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published by UNC Research

Features · Saturday, January 1, 2000

The Predator In The Stone

North Carolina's Triassic Terrorist

by Neil Caudle

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The beginning we'll have to imagine.

It might have been late afternoon. To the west, on the flanks of the mountains, shadows descend on the conifers, restless and dark. Near the edge of a stream, a slender, long-legged reptile wades out on an apron of mud. The mud is too soft. He mires in it, thrashing. And that's when the predator charges, wading upright on hind legs through the mud, clamping down with its five-fingered hands, and biting so hard and so deep into the neck of its prey that the teeth penetrate the vertebra, crushing the bone. The predator tries to drag its victim back to the bank, but the mud is too soft. He staggers and topples, and sinks belly-down in the mud.

Buried together, their bodies decompose. The mud hardens around them, the hip of the predator pressed to the spine of its prey. Continents divide. Africa tears itself away, heading east. Time piles up layers on layers of stone.

And then one day in September 1994, Brian Coffey, an undergraduate geology student at Carolina, strolls around in a brick quarry somewhere south of Durham, studying ancient river deposits. He's brought along his roommate, Marco Brewer, an anthropology major. They hike up and down the undulating bedding horizons, where a bulldozer

has shaved off chunks of the sandstone. The afternoon wears on, and they are just about to leave when they cross a dried-up wash, and Coffey, already the sort of geologist who reads the earth's fine print as he goes, spots a grayish speck of bone.

He finds another, and another-a trail of them like bread crumbs, scattered up the wash. Coffey and Brewer follow the trail uphill, finding larger and larger fragments, until Coffey can't take the suspense.

"Forget these little pieces," he says. "I'm going up *there*." He scrambles up to the source of the wash and drops to his knees in a semicircle of bone. He and Brewer pick up chunk after chunk, dropping them into sample bags. Then Coffey begins tapping at the soft stone with his rock hammer. The pick of the hammer smacks something hard.

It takes his breath.

"Whoa," he says. *"Whoa."*

The next day, Joe Carter, professor of geology, looks up, and here's Brian Coffey holding what appears to be an enormous anklebone.

Yes, Carter is interested. But at this moment, he has not agreed to double his workload for the sake of this fossil, whatever it is. After all, Carter's specialty is the microstructure of mollusks, and this thing Coffey has brought him is certainly not a clam. Yes, Carter understands vertebrate paleontology. He's taught a course in it for 20 years, and he's written a guide to the fossils of North Carolina. So he knows, even before the anklebone has been cleaned, that it belongs to a reptile, very large and very old. What he doesn't know, yet, is that this creature is about to swallow a very big chunk of his life.

Carter has to do some fast thinking. Triangle Brick Company, which operates the quarry, says, sure, you can

collect the fossil, but please do it soon. The bulldozers are waiting. So Brian Coffey, Marco Brewer, and several students in Carter's paleontology class go to work in the quarry. Under Carter's direction, they pry out some big chunks of sandstone, label them carefully, and haul them away. They lug 150 pounds of rock into the geology lab.

The beast has arrived, but nobody knows exactly what it is. It is certainly reptilian, and old-late Triassic, which preceded the Jurassic and Cretaceous, the age of dinosaurs. The only large reptile of the Triassic ever found in North Carolina was a phytosaur, a relatively common, crocodile-like animal. So, for the time being, Carter and his students assume that they're working on some kind of phytosaur.

Phytosaur or not, the beast is taking over Mitchell Hall. Since there is no vertebrate paleontology lab, let alone a full-time staff to do the prep work, Carter carves up his office and gives away half to the fossil. More and more, these days, Carter feels the fossil demanding his attention, like a riddle that wants to be solved.

"This is something special," Carter tells himself. "This is the kind of thing that comes along maybe twice in a lifetime." Maybe the time has come to diversify-to make some room among his bivalves for these anonymous bones.

For a while, the project gets spare-time attention from Carter, and from Coffey and Brewer, who have even been cleaning a few of the bones in their kitchen at home.

"We're thinking, this will be fun, an exercise in learning how to do this," Coffey says. "Since we found all of these pieces together in one place, we knew they belonged together. So it's sort of like working a jigsaw puzzle, except you don't know how the picture is supposed to turn out."

On study breaks, Coffey wanders down the hall to Carter's lab and works on the fossil. Carter, meanwhile, immerses himself in Triassic vertebrate paleontology, reading

everything he can find. He and the students assemble an ankle, a hip, and a leg. They begin to suspect that this creature is no phytosaur.

So Carter calls up Paul Olsen from Columbia University, an expert on Triassic fish and reptiles. Olsen arrives in Chapel Hill, studies the fossils for a few rapid heartbeats, and says, "You've got something good here. And you don't have just one creature. There are fragments of three or four creatures. This one was here and this one was here…"

As he sorts his way into the largest of these animals, Olsen begins to recognize pieces that seem, as they say in the field, "diagnostic." Among them is a pubis bone-a long, post-like structure projecting down from the pelvis. This pubis bone has a boot-shaped end, like a dinosaur's. But this beast was not a dinosaur. The foot and ankle, which come out of the sandstone largely intact, look crocodilian. The only animal with a booted pubis bone and a crocodilian ankle is a big Triassic predator never before found in the eastern U.S. It is a rauisuchian.

The word seems as alien as the creature itself: *raw ih SOO kee un*. When they were first discovered, the rauisuchians were thought to be ancestral to dinosaurs, but they are not. They occupy their own evolutionary branch, one that dead-ends during a mass extinction at the close of the Triassic. They were predators, and they bore some passing resemblance to crocodiles, but they prowled dry ground more like lions or bears. They have even been called "bear crocs."

Let that notion percolate a minute. *Bear crocs*. Nature, in a wildly experimental rehearsal for *Tyrannosaurus rex,* concocted something like a fusion of crocodile and grizzly bear and set it loose on the semiarid, tropical landscape of Pangea, to terrorize every living thing. It was burly and powerful, and it could rise up on its back legs, or charge on all fours.

"Children will see a picture of this and call it a dinosaur, because it looks like a dinosaur," Carter says. "But it's not. It was Nature's first attempt to build a dinosaur-like predator. And it almost was a dinosaur. It just had the wrong feet."

The rauisuchian was a plodder, not a sprinter. Its foot landed flat on its heel (much like the foot of another incompletely evolved biped-man). Dinosaurs walked on their toes, as horses do, which made them faster and more agile than the rauisuchians. But during the late Triassic, while the diminutive ancestors of dinosaurs were scampering around in the underbrush, this rauisuchian was ruling the late Triassic roost. The beast was engineered to kill, to take its prey alive and to swallow smaller animals whole.

This one was well preserved. As the skeleton lay buried, intermittent periods of drying and wetting leached calcium out of the mudstone and coated some of the bones. When Carter and his students flaked away the calcite glaze-milky gray, like a sugar coating-the bone underneath was pristine.

Even the skeleton's position in the sandstone was remarkable. The rauisuchian did not lie on its side, as you would expect to find an animal that has died and fallen, or one washed away in a current. It was belly-down, as if it had sunk in the mud. The bulldozer had scraped away some of the upper skeleton, including most of the skull. This makes sense, to Carter. When a reptile dies, he says, a massive ligament that holds its neck upright tightens, pulling the head up and back, where it would be the first part exposed by the blade.

Work on the fossils gathers momentum, even though Brian Coffey has moved on to graduate school in geology at Virginia Tech. By now, the rauisuchian has attracted a steady stream of students. A fraternity of fossil conservators organizes in Mitchell Hall. New pledges do the routine chores until they prove they can handle the brushes and dental picks or have a knack for puzzle-matching bone.

One of these students, Sam (please don't call her Samantha) Harlow, turns out to be very handy using a microscope to align small bits of fossil by matching the tiny marks of striation in the bone. It is tedious, exacting work, but something about it compels her.

"There's a sense of awe to be working on a creature that was alive two hundred and twenty-one million years ago," she says. "All of us who have worked on this get incredibly emotionally attached to this animal, because you look at the bones and you see the creature fleshed out and running around."

The team includes David and Matthew Campbell, brothers and geology students, and Margaret Moncure, a student from the University of Michigan, who gets wind of the project and arrives to help work on the hip. Carter and his students clean and assemble bone after bone, working on pieces of several animals without knowing exactly where one ends and the other begins. Eventually, the outlines of a second reptile, smaller and more slender than the rauisuchian, begin to emerge.

So Carter calls on Paul Olsen again, and Olsen and Carter spend a weekend in Mitchell Hall. By Sunday, they are recognizing the diagnostic parts of the slender reptile, which had been pinned underneath the rauisuchian. Once they know what they're looking for, they find it everywhere-and fast.

"We were actually running up and down the hallway, bringing each other pieces of this thing," Carter says. "After a half hour, we had all of it together, and we screamed. Literally screamed. Our chairman was working in his office, and he came out in the hall thinking a couple of kids were carrying on."

The animal is worth the commotion. It is a rare, crocodile-like sphenosuchian, perhaps the best-preserved example of its kind from the Late Triassic. A gash in its neck bones

suggests to Olsen a lethal bite wound.

But there's more. In the muddy sandstone where the rauiscuhian's belly would have been, Carter's team uncovers a tableau of the creature's last meals. Mingled with various broken bones are bits of armor plating from an armadillo-like reptile, and the bones of a cat-sized animal, *Plithogomphodon herpetairus,* a relative of the reptiles believed to be ancestral to mammals.

There is no way the geology department can work on all of these fossils at once, so Carter hands the near-mammal and the sphenosuchian off to Paul Olsen and to Hans-Dieter Sues at the Royal Museum in Ontario, Canada. But the rauisuchian would remain at home. Carter knows that this fossil is the largest land-dwelling Mesozoic vertebrate ever discovered in the Triassic rocks of North Carolina. It may even be the most important fossil ever found in the state.

"We decided that this should be a North Carolina project," Carter says. "We would use consultants outside the state, but most of the work will be done right here."

Even so, Carter worries that the project will demand more time than he can afford. While it is just fine for undergraduates to help clean and conserve the fossils, the detailed analysis of the rauisuchian will require hundreds of hours of careful calculation. Since there is only one of Carter, and work enough for two, what he needs is a research partner, a graduate student who could specialize in vertebrate paleontology. But where would he find one of those?

Sometimes, the lightning bolt of luck strikes twice in the same laboratory. For Joe Carter, the second bolt had just arrived. From Switzerland.

Karin Peyer is destined to be a vertebrate paleontologist. There is no doubt about that. In Switzerland, she was well on her way. But then she hit a major snag. She landed in

North Carolina, of all places, because her husband, Urs, had come to Carolina to work on a Ph.D. in finance. She is a long way from home, and a long way, she believes, from the bones of any giant reptiles.

And then she meets Joe Carter. And he shows her the fossils. They are breathtaking. Some of them are so immaculately preserved that they almost seem to have materialized from Karin Peyer's dreams. Carter is asking her if she would like to work with these fossils. Yes. The answer is yes.

Carter, Peyer, and Sam Harlow assemble key pieces of the arm, and the size and shape of the creature snap into focus. Carter and Peyer begin drawing the animal life-size, carefully inking each piece of the skeleton into a silhouette that covers a wall. With a small grant, Peyer flies to Europe and studies rauisuchian specimens. Carter has already traveled to Germany and to Texas on the same sort of mission. Back in the lab, they compare notes. Most of the fossils they've seen are not as robust in the shoulder as the Carolina example, which probably measured 11 feet long and weighed just under a ton. North Carolina's rauisuchian also differs from others in another crucial part of its anatomy, its hand, which is virtually complete, right down to the claws.

"We have the most perfectly preserved hand of any rauisuchian," Carter says. "And I think for the very first time, we know what the hand structure was like."

The digits were short and stout, and the thumb and first finger overlapped, near the wrist, with a strangely interlocking, tongue-and-groove joint. This feature doesn't appear in any of the other 24 rauisuchian specimens on record. Because of that joint, Carter and Peyer are certain they are working with a new species.

"This particular hand is unique among rauisuchians and perhaps even among reptiles," Carter says. "To link bones

together like that is going to make them stronger, which is compatible with the fact that this guy probably had a very powerful forelimb."

Ridges on the lower arm were probably muscle insertion spots, indicating that a strong muscle joined the forearm with the upper arm.

"All of this adds up to an animal with very powerful arms that could grab onto things and hold them very firmly until it made its kill," Carter says.

The rauisuchian was big and strong, but not necessarily healthy. Carter and Peyer find large, round pits-abscesses-in several parts of the skeleton, probable signs of systemic disease. For Carter, this deepens the mystery. Was the creature already dying as he attacked his prey, too weak and sick to climb out of the mud? Or did the rauisuchian die and then happen to wash up with the sphenosuchian?

We will never know the answers for certain, of course, but for Carter and his students, five years of painstaking work has uncovered more than enough detail to flesh out a sensational new beast for the state's prehistoric menagerie. When work on the fossil is finished and published, and Karin Peyer has extracted what she needs for her master's thesis, the bones will travel to the North Carolina Museum of Natural Sciences, which is already preparing an exhibit.

By then, Joe Carter will have reclaimed a big chunk of his life.

"I don't plan to become a vertebrate paleontologist," he says. "But I couldn't pass up an opportunity like this-for me, for my students, or for North Carolina. Sure, this was a shift, a change of direction for me. But every paleontologist learns to be a jack-of-all-trades. Whether we study vertebrates or invertebrates, we use the same tools."

Meanwhile, in Blacksburg, Virginia, Brian Coffey is

working on a doctorate, mapping the rocks of the coastal plain from the early Cenozoic. He will always remember the fossils as a sidetrack, an exciting diversion. But he goes for rocks, not the animals inside them. And for Coffey, the looking, not the finding, is the point.

"When you're a geologist," he says, "you get in the habit of looking for something, wherever you are. That day in the quarry, we just happened to find something neat."

Neil Caudle was the editor of Endeavors *for fifteen years.*

Peyer studied fossils in Europe using a travel grant from the Martin Fund. Carter studied fossil rauisuchians in Texas and Germany using a travel grant from the University Research Council. Recently, Carter received an award for the best paper of the year from the Journal of Paleontology. The paper, "Thermal potentiation and mineralization evolution in the bivalves," describes how long-term changes in the composition of bivalve shells correspond to changes in global climate.

Learn more:

- Dinosauria.com's Rauisuchians
- Dr. Ron Blakey's Geology Site
- Douglas Henderson's Triassic Earth History Illustrations

From the Winter 2000 issue of *Endeavors*.