SCIENCE

World's 'Smallest Dinosaur' Revealed to Be a Mystery Reptile

Paleontologists analyzed two skulls and made the call, but aren't sure about the exact type of animal they've discovered

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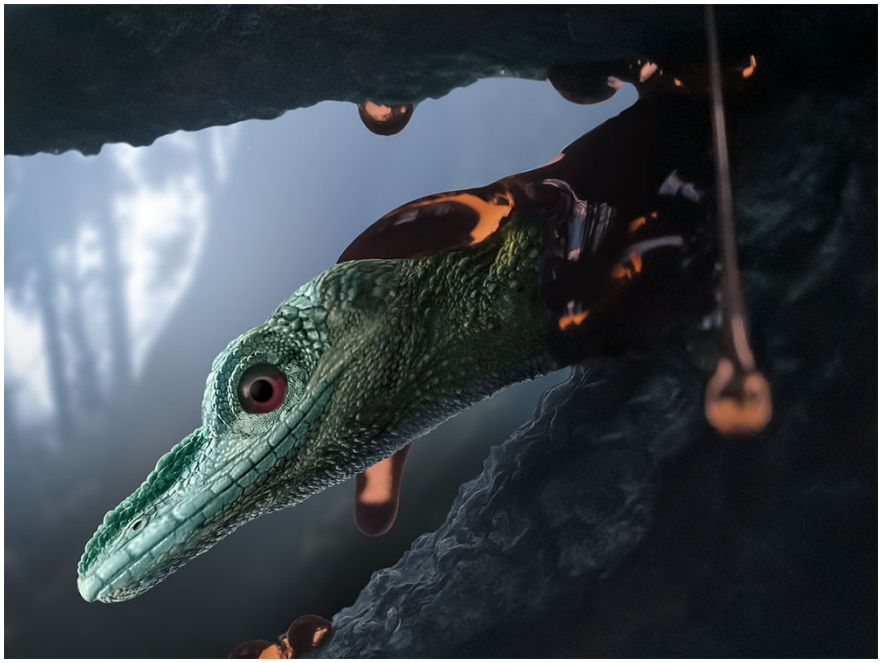

An artist's rendering of *Oculudentavis naga* Stephanie Abramowicz / Peretti Museum Foundation / Current Biology

The amber-encased fossil was touted as the smallest fossil dinosaur ever found. Known from little more than a peculiar skull, and described early in 2020, *Oculudentavis khaungraae* was presented as a hummingbird-sized toothed bird—an avian dinosaur that fluttered around prehistoric Myanmar about 100 million years ago. But from the time this Cretaceous creature

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appeared in the pages of Nature, debate and controversy have circled this strange fossil and its identity. And today, in a peer-reviewed paper published in Current Biology, scientists have confirmed this small creature was no bird at all.

The original *Oculudentavis* fossil is preserved in a chunk of amber from the southeast Asian country of Myanmar. When it was presented in *Nature* in March of 2020, outside researchers quickly pointed out that *Oculudentavis* was not really a bird. The fossil seemed to represent a small reptile that simply resembled a bird thanks to a large eye opening in the skull and a narrow, almost beak-like snout. The original *Nature* paper was retracted and a reanalysis of the paper's dataset by another team supported the idea that the fossil wasn't a bird. A second specimen soon turned up and appeared in a pre-print the same year, adding evidence that these fossils were far from the avian perch on the tree of life. That study has since evolved into the *Current Biology* paper on what *Oculudentavis* might be, and it suggests that this bird was really a lizard.

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How could a little reptile be mistaken for a bird in the first place? There are several factors that played into the confusion, says lead author and University of Bristol paleontologist Arnau Bolet. "The long and tapering snout and the vaulted skull roof gave the first fossil the overall appearance of a bird-like creature," Bolet says. But a closer examination of the fossil, Bolet notes, showed many lizard-like traits not present in birds. The teeth of *Oculudentavis* are fused to the jaw, for example, which is a trait seen in lizards and snakes. And the shape and connections between particular skull bones in the fossil are seen in lizard-like reptiles and not birds. The discovery of a second possible *Oculudentavis* fossil helped confirm the conclusion.

Organisms preserved in amber are difficult to study from the outside, but the team created CT scans of the reptile inside the second specimen and also reanalyzed the scans from the original specimen. The second fossil differs in some ways from the first, and so Bolet and colleagues gave the second, slightly-smushed fossil a new name—*Oculudentavis naga*, named after the

Naga people who live in the vicinity of Myanmar's amber mines. There are enough differences between the skull bones of the two fossils that there seem to have been at least two *Oculudentavis* species, the researchers propose, both representing some mysterious form of lizard. Then again, outside experts like Michael Caldwell of the University of Alberta suggest, *Oculudentavis* might not be a lizard at all but something much more ancient and unusual.

The amber preserved part of *Oculudentavis naga* includes its skull, scales and soft tissue. Adolf Peretti / Peretti Museum Foundation

Despite its use in common language, "lizard" doesn't mean just any sprawling reptile with four legs. The modern tuatara, for example, looks like a lizard but actually belongs to a different evolutionary group that last shared a common ancestor with lizards more than 250 million years ago. A lizard, more specifically defined, belongs to a particular group of reptiles called squamates that also includes snakes and "worm lizards."

"What is this thing? I think it remains an open question," Caldwell says.

In the new study, the authors used several different comparative techniques

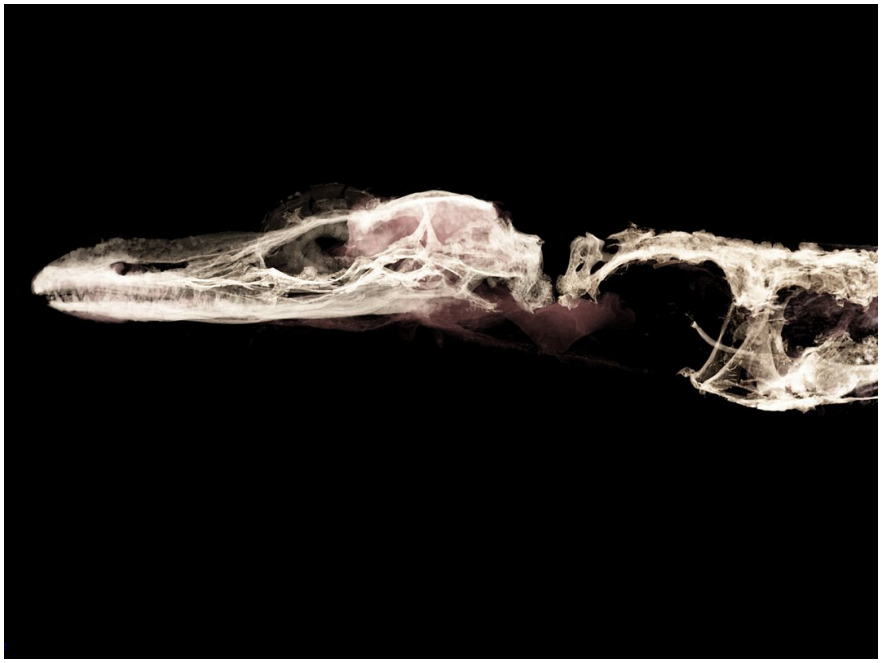
to determine how *Oculudentavis* relates to other lizards. But none of the attempts provided a consistent answer. In some hypothetical evolutionary trees, for example, *Oculudentavis* seems to be one of the earliest lizards, while in others it seems to be related to the ancestors of the seagoing mosasaurs that thrived during the Cretaceous. "Although *Oculudentavis* has many peculiarities that make it a weird lizard, facing difficulties in working out the affinities of a fossil lizard to a specific group of lizards is not unusual," Bolet says, noting that the possible discovery of more fossils with parts of the skeleton other than the head might help.

Paleontologists as yet know little of the lizards and other reptiles that were around during this time. "*Oculudentavis* comes from amber deposits about 98 million years old," says University of Bristol paleontologist Jorge Herrera Flores, "and, so far, the fossil record of terrestrial squamates of that age were extremely rare and scarce." The *Oculudentavis* fossils not only help fill that gap, but suggest that there is much more to be found. After all, Herrera Flores points out, there are over 10,000 species of squamates on the planet right now. Even accounting for how difficult it can be for small animals to become part of the fossil record, there are undoubtedly many new finds that will help paleontologists better understand the world of small reptiles in the Age of Dinosaurs.

Efforts to find more fossils like *Oculudentavis*, however, are complicated by the "blood amber" market that often brings these fossils to the attention of researchers. The mines where Cretaceous amber fossils are found are controlled by the Myanmar military, which seized control of the country earlier this year and for years has committed acts of genocide against the country's Muslim Rohingya people, among others. High-priced sales of amber specimens have fueled the conflict, and even ethically-sourced fossils often end up in the hands of private dealers who restrict access to researchers and stall efforts to re-investigate previous results.

The uncertainty around *Oculudentavis* makes sense given how odd the fossils look even at a glance, especially compared to other lizards that have been found in amber from around the same place and time. "I think these two things are really interesting," Caldwell says, "not because they're birds and not because they're lizards, but because they're some kind of proto-lizard things."

The isolated location of prehistoric Myanmar might explain why such a confounding creature evolved in the first place. During the time *Oculudentavis* was climbing around, what's now Myanmar was a piece of land that split off from other landmasses. The area was encapsulated as an island, isolated in the ancient sea, and such places often act as refuges where ancient lineages evolve in isolation. "From what I can see from the vertebrate remains," Caldwell says, "some very unique things are there and have really ancient ancestry."



CT imaging allowed researchers to examine each feature of *Oculudentavis naga* at high resolution without damaging or destroying the specimen. Edward Stanley / Peretti Museum Foundation

What role the *Oculudentavis* species played in their ecosystem is another puzzle. The shape of the jaws and tiny teeth, Bolet says, hint that this reptile snatched insects. Perhaps this creature climbed through ancient forests, looking for invertebrate morsels to eat. Likewise, says study co-author Susan Evans, “there is also some evidence from the skin folds under the head that these animals used them for some form of display,” similar to anole lizards today.

Rather than coming to a neat conclusion, the story of *Oculudentavis* has raised additional questions. If this reptile really was a lizard, what kind is it? And why is it so different? And if it’s not a lizard, what evolutionary story does the fossil tell? The strange traits in these two specimens might hint that they represent an evolutionary branch that goes off deep into the prehistoric past, one that experts are only beginning to become aware of.

Riley Black | | READ MORE

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