Chapter 46

Evolutionary Aside 46.3--Evolution of Flight in Vertebrates

How flight evolved in vertebrates is somewhat of a mystery. We have little idea how flight came about in both pterosaurs and bats because no fossils exist of the species ancestral to either type. As a result, we do not have a good idea of what type of animal either of these groups evolved from.

By contrast, as discussed in chapter 35, we know that birds evolved from dinosaurs, and particularly from small theropod dinosaurs. We also know that feathers evolved prior to the emergence of flight, perhaps for insulation or for displays in social interactions. Several hypotheses have been put forward about the evolutionary transition from a feathered dinosaur to a flying bird:

1. The "ground-up" hypothesis suggests that ground-dwelling feathered dinosaurs chased insects, and when the insects jumped into the air to escape these dinosaurs would leap up to grab them. Protofeathers may have provided a little bit of lift, thus enabling the dinosaurs to capture some prey that otherwise would have escaped. As a result, any mutation that enhanced the ability to get off the ground in such leaps would have been selected for, eventually leading to the evolution of wings and flight feathers.
2. The "trees-down" hypothesis proposes that ancestral dinosaurs lived in trees and that early feathers provided a little bit of lift that gave them some gliding ability, just as many vertebrates such as flying squirrels and flying lizards glide from tree-to-tree or tree-to-ground today. If this were true, then again any mutation that improved the ability to glide and subsequently to engage in powered flight, might be favored.
3. The "changing use of wings through growth" hypothesis is a recent idea suggested by functional studies that indicate in some species, young birds that have not yet fledged sometimes run up a vertical surface such as a tree. They flap their wings as they run, and this flapping pushes the body against the substrate, allowing their claws to gain a hold and thus letting the birds run up nearly vertical surfaces. In this way, an arm structure that could produce sufficient force would be beneficial; selection would therefore favor changes that increased the force. The forearm and feathers could be transformed into a structure that could produce enough force to fly (assuming that the stroke of the arm changed such that the force produced lift away from the surface, instead of toward it).

As with any scenario for the evolution of a trait that occurred 150 MYA, testing these hypotheses is not easy, especially since they refer to the functional capabilities of extinct species. For this reason, scientists are still uncertain, and the debate continues.