Notes from the 2006 AAAS Annual Meeting

SLASH-AND-CHAR IMPROVES AMAZONIAN SOIL

Archaeologists venturing into Amazonia in the 1870s noted anomalous patches of dark fertile soil amid the highly weathered yellow oxisols that dominate the region. Until recently, few believed these soils—now called *terra preta de indio* (Indian dark earths)—were human artifacts. That's because it was widely believed that Amazonia had never supported large human settlements. Over the past decade, however, that belief has been undermined by discoveries of extensive earthworks, roads, and permanent villages in coincidence with terra preta. Just how ancient peoples enriched these soils—and how their fertility has persisted for centuries after the diseases and guns of the conquistadors largely eliminated their makers—is one of the "emerging great mysteries of the human past," geographer William Woods of the University of Kansas told a panel at the annual meeting of the American Association for the Advancement of Science (AAAS), held 16–20 February in St. Louis. Probing these mysteries could provide important insights into both sustainable agriculture and soil carbon sequestration, he said.

Archaeologist Eduardo Neves of the University of São Paulo, Brazil, believes the earliest terra preta was created unintentionally by the accumulation of household waste, charcoal, animal bones, and other debris around villages perhaps 2500 years ago. Digging at sites on the floodplain near Manaus, Neves finds the terra preta chock-full of broken pottery. With fish, manatees, turtles, and birds for protein, supplemented by backyard manioc and edible palms, people living near rivers most likely had no need for intensive agriculture, he told the panel. And his dating of soil profiles has convinced him that the 1/2- to 2-meter layers of terra preta formed much faster than the previously assumed rate of 1 centimeter per decade: "We're talking perhaps 40 to 50 years."

Some 800 kilometers away, in the uplands around Santarem, Woods studies remnants of much larger settlements. He believes the extensive terra preta fields there reflect deliberate soil enhancement for growing crops such as maize to support hundreds of thousands of people. Terra preta patches range from one to hundreds of hectares in extent. Woods estimates that soils modified by pre-European activities may cover 10 percent of Amazonia, an area the size of France.

The key to their creation appears to be charring of biomass: slash-and-char rather than today's slash-and-burn. Kayapó farmers in the region continue a similar practice, chopping weeds and burning the still-green material in smoldering fires. The result is organic-rich charcoal known as bio-char, which makes up 35 to 45 percent of the carbon in terra preta. Cornell University biogeochemist Johannes Lehmann noted that bio-char retains 50 percent of its carbon, while ash from biomass burning retains only 3 percent. Converting biomass into bio-char greatly lengthens carbon residence times when added to soil, increases nutrient-holding capacity, reduces methane and nitrous oxide emissions, and supports greater crop yields, Lehmann said. He also envisions production of "bio-char bioenergy," which, unlike other biofuel processes, would yield carbon-sequestering soil amendments along with energy.

PROFILING EMERGING PATHOGENS

Humans are afflicted by 1407 recognized species of pathogens, and 177 of these are considered emerging or reemerging, reports Mark Woolhouse of the University of Edinburgh, Scotland. Despite current fears of a potential bird flu pandemic, only a minority of emerging pathogens will ever succeed in causing epidemic disease in humans, he told an AAAS session. To help guide surveillance efforts, Woolhouse and a colleague recently surveyed the literature to profile the characteristics of emerging pathogens (see the December 2005 issue of *Emerging Infectious Diseases*).

While 58 percent of human pathogens can also infect animals, 73 percent of emerging pathogens are zoonotic. Bacterial diseases dominate the roster of human ills, yet the majority of emerging pathogens are viruses, predominantly RNA viruses, which have relatively small genomes and high mutation rates. Ungulates are the most important reservoirs for both current and emerging human pathogens, while carnivores, rodents, primates, birds, bats, and marine mammals follow in rank order. Overall, the taxonomic relatedness of potential hosts is not as important to cross-species pathogen jumps as a broad host range.

West Nile virus, for example, has swept throughout the United States and into Canada, Mexico, and the Caribbean since 1999. Alan Barrett of the University of Texas Medical Branch told the panel that the virus has been found to infect 288 bird species, 59 mosquito species, and 30 mammals from horses to alligators since arriving on the continent—"an amazing number of hosts for a vector-borne virus." The virus has been evolving slowly, he said, yet human case levels remain high and the virus shows no signs of becoming endemic rather than epidemic.

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