

A photograph of a person wearing a plaid shirt and blue jeans, using a shovel to dig into the ground. The ground is composed of dark, rich soil, likely Terra Preta, which is being excavated to reveal a layer of grey, charred rocks and debris at the bottom. The background shows a pile of dried banana leaves and other organic matter.

SUPER SOIL

THE MYSTERY OF TERRA PRETA

BY DANIELA WEIL

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The Amazonian rainforest occupies nearly half of the South American continent. Scientists call it the “lungs of the world” because its countless trees produce almost a quarter of Earth’s oxygen. Surely, you’d think, such rich forest must sit on fertile soil. Think again.

The truth is that beneath this dense forest lies possibly the worst soil in the world. Known as “oxisol,” this sandy, reddish dirt is highly acidic and poor in nutrients. Year after year, most people who attempt to farm in this region fail. They burn down the forests for their fields, but only succeed in creating ecological catastrophes and barren farms where nothing grows.

That is, unless they find *terra preta*, or Amazonian dark earth.

What is terra preta? Found scat-

tered throughout the jungle, it is a super soil, perhaps the most fertile soil on the entire planet. Its composition and origin have captured the curiosity of scientists. And because this soil holds a surprising number of ancient human artifacts, archaeologists who study it have unraveled some of the mysteries

about the people who lived in this land in prehistoric times.

TREASURE IN THE AMAZON

In the 1540s, the Spanish explorer Francisco de Orellana sailed down the Amazon

River looking for El Dorado, a legendary lost city of gold. He never found it. But he did describe seeing big civilizations in the midst of the jungle—cities with thousands of people, roads, canals, and complex societies.

Strangely, the civilizations that Orellana described were never seen again. All evidence points to the

region back then looking much as it does today: a few hundred Indians living in small, scattered tribes.

We know very little about prehistoric Amazonians. Their culture and traditions were passed down by word of mouth, just as they are today. Because they did not use writing, much of their history has been lost. There’s no trace of a lost civilization—until you look more closely at terra preta.

The first settlers who came to live in the Amazon region in Brazil learned about this amazingly fertile soil from the Indians. They called it *terra preta de Índio* (in Portuguese, “Indian’s black earth”). Scientists first learned about it in the 1870s. Today, researchers refer to it as TPI.

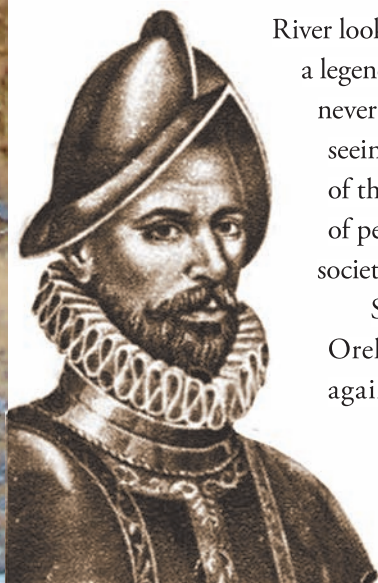
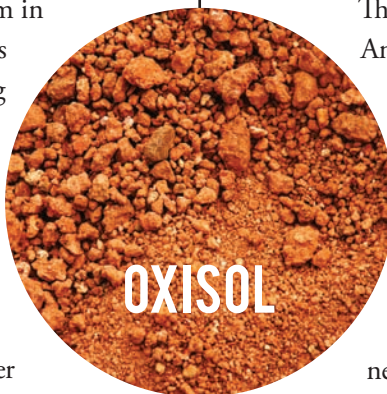
But where did the rich soil come from? Researchers argued about this for nearly a century. Some suggested that TPI had formed naturally from organic material in extinct lakes or from volcanic ashes. They believed ancient Indians had looked for these fertile areas and settled on them—hence the human artifacts and remains.

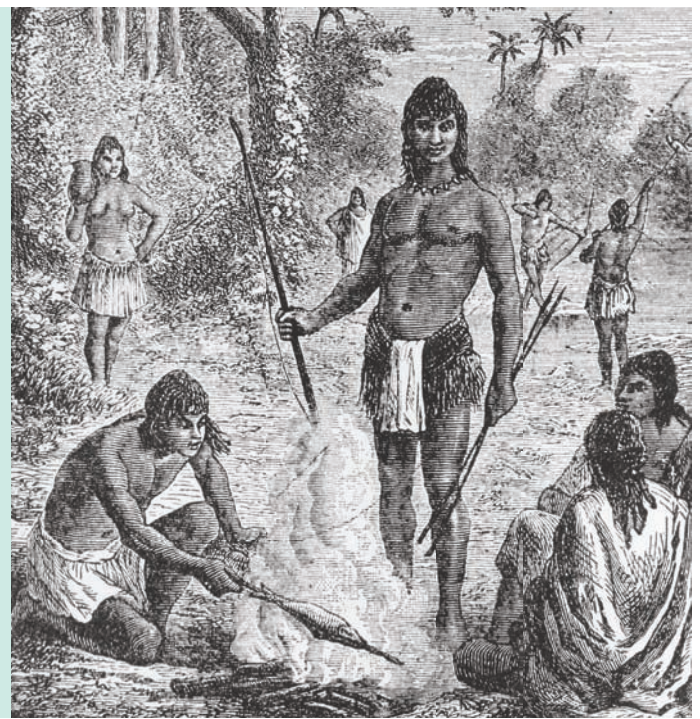
More recently, researchers studied the soil’s composition. They found plenty of nutrients including nitrogen, phosphorus, calcium, zinc, and manganese. The soil is also packed with organic matter (decayed plants, animal and human feces, and bones from fish and other animals). One more surprising ingredient makes this soil different from all other soils: charcoal. TPI contains more charcoal than any other soil on Earth.

Scientists used carbon dating to estimate the age of the charcoal, along with the organic remains and artifacts. The results revealed that TPI is about 2,000 years old, pointing to one conclusion: this super soil was made by humans.

A HAPPY ACCIDENT?

Picture a village in the jungle about 2,000 years ago. Houses are built from dried palm leaves. Outside, women cook in clay pots over a fire. Behind each home is a trash pile holding fish bones, fruit, and old roof leaves. A child uses a bush as a natural toilet. Over time,





Terra preta sites in the Amazon (left) hold clues to how native people lived hundreds of years ago (right).

all this organic matter decomposes to create fertile soil. It's like a huge, prehistoric compost pile.

But what about the charcoal?

Claide Moraes, a professor of Brazilian archaeology at the Federal University of Western Pará, has studied TPI for over a decade. "The traditional way to get rid of garbage in the Amazon is by burning trash," he points out.

This kind of slow, low-temperature burning turns organic matter into charcoal without totally disintegrating it, he explains.

If you cut down trees and burn them completely—a process called slash-and-burn—all you'll see left behind is a heap of powdery

ashes. You'll also release high amounts of carbon into the air, contributing to global warming. Amazonians, on the other hand, used a technique called "slash-and-char." They didn't burn wood all the way. It was an environmentally friendly process that released much less carbon into the air.

It turns out that charcoal is an amazing natural fertilizer. It also acts like preservatives in food: it makes the soil stay fertile for thousands of years. Charcoal's neutral pH (not

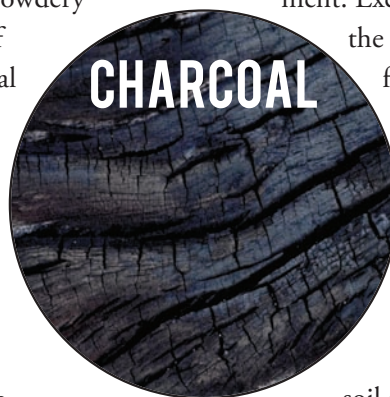
acidic, like oxisol's) also helps preserve the ancient artifacts as well as the animal and human remains embedded in the soil. Today, pedologists (soil scientists) call charcoal that's produced by slash-and-char "biochar." It can be used as a fertilizer.

So did Indians make TPI intentionally, or was it all a happy accident? This question still intrigues scientists today.

The large quantities of biochar could mean they were manufacturing it and adding it to the soil on purpose. After all, farming with TPI meant they didn't have to pack up and leave to search for new farmland every few years.

However, some archaeologists make a different argument. Excavations reveal that most TPI occurs in the "downtown" areas of villages—not where farming was typically done. Also, food remains found in TPI show that protein (animal-based food) was plentiful. So perhaps farming wasn't that important to the ancient Indians—which means manufacturing TPI wouldn't have been worth the effort.

Perhaps Indians manufactured the soil intentionally, but not for farming. Maybe they used it for smaller backyard gardens. Or maybe it even helped them with hunting—fruit trees growing



on TPI from discarded seeds would have attracted more animals that the Indians could kill and eat.

THEN AND NOW

The riddle of terra preta does not end here. Archaeologists are researching dozens of TPI sites throughout the Amazon. Every piece of pottery, splinter of chipped rock, fish bone, and clod of charcoal they collect helps them form a picture of the people who lived there thousands of years ago.

“One of the principal findings of my research,” Moraes says, “is that around one thousand years ago, there was a period of peak human occupation in the Amazon.” Moraes and his team now believe that more Indians may have lived in the ancient Amazon than anywhere else in Brazil, perhaps numbering in the hundreds of thousands. This is different from all previous theories of human occupation in the Amazon.

Archaeologists have also uncovered evidence of a highly sophisticated system of water channels, roads, and war trenches. Some TPI sites are so large that they may have been the sites of big cities, like the ones described by Orellana.

However, by the time the Europeans arrived in the 1500s, there had been a major decline in the Amazonian civilization. “In this period, we



Researchers excavate artifacts left behind by ancient Amazonians.

start seeing evidence that these populations became so big that they started to come into conflict with each other,” Moraes says. The arrival of Europeans, bringing guns and diseases and causing a major loss of habitat, further reduced the native population.

For today’s Amazonians, TPI means a good way to grow food. Anything they plant in it grows. For archaeologists, it is the key that can solve the mysteries of lost prehistoric civilizations.

But pedologists around the world have their eyes on one element of terra preta in particular: biochar. If they could replicate the amazing recipe of TPI, it could improve poor soils globally. Some studies suggest that biochar added to oxisols can increase crop yields by 800 percent.

Even the process of making biochar is a kind of ecological magic. Carbon gets locked into the charcoal, rather than being emitted into the air. This means sending far less carbon into the air than with slash-and-burn. Scientists think biochar could be a major player in reducing global warming.

It looks like the Amazonian El Dorado may have finally been found. But it is not gold—it is black. 🐸

Daniela Weil is a writer and illustrator living in Texas. She grew up in Brazil but has never stumbled across El Dorado. (Though she might not tell us if she had.)



Adding biochar to poor soil can dramatically boost its plant-growing power. In this experiment, the corn on the left was grown with biochar.