SCIENCE | NEWS

The smallest known dinosaur is actually a peculiar ancient lizard

An amber-encased fossil seemed to be a hummingbird-size dinosaur. Now it's been reclassified as a big-eyed lizard.

Some 99 million years ago in what's now Myanmar, tree resin oozes over and entombs Oculudentavis khaungraae, an enigmatic animal now classified as a lizard.
ILLUSTRATION BY STEPHANIE ABRAMOWICZ

BY **MICHAEL GRESHKO**

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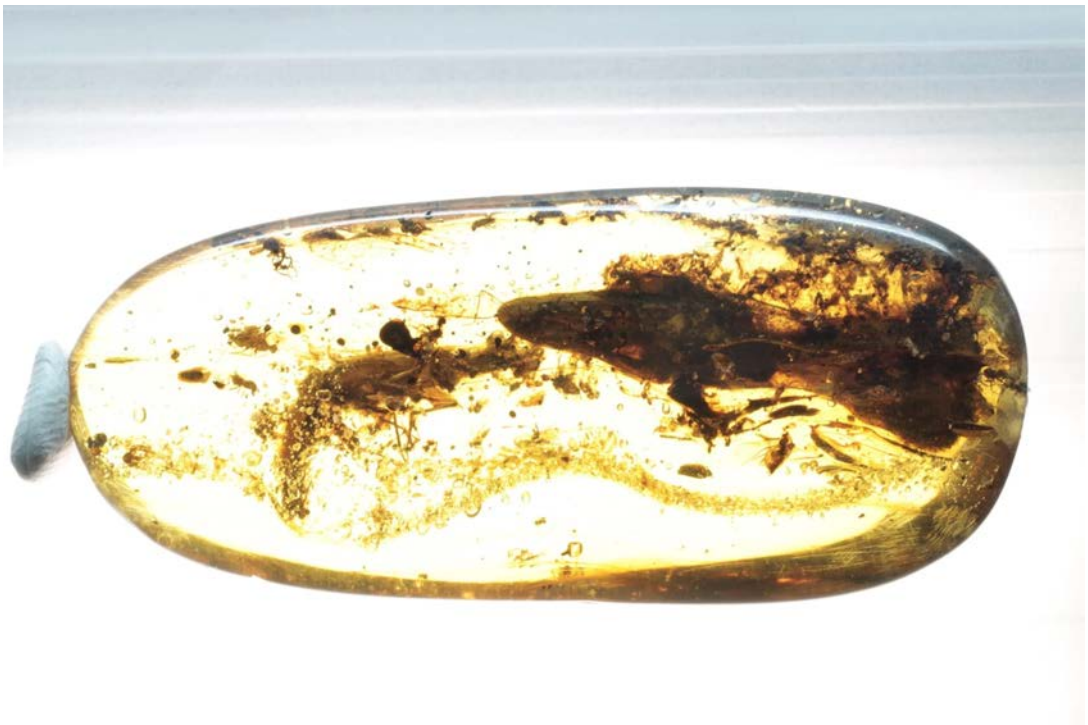
A newly described fossil preserved in amber reveals that a 99-million-year-old creature called *Oculudentavis*, recently heralded as a hummingbird-

In March, the first known amber-encased skull of *Oculudentavis* made a global splash, appearing on the cover of the scientific journal *Nature* and garnering widespread media coverage, including by National Geographic. At the time, the scientists interpreted the 14-millimeter-long skull as the preserved remains of an early toothed bird with lizard-like eyes. Since these types of prehistoric birds are recognized as part of the dinosaur family tree, the result was hailed as the smallest fossil dinosaur ever found.

However, the original fossil was just a skull, leaving the rest of its body unknown. Now, a team of paleontologists has identified a second fossil of *Oculudentavis* that includes both a skull and additional portions of a body. That fossil confirms that the critter was in fact a lizard—albeit a rather strange one.

"You've got this weird, big-eyed, kind of crested-nose thing that certainly doesn't at first look like a lizard," says study co-author Susan Evans, a paleontologist at University College London. "It's weird, but it's a lizard."



This cut and polished lump of amber holds the second known specimen of Oculudentavis, and the fossil is the first to contain parts of the animal's body in addition to the head.
PHOTOGRAPH BY ADOLF PERETTI, PMF

Though "dinosaur" comes from the Greek for "terrible lizard," true lizards and dinosaurs diverged from one another approximately 270 million years ago. *Oculudentavis*'s large eyes and jaw anatomy suggest that it was active during the day and snapped up prey such as small insects with a quick but

contemporaries faced similar evolutionary pressures: perhaps a shared taste for bugs, or a shared life in the trees. Evolution gradually shaped *Oculudentavis* and its distant bird relatives into similar forms—a process much like the one that gave marine mammals streamlined, fish-like bodies.

"The skull of *Oculudentavis* is strikingly different from any known lizard and represents a startling instance of convergent evolution," the researchers write in a preprint describing the new fossil.

Redescribing an ancient creature

Like the original *Oculudentavis* fossil, the new specimen hails from the amber mines in northern Myanmar's Kachin state. Side by side, the two fossils don't look exactly alike: The original specimen's snout looks more tapered, while the new specimen's snout appears to have a central crest. To some outside paleontologists, the difference is enough to suggest they may not be the exact same species. "That sort of finer precision is a little bit up in the air," says University of South Florida paleontologist Ryan Carney, who wasn't involved with either study.

However, the new study's authors say that from bone to bone, the two fossils are anatomically similar enough to justify calling both members of the same species, *Oculudentavis khaungraae*. Any differences between the two specimens might come down to the way each fossil deformed over time, or perhaps whether one is male and the other female.

From the shape of its jaw bones to the arrangement of openings in the back of its skull, the new *Oculudentavis* fossil has many defining lizard traits. Although the skulls may look bird-like, *Oculudentavis* also is missing several hallmark dinosaur traits, such as a pair of holes in front of its eye sockets that often appear in theropods, the group of dinosaurs that gave rise to birds. And unlike dinosaurs' socketed teeth, the teeth on the new fossil skull are fused to the jaw's inner edges, like lizard teeth. The new fossil also has preserved scales and a lizard-like shoulder region.

The description of the new *Oculudentavis* fossil has been submitted to the scientific journal *eLife*, but it hasn't yet been peer-reviewed and formally published. Researchers say they released their findings early to respond to the widespread rumors of a second specimen. "We got to the stage that we thought perhaps we had to [publish a preprint] to put an end to the speculation," Evans says.

Using high-energy x-rays from a particle accelerator, researchers scanned the new Oculudentavis fossil to see details as tiny as a human red blood cell.
IMAGE COURTESY OF EDWARD L. STANLEY

The new preprint isn't the first to suggest that *Oculudentavis* was a lizard. Based on the unusual anatomy of the original skull, an outside team of Chinese paleontologists published their suspicions that *Oculudentavis* wasn't a dinosaur in early June. Now, with the second fossil in hand, the scientists who originally described *Oculudentavis* as a toothed bird agree that the creature wasn't a dinosaur.

"I do think that [the new paper's researchers] are right, that it is a lizard," says original study co-author Jingmai O'Connor, a paleontologist at China's Institute of Vertebrate Paleontology and Paleoanthropology. "This specimen does show conclusively that *Oculudentavis* is not a bird."

On July 22, the original study describing *Oculudentavis* was retracted from *Nature* to "prevent inaccurate information from remaining in the literature."

"It's shocking … that's a really big deal," says reptile expert Mark Scherz, a postdoctoral researcher at Germany's University of Konstanz. "On the other hand, it is the right thing for them to do."

Misidentifications are not uncommon in paleontology. The fossil record is hard to interpret, especially when dealing with incomplete specimens. But

involved fossil fakes.

For O'Connor, *Oculudentavis* presents a cautionary tale. "Even in the paper, we were like, It has a lizard's eye. So these are all things that we had recognized before—but we just had avian tunnel vision," she says. "Everything is clearer in hindsight."

Controversial fossils

The global attention on *Oculudentavis* also highlights the ethics of studying Burmese amber. The mining areas lie within a region home to a long-simmering conflict between the Myanmar military and rebels fighting for the independence of the Kachin state. A 2018 military offensive to take over amber mining areas displaced thousands of indigenous Kachin, according to the Kachin Development Networking Group. In 2019, a United Nations Human Rights Council report found that conflict in the region is driven in part by the desire to exploit natural resources, including gold, jade, and amber.

Until that point, "most of the people in the [paleontology] community had not been aware, to that degree, [of] the way that that amber makes it onto the market and the number of problems with it," Scherz says.

In April, the Society of Vertebrate Paleontology circulated a letter to scientific journals initially calling for a moratorium on publishing descriptions of Burmese amber fossils bought after June 2017, to steer clear of any material associated with the 2018 offensive. The original *Oculudentavis* skull was acquired in 2016.

The U.N. report, however, doesn't recommend a full moratorium on business activity in Myanmar. Instead, it calls on businesses to ensure that their operations and supply chains respect human rights and have no connections to Myanmar's security forces. On July 22, 2020, the Society of Vertebrate Paleontology sent out a follow-up letter with further information on the conflict, including the U.N. report.

"We recognize that some amber specimens may not be linked to illegal trade and human rights abuses, but the situation in Myanmar is so complex that scientists should be aware of how the amber trade has been used in internal conflicts," the Society of Vertebrate Paleontology wrote.

The researchers behind the new *Oculudentavis* fossil say that they worked hard to ethically source the specimen, which first came to light in late 2017 when gemologist and amber collector Adolf Peretti—a co-author of the new study—was shown the fossil during a humanitarian visit to Kachin. In an email to National Geographic, Peretti says that a local Burmese gemologist

the fossil on consignment and bought it the following year.

Peretti specializes in authenticating colored gemstones, a process he hopes to apply to Burmese amber. In the study, Peretti avows that "no funds from the sale of this amber specimen have been directed to support conflict in Kachin." Peretti adds that funds from the sale were distributed to Burmese charities.

The preprint says that the fossil was legally exported to Switzerland and is now overseen by the Peretti Museum Foundation, a nonprofit he recently founded. Under Swiss law, all of the foundation's fossils—including the new *Oculudentavis*—must be kept indefinitely for science. Peretti says that researchers can see and study the fossils at the nonprofit's Swiss headquarters.

For Juan Daza, a co-author of the new study and a paleontologist at Sam Houston State University, the study could provide a model for how to ethically source Burmese amber amid the complexities of conflict in the region. "We're trying to do things in the right way," he says.

Editor's Note: This story has been updated with additional information about the 2019 U.N. report.

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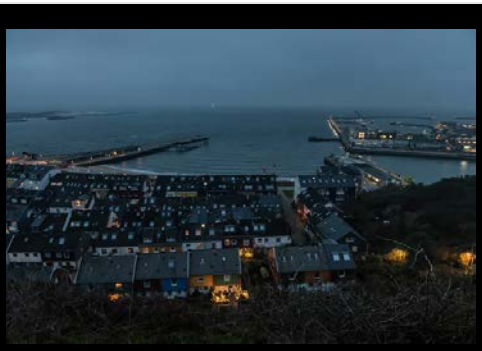

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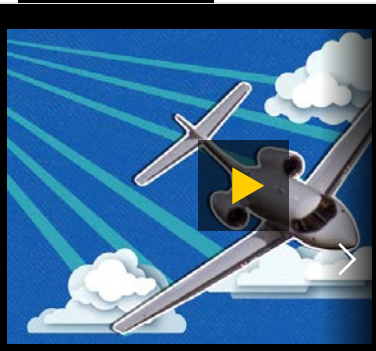

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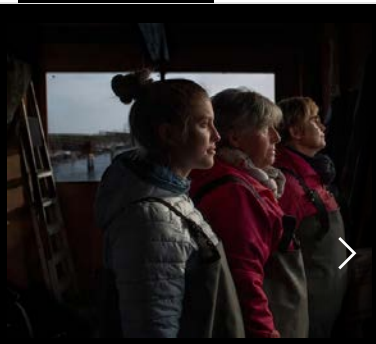

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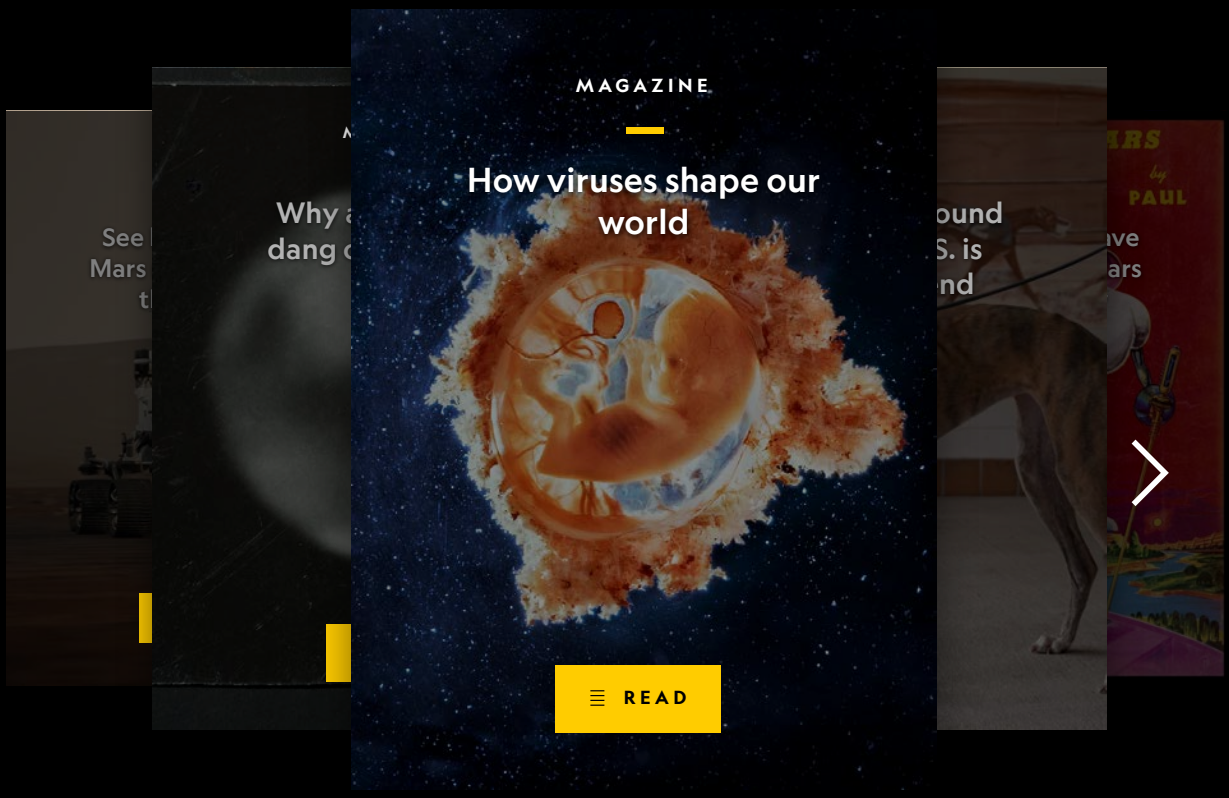

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