

## Lecture 4: Avian evolution

### Class Business

- Days and times available for (required) Biological Collections tours are now all posted on the class web page; I apologize for the delay. Please check them and plan to attend one. If your schedule of classes makes it impossible for you to attend any of the 4 opportunities listed, you **MUST LET US KNOW BEFORE THE LAST WEEK OF CLASSES.**

### 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 relationship 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 theropod 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 theropod (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 theropod 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).