Researchers work across fields to uncover information about hadrosaur teeth

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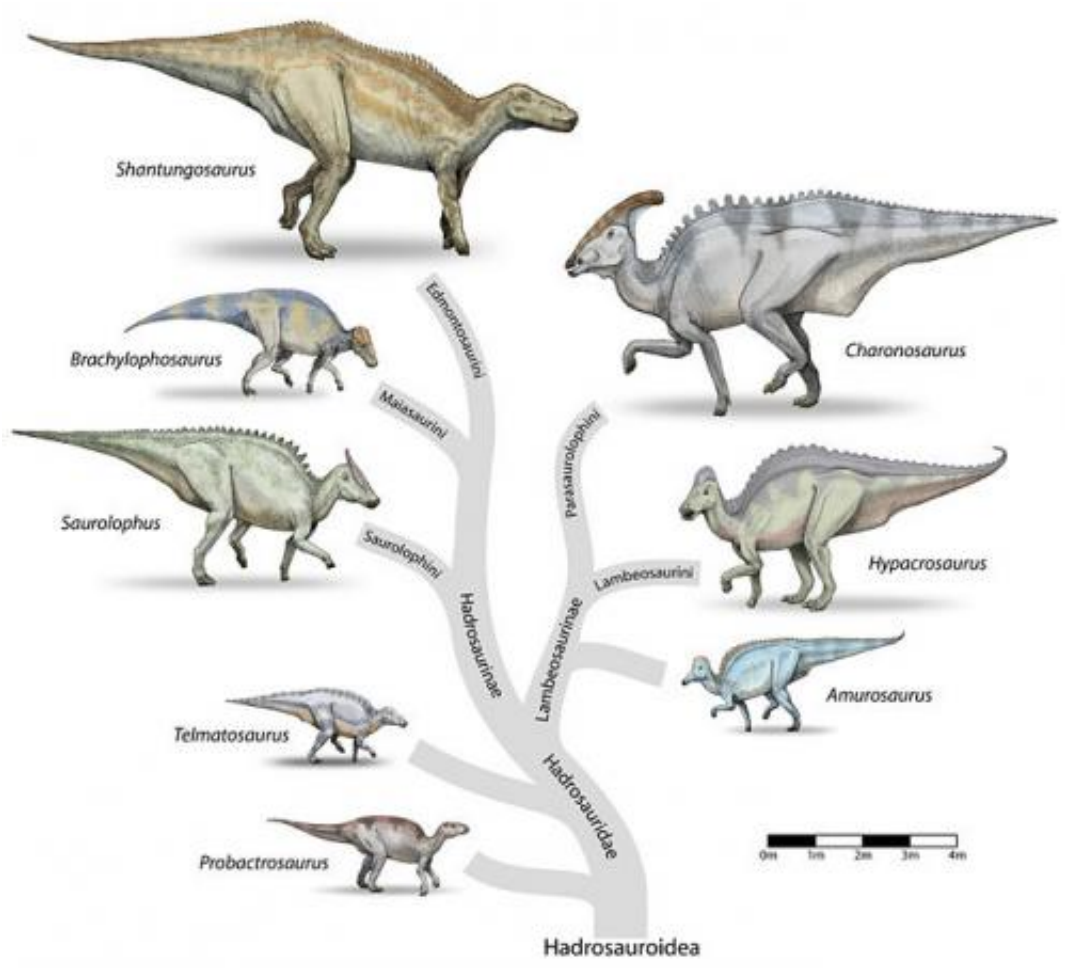

Family tree of the Hadrosauroidea. Representative genera of each tribe are shown to scale. Credit: Wikipedia/GNU

(Phys.org)—An unusual collaboration between researchers in two

disparate fields resulted in a new discovery about the teeth of 65-million-year-old dinosaurs.

With the help of University of Florida mechanical engineering professor W. Gregory Sawyer and UF postdoctoral researcher Brandon Krick, Florida State University paleobiologist Gregory Erickson determined the teeth of *hadrosaurs*—an herbivore from the late Cretaceous period—had six tissues in their teeth instead of two. The results were published in the journal *Science* Oct. 5.

"When something has been in the ground 65 million years, by and large we pick it up and we look at it and say, 'oh, look at what has been preserved.' But we don't mechanically interrogate fossils to see if there is other information," Sawyer said. "When we started to mechanically interrogate these teeth, what we found was all of these properties were preserved, and one other thing: these teeth were a lot more complicated than we thought."

For years, Erickson, who has a background in biomechanical engineering and studies bone biomechanics as a paleobiologist, had thought so. So he turned to the UF Tribology Laboratory, which researches the science of friction and surface wear.

Engineers don't often see the interesting paleontological questions, Sawyer said. One look at the surface of the dinosaur teeth piqued his interest, however, because he is intrigued by how wear occurs across surfaces with different materials. The shape of the tooth made him think it was much more complex than previously thought.

From an engineering perspective, Sawyer said his lab often works with composites that contain different material properties that wear differently, so the question was whether just two materials—enamel and dentine—would wear the way the hadrosaur teeth did. Sawyer and Krick

thought not, and turned to nanoindenters and microtribometers.

Just a decade ago, a paleontologist might not have asked engineers for help, and they could not have helped him. In the last 10 years, however, Sawyer said advances in engineering—tribology and nanoscience, in particular—make it possible to test more materials, even those millions of years old.

Erickson said reptilian dinosaurs have been dismissed as simplistic creatures in their feeding and dental structure. They were herbivores, their teeth composed of enamel and dentine. The fossil record did little to contradict that.

Testing with nanoindenters and microtribometers, however, proved the conventional wisdom wrong.

"*Hadrosaurs*' teeth were incredibly complicated, among the most complex of any animal," Sawyer said. "These dinosaurs had developed a lot of tricks."

The duck-billed hadrosaur was a toothy creature with up to 1,400 teeth, Erickson said. The teeth migrated across the chewing surface, with sharp, enamel-edged front teeth moving sideways to become grinding teeth as the teeth matured. The adaptation allowed *hadrosaurs* to bite off chunks of bark and stems and chew them to a digestible mush, leading Erickson to describe them as "walking pulp mills." The teeth wore down at the rate of 1 millimeter per day, cycling through the jaw like a conveyor belt, before falling out or being swallowed. The dinosaurs lost about 1,800 teeth a year, leaving behind plenty of fossils for testing.

When the fossils emerged from batteries of tests, the researchers found six tissues in the tooth structure, not two.

"Modern tools told us there were different materials in there," said Sawyer, who is also a UF Research Foundation Professor and Distinguished Teaching Scholar.

Erickson said the work could not have been accomplished without Sawyer's lab, "arguably the best tribological lab in the world," and said he is excited about the possibilities for new avenues of research. There are drawers full of fossils in collections around the world that may have more information to yield.

Sawyer agrees, and says that more engineering data could well be buried in fossils.

"Perhaps now it makes sense to take some of that fossil record, when we have other pieces of the record, and start to do things like sectioning and histology," Sawyer said. "There are opportunities now with modern scientific tools to probe their mechanical and tribological properties. If we treat a fossil as a modern material, what happens? Do the mechanical properties track?"

The collaborative nature of the Florida university system was a key to getting the work done, Sawyer said, as was the funding his research gets from the University of Florida Foundation.

"It took us five years to do this because it was always a side project and wasn't funded. We could chew on it at our own pace," Sawyer said. "This is exactly what you hope for when you endow research, that people will take those funds and do things that are scientifically significant."

Provided by University of Florida