going into my chemical ecology class next fall," she says. This mix-and-match approach might also have a practical payoff, says Gribble: It could be used against pests someday, "much like we use DEET to repel mosquitoes."

The hunt is now on for other insects that use such sophisticated chemistry. "Once you find something, it's going to turn up all over the place," Meinwald says. Considering that fewer than 5% of insects have even been identified, let alone studied chemically, Eisner says, "I revel in the thought that insects are the great frontier."

–LUIS CAMPOS

Luis Campos is a summer intern at *Science*.

ARCHAEOLOGY

Green Farming by the Incas?

Many of us once liked to think that ancient peoples lived in harmony with the land, but that romantic notion withered in the 1990s, as studies showed that many civilizations overfarmed the land, damaging their livelihood as well as their environment. Now, however, a sediment record and archaeological evidence from a high South American valley suggest that one ancient people, the Incas, used conservation practices such as canals, terracing, and perhaps even tree planting so successfully that they actually restored degraded farmland. Those same tactics may work to help Peruvian farmers today, says botanist Alex Chepstow-Lusty of the University of Cambridge, England, co-author of the new findings. "We're convinced the [early Inca] built the ideal cultivation system for the highlands," says another co-author, archaeologist Ann Kendall.

The findings, appearing last month in *Tiahuantinsuyu*, an annual compilation of Andean archaeology, and in the journal *Mountain Research and Development*, are based on an 8-meter core taken from a small, dry lake at the bottom of the 3300-meter-high Patacancha Valley in southern Peru and on nearby archaeological digs. Although the evidence is centered on this intensely studied valley, the researchers think the findings apply to other parts of Peru, where abandoned Inca canals and terraces still cover nearly a million hectares.

The lowest layers of the core, radiocarbon dated from 2000 B.C. to A.D. 100, paint a picture of a pre-Incan land cleared and intensively farmed. The team found high levels of pollen from ambrosia, a daisy-like weed that flourishes in disturbed soil, and from pasture grasses and quinoa, an ancient food crop. The core also shows repeated spikes of inorganic sediments flowing into the lake—a sign that soil washed off the hillsides during floods. And the archaeological record suggests that farmers of the time built only rudimentary terraces. By A.D. 100, a cooling climate—and possibly degraded soil—reduced farming in the valley, but erosion continued, says Chepstow-Lusty.

Then about A.D. 1000, shortly before the Inca took over, a suddenly warmer and drier climate was accompanied by an enormous increase in pollen from the alder tree *Alnus acuminata*, a nitrogen-fixing species that thrives on eroded soils. The signature of soil erosion plummeted, and pollen and seeds from maize and other crops appeared.

ANN KENDALL

New life from old terraces. Incan terraces and canals once helped restore degraded land and may help farmers today.

At just this time, excavations in the valley point to the beginning of a systematic effort to farm the area with soil-sparing techniques, says Kendall, who directs the Cusichaca Trust in Bellbroughton, England, a rural development project that revives ancient farming practices. The Incan system included a well-built 5.8-kilometer canal to bring in water from streams and lakes at higher altitudes, says Kendall; it had layers of well-fitted stones, sand, and clay, and drop structures to distribute the flow evenly to the plots. Terraces proliferated—so many that Kendall speculates "people may have literally dragged the soil that had fallen into the valleys and riverbeds back to the hillsides" to build them. "What prompted people to say, 'OK, let's build thousands and thousands of terraces' is anyone's guess," says Chepstow-Lusty. "But when they found it worked, they kept developing it."

Excavations of nearby dwellings suggest that as the terraces were built, the valley's population quadrupled to modern levels of about 4000, showing that the land was able to support more people with less damage, says Kendall. *Alnus* trees persist in the pollen record too, even though the growing population apparently relied on the trees for firewood and building. (Excavated buildings have *Alnus* door lintels and roof beams.)

The trees may originally have spread because of the warmer climate, but the researchers suggest that there must have been a system for conserving them, and that they would have stabilized soil on the steep slopes. "There were so many people that the very fact there were any trees left means they did something," says Kendall. Indeed, chroniclers writing shortly after the Spanish conquest in the early 1500s report that the Inca had had a strong tradition of tree planting; *Alnus* cultivation was overseen by the emperor himself, and illegal woodcutting and burning was punishable by death. After conquest, the terraces and trees went into decline. *Alnus* now grows only in a few remote ravines.

Some researchers are skeptical that the Inca consciously practiced agroforestry. "One core doesn't clinch the case for active management," says Alan Kolata, director of the Center for Latin American Studies at the University of Chicago. Still, he agrees that other features of early agricultural systems, such as terraces, probably did conserve soil and boost crop production.

Moreover, some of these ancient tactics may still be practical. The Cusichaca Trust has funded a project in the Patacancha Valley to excavate terraces and then rebuild them with old methods. Since 1995, local families have rebuilt the canal and replanted 160 hectares of old terraces in potatoes, maize, and wheat. They report that the terraces produce well and use less fertilizer than other lands. "These people [had] hundreds of years to learn what worked on the land and what didn't," says University of Florida, Gainesville, geographer Michael Binford. "If we pay attention to what they did, we might just learn something."

–KEVIN KRAJICK

Kevin Krajick is a writer in New York City.