The Cahokia question: Small state or jumbo chieftdom?

Was the mound-building settlement of Cahokia, near modern-day St. Louis, the seat of a small state or of a jumbo-sized chieftdom? The question is important because one of the first steps in figuring out how states emerged from their societal precursors is establishing just which ancient settlements qualify as states. A state is significantly more complex than a chieftdom, with at least three layers of political hierarchy and technological specialization, among other features. These complexities usually arise whenever a settlement reaches a certain size. But there are a couple of cases where it’s not clear statehood happened. One such outlier is Cahokia.

“It’s really big, but it’s always described as a chieftdom,” says SFI External Professor Peter Peregrine, a professor of anthropology at Lawrence University. It’s judged to have been a city of 3,000 to 10,000 people, with 6,000 to 40,000 in the surrounding region. But despite being one of the most extensively excavated and studied archaeological sites in North America, the jury is still out on Cahokia.

“A lot of questions remain,” says Peregrine. “Was this one big urban landscape? How was this whole thing organized? Given the apparent scale of Cahokia, you’d think that it had a higher level of organization.”

To try to settle the matter, Peregrine and SFI Omidyar Fellow Scott Ortman and Research Associate Eric Rupley have invited nine Cahokia experts to Santa Fe in late May to meet face-to-face and begin to hash it out.

“It’s a small community of scholars that communicate a lot,” says Peregrine. “There will be some fireworks.” And, hopefully, some progress in understanding what might have been North America’s first state, he says.

The emergence of the state is the focus of a three-year research project under way at SFI, funded by the John Templeton Foundation. See the SFI Bulletin at www.santeafe.edu/bulletin for a detailed look at this research.

Why seafaring mammals need to be larger than landlubbers

Why are whales so much bigger than elephants? In a recent paper in PLoS One examining what might have caused mammalian species to evolve to the sizes they did, SFI External Professor Peter Peregrine, a professor of anthropology at Lawrence University. It’s judged to have been a city of 3,000 to 10,000 people, with 6,000 to 40,000 in the surrounding region. But despite being one of the most extensively excavated and studied archaeological sites in North America, the jury is still out on Cahokia.

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Aeriel view of Cahokia, circa AD 1150-1200 (Image courtesy of Cahokia Mounds State Historic Site, painting by William R. Iseminger)

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RESEARCH NEWS

Laws of technology scale hold up

Several mathematical relationships between the scale and cost of technological production have been proposed—Moore’s Law for computer circuits and Wright’s Law for aircraft production—but each suggests a slightly different economy of scale. These hypotheses haven’t been tested systematically and with large numbers of technologies, before, says SFI External Professor Jessika Tränkler. And her collaborators collected data for 62 technologies, ranging from chemicals production to energy devices (such as photovoltaic cells) and information technologies, spanning periods of between 10 and 39 years, and then evaluated each of six proposed “laws” using hindcasts—up to six years after the data to predict later costs—against the observed data. They found that production does grow exponentially for a wide range of products, and that a combination of an exponential decrease in cost and an exponential increase in production renders the performance of Wright’s Law and Moore’s Law virtually indistinguishable.

Estimating the potential costs of low-carbon technologies is one of the main applications the researchers envisage for their findings. The results imply that stimulating growth through public policies might accelerate the realization of efficiencies of scale.

The paper, based on research that began at SFI, appeared in PLoS One on February 28, 2013. Co-authors include SFI External Professor Doyne Farmer, former SFI Postdoctoral Fellow Bela Nagy, and St. John’s College student Quan Bui. "\n
Nonlinearities from the editor

Those attending a recent book signing party in New York hosted by SFI Trustees Gerry O’Hstrom had the great fortune of witnessing a custom rhyme by rapper Babu Bala. "I want to dedicate this book to the trustees Chair Michael Mauboussin’s new book The Equation: Making Stink and Lack Chicago and scenes, Sports, and Investing. A few lines: When it comes to predicting my success Even Mauboussin has no solution yet And that’s a parking lot escape The world is a random place But at the same time It feels like the hand of fate I want answers I hope they have in Santa Fe Brinkman’s work is edictic You can see his research really pretty in the diagram on natural selection at http://bit.ly/22HAHXK. By popular demand and with the backing of longtime sponsor Los Alamos National Bank, you can now participate in SFI’s Community Lectures live, online, and from anywhere in the world. Tune in on YouTube (www.youtube.com/santafeinst), join the live discussion on Twitter (Wint, live or RT, joke), and please ask questions for the speaker by email or Tweet. The live Twitter discussion is expertly orchestrated by my colleague Juniper Lovato. Next opportunity is May 30. See the article on page 4 of this issue for details.

Finally! It’s been a haul, but the new and improved SFI Bulletin is OUT. With embedded videos, interactive illustrations, and articles written by our researchers, I think you’ll enjoy it. You can download it on various formats, depending on what platform you’re using, at www.santafe.edu/bulletin. We know it won’t be perfect, but what you’re reading is state of the art. With the help of A Arts Creative, we’ve leapfrogged to a publication created in HTML5, which is to say it’s all web and isn’t built on the operating systems of individual device makers. Are there imperfections? Yes, will we sort those out? Yes. Do let us know what you think by taking the short survey.

Lastly, if you’re visiting SFI this summer, and if you’re not too busy, please submit a photo in our 2013 photo contest. There are four categories: Complexity in Science & Nature, SFI People, SFI The Place, and SFI Summer Programs. There are prizes and recognition for winning entries. More at www.santafe.edu/contest.

—John German, jdg@santafe.edu

CREDITS

Editor John German
Contributors: Rachel Miller, Larry O’Hanlon, Krista Zala, Nathan Collins, Jenna Marshall
Design & production: Michael Vittitow
VP for Outreach: Ginger Richardson

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

Follow SFI online at www.santafe.edu

GRANT NEWS

Six new grants to SFI investigators

The John D. and Catherine T. MacArthur Foundation has awarded the Santa Fe Institute a two-year, $305,000 grant to support the Institute’s scientific activities, including workshops, working groups, and scientific visits. For more information, see the Institute’s research news, SFI News, and the emergence of the archaic state. The new, interactive SFI Bulletin, online now at www.santafe.edu/bulletin, explores the ever-increasing complexity of human society and the emergence of the archaic state.

The SFI Bulletin is a bimonthly publication of Santa Fe Institute to keep its community informed. Please send comments or questions to John German at jdg@santafe.edu.

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Richardson. The Prize for Outstanding Teaching recognizes teachers in Santa Fe schools who excel at encouraging their students’ creativity and scientific exploration.

This year’s teaching prize recipients are Claudia Vanderkolk, a math teacher at Santa Fe High School, and Suzanne Rodriguez, who teaches middle school math at El Dorado Community School.

In 2002 Rodriquez re-started El Dorado’s science fair program and recast it to focus on inquiry-based projects. She also started an after-school invention club for highly motivated students and created a Math Blitz curriculum that now is used at several other middle schools.

Vanderkolk says her greatest reward is the inspired moment when a mathematical concept becomes clear to a student. “That’s the type of thing that makes it exciting for me – those ‘aha’ moments,” she says.

Her 2011-2012 Advanced Placement Calculus class had a 5.21 on the AP exam, well above the national average of 2.84, with 60 percent of the class scoring a perfect 5.

She loves advanced math and enjoys teaching it to high school students because they are capable of new levels of understanding, both in academia and in the larger world.

of her wealth of knowledge and experience, she sustained a deep intellectual curiosity and openness to ideas to the end of her life. I will truly miss her warmth, generosity, and brightness.”

A memorial gathering will be held June 1 at the New Mexico History Museum.

To post a remembrance of Cordell, visit SFI’s website: www.santafe.edu/vedw/

Trapped atmospheric waves linked to weather extremes
Regional weather extremes in recent years, such as the 2011 U.S. heat wave or the 2010 Russia heat wave coinciding with the Pakistan flood, may have been intensified by a subtle resonance mechanism that temporarily disturbs the patterns of atmospheric air flow around the globe’s Northern hemisphere, according to a study published February 25 in PNAS.

The authors, including SFI External Professor John Schellnhuber, developed equations that describe the wave motions in the extra-tropical atmosphere and show what conditions those waves can grind to a halt and become amplified, and were able to match their results with weather data. Their results advance the understanding of the relationship among climate change, natural variability, and the increasing number of regional weather extremes.

Artifacts reveal social networks of the past
People of the late pre-Hispanic Southwest were able to maintain surprisingly long-distance relationships with nothing more than their feet to connect them, according to a March 25 PNAS paper co-authored by SFI External Professor Aaron Clauset.

The researchers used formal social network analysis to determine what the artifacts from some 700 sites in the western Southwest could tell them about how social networks shifted and evolved during a period that saw large-scale demographic changes, including long-distance migration and coalescence of populations into large villages.

Long-term evolutionary outcomes are predictable
A Stanford study co-authored by SFI External Professor and Science Board co-chair Marcus Feldman suggests that long-term evolutionary outcomes are surprisingly predictable. The researchers set up a computer simulation in which 128 images of proteins continuously folded into new shapes, competing to bind with other molecules, called ligands, in each new configuration. The better each protein could attach itself to the ligand, the more ligands it would scoop up, and the greater its fitness - that is, its average number of successful "off-spring" would be higher. The researchers ran the simulation for 10,000 generations.

"Even though things look complicated, the possible evolutionary trajectories are quite constrained," said lead author Michael Palter. "There are only a few viable mutations at any point, which makes the dynamics predictable and repeatable, even over the long term." Their paper appeared March 6 in the Journal of the Royal Society Interface.

Sea temperatures offer forecast of malaria outbreaks
Measurements of colder-than-normal July sea surface temperatures in the tropical South Atlantic can be used to accurately forecast malaria epidemics in the arid and semi-arid regions of northwest India up to three months earlier than standard monsoon-based forecasting, according to SFI External Professor Mercedes Pascual and her colleagues, who summarize their findings in a March 3 paper in Nature Climate Change.

The new forecasting tool should improve public health in the region by increasing warning time, thereby informing decisions about treatment preparedness, insecticide spraying, and other disease-prevention strategies.

Warming to shift regions suitable for wine production
Rising temperatures and decreasing rainfall could alter the balance of temperature and moisture needed for grape growing and shift the global geography of wine production, according to a study published April 8 in PNAS.

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Pat Kuhlhoff: Giving freely, giving back

There are many ways to support a cause. Pat Kuhlhoff gives freely of her time as a “saintly volunteer” in Santa Fe, and she financially supports causes she believes in. She says she supports SFI because its scientists also share freely, working hard to make complexity accessible to the public. "The kind of work they're doing is so vital to humanity, it would be criminal to keep it secret or for someone to own it. That's one of the things I admire about their philosophy and how they work," she says.

Kuhlhoff moved to Santa Fe in 1989. Like many retirees, she had an abundance of time and energy. She soon found outlets for her interest in history as a volunteer at El Rancho de las Golondrinas, the Santa Fe Opera, and the Palace of the Governors History Museum.

About 10 years ago she began attending SFI public lectures with friends. She especially enjoys the Stanislav Ulam Memorial Lecture Series every fall because, with three lectures in three nights, the speakers can delve deeply into a complex issue and explain SFI's creative approach to problems.

"I feel like I'm giving to an organization that is doing something for the betterment of the human race, and I think that's really important in these times when there's an awful lot of self-centeredness," Kuhlhoff says. "It's a marvelous group of intelligent people who are figuring out how to improve the human condition."