SANTA FE INSTITUTE

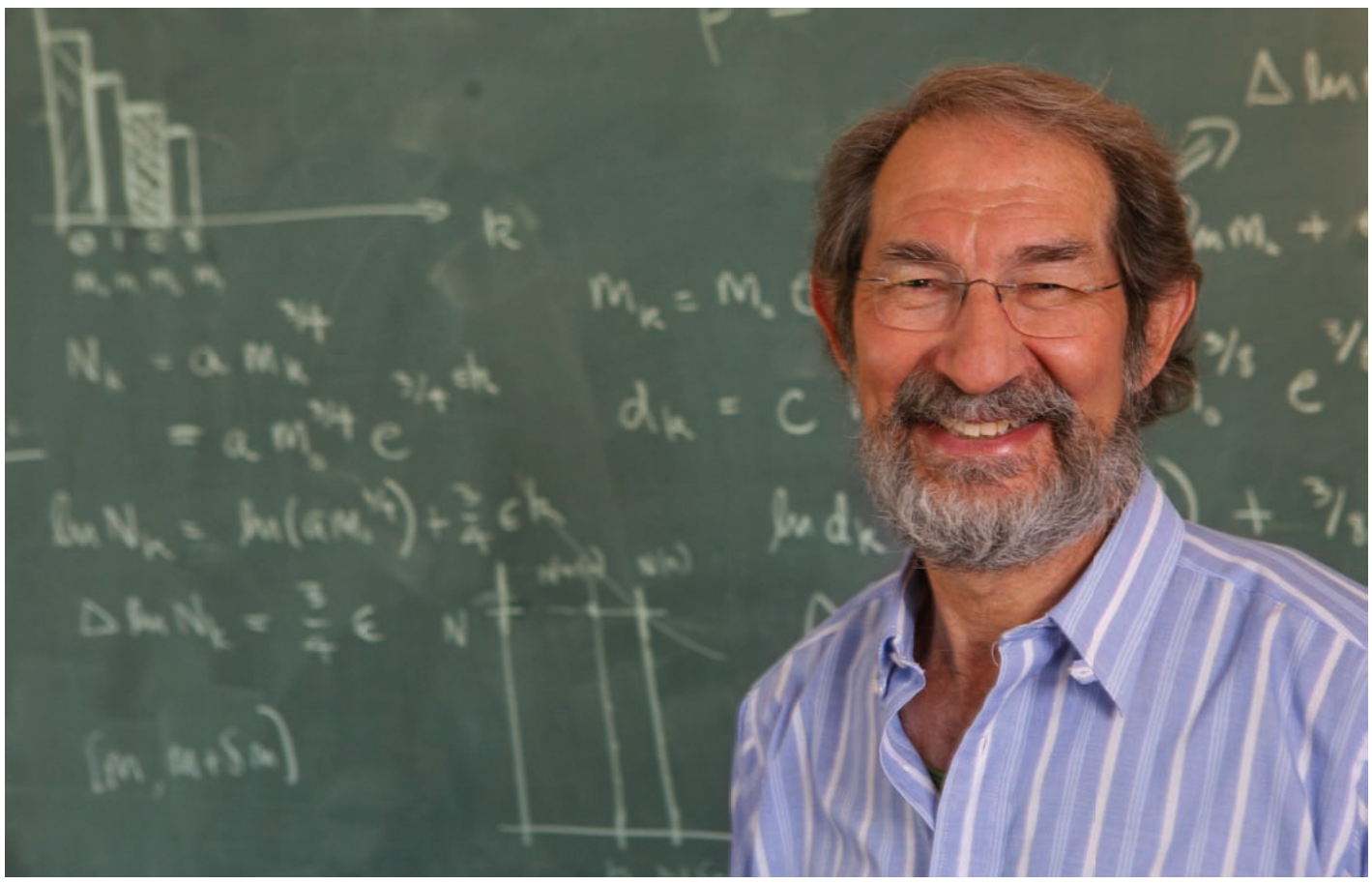
Update

January 2008

Welcome to the new SFI Update

We have recast the Update to bring you deeper and richer information about the Institute and its people. We hope you enjoy the new format. Please send comments and suggestions to Ginger Richardson at grr@santafe.edu.

INSIDE SFI



SFI President and Distinguished Professor Geoffrey West

Geoffrey West discusses the Institute's outlook for 2008

SFI President and Distinguished Professor Geoffrey West talked with the *Update* recently about the Institute's achievements in 2007 and its outlook for 2008.

***Update:* As you look back on 2007, what stands out in your mind?**

Geoffrey: One of the more gratifying events was the approval of our core grant with the National Science Foundation, which was up for five-year review. Our award is unique because, almost without exception, NSF awards are for very specific, well-defined research projects. Ours is the only one that has in the same proposal a mix of questions in anthropology, archaeology, economics, biomedical sciences, biological sciences, mathematics, physical sciences, all the way through the interpretation of quantum mechanics.

The NSF doesn't have a mechanism for such broad grants, and this puts ours at tremendous risk. To be more like the others, we would have to submit 10 or 15 separate proposals, but that would be antithetical to what we are trying to do. So this year our proposal went through 50 reviews and five panels, and we were successful. In fact, the award was a 30 percent increase from the last one. That's an important shot in the arm for us. The thing we struggle with is the balance between conventional research and doing things that are really transformational, transdisciplinary, more risky and speculative. So it's good to know that even though we're doing things that don't quite fit, when we play on the conventional academic playing field, we're still successful.

Of course, this award is a minority of our funding, but it's extremely important and we value it tremendously. We need that credibility when it comes to competing for awards from and collaborating with private foundations, universities, and government agencies.

***Update:* What were some of SFI's research trends in 2007?**

Geoffrey: We've had some tremendous successes. Some of the work [SFI Professor] Sam Bowles is doing on altruism and economics and social behavior has gotten recognition. Some of the work on cities we did has been recognized in *New Scientist* and *Seed* magazine and so on.

I think this year we began to recognize that a lot of the work that goes on here could be put under the umbrella of sustainability – the work on innovation,

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IN THIS ISSUE

GRANT HIGHLIGHTS

Bengier Foundation gift benefits GUTS program

SFI Executive Director for Development and Corporate Relations Shannon Larsen says a recent grant from the Bengier Foundation for Project GUTS – Growing Up Thinking Scientifically – is a welcome gift for the program.

The gift is $150,000 per year for three years, for a total of $450,000.

Project GUTS is a summer and after-school program that encourages sixth- through eighth-grade students to look at the world beyond their everyday awareness, ask questions, develop answers to the questions through scientific inquiry, and formulate solutions to the problems posed by their inquiry.

"We are thrilled that the Bengier Foundation has made this leadership gift to Project GUTS," Shannon

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Gary and Cynthia Bengier

LIT BITS

Homology search with fragmented nucleic acid sequence patterns; Mosig, A.; Chen, J.J.L.; **Stadler, Peter [SFI External Professor]**; *Algorithms In Bioinformatics, Proceedings* 4645, 2007, pp. 335-345

Nonergodicity and central-limit behavior for long-range Hamiltonians; Pluchino, A.; Rapisarda, A.; **Tsallis, Constantino [SFI External Professor]**; *EPL* 80 (2), 2007, pp. 65-70

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Evolution of the vertebrate Y RNA cluster; Mosig, A.; Guofeng, M.; Stadler, B.M.R.; **Stadler, Peter [SFI External Professor]**; *Theory in Biosciences* 126 (1), March 2007, pp. 9-14

Prokaryote phylogeny meets taxonomy: An exhaustive comparison of composition vector trees with systematic bacteriology; Gao, L.; Qi, J.; Sun, J.D.; **Hao, Bailin [SFI External Professor]**; *Science In China Series C-Life Sciences* 50 (5), October 2007, pp. 587-599

Coevolution of languages and genes on the island of Sumba, eastern Indonesia; **Lansing, Steve [SFI Professor]**; Cox, M.P.; Downey, S.S.; Gabler, B.M.; Hallmark, B.; Karafet, T.M.; Norquest, P.; Schoenfelder, J.W.; Sudoyo, H.; Watkins, J.C.; Hammer, M.F.; *Proceedings of the National Academy of Sciences* 104 (41), Oct. 9, 2007, pp. 16022-16026

Distinguishing noise from chaos; Rosso, O.A.; Larrondo, H.A.; Martin, M.T.; Plastino, A.; **Fuentes, Miguel Angel [SFI Postdoctoral Fellow]**; *Physical Review Letters* 99 (15), Oct. 12, 2007, pp. 432-435

Effects of body size and lifestyle on evolution of mammal life histories; Sibly, R.M.; **Brown, Jim [SFI Science Steering Committee Member]**; *Proceedings of the National Academy of Sciences* 104 (45), Nov. 6, 2007, pp. 17707-17712

Evolution of animal personalities; Wolf, M.; **van Doorn, Sander [SFI Postdoctoral Fellow]**; Leimar, O.; Weissing, F.J.; *Nature* 450 (7167), Nov. 8, 2007, pp. E5-E6

Increased sequence diversity coverage improves detection of HIV-Specific T cell responses; Frahm, N.; Kaufmann, D.E.; Yusim, K.; Muldoon, M.; Kesmir, C.; Linde, C.H.; Fischer, W.; Allen, T.M.; Li, B.; McMahon, B.H.; Faircloth, K.L.; Hewitt, H.S.; Mackey, E.W.; Miura, T.; Khatri, A.; Wolinsky, S.; McMichael, A.; Funkhouser, R.K.; Walker, B.D.; Brander, C.; **Korber, Bette [SFI External Professor]**; *Journal of Immunology* 179 (10), Nov. 15, 2007, pp. 6638-6650

Dynamics of cancer - Incidence, inheritance, and evolution, by S.A. Frank; **Krakauer, David [SFI Professor]**; *Science* 318 (5853), Nov. 16, 2007, p. 1070

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The SFI *Update* (sfiupdate@santafe.edu) is published monthly by the Institute to keep our community informed about our current work and activities.

ON & OFFS

For SFI's schedule of workshops, lectures, and colloquia: *http://www.santafe.edu/events/index.php*

COMINGS & GOINGS

For a schedule of SFI visitors: *http://www.santafe.edu/events/calendar-visitors-week.php*

> *Bengier Foundation*

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says. "It is a gift that provides not only much-needed support for this exciting program, but it also marks an important milestone in our 25th Anniversary Campaign."

The foundation was formed in 2004 by Gary and Cynthia Bengier, who retired from professional business careers at early ages. Their goal was for the foundation to "give a helping hand to bright, hardworking young people who need a little help to find their own success."

Gary, a member of SFI's Board of Trustees, capped a 23-year business career by building and leading the financial team in the early formative years at eBay. Cynthia retired from banking in 1999, working last as director of strategic planning and product development for the banking consortium Mondex USA.

"Gary and Cynthia Bengier, through their foundation, have long been committed to improving the quality of education in the U.S.," Shannon adds. "This campaign pledge to SFI attests to the quality and competitiveness of our education programs and will hopefully encourage other forward-thinking individuals or foundations to step forward in support of a complex systems approach to science education."

> *Geoffrey West*

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the work on robustness, questions to do with the sustainability of the financial markets – those kinds of questions that interface with energy, the environment, and climate. Now obviously we are not going to solve the big problems of sustainability or of global warming. But we have started to think in terms of providing a more holistic conceptual framework so these questions can become more integrated and seen as a whole.

In terms of my own work, it is clear that understanding cities and urban dynamics is starting to become more crucial. More people now live in cities than live in rural areas on the planet – it broke 50 percent this year – and in the U.S. that number is now 80 percent, whereas in the year 1800 it was 4 percent. People estimate that by 2050 the world number will be 80 percent. Cities are the source of pollution and global warming and also the origin of the solution. So you had better understand the dynamics of cities.

***Update:* What do you see as potentially emergent research areas for 2008?**

Geoffrey: An exciting bunch of issues is asking whether there are laws of history, a science of history. Some people call it virtual history. And we will have a very interesting workshop in March on that. Goodness knows if that is an area we will expand into. These are the kinds of seeds we will plant and see.

Another one is the interface between art, mathematics, and complexity. Is there a dynamics of emergence in art – in terms of in an art movement or in a painting itself? The way I started to see it this year is really a revisit of the C.P. Snow two cultures problem – the idea that science is driving the evolution of modern society and civilization and yet science is somehow disconnected from traditional culture and the arts and humanities. I consider this, what we're doing, as revisiting that question and trying to bridge the two cultures, but with the benefit of complex systems thinking, which was excluded at the time of C.P. Snow.

Complexity in its general sense, and certainly transdisciplinary approaches, invites one to start thinking about the relationship of science to art, history, literature, music, even laws. In fact we are going to look at law as a complex system, which it is. Can you learn something about jurisprudence, about the conceptual framework of law, and how does that impact thinking about legal questions into the 21st century?

We are also going to look at the different efforts going on here in the evolution of language, to review all of those as a package with the wisdom of the Science Board and really start a dialogue about what we are we trying to accomplish with all of these various programs in language and how to they relate to each other.

Another area of exploration is what we are calling international negotiations. This arose because the view of some people who approached us, some associates of Henry Kissinger, is that the system [of traditional diplomacy] is broken because it was developed hundreds of years ago and was effective when very traditional states with very defined needs – you know, Germany, France, Italy – interacted with each other. And that just isn't appropriate any more. One of the most obvious examples is this band of bloody extremists living in a bunch of caves somewhere probably in Pakistan that almost has equal power to the United States of America, which is the most powerful nation that ever existed in terms of traditional power. But now the evidence is maybe that isn't so true. Every time you go to an airport you are reminded of that.

So we need to rethink all that, and we are asking whether there is something we can do, some ideas, in terms of bringing together, initially, a group of people who have played a significant role in international negotiations, who have thought about it seriously, with those of us who haven't, but we think about science and we can talk about it from that perspective, and maybe out of that we can start a bunch of ideas floating around. So that's really exciting.

Again, it's one of those things that we float, and then we ask if we should do it again but more seriously, and is there something that's substantive to where we can start to influence things. And I don't know the answer. Some of these ideas may take on new life.

***Update:* What are some challenges the Institute faces?**

Geoffrey: One thing that is on my mind is that SFI was

Glacier, courtesy National Science Foundation

SFI IN THE NEWS

SFI Postdoctoral Fellow Dan Hruschka was among researchers quoted in a Nov. 20 *New York Times* article about research into the value of denial and the benefits of forgiveness in human relationships. Dan's team ran a series of simulations of a game in which players made cooperative investments. Players who developed trusting relationships over many transactions were willing to overlook a few selfish violations of the game's rules by the other, but they ostracized strangers after a single violation. When the simulations were run over many generations, these tendencies held up, suggesting that a "pattern of forgiving behavior defined stable groups that maximized the survival and evolutionary fitness of the individuals," according to the article. SFI was described as a "research group that focuses on complex systems."

SFI External Professor Daniel Schrag (Harvard University) was featured Nov. 30 on Minnesota Public Radio and Nov. 19 on CNET.com News on the topic of geoengineering – blunting climate change via planet-scale engineering projects, such as building giant space mirrors over Greenland to slow glacier melt. The CNET article quoted Daniel from a presentation he gave during a November meeting at MIT: "We don't understand the climate system very well and so trying to engineer a system that is probably unknowable and almost certainly uncontrollable is a very frightening thing," Schrag said. He added: "With climate engineering, we're not the only ones that can do it. There are any one of 25 countries that could do it. Who gets to control it? Who gets to decide?"

A Dec. 7 EDIE.net article reported that according to the London Accord, climate change can be solved with the right level of investment, and "a total of $600 billion a year will need to be invested by the private sector into research and development to tackle climate change." The London Accord, a cooperative project to develop an investment map for the energy supply and climate change community, is sponsored by the City of London Corporation, BP, Forum for the Future, Gresham College, and Z/Yen Group and includes research contributions from Reuters, the London School of Economics, and SFI. EDIE.net is an online environmental news and information site.

An article in the Oct. 26 *Albuquerque Journal* featured the work of SFI Professor Sam Bowles to understand the evolution of "parochial altruism" – hostility toward outsiders but cooperation with members of one's own racial, ethnic, or social group – in human society. He concludes such behavior could have evolved if the combination of altruism and parochialism contributed to success in conflicts.

> *Geoffrey West*

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founded with a heavy dose of physics and people who came out of physics who were interested in seeing how their thinking could influence other things. That has been very successful. But as the Institute grew, we brought in a lot of traditional social scientists who were looking for new paradigms for thinking about some of the critical problems both in the social sciences and biology.

So that physics-centered base, even though it's still here, is much diminished, and I am beginning to think that it might be good to re-engage more physicists. Not as physicists per se, but to start engaging them in conversations with people who are dealing with crucial and fundamental problems in biology and in the social sciences. We ought to be playing a leading role in asking to what extent you can apply physics and mathematics to some of these areas. That's not to say we aren't doing that. We are doing that, but I would like to reach out and get a few of these quantitative thinkers explicitly involved. That's a question mark. We'll see.

Another continuous challenge for the Institute is finding new people. The SFI community, as evidenced by the number of visitors and workshops and the additions to the external faculty, continues to grow. One of the important things we're trying to do is get mid-career kind of people in here, and we are doing that. The problem we still face, the challenge, is finding the new, exciting minds who really have eclectic, wide tastes. How do we identify those people and get them on board here as resident faculty? That is one of the main challenges I see for 2008.

PEOPLE

Strogatz produces DVD series on chaos, complexity

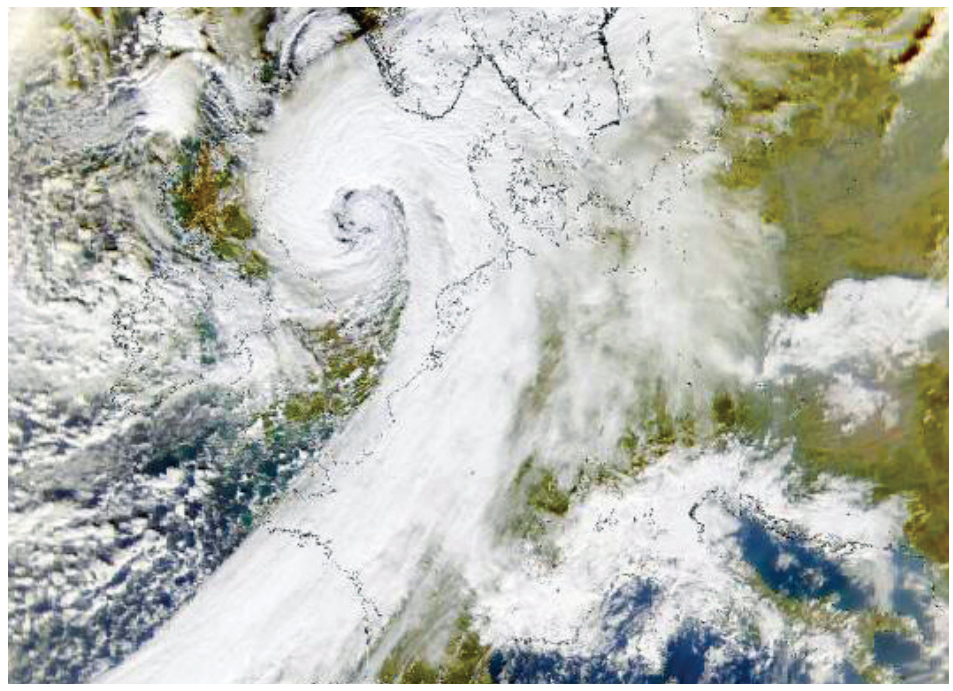
SFI External Professor Steven Strogatz has produced a 24-lecture series on chaos theory for The Teaching Company (www.teach12.com). The series, to be released on DVD this year, is designed for a well-educated adult audience.

"They told me to think of doctors, lawyers, people who read *The Economist*," he says. "I think of it as chaos for poets rather than chaos for mathematicians."

Steven, whose recent work has focused on chaos and complex systems applied to physics, engineering, and biology, is the Jacob Gould Schurman Professor of Applied Mathematics and professor of theoretical and applied mechanics at Cornell University. His 1998 *Nature* paper with SFI External Professor Duncan Watts, "Collective dynamics of small-world networks," is regarded as a seminal contribution in the study of complex networks.

Steven Strogatz

His most recent book, *Sync: the Emerging Science of Spontaneous Order* (Hyperion, 2003), describes the order behind such phenomena as traffic jams, firing neurons, and solar system dynamics and was acclaimed for its popular accessibility. The Teaching Company selected him, in part, for his abilities as an educator and story teller.



Above: Chaos-related DVD topics include the unpredictability of weather. Image: NASA/ Goddard Space Flight Center

Steven says he took pains to help make the two dozen half-hour DVD lectures engaging to a non-math audience by relating the work to a wide range of topics.

Among the series' topics are discussions of the butterfly effect, Henri Poincaré's discovery of chaos in the three-body problem of astronomy, the unpredictability of weather, universality, fractals, power laws as related to earthquakes and internet traffic, and chaos principles in ancient creation myths.

He says he also struggled to strike an appropriate balance between chaos theory per se and more recent pursuits in complexity science and nonlinear dynamics.

He devotes a half lecture on recent work by SFI researchers to quantify scaling laws in biology.

He says engaging new audiences in the principles of complexity and chaos "is good for the whole discipline. It's an opportunity for cross-fertilization among biologists, economists, and other fields."

He is considering proposing additional topics for future recorded lectures.

"I care about, and enjoy, as much as anything else, explaining these things not just to students but to ordinary people," he says. "I personally have loved the process."

IMPACT

Emergent behavior workshop bridges multiple research fields

Researchers from 15 institutions in the U.S. and Japan gathered in Santa Fe Dec. 7-9 for a three-day workshop, Models of Emergent Behavior in Complex Adaptive Systems.

The workshop was jointly sponsored by SFI and the Institute for Complex Adaptive Matter (ICAM), a multi-institution research program of the University of California. The workshop's focus was exploring similarities and differences in the emergent behaviors of complex adaptive systems when viewed from many scientific perspectives.

Each speaker was challenged to speculate as to how advances in their own fields might apply elsewhere. According to workshop co-organizer David Pines, who is ICAM's co-director and SFI Science Board member, the gathering resulted in a number of fruitful cross-disciplinary discussions about how understanding emergent behavior in one system can inform research across time and scale in fields ranging from biochemistry to archeology.

"A meeting like this is all about the people," says David. "It was a special opportunity to transfer ideas from one field to another and to make unexpected connections. New ideas and applications emerged from the talks and the discussion, and many participants left with a sense of new directions they might wish to pursue."

The workshop's organizers included David, Simon Levin (SFI Science Board Co-Chair and Moffett Professor of Biology at Princeton University), and Carl Simon (Center for the Study of Complex Systems, University of Michigan).

Through ICAM, scientists from 52 branches representing many fields and institutions collaborate in identifying major new research themes and carry out collaborative research in complex adaptive matter. For more information: **http://icam-i2cam.org.**

For a list of workshop speakers, **www.santafe.edu/events/workshops**.

INSIDE SFI

Talks highlight journalists' view of science


John Whitfield

What makes good science journalism and how should researchers work with reporters to achieve it? Those were the common threads during a fall 2007 series of discussions organized by author and science writer John Whitfield.

John, a London-based freelance science journalist, spent three months at SFI recently as part of a special research appointment.

The science writing discussions were intended to "impart a sense of how science looks from my side of the fence," he says. "My hope was to help researchers at SFI work more effectively with the news media."

In two sessions given by John, discussants reviewed articles from various publications all on a single research topic, with discussion of the quality of the coverage from the researchers' perspectives.

Guest presenters included *Nature* opinions section editor Sara Abdulla (who described what makes a good opinion piece or book review for an academic journal), *New Scientist* journalist Jim Giles (who described investigative journalism's role in science), and *New York Times* reporter Sandy Blakeslee (who offered some criteria journalists look for when reporting about research).

Those criteria, according to Blakeslee: It's clear what the research is about, it's clear why someone should care, and it's clear why the work should be reported now.

John, a former reporter and editor at *Nature*, is best known for his 2006 book *In the Beat of a Heart: Life, Energy, and the Unity of Nature* (**http://www.inthebeatofaheart.com/**).

He returned to London in December but plans to maintain ties with SFI.

INSIDE SFI

CASITA offers SFI web forum

Members of SFI's extended community now may meet and interact in cyberspace with the rollout of CASITA, a website created to disseminate SFI ideas and multimedia content and build community conversations around the ideas of complex systems and multidisciplinary research. In addition to compiling a variety of materials in one place, CASITA is reuniting alumni of various Institute educational activities.

"When the Institute was started more than 20 years ago, we didn't have universal email," says Education & Outreach Director Ginger Richardson, "but we have it now, and we can find people with connections to the Institute and give them the opportunity of registering with CASITA to keep in touch."

The website, reachable for affiliated individuals through the SFI homepage, offers members a menu that includes events, videos, image galleries, publications, keeping in touch, getting involved, benefits, shared folders, a directory of CASITA members, forums, blogs, and a calendar.

"The Institute has about 1,500 alumni, and up to now they've never been able to easily communicate with each other," says Ginger. "They finish their work or study, then they move on. CASITA will change that. Alumni, Business Network members, and researchers within SFI will be able to tap it as an intellectual resource."

The website was launched in June 2007 as a portal for disseminating information and content through the Business Network. It is now being rolled out at various levels of access within the extended community. The next phase will be launching it through SFI's international network of International Fellows and associated researchers.

CASITA now offers a forum for both SFI Business Network members and SFI alumni (Alumni page shown).

The name CASITA – the acronym for Complex Adaptive Systems IT Area – also references the fact that the website acts as gathering place or "small house" for its various communities. The term was coined by Robert Ghanea-Hercock of BT (formerly British Telecommunications), a long-term Business Network member.

Registering for alumni is easy. Go to **http://sis-alf-prod.santafe.edu:8080/alfresco/service/apply/casita08/start?guest=true** and type in your email address to begin the application process.

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