

Pigment or bacteria? Researchers re-examine the idea of 'color' in fossil feathers

5 March 2014

Paleontologists studying fossilized feathers have proposed that the shapes of certain microscopic structures inside the feathers can tell us the color of ancient birds. But new research from North Carolina State University demonstrates that it is not yet possible to tell if these structures – thought to be melanosomes – are what they seem, or if they are merely the remnants of ancient bacteria.

Melanosomes are small, pigment-filled sacs located inside the cells of feathers and other pigmented tissues of vertebrates. They contain melanin, which can give feathers colors ranging from brownish-red to gray to solid black.

Melanosomes are either oblong or round in shape, and the identification of these small bodies in preserved feathers has led to speculation about the physiology, habitats, coloration and lifestyles of the extinct animals, including dinosaurs, that once possessed them.

But melanosomes are not the only round and oblong [microscopic structures](#) that might show up in fossilized feathers. In fact, the microbes that drove the decomposition of the animal prior to fossilization share the same size and shape as melanosomes, and they would also be present in feathers during decay.

Alison Moyer, a Ph.D. candidate in paleontology at NC State, wanted to find out whether these structures could be definitively identified as either melanosome or microbe. Using black and brown [chicken feathers](#) – chickens are one of the closest living relatives to both dinosaurs and [ancient birds](#) – Moyer grew bacteria over them to replicate what we see in the fossil record. She used three different types of microscopy to examine the patterns of biofilm growth, and then compared those structures to melanosomes inside of chicken [feathers](#) that she had sliced open. Finally, she compared both microbes and actual melanosomes to structures in a fossilized feather from *Gansus yumenensis*, an avian dinosaur that lived about

120 million years ago, and to published images of fossil "melanosomes" by others. Her findings led to more questions.

"These structures could be original to the bird, or they could be a biofilm which has grown over and degraded the feather – if the latter, they would also produce round or elongated structures that are not melanosomes," Moyer says. "Melanosomes are embedded in keratin, which is a very tough protein, so they're hard to see unless there's been some degradation. But the bacteria are doing the degrading, and so that may be what we're seeing, rather than the melanosome itself. It's impossible to say with certainty what these structures are without more data, including fine scale chemical data."

The research appears online in *Scientific Reports*. Possible next steps for Moyer include testing for the presence of keratin or bacteria within the fossils, by looking for their molecular signals.

"The technology that we have available to us as paleontologists now is amazing, and will make it much easier to test all of the hypotheses we develop about these fossils," Moyer says. "In the meantime, perhaps we can establish some basic criteria for identifying these structures as [melanosomes](#), such as whether they're found within the feather's interior, or externally."

Provided by North Carolina State University

APA citation: Pigment or bacteria? Researchers re-examine the idea of 'color' in fossil feathers (2014, March 5) retrieved 12 April 2021 from <https://phys.org/news/2014-03-pigment-bacteria-re-examine-idea-fossil.html>

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