Lecture 4: Avian evolution

Class Business

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Reading for this lecture

Required. Gill: Chapter 2.
Optional. Procter & Lynch: Pages 13-21.

1. Origins of Birds

A) HOW DO WE KNOW THAT BIRDS EVOLVED FROM REPTILES?

i) Birds share many features in common with modern reptiles, and differ in significant ways from mammals. These features include: a lower jaw made up of several bones fused together (mammals have 1 bone), a single bone in the middle ear (mammals have 3), a single occipital condyle joining the skull to the first neck vertebra (mammals have 2), a sclerotic eye ring, similar scales on legs to reptile scales, nucleated red blood cells (in mammals, red blood cells lack nuclei), similarities in their eggs compared to reptiles, etc.

ii) This relationships has been known since the 1860s, when Sir Thomas Huxley described birds as "glorified reptiles".

iii) Although it is well accepted that birds are reptiles, there remains a (rapidly fading) debate about which group of reptiles birds evolved from. Most people, however, believe that birds arose from therapod dinosaurs.

B) ARCHAEOPTERYX LITHOGRAPHICA

i) First fossil found in 1861 in Germany. Crow-sized. Probably terrestrial, but capable of climbing and weak flight. Alive in late Jurassic (135-155 million years ago).

ii) "Missing link" between reptiles and birds. Shares features of bird: looks like a therapod (specifically, a coelurosaur) dinosaur, but it has feathers that are essentially identical to those of modern birds.

iii) First specimen was identified shortly after Darwin published the "Origin of Species". Soon became a strong piece of evidence for the idea that different types of organisms are related to one another and have common ancestors.

C) WHICH REPTILES DID BIRDS ARISE FROM?

i) Most people believe that it was the **theropod dinosaurs**. *Archaeopteryx* and modern birds both share many features with theropods.

ii) Key similarities that birds share with theropods include: features of the skull (**fenestra**, **sclerotic ring**); a long, flexible, S-shaped neck; fused **clavicles** ("collarbones"; forming the **furcula**, or "wishbone"), **sternum** (breastbone), and pelvic bones; elongation of the digits in the forelimbs; **bipedalism**; **digitigrade** walkers (walk on toes); pneumatic (i.e., filled with air spaces) bones.

iii) Differences between modern birds and *Archaeopteryx* include: toothless beak; fused "hand" elements; tail bones greatly reduced to form the **pygostyle**; deeply keeled sternum (this last thing is absent in flightless birds).

iv) Alternative idea: A few paleontologists do not believe the theropod origin of birds. Instead they argue that birds evolved from an earlier group of reptiles, the thecodonts.

D) RECENT DISCOVERIES

i) In recent years new fossils have been found, many of them in China, which have strengthened the case for a link between birds and dinosaurs. These include fossils of animals that are clearly therapod dinosaurs, but which have feathers or feather-like structures (e.g., *Sinosauropteryx*, *Caudipteryx*), and also fossils of animals that appear to be intermediate between *Archaeopteryx* and modern birds (e.g., *Sinornis santensis*).

E) EVOLUTION OF MODERN BIRDS

i) During the Tertiary period much diversification of birds.

ii) Evolution of some truly enormous birds, including predators 2-3 m tall (e.g., diatrymas) and vulture-like birds with up to 8 m wingspans (teratorns).

iii) Orders of modern birds arose about 60 million years ago, early in the Tertiary.

iv) Many modern genera of birds were present by the end of the Tertiary (5-10 million years ago).