THE AVIALAE

A. Shared derived characters of Avialae
B. Archaeopteryx as a bird and as a dinosaur
C. Cretaceous birds
D. Origin of feathers and of flight
E. The Bird-Dinosaur “Debate”

Cladistic context for avian theropods

LIVING AVIAN DINOSAURS

5,000 species
Figure 1: Descriptions of non-avornithine bird genera over time. Note the steep increment of new discoveries during the past two decades.

Figure 2: Reconstructions of the ornithomimid Velociraptor mongoliensis (left, after Paul 1988) and the ornithopod Camptosaurus oweni (right, after Currie 2000) scaled to a rock pigeon (Columba livia).

Figure 16-35: Evolution of derived characters of birds.
Carpometacarpus
Feathers
Wishbone
Keeled sternum
Expanded skulls, huge orbits
Toothless
Unique shoulder joint
Hollow, pneumatic bones
Alula
Synsacrum
Pygostyle
Tarso-metatarsus
3/4 foot

Unique shoulder joint

Hollow, pneumatic bones

Alula

Unique shoulder joint

Hollow, pneumatic bones
Figure 16.33 Evolution of the vestibular brain. Note the phylomorphological specialization of the cerebellum.

- BIRD BRAINS
- BIG
- exceptional hearing (long wavelength)
- atmospheric pressure detection

- Triosseal canal

5
Reflexed hallux = avian-style opposable thumb
Avian respiratory system: unique!

Avian digestive system
No bladder!

THE MESOZOIC AVIARY

Gradual acquisition of avian traits
Archaeopteryx: bird
- Expanded braincase
- Wishbone
- Keeled sternum
- Asymmetric feathers
- Pneumatic bones
- Long arms
- Sharp claws
- 7 specimens, 1 feather:

Archaeopteryx: dinosaur
- Teeth
- Three-fingered hands with claws
- Raptor-style saurischian pubis
- Long, stiffened tail with zygapophyses
- Ascending process on astragalus

Late Jurassic
The Bird Fossil Record: BAD!
Late Cretaceous! pygostyle

Long coracoid pygostyle

Confuciusornis

Carpometacarpus

Reduction in number of trunk vertebrae

Flexible furcula
**Iberomesornis**

Shorter trunks
Full caudal rotation of pubis
Loss of teeth +

**Ichthyornis**

Look, Ma, no claws!

**Hesperornis**

Late Cretaceous
Alvarezsauridae: What the heck are they?

*Shuvuuia* (L. Cret, Mongolia)

*Sinornithosaurus*
*Protarchaeopteryx*
*Sinosauropteryx*
*Caudipteryx*
Remiges

Rectrices

Protarchaeopteryx

Dilong Paradoxesis (Feathered Tyrannosaurid?)
Microraptor

The so-called ‘four-winged’ dinosaurs
How do we know these didn’t fly?

1. Feathers symmetrically vaned
2. Minimal feathers on arms and tail
3. Relatively short arms

Why feathers?

1. Insulation
2. Display/species recognition
3. Insect-catching
4. Improved speed/lift on the ground
Arguments against Birds as Dinosaurs

1. *Archaeopteryx* (the oldest known bird) is found in Late Jurassic rocks. It’s supposed “ancestors” - the dromaeosaurids - are found from only in Cretaceous rocks. Therefore, traits in common must be convergent, not shared derived, traits.

2. The oldest known bird is actually the Late Triassic *Protoavis* (not *Archaeopteryx*), thus birds far precede dromaeosaurids.

3. The first feathers appear in the Late Triassic on the non-dinosaurian archosaur - the glider *Longisquama*, which is the probable ancestor of birds.
Arguments for Birds as Dinosaurs

Birds and dinosaurs (especially coelurosaur theropods) share many derived traits, including:

- Perforate acetabulum (Dinosauria)
- Opisthopubic pelvis (embryonic birds → normal saurischian pelvis) (Dromaeosauridae)
- Thin-walled, hollow bones (Theropoda)
- Ornithoid-style eggshell (Theropoda)
- Expanded braincases and kinetic skulls (Theropoda)
- Wishbone (Theropoda)
- Juvenile three-fingered hand (living Hoatzin) (Theropoda)
- Rigid tails (Tetanurae)
- Semilunate carpal, ascending process on astragalus (Coelurosauria)
- Enlarged second toe claw (fossil Rahonavis) (Dromaeosauridae)
- Hand-arm structure (Dromaeosauridae)
2nd toe of *Rahona*
BASIC TYPES OF AMNIOTE EGGSHells

Tyrannosaurid wishbones

Velociraptor wishbone

A Cineradiographic Analysis of Bird Flight: The Wishbone in Starlings Is a Spring

Fig. 1. There is the x-ray image of the avian wing based on cineradiographic analysis of the wing and cervical flexion. a, left; b, right; c, middle. a, the wing is extended; b, the wing is flexed; c, the wing is extended and extended the cervical flexion. This figure shows that the wishbone in the wing and cervical flexion is a spring. Fig. 2. The curve of the distance from the base of the wishbone to the wing joint is shown in the graph. The graph shows that the distance from the base of the wishbone to the wing joint increases with increasing wing flexion and cervical flexion.