Dinosaur bones are home to microscopic life

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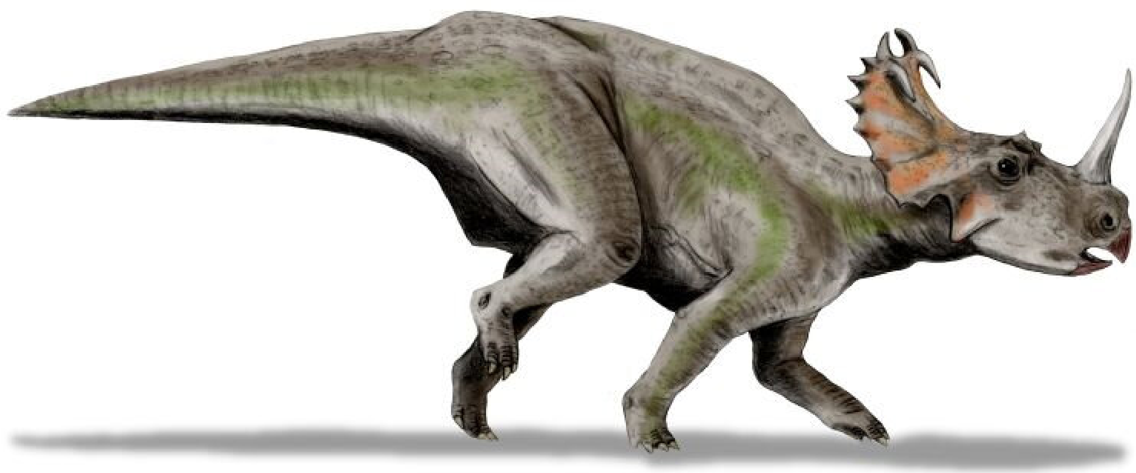


Centrosaurus, the Triceratops relative whose bones contained modern microbes. Credit: Nobu Tamura

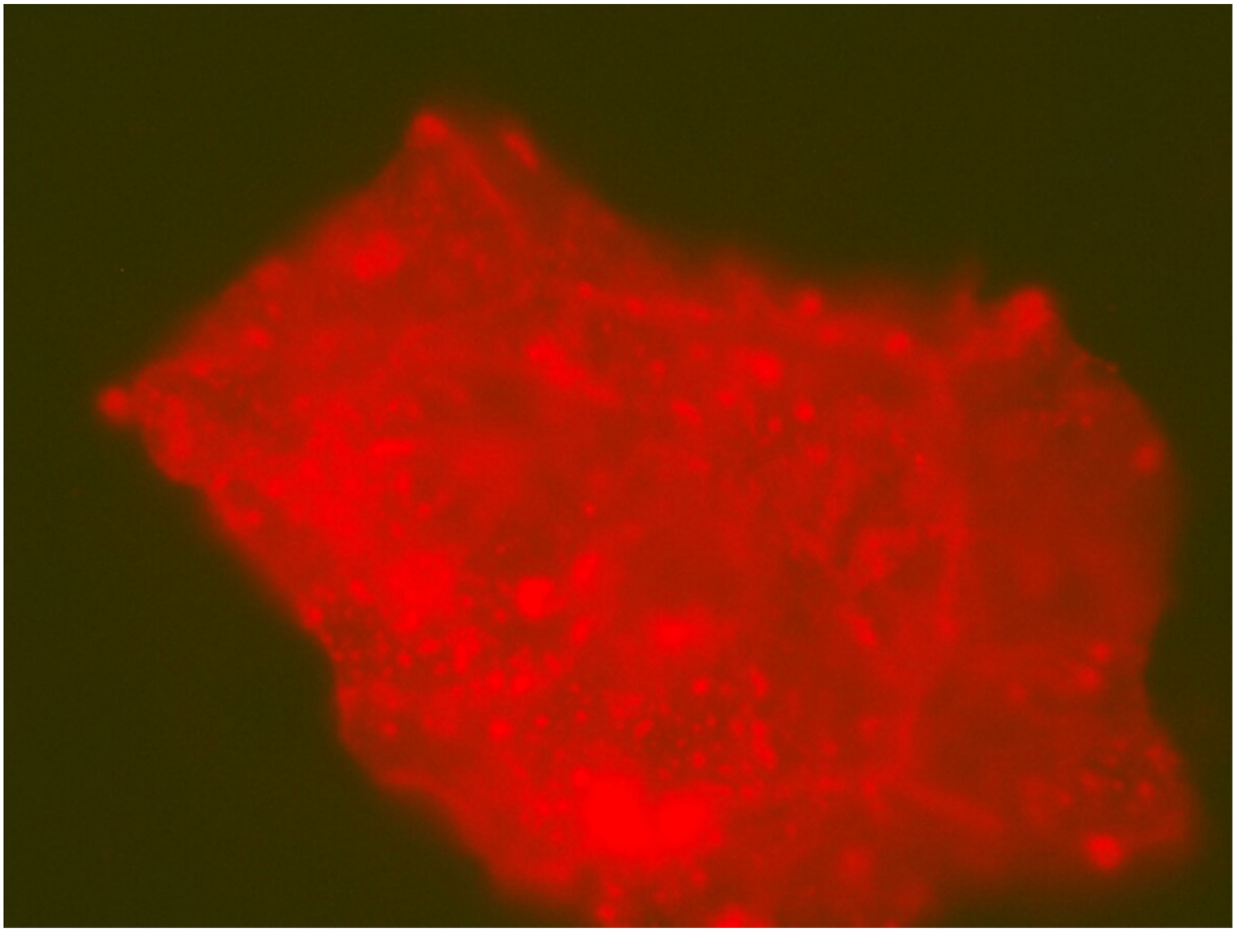
Bad news, Jurassic Park fans—the odds of scientists cloning a dinosaur from ancient DNA are pretty much zero. That's because DNA breaks down over time and isn't stable enough to stay intact for millions of years. And while proteins, the molecules in all living things that give our bodies structure and help them operate, are more stable, even they might not be able to survive over tens or hundreds of millions of years. In a new paper published in *eLife*, scientists went looking for preserved collagen, the protein in bone and skin, in dinosaur fossils. They didn't find the protein, but they did find huge colonies of modern bacteria living inside the dinosaur bones.

"This is breaking new ground—this is the first time we've discovered this unique microbial community in these fossil bones while they're buried underground," says lead author Evan Saitta, a postdoctoral researcher at the Field Museum. "And I would say that it's another nail in the coffin in the idea of dinosaur proteins getting preserved intact."

Saitta began researching organic molecules in fossils as part of his doctoral thesis at the University of Bristol. "My Ph.D. work focused on how soft tissues fossilize and how these materials break down. Some molecules can survive in the fossil record, but I suspect proteins can't; they're unstable on those timescales in the conditions of fossilization," explains Saitta.

However, some paleontologists have reported finding dinosaur bones that contain exceptionally preserved traces of the protein collagen, along with soft tissues like blood and bone cells. "There's been an uptick in interest in these supposed dinosaur proteins," says Saitta. So, he set out to try to independently verify the presence of collagen in dinosaur fossils.

Saitta took pains to collect dinosaur fossils under as sterile conditions as possible so that new proteins or bacteria wouldn't be introduced to the fossils and skew the results. He took a pickaxe, saw, blowtorch, ethanol, and bleach, out to Dinosaur Provincial Park in Alberta, Canada.



A fluorescence microscopy image showing lit-up modern microbes that took up residence in a Centrosaurus fossil. Credit: Evan Saitta, Field Museum

"There's a single layer where there's practically more bone than rock, it's ridiculous how concentrated the bones are," says Saitta. A site with lots of bone was key, because a slow, meandering dig would open up the fossils to more chances to be contaminated by the surface world. "To collect these bones in a very controlled, sterile way, you need a dig site with a ton of bone because you have to find the bone quickly, expose just enough of one end to know what it is, then aseptically collect the unexposed bit of the bone and surrounding rock all in one." Saitta collected 75-million-year-old fossils from Centrosaurus—a smaller cousin of Triceratops—and then took the bones back to various laboratories to examine their organic composition.

Saitta and his colleagues compared the biochemical makeup of the Centrosaurus fossils with modern chicken bones, sediment from the fossil site in Alberta, and thousands-of-years-old shark teeth that washed up on the shore of Saitta's hometown of Ponte Vedra Beach, Florida. "We visited multiple labs, and the different techniques gave us consistent and easily interpretable results, suggesting that the aseptic collection was sufficient," says Saitta. They found that the Centrosaurus fossils didn't seem to contain the collagen proteins present in fresh bones or the much younger shark teeth. But they did find something else: "We see lots of evidence of recent microbes," explains Saitta. "There's clearly something organic in these bones." And since the labwork indicates that Saitta's anti-contamination measures worked, these organic materials must have gotten there naturally.

"We found non-radiocarbon dead organic carbon, recent amino acids, and DNA in the bone—that's indicative that the bone is hosting a modern microbial community and providing refuge," Saitta says. He thinks, as others have previously suggested, that the modern microbes and their secretions, called biofilm, are likely what other researchers have seen in fossils and reported as dinosaur soft tissues. "I suspect that if we began to do this kind of analysis with other specimens, it would begin to explain some of the so-called dinosaur soft tissue discoveries," he says.

Surprisingly, the modern microbes present in the dinosaur bones aren't quite the same run-of-the-mill bacteria living in the surrounding rock. "It's a very unusual community," says Saitta. "Thirty percent of the sequences are related to Euzebya, which is only reported from places like Etruscan tombs and the skin of sea cucumbers, as far as I know."

Saitta and his colleagues aren't sure why these particular microbes are living in the dinosaur bones, but he's not shocked that bacteria are drawn to the fossils. "Fossil bones contain phosphorus and iron, and microbes need those as nutrients. And the bones are porous—they wick up moisture. If you were a bacterium living in the ground, you'd probably want to live in a dinosaur bone," he says. "These bacteria are clearly having a jolly good time in these bones."

The discovery could help further the emerging field of molecular paleontology, says Saitta. "It's one of the new frontiers of modern paleontology. We are beginning to undertake a very different kind of fossil hunting. We're not just looking for bones and teeth, hoping to find new species, we're doing molecular fossil hunting—it opens up an entirely new line of evidence by which to study life in the past. Molecular fossils can tell us things we never thought we'd be able to investigate. Distinguishing what is modern from what is ancient is important."

Provided by Field Museum

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