure. Participants also heard presentations by philosopher-cognitive scientist and SFI External Professor Ray Jackendoff (Tufts University) and physicist Victor Yakovenko (University of Maryland), an SFI visitor.

The working group examined the paleological record for the multiple places and times the



A Mayan temple at Tikal, Guatemala, marks the reign of Yik'in Chan Kawil, approximately 740 A.D. (Image: iStockphoto.com/Steve Geer)

signs of unequal wealth and status arose, and the close association between the emerging dynamic of persistent inequality and the domestication of plants and animals.

It also studied early agricultural societies in which persistent inequalities did not arise, and others in which inequality emerged well before domestication, cases that Sam calls "the dogs that didn't bark, and the barking things that were not dogs."

"Our goal was to nail down the facts of these transitions as well as the transitions that did not happen," says Sam. Among the promising explanations, he said at the conclusion of the meeting, "are models based on the new forms of wealth introduced by domestication that could readily be stored, defended, and inherited, and new social networks structured in ways that allowed big men and chiefs to exercise political power and limited the capacity of others to vote with their feet."

It was the third meeting on related topics organized by Sam, whose research explores not only historical evidence of wealth inequality, but also the evolving nature of wealth throughout time and the future of wealth inequalities in the knowledge-based economy. ■

### > John Chisholm continued from page 1

every SFI annual meeting since. He holds bachelors and masters degrees from MIT and an MBA from Harvard Business School. He also chairs the MIT Club of Northern California and served on the visiting committee of the MIT math department.



"The lively exchange of ideas between SFI and leading-edge technology companies advances the objectives of both," says Chisholm. "I am excited about helping more executives and organizations discover the benefits of engaging with and supporting SFI."

"SFI's research continues to inspire and inform people in business, government, and academia," says Shannon Larsen, SFI Vice President of Development and Corporate Relations. "We have built strong relationships in the last two decades and are so grateful when people give back."

After years of building businesses, John will take time off in 2009 to travel, support various nonprofits, and plan his next venture. ■

## LIT BITS (cont.)

On a q-central limit theorem consistent with nonextensive statistical mechanics; Umarov, S.; **Tsallis, Constantino [SFI External Professor]**; Steinberg, S.; *Milan Journal of Mathematics* 76 (1), December 2008, pp. 307-328

Controlling across complex networks: Emerging links between networks and control; **Clauset, Aaron [SFI Postdoctoral Fellow]**; Tanner, H.G.; Abdallah, C.T.; Byrne, R.H.; *Annual Reviews in Control* 32 (2), December 2008, pp. 183-192

The organization of intrinsic computation: Complexity-entropy diagrams and the diversity of natural information processing; Feldman, D.P.; McTague, C.S.; **Crutchfield, Jim [SFI External Professor]**; *Chaos* 18 (4), December 2008, pp. 59-73

Evolution of spliceosomal snRNA genes in metazoan animals; Marz, M.; Kirsten, T.; **Stadler, Peter [SFI External Professor]**; *Journal of Molecular Evolution* 67 (6), December 2008, pp. 594-607

q-Gaussians in the porous-medium equation: Stability and time evolution; Schwammle, V.; Nobre, F.D.; **Tsallis, Constantino [SFI External Professor]**; *European Physical Journal B* 66 (4), December 2008, pp. 537-546

Incipient criticality in ecological communities; Zillio, T.; Banavar, J.R.; **Green, Jessica [SFI External Professor]**; Harte, J.; Maritan, A.; *Proceedings of the National Academy of Sciences* 105 (48), December 2, 2008, pp. 18714-18717

Scaling theory for information networks; Moses, M.E.; **Forrest, Stephanie [SFI External Professor]**; Davis, A.L.; Lodder, M.A.; **Brown, Jim [SFI External Professor and Science Steering Committee Member]**; *Journal of the Royal Society Interface* 5 (29), December 6, 2008, pp. 1469-1480

Transposable elements as genomic diseases; **Wagner, Andreas [SFI External Professor]**; *Molecular Biosystems* 5 (1), 2009, pp. 32-35

A topological approach to chemical organizations; Benko, G.; Centler, F.; Dittrich, P.; Flamm, C.; Stadler, B.M.R.; **Stadler, Peter [SFI External Professor]**; *Artificial Life* 15 (1), Winter 2009, pp. 71-88

Diversity, dilemmas, and monopolies of niche construction; **Krakauer, David [SFI Faculty Chair]**; Page, K.M.; **Erwin, Douglas [SFI Professor]**; *American Naturalist* 173 (1), January 2009, pp. 26-40

tRNAdb 2009: Compilation of tRNA sequences and tRNA genes; Juhling, F.; Morl, M.; Hartmann, R.K.; Sprinzl, M.; **Stadler, Peter [SFI External Professor]**; Putz, J.; *Nucleic Acids Research* 37 (SP ISS), January 2009, pp. 159-162

The virtues and vices of equilibrium and the future of financial economics; **Farmer, Doyne [SFI Professor]**; **Geanakoplos, John [SFI External Professor]**; *Complexity* 14 (3 SP ISS), January-February 2009, pp. 11-38

Econophysics: Present and future (introduction); **Shubik, Martin [SFI External Professor]**; **Smith, Eric [SFI Professor]**; *Complexity* 14 (3 SP ISS), January-February 2009, pp. 9-10

Building theories of economic process; **Shubik, Martin [SFI External Professor]**; **Smith, Eric [SFI Professor]**; *Complexity* 14 (3 SP ISS), January-February 2009, pp. 77-92

Econophysics and the challenge of efficiency; **Lillo, Fabrizio [SFI External Professor]**; *Complexity* 14 (3 SP ISS), January-February 2009, pp. 39-54

A survey of nematode SmY RNAs; Jones, T.A.; Otto, W.; Marz, M.; Eddy, S.R.; **Stadler, Peter [SFI External Professor]**; *RNA Biology* 6 (1), January-March 2009, pp. 5-8

## > SFI's 2009 outlook continued from page 2

another \$1 million. Inevitably, this is going to have some very serious consequences and require some great sacrifices.

**Update:** How will this affect SFI's research?

**Geoffrey:** The bottom line is that cuts were made on the basis of two major philosophical premises. First, preserve SFI's scientific activity as much as possible, because that's who we are, and second, protect jobs whenever possible. We'll continue to work within these parameters. (See "SFI budget cuts" at right.)

One of the things I can assure the Institute's community is that the effects on science will be minimized. We may not have quite as many workshops or be able to support quite as many visitors, but the work of the Institute, which has grown extraordinarily in the last two to three years, will be maintained at a high level. Our proposed cuts represent in excess of a 25 percent cut in the "discretionary" part of the budget but will only result in a less than 5 percent cut in scientific activity. However, the proposed cuts cannot be maintained indefinitely and a vigorous search for new revenues is under way.

The overall impact of the Institute is growing at a very impressive rate, so it is particularly ironic that, at the very time that SFI thinking is most needed, we're having to cut back. Having said that, crises always bring opportunities. One of the things we can do as a community is spread the message that we need SFI-style thinking now more than ever.

**Update:** Any good news on the horizon?

**Geoffrey:** The obvious answer is the stimulus package. One of the things I fear, however, is that the vast majority of new science funding will be for equipment, infrastructure, and existing research projects, and there will be precious little for new thinking. The counter to that, however, is that the President has made some marvelous choices in his scientific team – for example, John Holdren as his science advisor and Steven Chu as the Energy Secretary. I am confident that these people will bring to the table a longer-term vision. And, of course, I believe SFI through its science should be playing a role in influencing some of the thinking in the administration. One of the things we will try to do is not only go to the agencies at the grassroots level, but also try to inform policy through our research.

More important, and in fact critical to us, is that some of the issues we are talking about – the market meltdown is one of them – arise because of the propensity of stove-pipe thinking and the lack of a more systemic integrated approach. There is hope we will start seeing more money going into global warming, the environment, energy problems, questions of urbanization, and understand-

ing the problems with bank lending – what SFI researcher John Geanakoplos termed "the leverage cycle." But if funding comes as it has been, in disconnected, highly focused pieces, we may just be fueling the problem. A stimulus package obviously is needed. But without a big vision of the integrated whole – seeing these problems as complex systems, which may lead to unintended consequences, sensitivity to initial conditions, small effects over here having huge effects over there, and so on – we run the risk of repeating past mistakes.

A good example is provided by what I heard in Dublin last week where people were telling me that the doom and gloom they are experiencing was the result of a problem that had to do with how mortgages were financed in this country. This is a marvelous example of the infamous metaphorical butterfly effect. Let's face it, subprime mortgages are an infinitesimal, relatively localized component of the total U.S. economy, and yet they've initiated an enormous long-range effect (in both space and time), not only on the U.S. economy, but on the economies of Ireland, Iceland, the U.K., etc., and, in fact, on almost every other problem we're facing! Because all of these problems are coupled and highly interrelated. And if we don't start thinking in those terms, we may be doomed to repeat the same problems.

As a physicist, it is tempting to view the financial crisis as having some of the well-known characteristics of a phase transition or tipping point (as when water freezes to ice). We are beginning to see large fluctuations and the subsequent development of an extraordinary long-range order that we now call the global economic meltdown, which has somehow connected the well being of Dubliners to a mortgage company in Indianapolis, and so on. This is the language of physics. But we must do more than talk metaphorically about tipping points and phase transitions. The real question is can we put this into a serious scientific framework that is quantitative, testable, and predictive? This is the kind of conversation we are facilitating at SFI.

**Update:** What do you see as some of the most promising SFI research ventures in 2009?

**Geoffrey:** I just alluded to some of the research in understanding financial markets and risk. For example, the work of Dooyne Farmer is very timely – both the financial markets work and the work on metrics for innovation, performance curves, and so forth. This is important in terms of assessing new technology that may help us come to grips with a number of environmental and resource questions. A related problem is to continue to develop ideas around the growth and decline of social organizations, such as corporations, and especially those of cities. Urbanization dominates the planet and cities are the

primary source of most of our problems, but also the source of their solutions. We desperately need to develop a serious quantitative theory of urbanization that incorporates theories of innovation and adaptation.

Consolidating the work that Sam Bowles is involved in – understanding altruism and social behavior – is clearly important as is our work on the underlying foundations of conflict where we are beginning a major new initiative. Other new initiatives that could have interesting implications include law as a complex system (with the Kauffman Foundation) and the intersection of history with complexity. All of these could be big winners. It's too early to tell, but these are the kinds of questions that are quintessentially SFI. Few people are thinking about these things in quite this way, and yet they are all highly relevant to the world today.

One of the things that unquestionably already is a winner is the renaming of the postdoctoral fellows programs as the Omidyar Fellowship Program. Taking the postdoc program to another level by getting it professionally organized will give it much greater visibility, lead-



Wall Street woes: Is the financial crisis a phase transition?

ing to an even greater impact than it already has. It will position SFI's program to produce the kinds of minds that we need to attack some of these critical questions. Intellectually this gift couldn't have come at a better time.

**Update:** Final thoughts?

**Geoffrey:** Despite the financial situation, I think this is a fantastic time for the Institute. I think we're seeing a playing out of the kind of phenomena that are manifested in complex systems. There is a developing recognition in the scientific, corporate, and government communities that this is the time for the kind of transdisciplinary, complex systems thinking associated with SFI to thrive. I think the Institute is well positioned intellectually to take advantage of these conditions. ■

## SFI budget cuts, reorganization under way

SFI announced in early February a second 10 percent reduction to the Institute's 2009 budget. The first round of reductions announced in late 2008 included a salary freeze, deferral of capital improvements, and other cost-cutting measures.

Institute Vice President Chris Wood says the second reduction is being accomplished through the following changes:

- Elimination of two staff positions;
- Reduction from full-time to two-thirds-time for three additional staff members;
- Elimination of employer contributions to the SFI employee retirement plan;
- Savings in the costs of SFI summer schools; and
- Reductions of administrative and support budgets to the bare minimum.

In addition, Institute President Geoffrey West has announced a reorganization of SFI's senior staff, including:

- Refocusing Chris Wood's responsibilities primarily on administration and oversight of the budget reductions;
- Naming Shannon Larsen Vice President for Development and Corporate Relations (formerly a director-level position);
- Naming Ginger Richardson Vice President for Education and Outreach (formerly a director-level position); and
- Naming David Krakauer as the first Chair of Faculty (a rotating assignment); in this role, David will focus the faculty on institutional initiatives, increase the engagement of external faculty, and oversee a more active sabbatical and Miller Fellows program.

These changes are intended to focus senior staff on matters critical to the Institute at a challenging time, says Chris. ■

## CREDITS

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## Book of cartograms redraws world map

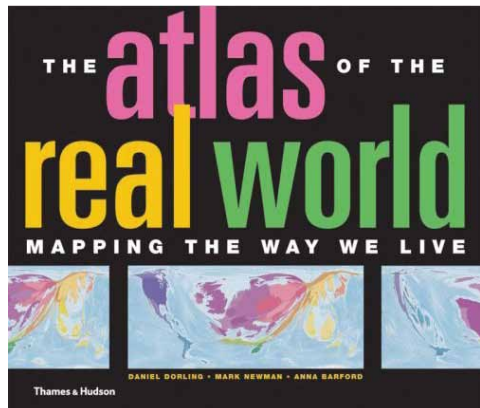
SFI External Professor Mark Newman and collaborators have published a book that enhances readers' understandings of complex demographic data.

*The Atlas of the Real World: Mapping the Way We Live* (Thames & Hudson, 2008) contains 366 cartograms depicting data sets as diverse as literacy rates, military spending, overweight children, television viewing figures, and endangered species.

Cartograms are maps that depict geographical areas rescaled as spatial representations of statistical information. They provide a visually compelling reference of how regions or countries compare not by their physical sizes but by their importance in the context of the statistical quantity under consideration.

The rainforests of South America, for example, with 30 percent of the world's fresh water, make that continent's nations balloon in an analysis of water resources, whereas Kuwait, dependent on desalinated seawater, disappears from the map.

Mark's co-authors are Daniel Dorling, professor of human geography at the University of Sheffield (England), and Anna Barford, a research associate at the University of Sheffield.



Mark is an assistant professor of physics and complex systems at the University of Michigan. His original cartogram work was done in collaboration with former SFI Postdoctoral Fellow Michael Gastner and former SFI Graduate Fellow Cosma Shalizi. They are best known for their cartograms that rescale U.S. states by voting patterns to offer more telling perspectives of U.S. elections than the traditional "red state vs. blue state" maps.

More of their cartograms are available at [www.umich.edu/~mejn/election/2008](http://www.umich.edu/~mejn/election/2008). ■

### > *Evolution and the law* continued from page 1

including a half dozen from SFI, will discuss with attorneys, law school professors, and other legal system experts the history and emergence of law, the cognitive and behavioral underpinnings of legal systems, how law is interpreted and acquires meaning, the capacity of legal systems to adapt and recover from abuse, and non-state alternatives to legal order.

Participants were selected for their imaginative approaches to legal research and thought, Jenna says.

She says each field has much to offer the other and believes complexity thinking could suggest models that advance our understanding of legal systems, much as concepts from physics have recast the way economists think about markets.

"I'm hoping to send 25 people home fired up about what complexity can offer legal research and how legal research can enrich complexity," she says. "I like to think of this as the beginning of a research program."

The gathering is the first time SFI has explored the research domain of law. The Kauffman Foundation is sponsoring the meeting. ■

*Discover* magazine's top science stories of 2008 included a study published in *Science* in April that mapped the flu virus's spread across the globe and found that every epidemic of the major strain of Influenza A since 2002 could be traced back to Asia. The research was *Discover's* #14 story overall, its #4 story in Health & Medicine, and its #1 story in infectious diseases. Former SFI Graduate Fellow Derek Smith is a member of the research team. <http://discovermagazine.com/columns/top-100-stories-of-2008>

A December 30 *New Scientist* article about social contagion – the tendency of people to share emotions and behaviors with the people they interact with – quotes SFI External Professor and Columbia University sociologist Duncan Watts, who points out that: "Social influence is mostly a good thing. We should embrace the fact that we're inherently social creatures and that much of who we are and what we do is determined by forces that are outside the little circle we draw around ourselves." [www.newscientist.com/article/mg20126881.600-how-your-friends-friends-can-affect-your-mood.html](http://www.newscientist.com/article/mg20126881.600-how-your-friends-friends-can-affect-your-mood.html)

A January 4 *WashingtonPost.com* article by SFI External Professor and Columbia University sociologist Duncan Watts notes that prediction of social trends is inherently difficult and mostly wrong. He gives two reasons. First, people's decisions are sensitive to minor details. Second, "social phenomena are never just the product of individual people making decisions, but emerge out of many people making decisions in conjunction with each other." He goes on to discuss experiments he and colleagues conducted using the Internet to explore why certain songs become hits while others don't. [www.washingtonpost.com/wp-dyn/content/article/2009/01/02/AR2009010202194.html](http://www.washingtonpost.com/wp-dyn/content/article/2009/01/02/AR2009010202194.html)

A January 14 article in *New Scientist* describes the work of SFI External Professor Stefan Thurner and colleagues at the Medical University of Vienna that tests Parkinson's law, conceived by C. Northcote Parkinson in 1955 to describe the tendency of work to expand to fill available time. Stefan and his colleagues created a network model of a committee and linked clusters to reflect how people would group themselves. The research shows that groups with fewer than 20 members tend to agree while groups with more than 20 members tend to split into

factions and struggle to make decisions. <http://www.newscientist.com/article/mg20126901.300-explaining-the-curse-of-work.html>

A January 21 article in MIT's *Technology Review* describes how SFI Postdoctoral Fellow Nathan Eagle is launching a project similar to Amazon's Mechanical Turk, which distributes assignments for simple tasks to people around the world over the Internet. The goal of [Nathan's] project, called txteagle, is to use cell phones "to leverage an underused work force in some of the poorest parts of the world...Eagle says distributing questions to participants in developing countries via text messages or audio clips could make certain tasks more economical, such as the translation of documents into other languages, or rating the local relevance of search results. It could also provide a welcome source of income for those involved." BBC News covered the project on February 11, as well. <http://www.technologyreview.com/business/21983/?a=f>

A February 2 *seedmagazine.com* article by SFI President and Distinguished Professor Geoffrey West describes the advantages and problems of urbanization. "Doubling the size of a city increases wealth and innovation by about 15 percent, but it also increases the amount of crime, pollution, and disease by roughly the same amount," he says. As cities grow, the pace of life also increases, perhaps unsustainably, he warns. "Can we have the kind of vibrant, innovative, creative society driven by ideas and wealth creation as manifested by the best of our world's cities, or are we destined for a planet of urban slums or the specter raised by McCarthy's *The Road*? The challenge is clear: The key to long-term sustainability of the planet lies in applying a scientific lens to cities, with the goal of understanding their dynamic structure, growth, and evolution." [http://seedmagazine.com/news/2009/02/urban\\_paradox.php](http://seedmagazine.com/news/2009/02/urban_paradox.php)

A February 12 *seedmagazine.com* article about the possible applicability of evolutionary theory to economics mentions both SFI Professor Sam Bowles and External Professor Lawrence Blume as two experts who hold that new models are needed for understanding economic systems and market behaviors. [http://www.seedmagazine.com/news/2009/02/adapting\\_to\\_a\\_new\\_economy\\_1.php](http://www.seedmagazine.com/news/2009/02/adapting_to_a_new_economy_1.php)



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