ScienceWatch – The First Feather

"There's been a debate for the last 159 years as to whether or not this feather belongs to the same species as the *Archaeopteryx* skeletons, as well as where on the body it came from and its original color." – R. Carney

If a feather falls in the forest and no one sees it happen does it exist? I'm not sure about the proverbial falling tree, but as for the feather the answer is yes. The real question about the first ever known feather is who does it belong to? Fossilized 150 million years ago, the source of the feather has been debated since its discovery in a German quarry in 1861.

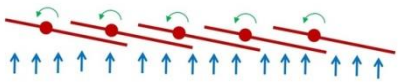
Many believe the feather belongs to *Archaeopteryx*, the iconic missing link between reptiles and birds, whose fossilized remains were also found the same year in a German quarry. Others say no. A 2019 report received much attention for concluding the feather did not match those of *Archaeopteryx* but belonged to "a different feathered dinosaur."

Now a study published online September 30, 2020 in *Scientific Reports* refutes that conclusion. Ryan Carney, a paleontologist at the University of South Florida, Tampa, FL, and his colleagues, compared the feather to those found with the 13 known fossils of *Archaeopteryx*, three of which have well-preserved feathers. They critically examined the feather and showed that its length, width, shape, curvature of the central shaft and the angle of barb attachment to the shaft all match that of an upper major primary covert (UMPC) of the *Archaeopteryx* wing. UMPC feathers overlay the longer flight feathers and aid in flight. The team examined "every feather in every *Archaeopteryx* fossil, every single barb of the isolated feather, and every relevant piece of literature on the feather from the 1800's until today," said Carney.

When they overlaid an outline of the feather onto a fossil *Archaeopteryx* wing it fit perfectly in place. Additionally, the team underscored the feather's provenance: Four *Archaeopteryx* fossils were found in the same quarry and at the same level as the feather.

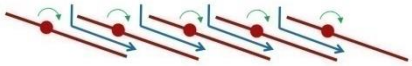
In 2012 Dr. Carney and colleagues used a scanning electron microscope to examine the feather's melanosomes, intracellular bodies responsible for coloration. Based on their shape, they concluded the feather was black. Here they compared the melanosomes with iridescent ones from extant birds and confirmed the feather was black and also matte.

The authors admit that the feather's provenance can never be determined with 100% certainty. Nevertheless, they contend that ". . . the most empirical and parsimonious conclusion is that the isolated feather represents a primary covert of *Archaeopteryx*." Future research will tell us if they are right.



Another long-running debate* among paleontologists concerns how well *Archaeopteryx* could fly. Like all modern flying birds its wing feathers are asymmetrical, i.e. the central shaft is off center, so the vanes on one side are wider than the other. This rotates

each feather during the down stroke because the wider vanes catch more air forcing them up against the central shaft of the overlapping feathers above them, making them interlock to generate lift and thrust. On the upstroke the rotation is reversed and the feathers separate to allow air to flow between them. In the accompanying figures small arrows represent feather rotation, large arrows air flow and lines represent asymmetrical, overlapping feathers.



Asymmetric feathers are a hallmark of flight, but could *Archaeopteryx* fly or just glide from tree to tree? A study published online March 13, 2018 in *Nature Communications*, by paleontologist Dennis Voeten and colleagues at the European Synchrotron Radiation Facility, Grenoble, France, assessed the flying ability of the magpie-sized creature. The team used a synchrotron, a powerful x-ray machine that detects tiny differences in fossilized bone density, to create 3-dimensional scans of the arm bones (humerus and ulna) from three *Archaeopteryx* fossilized skeletons.

"We immediately noticed that the bone walls of *Archaeopteryx* were much thinner than those of earthbound dinosaurs but looked a lot like conventional bird bones. . . .[T]he bones of *Archaeopteryx* plot closest to those of birds like pheasants that occasionally use active flight to cross barriers or dodge predators, but not to those of gliding and soaring forms such as many birds of prey and some seabirds that are optimized for enduring flight," said Voeten. Could it fly like an eagle? No, but it could do short distance flapping like a turkey.

The way it flapped would appear odd to us. Its shoulder joints are oriented differently from modern birds, meaning it's unlikely it could lift its wings above its back. Senior author Sophie Sanchez said it probably used a unique flying style resembling the butterfly stroke of swimmers. It must have been quite a sight.

Saul Scheinbach

*How birds first took to the air is also still debated. For a discussion of that argument see *The Ups and Downs of First Flight* at http://hras.org/sw/Sw0303.html.