Natural Sciences 360 Legacy of Life Lecture 15 Dr. Stuart S. Sumida

DINOSAURIA

Dinosaurian groups more derived than Herrerasaurs may be divided into two groups based on hip construction:



SAURISCHIAN

ORNITHISCHIAN

(Note position of pubis.)

Crocodylomorpha Pterosauria Eoraptor Herrerasauridae Saurischia Ornithischia





Stegosauria

Characteristic Features:

- •Middle Jurassic to most Cretaceous
- •Best known for their osteoderms along axial column. Often expressed as spikes or plates.
- •The osteoderms near the shoulder modified as "parascapular spines."
- •Very tall vertebrae (tall neural arches).



Stegosaurus



Type specimen of Stegosaurus



Stegosaurus: skeletal reconstruction.





The jaw joint is out of line with the tooth row in stegosaurs – an herbivore thing to do.

Reconstruction of skull of **Stegosaurus**





Each toe like a hoof.

Less, lighter bone to support more weight in bipedal, almost orthograde position.



Pelvic girdle of **Stegosaurus**



Ankylosauria

- •Middle Jurassic to Late Cretaceous
- •Large herbivores
- •Large, herbivorous quadrupeds (though not usually as large as stegosaurs.
- •Most defining features include features that have to do with armor.
- •Developed a secondary palate to aid in breathing while chewing.



A, B: Skull of Ankylosaurus magniventris (Ankylosauridae) in dorsal and occipital view. C: Skull of Saichania chulsanensis (Ankylosauridae) in dorsal view. D, E: Skull of *Euoplocephalus tutus* (Ankylosauridae) in lateral and occipital view. Scale = 10 cm. (C after Maryańska 1977; others after Coombs 1978*a*.)

Ankylosaurid skulls



Nodosaur tail.



Ankylosaurus – reconstruction by Mark Hallet



Ankylosaurus - Sibbick reconstruction.



CERATOPSIA

Relative late-comers to the scene: Known from Middle to Latest Cretaceous.

In All members of the **CERATOPSIA**:

- •Skull has a narrow but deep, beak-like snout.
- •Posterior margin of the skull overhangs the neck.

Have an additional, unpaired median bone: the *rostral* bone, anterior to the premaxillaries.
Rostral bone probably covered with horny sheath – "ramphotheca."



Frontal head reconstruction of **Styracosaurus**



Sculpture reconstruction of Styracosaurus



Chasmosaurus

Triceratops – note complex narial opening





PACHYCEPHALOSAURIA

Known from Early to latest Cretaceous.

•Defined primarily by PACHYOSTOSIS (extreme thickening) of skull roof – usually parietal and frontal bones.

•Adjacent bones on rear margin of skull, the squamosals, often ornamented with prominent tubercles.

•Tongue-and-groove articulation between vertebrae to reinforce vertebral column.

•Obligate bipeds.





Prenocephale



Stegoceras

A-D: **Prenocephale** A





Reconstruction of *Pachycephalosaurus* head (William Zucconi)





Skull of *Prenocephale;* fused frontal and parietal

Reconstruction of **Stegoceras**



Dorsal view of *Homalocephale*Note width of body outline, indicative of herbivorous nature.



Did pachycephalosaurs butt heads?

Alignment of dome and articulation between skull (occipital bone) and first vertebra (atlas vertebra) suggests butting occurred.

Scott Sampson suggests it was more likely side-butting. That way, glancing blows are not as damaging.



Reconstruction of *Pachycephalosaurus* (John Gurche)
The danger of basing conclusions on extremely fragmentary specimens...



Majungatholus partial specimen originally assigned to Pachycephalosauridae





Majungatholus is actually an albeosaurid theropod. Ornithischia (The "Bird-hipped Dinosaurs")

Lesothosaurus Thyreophora Stegosauria Ankylosauria Cerapoda Euornithopoda (=Ornithopoda) Pachycephalosauria Ceretopsia

CERAPODA

•A "Diastema" present (gap between teeth of premaxilla and maxilla).

•Teeth are present on the premaxilla. However, only five or fewer teeth on the premaxilla.

ORNITHISCHIA



ORNITHOPODA Early Jurassic to Late Cretaceous

- •Pronounced ventral offset of premaxillary tooth row relative to maxillary tooth row.
- •Jaw articulation far below tooth row.
- •Skull rectangular in occipital (back) view.
- •Palpebral bone(s) often present.

Skull of *Hypsilophodon* – a primitive member of Ornithopoda



Skull of *Hypsilophodon* – a primitive member of Ornithopoda



ORNITHOPODA

Three Major Groups

Heterodontosauridae Hypsolophodontia Iguanodontia

ORNITHOPODA



Heterodontosauridae

Considered most primitive member of Ornithopoda

Early Jurassic

•A large canine-like ("caniniform") tooth in both maxilla and dentary.

Two anteriormost dentary teeth small and without any denticles or other ornamentation.
Relatively large manus (hand).

Skull of *Heterodontosaurus*



Two anteriormost dentary teeth small and without any denticles or other ornamentation. Body outline reconstruction of *Heterodontosaurus* (Animal was about one meter long.)



Relatively large/long manus (hand) for group.



Tianyulong confuciusi is a small heterodontosaurid from the Early Cretaceous of China that has "feather-like" integumentary structures.

ORNITHOPODA



Hypsolophodontia

Middle Jurassic to Late Cretaceous

A series of genera that are difficult to group clearly, but all are definitely more primitive that Iguanodontia.

All ornithopod features plus: •Scapula (shoulder blade) shorter than humerus.

- •Ossified tendons in tail.
- •Prepubic process rodlike (not clublike).

Skull of *Hypsilophodon*



Hypsilophodon – body outline reconstruction



Hypsilophodon – reconstruction of pelvic girdle



Prepubic process rodlike (not clublike).

Hypsilophodon



ORNITHOPODA



Iguanodon was the first dinosaur fossil ever found, the distal part of a femur, mistakenly identified as "*Scrotum Humanum*."



As the first dinosaur ever found, *Iguanodon* has had lots of time to be misinterpreted.







Waterhouse Hawkins: The Crystal Palace





Iguanodontia

Late Jurassic to Late Cretaceous

- •Premaxilla edentulous (without teeth).
- Teeth leaf-shaped with denticles.
 Narial opening enlarged relative to orbit



Teeth leaf-shaped with denticles.

Narial opening enlarged relative to orbit (as compared to other ornithopods).



Mummified hadrosaur skin: one of the few examples of where we know what the skin looked like. (And no, we can't get DNA our of it.)



Miasaura (Hadrosaurinae)

Skeletons of babies; Royal Tyrell Museum of Paleontology





Miasaura

More derived members with extremely developed hollow crests on the head and down to the nose.



This crest has the form of a simple prong at the back of the head; it is not tubular but the sides of the face in front of the eyes are indiowed out as if to contain a flexby pouch which could have been puffed up to form a resonator similar to the large flexby nose of elephant seals.



Kritosaurus The Roman nose of this badrosane was thick and flattened and did not contain resonating tubes. It may not have been such an accomplished caller as other species, relying instead on its visual appearance.

Parasaurolophus

The long, tubular creat of this dimonane is eminerarly recognitable. Distinctive profiles never probably important features in the social life of this discoane. The tube was also a resonator for producing low fragmency bellown, again to help with recognition, but perhaps also as a berd userning sossaid.

Lambeosaurus

This distinctive, believed like creat would have created a totally different resonant sound from the tube-created types. The color scheme may be imaginary (color pigments do not fossilize) but large cycs and sharp vision may used have gone together usith colorful bodies.





Parasaurolophus has one of the most extremely developed crests.



Corythosaurus


Hypacrosaurus



SAURISCHIA



SAUROPODOMORPHA

Upper Triassic through end of Cretaceous

Features that define Sauropodomorpha primarily associated with adaptations for herbivory, large size and, later, graviportal locomotion:

- •Relatively small head
- •At least ten vertebrae in very long neck.
- •Teeth coarsely serrated.
- •Enlarged sacrum
- •Extremely large thumb with enlarged claw.



More primitive Sauropods

> BIPEDAL, Extremely large thumb with enlarged claw.

Seismosaurus, a more derived sauropod.



Small head Long neck



Plateosaurus is amongst the best known of primitive sauropods.



Very large animal, but it retains primitive dinosauian condition of being pronograde biped.



Alamosaurus, adult and juvenile, Late Cretaceous of Texas.



Camarasaurus

Skull











Camarasaurus

Brachiosaurus

Skull



Brachiosaurus – muscular reconstructions



Diplodocus



Apatosaurus







One of the more wildly constructed relatives of *Diplodocus* and *Apatosaurus*...



Amargasaurus





