ScienceWatch – The Ups and Downs of First Flight

It's not easy to explain what caused the ancestors of modern birds to develop wings and first take to the air. Even Darwin had a problem using his theory of natural selection to explain the formation of wings (and eyes). After all, wings (and eyes) are complex structures, and until completely functional could not be used for flying (or seeing). So what advantage could cause a lineage to maintain non-functioning wings generation after generation until they could be perfected for flying? Scientists agree that the intermediate structures must have provided some benefit-probably unrelated to flying. However, that's all they agree on.

Two different hypotheses seek to explain how partially functional wings could be useful.* One starts from the ground up. It says that running (**cursorial**) along the ground and flapping feathered arms gave protobirds an advantage over their competitors by allowing them to jump higher into the air to obtain more food, probably flying insects. The other hypothesis starts from the trees down. It says that protobirds used their feathered arms to glide from tree to tree (**arborial**) to better escape predators and also obtain food more easily. In either case natural selection would favor more robust wings, eventually leading to sustained flight.

Each theory has its adherents and each side passionately seeks evidence to support its position. Cursorial advocates point to the many fast-running, feathered dinosaur (theropod) fossils that have been found recently to bolster their theory. Many scientists believe that some feathered theropods are the ancestors to modern birds. They favor the cursorial hypothesis because it fits with their overall scheme on how birds originated. "Absolutely not," say arborial proponents. They favor the arborial hypothesis because gliding into the air from a tree is much easier than trying to achieve flight from the ground. They point to *Archaeopteryx*, a 150-million-year-old fossil that paleontologists have considered a major link between reptiles and birds since its discovery over 100 years ago. *Archaeopteryx* had claws on its wings, a long flat tail and was a weak flyer at best. Arborial supporters say all these features mean it took off by climbing trees, and that's how flight began.

Now a report of a small, feathered dinosaur about 125 million years old, in the January 23rd, 2003 issue of *Nature* bolsters the arborial hypothesis. The find was made in Liaoning province in northeastern China, by a team of Chinese paleontologists headed by Xing Chu of The Chinese academy of Sciences in Beijing. That region has produced other non-avian theropod dinosaurs with feather-like structures. However, this is a spectacular find unlike any other because it has feathers on all four limbs. And while cursorial supporters have used the other finds of feathered theropods to support their side, this discovery throws cold water on that because this animal was a theropod that clearly was not fast-running and used its wings for gliding. The report describes a small dromaeosaur dubbed *Microraptor gui* about 77cm (30 in.) long with asymmetric, vaned feathers, suitable for flight and present on all four limbs as well as the tail. Dromaeosaurs constitute a small group of theropods that are thought to share a common ancestor with birds dating back to the Jurassic period. Dromaeosaurs are popularly, but incorrectly,

known as “raptors”. Striking examples of the group are *Deinonychus* (terrible claw) with a switchblade type hind claw for ripping open prey, and *Velociraptor* (swift seizer), the “raptors” made famous in *Jurassic Park*.

Although much less fierce than its larger cousins, *Microraptor gui* also has claws on all four limbs. As a result, Xu *et al*. contend that it used its claws to climb trees because it must have been a glider, and that during the evolution of flight the hind wings were lost. This flies in the face of the fact that *Archaeopteryx*, with no apparent hind wings, is 20-25 million years older. Paleontologists are now re-examining specimens of *Archaeopteryx*, looking for vestigial hind wings. But Howard Zimmerman, co-editor of *The Scientific American Book of Dinosaurs*, has a different interpretation. He says *Microraptor gui* cannot be a missing link between dinosaurs and birds be cause it is younger than *Archaeopteryx*. Instead it may represent a dinosaur line that independently evolved feathers.

Meanwhile, Kenneth Dial, a behavioral ecologist at the University of Montana, Missoula, says that neither hypothesis is quite right. Writing in the January 17, 2003 issue of *Science*, he says that ground-dwelling protobirds used their wings to aid in running up inclined objects, like trees, to escape predators. He bases his statement on high-speed video recordings he made of juvenile chukar partridges (*Alectoris chukar*) running up bales of hay. The birds flap baby wings to aid their climb, but at an angle that presses the animal towards the ground, creating better leg traction and acting like the spoilers on a racing car. Dial says that if modern birds can use wings not yet capable of flight as spoilers, it’s likely that protobirds did too.

The argument over how wings evolved in birds has been going on for over 100 years. No one observed the first flight and the opposing hypotheses cannot be tested directly. So the dispute will likely continue for some time.

*The origin of feathers is a separate issue from wings. Several hypotheses exist to explain why feathers evolved. They include: insulation, mating displays, camouflage, and species recognition.

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