that's either totally wrong or right, that information has to be made public [in a journal]. All sorts of people can look at it and make up their minds."

Hahn acknowledged that she is not versed in the complicated cryo-EM technique enough "to really judge one way or the other" whether the criticisms are legitimate. She says Sodroski told her that Mao previously used cryo-EM to study graphite and routinely pieced together suboptimal images, which may help explain how he achieved a higher resolution than specialists who study only biological samples. She insists that the paper received a bona fide peer review at *PNAS* and urges people to remember that Sodroski has a record of producing credible work. "My gut tells me that Joe is right."

Bette Korber, an immunologist at the Los Alamos National Laboratory in New Mexico who uses models of HIV trimers to help design vaccines, admires how Sodroski is handling the criticism. "He is systematically addressing the points raised in reviews or in conversation with other scientists in the field," Korber says. "I've known Joe for most of my professional career, and find him to be a person of great integrity, and I am optimistic he will continue to be able address the concerns of others as research advances in this area."

Sodroski impressed many HIV/AIDS researchers in March 2012, when he first presented the work at the Conference on Retroviruses and Opportunistic Infections, a meeting Hahn helps organize. By then, the work had already sparked skepticism in cryo-EM circles. When he first shopped a paper claiming a 2.6-Å structure—near atomic level—Henderson, for one, was incredulous. "If true, several synchrotrons in the world and cryo-EM specialists would all be out of business," he says, noting that he refereed conflicting reviews of this version of the paper for *Nature*.

Last August, Sodroski's group published an 11-Å version of the trimer online in *Nature Structural & Molecular Biology,* a resolution more plausible to Henderson and others. But when Henderson was later asked by the same journal to referee a paper describing the 6-Å trimer, he wrote an extensive critique. The *PNAS* paper, he says, is revised only slightly from the version he read. "I was shocked," Henderson says. "They completely ignored my five pages of critiques."

Hahn says she has yet to see an experiment that proves Sodroski and Mao made a mistake. "Ultimately," she says, "the biology has to decide who's right and who's wrong."

–JON COHEN

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SOCIAL SCIENCE

Study Links Climate Change And Violence, Battle Ensues

In many large cities, police know that a hot summer will be a busy time, as murder and mayhem spike with the temperature. Some social scientists say that the same pattern could hold globally. Along with wilted harvests and a loss of biodiversity, they say, climate change could lead to escalating violence. Now, a study published online this week in *Science* tries to quantify the increase (http://scim.ag/SHsiang). Based on dozens of published studies correlating extreme weather and human conflict, it concludes that warmer temperatures and more extreme rainfall patterns could boost interpersonal violence by 16% and group conflicts in some regions by 50% by 2050.

"We were conservative and the result is still clear," says econometrician Solomon Hsiang, the paper's lead author, who will soon join the University of California, Berkeley. Thomas Homer-Dixon, a political scientist at the Balsillie School of International Affairs in Waterloo, Canada, who has studied climate change and conflict since the 1990s, agrees. "This study, precisely because it's an extremely carefully done meta-analysis, will push the debate a big step forward."

The study's critics, however, aren't impressed—and the paper is adding fuel to a long-standing dispute over the possible links between climate and conflict. One problem, they argue, is that the study conflates weather with climate. Another is that the researchers may have based their conclusions on a biased subset of studies. "They are more optimistic and confident in their results than I would be," says Andrew Solow, a statistician at the Woods Hole Oceanographic Institution in Massachusetts.

Standing in the crossfire is Hsiang, who says that when he first got interested in the issue 2 years ago while finishing his Ph.D. dissertation at Columbia University, "I had no idea that I was stepping into the middle of a debate that has been raging for 20 years."

The climate-violence connection has long intrigued scientists. Psychological studies have shown that people become more aggressive when the temperature becomes uncomfortably hot, and higher temperatures are known to correlate with higher urban homicide rates. Researchers have also fingered extreme precipitation—floods and droughts—for promoting violence.

In his dissertation, Hsiang explored a possible association between conflict and shifting weather patterns due to El Niño events in the Pacific Ocean. The work led to a 2011 *Nature* paper that demonstrated that conflicts spiked in areas affected by El Niño. A year later, he began collaborating on a broader study with Marshall Burke and Edward Miguel, both economists at Berkeley.

They started with "about 1000" papers that touched on the topic, which they whittled down to several hundred that had sufficient data for analysis. Many of these were cross-sectional, comparing rates of violence between places that have different climates. "That is a very tempting approach," Hsiang says. "The problem is that when we compare populations in very different locations, they

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Heated conflict. Researchers debate whether climate change spurs violence, such as the conflict in Sudan's Darfur.

are different in ways that we can't capture in a model." Differing histories and cultures, for example, may better explain patterns of violence than differences in climate.

To avoid that problem, Hsiang and his coauthors restricted themselves to 61 longitudinal studies that collected conflict and weather data from the same places over time. The "mountain of data" covered a range of scales, from studies of interpersonal violence such as assault, murder, and rape, to group- or state-level conflicts such as riots and wars. The studies spanned all regions of the world and stretched back 10,000 years. A majority had been published since 2009.

A clear pattern emerged. When the average precipitation or temperature in a place strayed from its average seasonal value, violence tended to increase. Interpersonal violence increased by 4% for an increase of 1 standard deviation away from the average (for example, a New York City summer about 3°C above average). And the effect was stronger for intergroup violence, with a 1 standard deviation difference translating into a 14% increase in the frequency of such conflicts. In some regions, those numbers could mean an increase of up to 50% in the frequency of violence by 2050, Hsiang and his colleagues note, if global temperatures increase by the 2 to 4 standard deviations projected by mainstream climate scenarios.

That forecast is unfounded, argues Halvard Buhaug, an economist at the Peace Research Institute Oslo, because the study suffers from "selection bias." The authors ignored some data in the selected papers, he says, and "more worrisome," appear to have used data "that return the strongest effects." Hsiang says they dealt with the potential for bias "head on" with statistical analysis, but found little.

The selected papers may have also confused "single sharp" weather events such as heat waves with longer term climate shifts, Solow says. He points out that in sub-Saharan Africa, there is no doubt that climate change has been unfolding over the past several decades. But over the same period, "the overall rate of civil conflict has declined."

Hsiang's study "is an amazing compilation and analysis of data" that "makes you think," says archeologist Richard Potts of the Smithsonian Institution in Washington, D.C. But he's not convinced, he adds, and "it does little to end the impasse" among those who foresee more violence in a warmer world, and those who are cool to the idea. **–JOHN BOHANNON**

DRUG DEVELOPMENT

Corruption and Research Fraud Send Big Chill Through Big Pharma in China

SHANGHAI, CHINA—The widening bribery investigation engulfing the Chinese branch of drug giant GlaxoSmithKline (GSK) focuses on the tactics of its sales people. But it also adds to a perfect storm of scandals involving multiple companies that could jeopardize China's rise as a center for global pharmaceutical R&D.

On 11 July, the Chinese government accused executives at GSK China of bribing officials, hospital employees, and doctors to promote or sell GSK drugs. Four Chinese GSK executives, along with at least 18 other employees and medical personnel, have been taken into custody, according to state press reports. Last week, GSK replaced its general manager for China and acknowledged in a statement that "Certain senior executives … appear to have acted outside of our processes and controls." The company also pledged to lower its prices in China.

The accusations come as China—particularly Shanghai—is emerging as a research hotspot for big pharma. Helping propel China's rise as a global research hub, officials encourage R&D investment in return for market access. With the corruption probe at GSK coming on the heels of other scandals directly connected to research, observers say that the industry should brace for harsh consequences. "Whatever happens to GSK will have a huge impact on pharmaceutical industry investment in China, on Chinese scientists' reputation, and on the future development of medicine," says a scientist familiar with R&D at GSK who did not wish to be named. Companies may consider stricter controls on big pharma's R&D operations in China. But no one expects companies to turn tail. "Exiting China is not in the cards," says Benjamin Shobert, director of the Rubicon Strategy Group in Seattle, Washington. "And China knows this."

The nature of the allegations against GSK, which involve funneling bribes through a Shanghai travel agency, surprised few in the industry. GSK is "certainly not an isolated case," says Yanzhong Huang, a global health fellow at the Council on Foreign Relations in New York City. Last December, the U.S. Securities and Exchange Commission charged Eli Lilly with violating the Foreign Corrupt Practices Act by bribing doctors on the Chinese state payroll with spa treatments, jewelry, and money. Industry insiders say that multinationals simply take cues from domestic counterparts, and lavish drug-sales inducements are a familiar practice in Western countries, such as the United States.

But other scandals have directly hit the growing drug R&D business in China. As big pharma closes or scales back research facilities in the United States and Europe, many companies are opening up shop in Shanghai or Beijing, attracted by an ample scientific labor force and a large patient pool for clinical trials (*Science*, 27 July 2007, p. 436). GSK is a giant on the Chinese scene, having spent more than $163 million on R&D in China in the past 2 decades. Its Shanghai center, launched in 2007, focuses on neurodegeneration. Other big players include Pfizer, which has invested more than $150 million in its Shanghai center, and Merck, which in 2011 pledged to spend $1.5 billion on R&D in China over 5 years (see table, above).

In both Chinese and multinational outfits, an emphasis on quick results may tempt researchers to cut corners. "We spend a lot of time teaching people how to follow the guidelines," says Zhai Yifan, CEO of HealthQuest Pharma, a biotech startup in Guangzhou. The potential for negligence was thrust into the spotlight in June, when GSK

Footholds in the Far East

	R&D center established	Investment	Staff
GSK	2007, Shanghai	$163 million over 20 years	400
Pfizer	2005, Shanghai	$150 million	700
Novo Nordisk	2002, Beijing	$40 million in 2010	100
AstraZeneca	2007, Shanghai	$35 million since 1996	
Merck	2011, Beijing	$1.5 billion pledged for 2011–2016	N/A
Roche	2004, Shanghai	N/A	110

Pharma mecca? Despite trimming Western operations, multinationals have lavished funding on R&D centers in China.

TABLE SOURCES: GSK, PFIZER, NOVO NORDISK, ASTRAZENECA, MERCK, ROCHE

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