Researchers are looking for additional clues, both in situ and on the tablets and vessels that record the early writing; Van Ess, for example, recently began digging at Uruk after the decade-long hiatus resulting from international sanctions against Iraq.

Those clues are hard to come by, however. Because builders at Uruk often used old tablets as fill, pinpointing their date and context is difficult. "Uruk is such a mess," says Englund. "The stratigraphic record is really quite horrible." And Dreyer—who continues his excavations—has yet to find significant material at Abydos that may shed more light on hieroglyphic evolution.

Three at once?

Archaeologists in Pakistan have had more luck in recent years. A team of U.S. researchers discovered compelling evidence in the late 1990s that the script from the Indus River valley also has a long and complex history. The Harappan civilization flourished there from 2800 B.C. to 1700 B.C. before collapsing; its script ceased to be used afterward, and the meanings of the signs remain a mystery. But although it never attained the complexity of the Mesopotamian or Egyptian writing systems, the Indus script nevertheless developed into a formidable grouping of signs.

The recent finds suggest that the script arose more than half a millennium earlier than previously believed. Pottery discovered at the site of Harappa includes markings that date from 3500 B.C. to 3300 B.C. and that appear to be precursors to that script. "I wouldn't call these signs writing," says Richard Meadow, a Harvard archaeologist who works at the site. "But these could be seen as part of an evolution of signs that continue to the Harappan period."

The Harappan and Abydos finds pose a major challenge to the traditional theory that writing diffused gradually from Mesopotamia to Egypt and perhaps to the Indus. All three areas were linked by trade in prehistory—Egypt to Mesopotamia through the Levant, and Mesopotamia to the Indus through modern-day Iran and the Persian Gulf coast. But the dominance of Mesopotamia is now in question.

"That the idea [of writing] passed from Egypt to Mesopotamia is quite a possibility now," maintains Dreyer. Others are not so quick to make that leap. "I'm undecided," says Baines, "but I don't think that's likely." Still other Mesopotamian scholars largely adhere to the old school of east-to-west influence, given what they say is the long evolution apparent from cylinder seals and the clay spheres.

Baines, however, posits a third possibility: that the two systems developed independently at about the same time. And if Harappa is included, then the evidence suggests that three separate systems with their own evolutionary paths began to mature nearly simultaneously. That would appear a stunning coincidence, but some researchers say contact with other groups, combined with an indigenous need to convey more complex information, might have been the not-so-coincidental common ingredients that made the Near East and the Indus advance so quickly.

"Writing develops in areas where people are interacting," says Jonathan Kenoyer, an archaeologist at the University of Wisconsin, Madison, who has dug along the Indus. "Yet these regions also developed their own unique forms of expression." This is true not only for the scripts, which are unrelated, but also for their function. In Egypt, for example, writing typically was focused on ceremonial uses, while accounting dominated Mesopotamian tablets.

However writing matured, scholars are left with the more daunting mystery of who laid the foundation for the artisans at Abydos, priests at Uruk, and the unknown makers of Indus script. "No one expected writing had such deep roots in prehistory," says Schmandt-Besserat. Deciphering that long and complex story is proving a formidable and controversial task, with no Rosetta Stone in sight. **–ANDREW LAWLER**

Next week: A special News Focus on the state of archaeology in Iraq.

PROFILE

Dollars and Cents vs. the AIDS Epidemic

An atypical economist is a driving force behind the new global health fund being debated this week at a special session of the United Nations

BOSTON—Jeffrey Sachs is in his office for the first time in 3 weeks—and he is here today only because a trip was canceled at the last minute. He will be here for 2 days before taking off again for meetings in Asia. Hundreds of e-mails are crying out for his attention, the accumulation of just a few days, and his telephones—including his ever-present cell phone—never seem to stop ringing. This Harvard economist is clearly no run-of-the-mill academic.

Tryin' to throw his arms around the world. Jeffrey Sachs has teamed up with U2's Bono and the Pope in a crusade to reduce disease rates in poor countries.

CREDIT: ELISE AMENDOLA/AP

Sachs is in demand—and constantly in the public spotlight—because he has jumped into one of the biggest and most visible international public health issues of the day: the tragedy inflicted by HIV/AIDS on the developing world, especially sub-Saharan Africa. He's become one of the most vocal advocates for a multibillion-dollar international program to tackle not only AIDS but the intolerable disease burden that, he argues, is holding back the developing world. He's constantly cajoling rich governments to open up their coffers and drug companies to loosen their intellectual property claims on drugs desperately needed in poorer countries.

But it's not just his cause that has made him visible. It's also his style. He recently teamed up with an international crew including Pope John Paul II and rock star Bono, U2's lead singer, to campaign for debt forgiveness in poor countries. The money, he says, could be better spent on health. A great fan of U2, Sachs spends about as much time on the road as the band does, some 25 days a month if he isn't teaching. And like Bono, Sachs can bring crowds to their feet—in his case with impassioned sermons on the rich world's obligation to drastically increase spending on public health in poor countries. "Jeff shakes up the world," says Harvard colleague Barry Bloom, dean of the School of Public Health. "He's not known for his inter-

est in balance and moderation."

Indeed, his demands are rarely restrained. His latest campaign is to persuade wealthy governments to donate $10 billion to a global health fund that would fight malaria, tuberculosis, and HIV/AIDS. From a macroeconomic perspective, he explains, $10 billion is not a lot of money: just four-hundredths of a percent of the rich countries' yearly income and only $10 for each of the 1 billion people who live in wealthy countries. And what it could buy is immeasurable: By relieving the disease burden in poor countries, the fund could be a fundamental tool to jump-start development.

Sachs is just one of several powerful voices—including Secretary-General of the United Nations Kofi Annan—advocating for the fund, but his credentials as a topflight economist have helped bring the argument into the mainstream. "Economists have a lot more weight with politicians than anyone in health could have," says epidemiologist and veteran public health expert William Foege of Emory University in Atlanta and chief adviser to the Bill and Melinda Gates Foundation in Seattle. "All one has to do is look at an average newspaper and see what proportion of it is dedicated to economics to understand how he has had an impact."

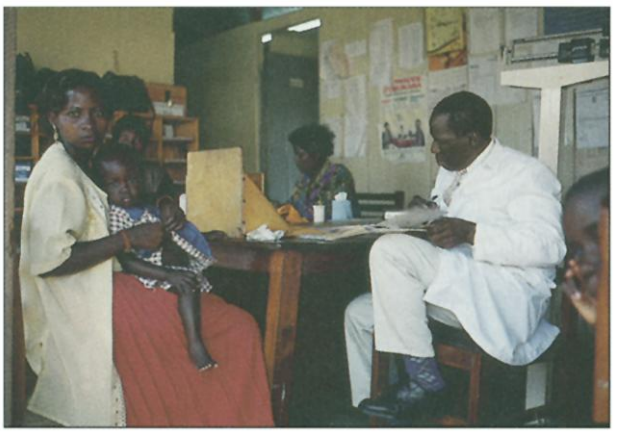
Whether or not Sachs should get the credit, the global fund is beginning to take off. In April, U.S. President George W. Bush pledged $200 million to the fund; in the last month, several more pledges have trickled in, including $100 million from the Gates Foundation, $100 million from the United Kingdom, and $127 million from France. As *Science* went to press, delegates at the United Nations Special Session on HIV/AIDS were beginning to hammer out how the fund would be organized.

No shrinking violet

Notoriety came early to Sachs. At the ripe age of 28, just 3 years after earning his Ph.D. in economics from Harvard in 1980, Sachs, now 46, became the youngest professor ever to win tenure there. (He shared that honor with fellow economist and incoming Harvard president Lawrence Summers.) It didn't take long before Sachs was making international headlines as an adviser to governments in Latin America and Eastern Europe. In Bolivia he helped to stem runaway inflation and restructure that country's international debt. In Poland, he advised Lech Walesa during the transition to a market economy, prescribing "shock therapy"—an abrupt end to price supports and trade barriers. "Probably the most important economist in the world," was how *The New York Times Magazine* once described him; "the world's best-known economist," according to *Time* in 1994.

But he had his detractors within the economics profession. In the early 1990s, he advised Russian President Boris Yeltsin to give the Russian economy the same shock therapy, but the country subsequently went into a tailspin. He was widely criticized by his colleagues, who said the therapy was too harsh and blamed it for the crushing difficulties (including the collapse of the public health system) Russia endured as it struggled to convert to a market economy.

Fresh from that setback, Sachs, who became head of Harvard's Institute for International Development in 1995, began to explore the unconventional ideas that now dominate his work—bringing together the disparate worlds of macroeconomics and public health policy. He didn't experience an epiphany, he says, but he came to a gradual realization of the limits of open markets and sound fiscal policy. A decade after he helped Bolivia back to its feet, it was clear that a stable economy was not enough. The country "still remained in a lot of trouble economically," he recalls. Similarly, he says, many supposedly stable African countries were failing to achieve macroeconomic growth.



Double-barreled approach. AIDS prevention will not work without a treatment program, insists Sachs. Here, a clinic in Uganda where researchers work to prevent mother-to-child transmission of HIV.

CREDIT: MALCOLM LINTON

Sachs returned to an old puzzle of macroeconomics: Why do tropical regions tend to be poorer than temperate ones? And as he worked in those regions, especially in Africa, he found disease staring him in the face. "More and more it grew on me as a fundamental part of the explanation of economic performance," he says. Chronic, energy-sapping malnutrition, as well as malaria and other infectious diseases, cause children to lag behind in school or drop out completely and limit the productivity of farmers and businesspeople alike.

In 1998, Sachs became director of the newly formed Center for International Development at Harvard. That year, with colleague John Gallup, he published an analysis of the effect of malaria on economic development. After taking into account factors such as geographical location, colonial history, and economic policy, they concluded that countries with severe malaria (in which roughly half the population is at risk of contracting the *Plasmodium falciparum* parasite) had one-third the income levels of equivalent countries without malaria—and a 1.3% lower growth rate per year. Malaria "has had a stranglehold on development in many parts of the world," he says. While that idea is still debated by macroeconomists—not everyone is convinced that the paper demonstrated cause and effect—it definitely rocked the development community.

The notion that health plays a role in economic success was not entirely new, says economist Michael Kremer of Harvard University and the Brookings Institution. But few economists had it at the top of the list, he says. That is reflected in funding for global health efforts—the U.S. Agency for International Development, for instance, spent more than twice as much on economic programs as on health in 1998.

"Jeffrey Sachs was one of the first who understood the impact of tropical diseases on development," says Hans Binswanger, an economist at the World Bank in Washington, D.C.

A global awakening

As Sachs immersed himself in public health, he was struck by how little money or scientific effort rich countries devote to tropical diseases, which claim millions of lives each year—a deficit that relentlessly widens the gap between rich and poor, he says. Almost as disturbing was the paltry support for African scientists. "I've met wonderful scientists—deans of medical schools, long-practicing clinicians—who have no resources," he says. "I meet unemployed or underemployed malariologists of tremendous skill all over Africa. ... They have wonderful suggestions about what to do, and they can't get anyone's attention."

As a neophyte in this world, "I was quite shocked," Sachs recalls. "I was not aware of how incredibly impoverished the global public health system was. I learned what other people knew, but ... the numbers mean something different to me as a macroeconomist than they do to a public health official. Many times I had to shake public health officials and say, 'Millions are not enough. This is a matter of billions of dollars at the minimum. And don't be shy of the billions, because that's what the macroeconomic

world is all about right now—and public heath is getting unbelievably short shrift compared to the urgency of the issues.' "

In hundreds of papers, Op-Eds, speeches, and behind-the-scenes meetings, Sachs has been working to bridge that gap, exhorting, cajoling, and shaming leaders of rich countries and donor agencies to support public health efforts in poor countries. And he is not shy about asking for billions. That's what is needed, he says, to deliver the drugs that can help stem the global AIDS epidemic. "Like many, Sachs came late to the AIDS issue, but when he took it on, he really took it on with a vengeance," says Binswanger.

Sachs sees the AIDS 2000 meeting in Durban in July last year as a turning point. Speaker after speaker reported that life-extending drugs are transforming the specter of AIDS in rich countries. At the same time, it was painfully clear that those drugs "reach almost nobody in poor countries—and that our world must not go on like that," Sachs says. "The notion that parents should be sent to their graves for lack of $500 a year in drugs strikes me as a mind-boggling miscalculation from an economic development point of view as well as being immoral."

One year later, "we're still without officially supported treatment programs," says Sachs. But although he is impatient, he sees progress. "It is now widely if not universally accepted that treatments should be part of official policy."

On the ground

Not only have governments recognized the need for treatment, says Sachs, but drug companies have responded to pressure from both the public and generic-drug manufacturers. The big AIDS drug companies have agreed to reduce their prices in developing countries or allow generic versions to be used, so that it is now feasible to think about treating an entire continent. "That is a real breakthrough," he says.

Treating millions of HIV-infected individuals in poor communities is easier said than done, but Sachs believes that with support from science, it is possible. In a "consensus statement" released in April, 128 professors from Harvard's medical school, school of public health, and other departments called for a series of intensive clinical trials to determine the most effective use of antiretroviral therapy in the developing world. That statement, spearheaded by Sachs, pointed to the success of small-scale use of "directly observed therapy" or DOTs—when a public health worker watches a patient take the necessary drugs—first used for treating tuberculosis. Scientific input and review of projects, similar to study sections at the National Institutes of Health, is critically important—and is something many past efforts have lacked, says Sachs. "There has been a tremendous amount of amateurism and seat-of-the-pants operations by donor agencies. Somehow proper science just doesn't get into the story."

Although Sachs is not lacking in confidence, many in the AIDS and development communities are skeptical. Some worry that an overemphasis on treatment will drain already scarce funds from prevention programs—the only way to slow the epidemic. "Jeff Sachs's view is that money is not scarce. But that has yet to be demonstrated in the real world," says senior economist Mead Over of the World Bank in Washington, D.C. And if they had to choose between prevention and treatment, many say prevention would save the most lives.

But Sachs argues that prevention will ultimately fail without treatment programs. "I'm utterly convinced that people will not get tested, will not consider themselves infected, if this is not put in a medical context," he says.

Bloom agrees. "I see the drugs as a catalyst that has caused a major change in people's thinking in what is possible and what is not possible," he says. Sachs's call for treatment "has opened a flood of possibilities that would not have come from prevention alone. People are not going to put $5 billion a year into condoms."

As pledges to the global fund accumulate, Sachs is increasingly optimistic and steadfast against naysayers. "Will rich countries actually be persuaded? Not if 'experts' say that it is impossible. The key, I believe, is to show the need, the feasibility, the enormous social benefits—and the enormous worldwide costs of doing nothing. I would advise the critics to learn a little about how large our economy really is, and how easily we could mobilize $10 billion per year from rich countries, if we decide to do so." **–GRETCHEN VOGEL**

ECOLOGY

Dammed If You Do, Damned If You Don't?

Battle lines are being drawn over the United Kingdom's first large-mammal reintroduction, the return of the European beaver

CAMBRIDGE, U.K.—Like many other regions throughout Europe, the spindly pine and birch forests of the loch-studded Scottish Highlands are haunted by the ghosts of charismatic species that gambol there no more. Wolves and brown bears, reindeer and lynx, wild boars and beavers all once thrived on the British Isles before humans extirpated them over the past few millennia. "There has been a sad decline in the [large] British mammalian fauna," says Martyn Gorman, a mammalogist at Aberdeen University. "We have a moral obligation to reintroduce these species wherever possible," he argues.

Not everyone agrees, however, and a major test of wills is shaping up over plans for the U.K.'s first large-mammal reintroduction: the European beaver (*Castor fiber*). Backers view bringing back the riparian engineer as a chance for Britain to get with the continental European mainstream and to put right a historical wrong. Critics, however, contend that in the 4 centuries since the beaver disappeared from the British Isles, its former habitat has become so degraded that it would be foolhardy to resurrect the species now. Forces aligned against the reintroduction have won an extra year to press their case: Scottish National Heritage (SNH), which is leading the bring-back-the-beaver movement, announced last month that it has postponed essential survey work on beaver habitat until next spring because of the foot-and-mouth disease crisis.

It's unclear exactly when the

Moral imperative? Some argue that humans ought to bring the beaver back to atone for its extirpation.

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