ScienceWatch – Birds(?) of a Feather??

In our minds feathers have always been linked to birds and only birds, whether flightless or not. Anytime fossilized feathers were discovered they were assumed to be from birds. Even the "first bird", *Archaeopteryx*, sported feathers 150 million years ago. That assumption can no longer be taken for granted. In the June 25th issue of *Nature* a group of paleontologists from China, Canada and the Natural History Museum in New York, describe two new fossils found in China. Portions of the fossilized bones clearly are covered with fossilized feathers, but the skeletons are those of dinosaurs not birds. The discovery lends support to the dinosaur-bird theory for bird origin; namely, birds evolved from two-legged, fast-running theropod dinosaurs like *Velociraptor* and its much larger, more famous cousin, *Tyrannosaurus rex*. Although the dinosaur-bird theory has become popular with the public, among scientists it is being more hotly debated than ever before.

The origin of birds has been controversial for over 100 years. In 1868 T. H. Huxley proposed that the recently discovered *Archaeopteryx* was descended from two-legged theropod dinosaurs, fossils of which were just being unearthed. For the next 50 years the dinosaur-bird link was widely accepted. But in the 1920's paleontologists began to think that the ancestors of birds should be found among the thecodonts, a more primitive reptilian group that lived about 230 million years ago and gave rise to the dinosaurs and modern reptiles. If true, then instead of evolving from dinosaurs, birds would be as equally related to them as they were to modern reptiles. The change in thinking arose from the fact that all the small bipedal theropods known up to that time lacked collarbones (clavicles), which are present in all birds as the fused wishbone (furcula). The thecodont, or reptilian, origin for birds was generally accepted for the next 50 years. But by the 1970's paleontologists began finding theropods with clavicles and even primitive wishbones similar to that present in *Archaeopteryx*. Couple that with new evidence for other bird-like features in theropods, like warm-bloodedness, and the paleontologists flip-flopped again to support the original dinosaur-bird theory. However, many scientists remained unconvinced and even now they continue to adhere to the reptilian origin for birds.

The critics still assert that birds split from their reptilian lineage early on, descending from thecodonts, rather than evolving from theropods much later. They contend that thecodonts were the ancestors of birds as well as dinosaurs and modern reptiles. To support their view they point to recent studies (reviewed in *ScienceWatch* last year), which concluded that birds could not have evolved from theropods because the two groups differ too greatly in respect to the architecture of both limb and lung. They also maintain that flight could not have been possible for ground-running dinosaurs, but had to arise in tree-dwelling forms where gliding could readily occur. According to the critics the similarities observed between theropods and birds are purely coincidental, arising from convergent evolution.

The two new fossils, dubbed *Protoarchaeopteryx robusta* and *Caudipteryx zoui*, have created quite a stir because they provide strong evidence to counter the critics. The fossils are about 145 million years old and, except for the presence of feathers, could be

taken for small, theropod dinosaurs. They come from the same site in China that in 1996 yielded another feathered fossil named *Sinosauropteryx*, which appeared to have a downy fringe along its neck and backbone. While proponents of the dinosaur-bird theory hailed it as supporting evidence, opponents countered that it was merely a reptilian fringe of internal collagen fibers that looked feathery because it had frayed (see the March/April 1997 *Audubon* for photos of this fossil).

Arguments like that don't work for the new specimens. Feathers, both down-like and vaned, are clearly present on the body, arms, legs and tail. *Protoarchaeopteryx*, in particular, has vaned, barbed feathers protruding from the end of its tail in a fanlike pattern. In all other respects both specimens are certainly dinosaurs, so the presence of feathers can no longer be an exclusive hallmark of birds. The feathers of both fossils are long and contain a central shaft. In both instances the vanes are symmetrical, whereas those of most flying birds, even *Archaeopteryx*, are asymmetrical. Asymmetrical vanes provide the lift required for flight. This coupled with the fact that the arms of both fossils are barely two-thirds as long as the legs, makes it highly unlikely that these animals could fly.

The presence of feathers on ground-dwelling, flightless theropods suggests that feathers were fully formed before flight had been achieved. What function could these feathers have had? Various ideas include insulation, camouflage, mating display and species recognition. Flight, it seems, was not what feathers were originally for and uncoupling feathers from flight fits in with the way many evolution biologists believe feathers evolved. They have long insisted that feathers could not have arisen fully formed and capable of flight, but evolved from intermediate structures that had to provide some advantage to the bearer other than flight in order to be favored by natural selection.

This latest discovery provides the evidence for that intermediate structure theory and also tips the balance in favor of the dinosaur-bird theory. But debate among the experts continues. Rather than being a snapshot in time of theropods evolving into birds, critics see the fossils as representing ancient birds that simply lost the ability to fly and came to resemble theropods. So while supporters are crowing that feathers are no longer a diagnostic characteristic of birds, critics remain unflappable.

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