

DIG THIS!

About 223 million years ago, a swampy pond in Petrified Forest National Park, one surrounded by towering trees and lush ferns, was teeming with a melting pot of otherworldly creatures. Today, paleontologists – and students from the park’s field institute – are digging through the dirt in search of rare fossils. And anything else they can find. By Annette McGivney | Photographs by John Burcham

A LONG TIME AGO, when the Earth was young and all the land on the planet existed as one giant continent called Pangaea, there was a swampy pond just north of the equator that was teeming with a melting pot of otherworldly creatures (see page 10).

Located along the western coast of Pangaea, this freshwater bog was ruled by the phytosaur, a top-of-the-food-chain predator that looked similar to the modern-day crocodile but grew to 30 feet in length. The pond was surrounded by towering coniferous trees, horsetails and ferns. A dog-sized reptile called an aetosaur, covered with plated armor, nibbled along the shore as fish with beaks broke the surface of the murky water. The pond existed during the Triassic, a period that followed the greatest mass extinction in the Earth’s history but preceded when giant dinosaurs dominated the landscape. The creatures hunted, mated, slept, defecated and died here. It was their home.

About 223 million years later, I am kneeling in the middle of waterless badlands, carefully picking apart dirt clumps that used to be the muddy bottom of the swampy pond, looking for traces of creatures that lived in this corner of Northeastern Arizona eons ago. As a participant in a fossil excavation class hosted by the Petrified Forest National Park Field Institute, I am getting to play paleontologist for a day and indulge my imagination as I dig. Maybe it’s the midday



PRECEDING PANEL: Volunteers and park employees participate in an August 2016 fossil excavation class at Petrified Forest National Park.

August sun baking my brain, but I can almost see the shadow of something very big, with a lot of teeth, sneaking up on me.

“The No. 1 rule in the quarry is that if you can’t find your digging tool, you’re sitting on it,” jokes Bill Parker, the park’s lead paleontologist and chief of science and resource management. Parker is surveying our group of seven students and six park staff, all bent over the ground as if we’re looking for a lost contact lens. After trekking for about a mile across a roadless area, carrying tools, water and gear boxes, we’ve ended up at this barren hillside, which looks like an empty parking lot but is a fossil-rich quarry site that Parker says “has not disappointed” since his staff began excavating it four years ago.

Parker, 49, has been shaking up the somewhat staid paleontological world since he arrived at Petrified Forest 15 years ago. He keeps the park on the leading edge of new discoveries and sometimes disproves long-held hypotheses



about the Earth’s ancient history. While Parker specializes in vertebrate paleontology and has authored or co-authored dozens of scientific papers in peer-reviewed journals over the past decade, he’s also made the study of Petrified Forest’s ancient riches an inclusive endeavor. In addition to encouraging academic paleontologists from all over the world to conduct research in the park, Parker invites the public to take part in excavations.

“The park’s study of fossils has really bloomed under Bill,” says Matt Smith, Petrified Forest’s museum curator, as he thrusts a shovel into a scree-filled hillside. Smith has been working at Petrified Forest for seven years and has witnessed the park’s scientific renaissance. His boss commandeered the facility’s laundry room and turned it into a lab where fossils are now sorted and studied. “We’re doing what I call Tom Sawyer paleontology,” Smith says with a laugh. “That means getting others to do the digging for us.” The free help has paid off in spades — not only for citizen scientists thankful for the experience, but also for the larger scientific community.

The park’s nonprofit educational affiliate, the Petrified Forest Field Institute, hosted its first season of citizen fossil digs in 2015. In August of that year, one of the participants, Stephanie Leco, unearthed a fossil that proved to be a species



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ABOVE, LEFT: Bill Parker, who’s been at the national park for 15 years, has worked to include the public in the park’s paleontology studies.

ABOVE: Parker and another park employee carry some of the tools used for fossil excavation.

of prehistoric fish thought to have been extinct in present-day North America during the Late Triassic. But the site where the dig took place — the swampy pond — was home to creatures from that time period. The find made national news and inspired Leco to bone up on her paleontology so she could give informed answers to a whirlwind of questions from the media.

After hitting the jackpot on her first fossil dig, Leco has returned for more. She is kneeling in the dirt beside me and using a rock hammer to split a clump of dirt. This time, Leco brought her boyfriend, Alexander, and her roommate, Taylor, to share in the experience. Our class also includes Parker’s son Zachary, who recently turned 12 — old enough to meet the field institute’s age requirement for a citizen dig. And Zachary

has brought along his best friend, Tate.

Parker says the rocky hillside where we’re digging used to be the eastern edge of the swampy pond, which once was 1 to 2 kilometers across. As the morning sun gradually climbs above our heads, we attack gray, hardened clay with picks and shovels to dig a trench, about 2 feet deep, that exposes a Triassic treasure chest. A 6-inch layer of fossil-rich soil contains at least 100,000 years of the pond’s history. Parker puts some of the soil from the bottom of the trench in his mouth to see if it tastes like silt instead of clay. Yes, he confirms to those nearby, we have hit pay dirt.

Now the real work begins. We switch to awls and whisk brooms for gentle soil removal, so we don’t destroy what could

be a world-famous find. Zachary and Tate's excitement is palpable and rivaled only by that of Leco. She's tasted the thrill of discovery at this quarry site once; could she get lucky again?

"We aren't just looking for fossils," Parker says. "We're trying to figure out the story of the Earth, going layer by layer, to find out what was happening to plants and animals at that time. I guarantee you are going to find phytosaur poop and teeth today. But go slow, because you also might find something new to science."

"A lot of fossils are just like shards of glass held together by mud," Smith adds. "This place is a jumble of bones, like a crime scene. It is full of weird Triassic stuff."

ALTHOUGH PETRIFIED FOREST is best known for its namesake logs, incongruously scattered across the treeless landscape, the national park also contains an important fossil record of the Earth's Late Triassic, with rocks that span in age from about 205 million to 225 million years. The Late Triassic was a time when many of the animal species that exist today were first getting a toehold on the slippery slope of evolution. The earliest ancestors of mammals, lizards, turtles, crocodiles and dinosaurs (which include modern birds) originated during the Late Triassic.

While this rich chapter in the Earth's history is impossibly

buried across much of the planet, it exists as an open book in Petrified Forest, where it is preserved in an exposed sedimentary layer called the Chinle formation. What today are barren gray, blue and pink badlands in Northern Arizona's Painted Desert were once a broad, semi-tropical river floodplain in western Pangaea. Frequent volcanic activity and continental uplift caused the rivers to frequently flood and change course. Animals were suddenly entombed in silt, creating a prime environment for fossilization. By the end of the Late Triassic, Pangaea began to split apart, and the land that is now the American Southwest continued to drift north, where it transformed into a desert but kept its fossilized secrets intact.

In 1905, naturalist and author John Muir visited Petrified Forest and made the first known collections of vertebrate fossils from the area. His writing about the scenic and historical value of the land helped motivate President Theodore Roosevelt to create Petrified Forest National Monument in 1906. The preserve was protected as a national park in 1962. Even though paleontologists have been conducting research in Petrified Forest for more than a century, it wasn't so aggressively pursued

Much of the paleontology work at Petrified Forest National Park occurs in an exposed sedimentary layer called the Chinle formation.

as a public endeavor until Parker came along. Brad Traver, the park's superintendent since 2011, has also sought to make Petrified

Forest more welcoming to the public. Concerns about theft of petrified wood caused previous superintendents to try and keep the park a secret, but Traver wants to protect the natural resources by publicizing Petrified Forest's treasures.

"We do groundbreaking research here," Parker says. "We've found fossils of several hundred types of plants and animals in the park."

Considering there are fewer than 300,000 fossil species ever discovered on the planet, the explosion of activity at Petrified Forest over the past 15 years is significant. In addition to Leco's find during the August 2015 citizen dig, Parker and his staff have discovered a new species of herbivorous reptile, *Scutarx deltatylus*, and a new class of carnivorous reptile called an azendohsaur. In addition, Parker's study of specimens found in the park of a crocodile-like creature called *Revueltosaurus callenderi* disproved a theory that the species was a dinosaur. His research helped show that dinosaurs didn't dominate the Earth until the Jurassic period, which followed the Late Triassic.

In 2004, Congress authorized buying 125,000 acres surrounding Petrified Forest to expand the park. But the bill didn't come with funding, and it took more than a decade to acquire 60,000 acres of ranch land that park staff identified as being most important for paleontological research and archaeology. The rest of the authorized land is still waiting for funding.

"Before we owned the land, I used to stand at the fence and drool," Parker says of one of the new purchase areas — Billings Gap, on the eastern end of the national park. "After the park boundary expanded in 2013, we found a phytosaur skull on the very first dig."

Parker discovered that Billings Gap once was home to the swampy pond.

"AWESOME!" ZACHARY EXCLAIMS as he unearths a 2-inch-long tooth as sharp as the tip of a steak knife. Parker says it is likely a phytosaur tooth, and he uses his phone to document his son's first paleontological find. Meanwhile, Tate discovers a tooth that's 3 inches long. Both boys wrap the specimens in toilet paper and place them in zip-close bags for later examination in the lab.

Park staff members work alongside the students to instruct us on our digging technique and help us discern fossils from rocks and mud. As Parker predicted, I'm finding mostly poop — smooth, round rocks the size and shape of elk droppings. I learn the scientific term for fossilized feces is coprolite.

"You can tell it's a coprolite by cracking it open and seeing its mineralized contents," says seasonal paleontologist Larkin McCormack, who's patiently coaching me on my rather impatient digging.

The numerous coprolites that I peel away from ancient mud are filled with sparkling red, white and pink crystals. I roll the fossils around in my hand and imagine how they once contained the remains of a meal enjoyed by a prehistoric creature.

Wind around the quarry kicks up as silver curtains of



Bill Parker's 12-year-old son, Zachary, holds a fossilized tooth he discovered during the August 2016 dig.

monsoon showers rotate across the horizon and creep toward us. Fat raindrops start to fall, and many of us stop digging to hurriedly find plastic bags to protect our cameras and phones. But Leco remains kneeling in the dirt, smiling at the ground as she uses a whisk broom to gently bring a potential fossil into relief. Digging for dinosaurs and other prehistoric creatures has been a dream for Leco since childhood. Her discovery last year allowed her to realize that dream beyond anything she imagined when she was a little girl.

"Digging for fossils fascinates me," she says. "It's the chance to be the first to see something that's been buried for millions of years. It's the full weight of time and science in the form of bone fragments that have survived long enough to be held in your hand."

While our dig doesn't produce anything as significant as Leco's discovery from 2015, Parker tells me later that our class, along with two others in the summer of 2016, still makes an impressive haul. The fossil finds include numerous teeth of what could be a new species of amphibian; a *revueltosaurus* tooth, possibly the oldest ever found in the park; a metoposaur's partial skull and other bones; the snout of a juvenile phytosaur, along with numerous phytosaur teeth and bones; various small reptiles; and fish bones.

After five and a half hours of digging, it's time to pack up the specimens and gear, then hike back to the vehicles. The Earth is rotating on its axis, just as it did 223 million years ago, and the sinking sun casts the quarry in a golden light.

Everyone is exhausted and satisfied, especially Tate. He found 16 teeth, the most among our group. Tate puts a shovel over his shoulder and looks back at the site of the swampy pond. His cheeks are bright red from the heat, his hair is wet with sweat, and he has a big smile across his face. "This was the most fun I had all summer," he says. **AH**

To learn more about upcoming citizen fossil digs and other classes offered by the Petrified Forest Field Institute, call 928-524-6228, Ext. 239, or visit www.petrifiedforestfieldinstitute.org.

