ARCHAEOLOGY

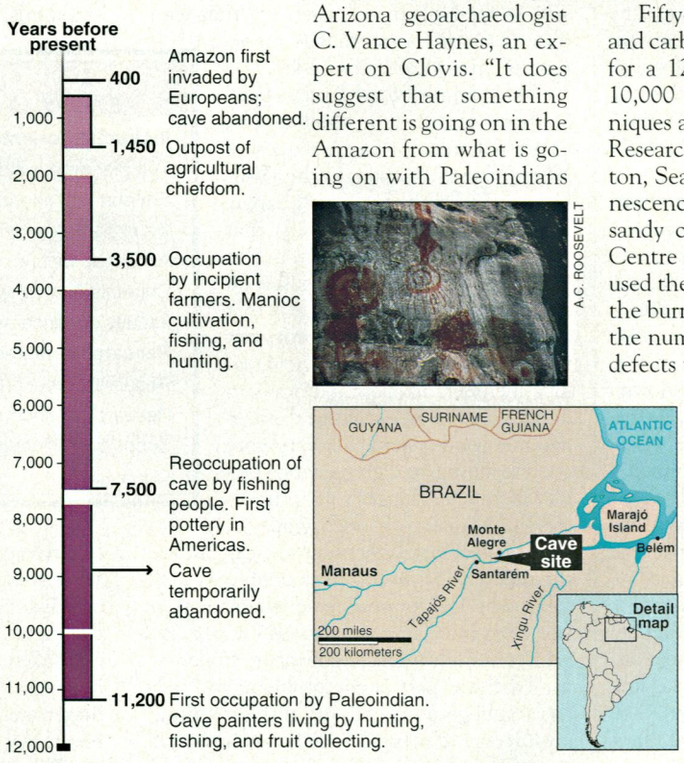
First Americans: Not Mammoth Hunters, But Forest Dwellers?

For archaeologists on the trail of the first Americans, fluted points found near the town of Clovis, New Mexico, in 1932 have been sharp indicators of the pioneers's identity. The points—10,900 to 11,200 years old and long accepted as the continent's oldest known human artifacts—were found among the bones of mammoths, leading to the conclusion that their makers were big-game hunters. Similar points have turned up since, helping to fill in a picture of these "Clovis people" as intrepid hunters who crossed a land bridge over the Bering Strait to Alaska, then swept rapidly across North America and into South America in pursuit of wide-ranging mammoths, mastodons, bison, camels, and other giant mammals.

But recently, evidence has been accumulating that the Clovis people may have shared the Americas with a different culture, one based on gathering fruits and nuts, fishing, and hunting small animals rather than felling mammoths. And a new excavation of a Brazilian cave, described on page 373, provides some of the strongest evidence yet for that notion. The new findings indicate that early Paleoindians were living in the Amazon jungle of South America at the same time as the Clovis people, 11,000 years ago, or shortly thereafter. Stone tools, lumps of paint, and the remains of their meals—including fruits, nuts, and bones—indicate these cave dwellers foraged for food in the forest and river basin, had their own distinct tool kits, and painted art on their cave walls.

"We found strong evidence that a culture quite distinct from the North American Paleoindian culture, but more or less contemporary with it, existed more than 5000 miles south, in this humid, tropical habitat," says Anna Roosevelt, an archaeologist at the Field Museum and the University of Illinois, Chicago, and lead author on the article.

These discoveries are surprising for another reason: Many archaeologists had assumed that tropical forests didn't provide enough food to support people until the advent of slash-and-burn cultivation, thousands of years later. But while questions have been raised about the dating of older sites in South America, such as Monte Verde in Chile and Pedra Furada in Brazil, most researchers agree that the dating of Roosevelt's site is solid enough to challenge this view. "It means you have people roaming around the Amazon very early," says University of Arizona geoarchaeologist C. Vance Haynes, an expert on Clovis. "It does suggest that something different is going on in the Amazon from what is going on with Paleoindians in the U.S." And some scientists say the differences mean that the Amazonians' ancestors may have arrived separately in a different migration over the Bering Strait—and perhaps they came over even before the Clovis people. "This suggests you could have had an earlier wave of people," says Ken Tankersley, an archaeological geologist at Kent State University in Ohio.



Early arrivals. Radiocarbon dates from a cave in Brazil indicate it was occupied from 11,200 years ago by people who gathered nuts, fished, and painted figures on cave walls *(photo)*.

Roosevelt and her colleagues have been excavating a warren of caves on a high plain 10 kilometers west of the lower Amazon River, in the sandstone hills of Monte Alegre—which means Happy Mountain in Portuguese—since 1991. A local school teacher led them to the most intriguing cave, Caverna da Pedra Pintada, where they found sandstone walls covered with red and yellow handprints and paintings of human-like figures, animals, and geometric shapes. Excavating layer after layer from the floor of the cave, they found burned food remains and stone tools.

In the deepest—and oldest—layers of the cave, the researchers found that the earliest cave dwellers left behind 30,000 stone chips and 24 stone tools, including two-sided projectile points, some of which had stems that probably were used on the tips of spears, darts, or harpoons—all sealed under a sterile layer of sand. The earliest inhabitants also left carbonized wood in hearths, and the remains of what they ate—thousands of fruits, seeds, and small and large fish and animals.

Fifty-six radiocarbon dates on the wood and carbonized plants put humans at the site for a 1200-year span between 11,200 and 10,000 years ago. Two other dating techniques also support the antiquity of the site. Researchers at the University of Washington, Seattle, used optically stimulated luminescence (OSL) on quartz grains from the sandy cave floor, and investigators at the Centre des Faibles Radioactivites in France used thermoluminescence (TL) on quartz in the burned stone tools. Both methods count the number of electrons trapped in physical defects within the quartz crystals: The electrons get trapped at a regular rate, forming the basis for a clock. In OSL, scientists release—and count—the trapped electrons by shining a bright light on the quartz; in TL, heat does the trick. Those methods usually produce older dates with wider ranges than radiocarbon dating produces. Indeed, they yield a spread of dates for the earliest cave layer that extend from 11,300 to 16,000 years ago, and Roosevelt argues that this bolsters the oldest of the radiocarbon dates.

Not everyone agrees with her on that point, however. There is a dispute about the accuracy of the dates at the older end of the radiocarbon range. Although Roosevelt argues for the first human occupation at 11,200 years ago, Haynes and some others feel 10,500 is safer. He and Tankersley say that any single radiocarbon date from a layer of soil is subject to error (the number of carbon-14 atoms emitted during each test can vary), so archaeologists usually take several dates from a soil layer and average them, giving more weight to the dates with the least amount of error. When Haynes averages the 14 earliest dates, for example, he gets a date of about 10,500. University of Massachusetts, Amherst, archaeologist Dena Dincauze agrees that the more recent dates are more reliable, noting that the earlier ones have larger error bars.

Roosevelt argues, however, that averaging is inappropriate for a cave floor that was repeatedly occupied for 1200 years, as it wouldn't point to the beginning of the occupation, but the middle. The average date also ignores the stratigraphy at the site, says Roosevelt. The oldest dates came from stone tools and burned seeds at the bottom of the earliest layer of the floor, while more recent dates came from artifacts just above them. And the oldest seeds produced a cluster of six dates contemporary with Clovis, with standard deviations ranging from 135 years to 300 years, which is less than the error bars on many dates from Clovis sites.

An argument over a rough 700-year spread may seem like splitting hairs, but that split is the difference between saying the people of Monte Alegre were among the first Americans themselves or descendants of the Clovis people. Haynes says: "My bias is they are descendants of Clovis." Those centuries may have been enough time for the Clovis settlers to move south, changing their tool kits and diet as they adapted to new terrain, he says. And there is archaeological evidence that people who made points similar to Clovis made it as far south as Panama, perhaps as early as 11,000 years ago, says Temple University archaeologist Anthony Ranere.

Other archaeologists, however, think that Haynes is cutting things too close. Even though Tankersley supports the younger dates for Monte Alegre, he says that Roosevelt's site is the latest in a series that shows humans using diverse tools and displaying diverse behavior at too early a time to be derived from the Clovis tradition. New technologies, he says, take more time to develop. Differences in tool kits found at sites in North and South America—including Hell Gap, Wyoming, Mill Iron, Montana, and Monte Verde, Chile—support the idea that there was more than one group of Paleoindians in America during this general period and that their ancestors may have come over in a different wave from that of the first Clovis people. Roosevelt agrees: "This is not Clovis. We haven't got the whole story. Something else was going on."

Although archaeologists may disagree about the initial occupation of Monte Alegre, they do concur that the cave adds other important details to the prehistory of the Americas. "This shows there were people living in the tropical rain forest before agriculture," says Gustavo Politis, an archaeologist at the University of La Plata and the University del Centro de la Provincia de Buenos Aires. For decades, many scientists thought no one could live in the jungle before agriculture because there wasn't enough starch in the plants to give them the calories they needed to survive. But the site shows that the people of Monte Alegre had a rich and varied diet from gathering fruit and nuts, fishing, and hunting animals in the forest. And over time, their descendants became increasingly sophisticated at surviving in the forest, setting up fishing villages on the shores of the river, developing pottery, and cultivating trees and crops on the uplands.

This cultivation, over thousands of years, has had an effect on the forest itself. "What's exciting about this is that it shows humans have been changing the forest from early on," says Dincauze. The clustering of plants, such as cashews, Brazil nuts, and certain palms, in parts of the forest today may be the result of prehistoric human activity, says Tulane University anthropologist William Balée. The so-called "virgin" forests of Amazonia may, in part, be the product of human hands.

–Ann Gibbons

PLANETARY SCIENCE

Gambling On a Martian Landing Site

Call it an exercise in anxiety. In a little over a year the Mars Pathfinder mission will land a small roving robot on Mars, giving planetary scientists their first close-up look at the Martian surface in 20 years. Unlike the Viking missions of the 1970s, done in costly style with two lander-orbiters, Pathfinder is arriving alone on a bulletlike trajectory. That leaves one chance to get the choicest scientific data about the planet's surface—and one chance to lose the entire mission if the lander falls on a steep slope or on a large rock. Last month, after two-and-a-half years of balancing considerations of scientific interest and safety, the Pathfinder project scientists finalized their choice of a landing site.

The effort was "fairly daunting," says Pathfinder project scientist Matthew Golombek of the Jet Propulsion Laboratory in Pasadena, California, who headed the selection process, and not just because so much is riding on the choice. "We just don't have any direct information on what the site looks like on a meter scale, which is what you're interested in for landing," says Golombek, despite 20 years of analysis of data from the Viking orbiters and landers. "It's terribly frustrating. So what you use is a suite of remote-sensing tools that let you infer something about the surface."

These inferences have led the Pathfinder team to a spot called Ares Vallis, where billions of years ago a huge flood burst from a narrow channel. What the probe will find there, team members hope, is a flat plain strewn with a geological treasure-trove of rocks from Mars's early days—but not so many rocks that they will endanger the lander. If the team has struck the right balance of prudence and curiosity, they will be richly rewarded. The craft might even encounter signs of now-vanished life. If they're wrong, they'll pay in lackluster data or a failed mission.

The design of the mission, the first in a series of landings and orbital observations whose ultimate goal is to return a bit of Mars to Earth in 2005, gave the researchers some severe constraints to start with. To be launched this December, the quarter-billion-dollar Pathfinder mission belongs to NASA's Discovery program, a series of "smaller, faster, cheaper, better" missions to the planets. Once it arrives at the red planet, "cheaper" will make for a thrill-packed descent: Instead of relying on expensive retrorockets to brake it to a soft landing, as the Vikings did, Pathfinder will streak into the upper atmosphere like a meteor, unfurl a parachute, briefly fire three small solid-rocket motors, and then free-fall the last 12 meters to the surface cushioned by airbags. The parachute is supposed to slow its speed from 1450 kilometers per hour to 155 kilometers per hour, but for the parachute to generate enough drag to do its job, the landing site has to be at a low altitude, where the atmosphere is thickest.

JPL

If all goes as planned... Roving robot will emerge from the Pathfinder lander, which rests on deflated air bags.

That took much of the planet out of the running, and other considerations eliminated most of the rest. The Pathfinder lander and its bread box–size robotic rover, nicknamed Sojourner, both rely on solar panels for generating electrical power. When