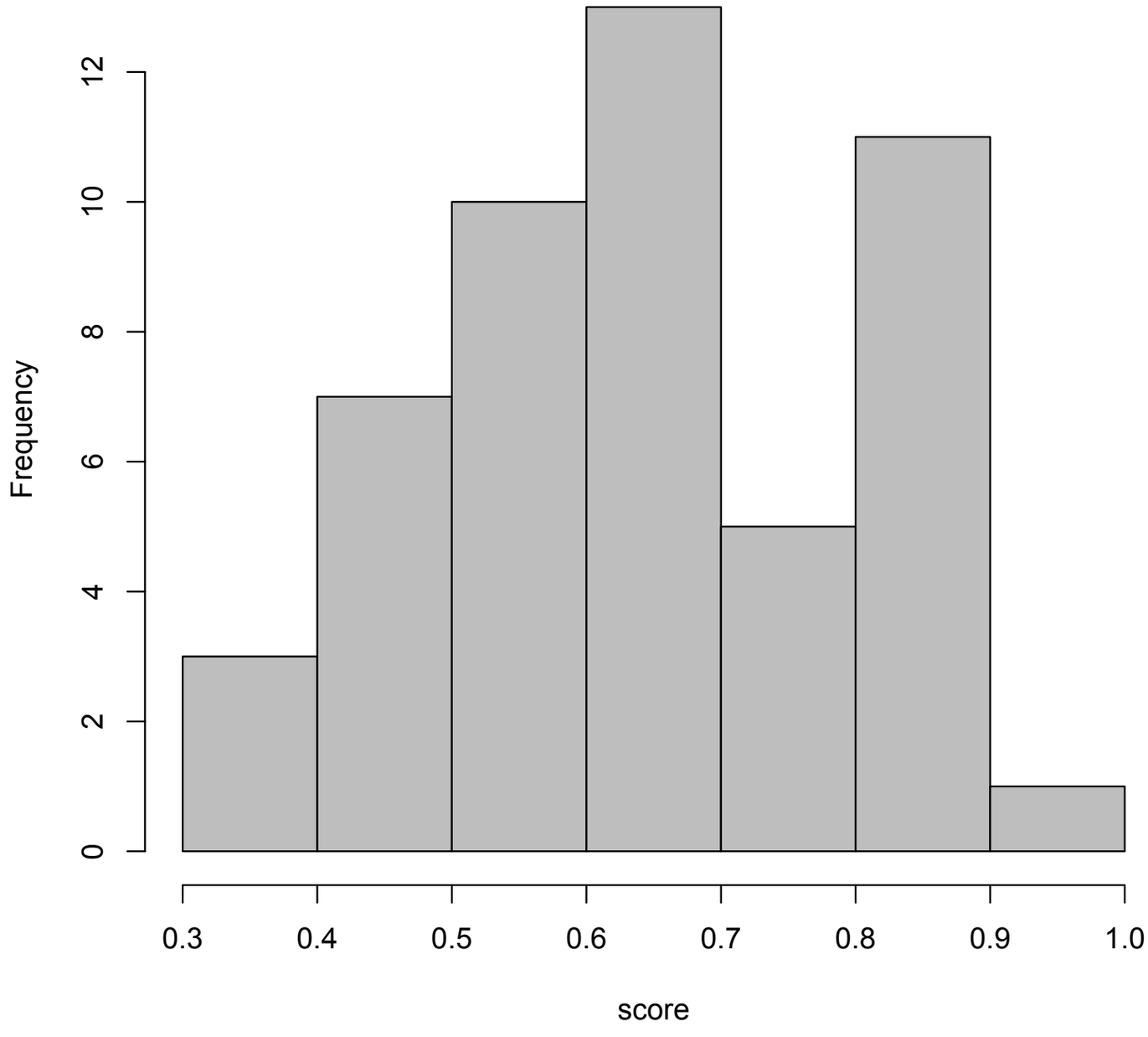


A: 90% - 100% (11)
B: 75% - 90% (12)
C: 65% - 75% (10)
D: 55% - 65% (10)
F: <55% (5)

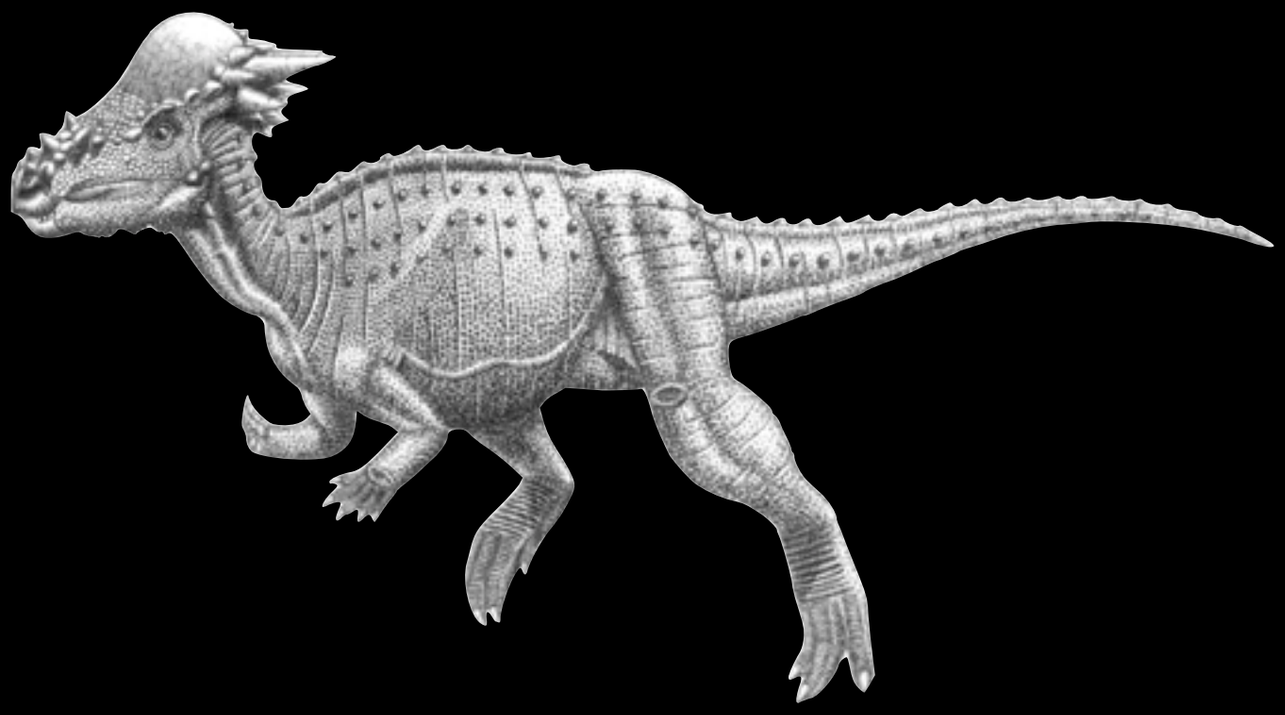
Average: 65%
Max: 91.6%
Add 8.3% to your score… this is your final score.

Ornithischia
Genosauria
Ceropoda
Marginocephalia

All marginocephalians bear a ridge, or shelf across the back of their skull

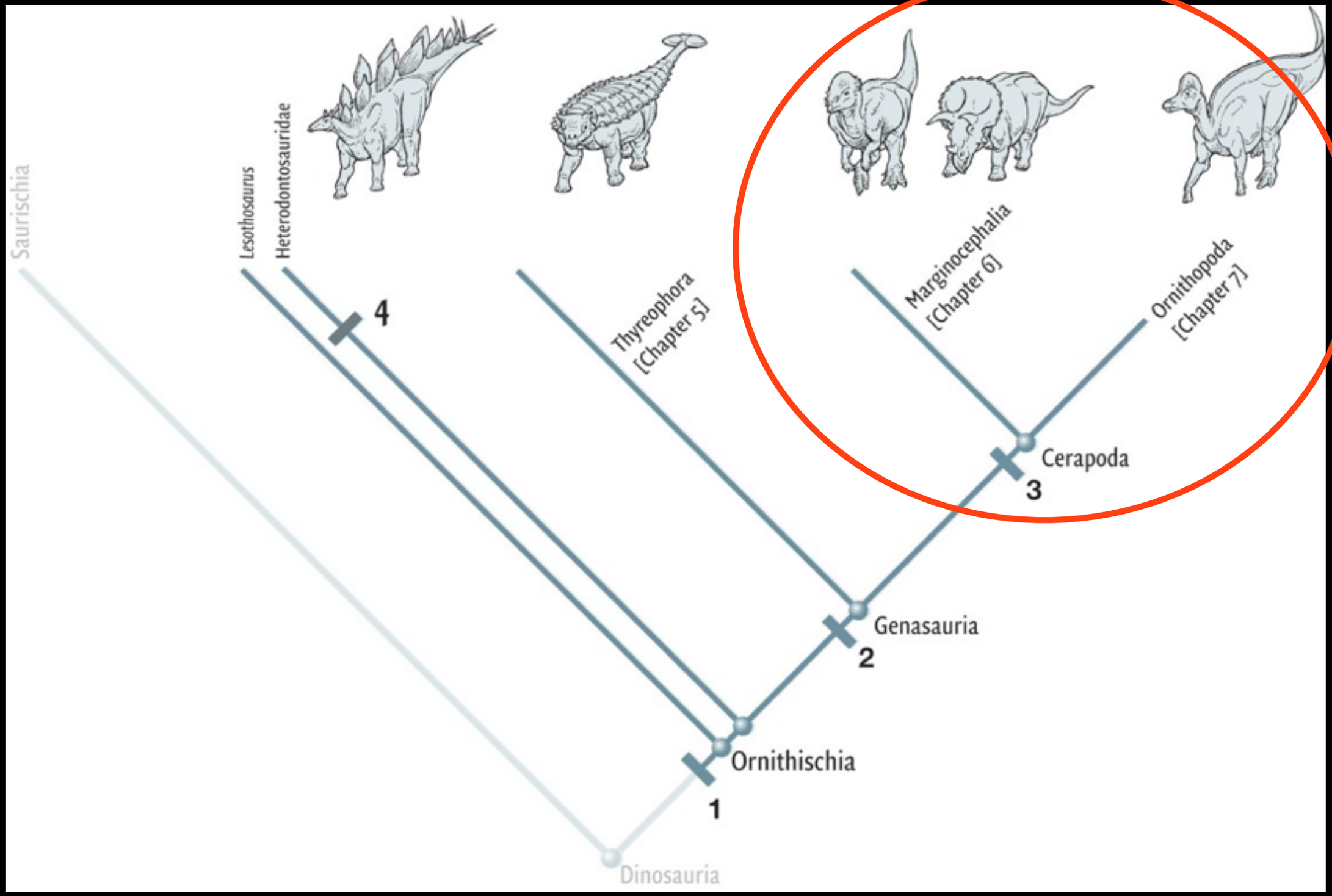
Many sizes and shapes
Cretaceous
Northern Hemisphere

Pachycephalosauria: ‘Thick Heads’
Ceratopsia: ‘Horn Face’



Stygimoloch

Styracosaurus



Ceropoda:

Gap btw. premaxillary and maxillary teeth
5 or less premaxillary teeth
Finger-like anterior trochanter

Ornithopoda

Ceratopsia

Pachycephalosauria

Marginocephalia

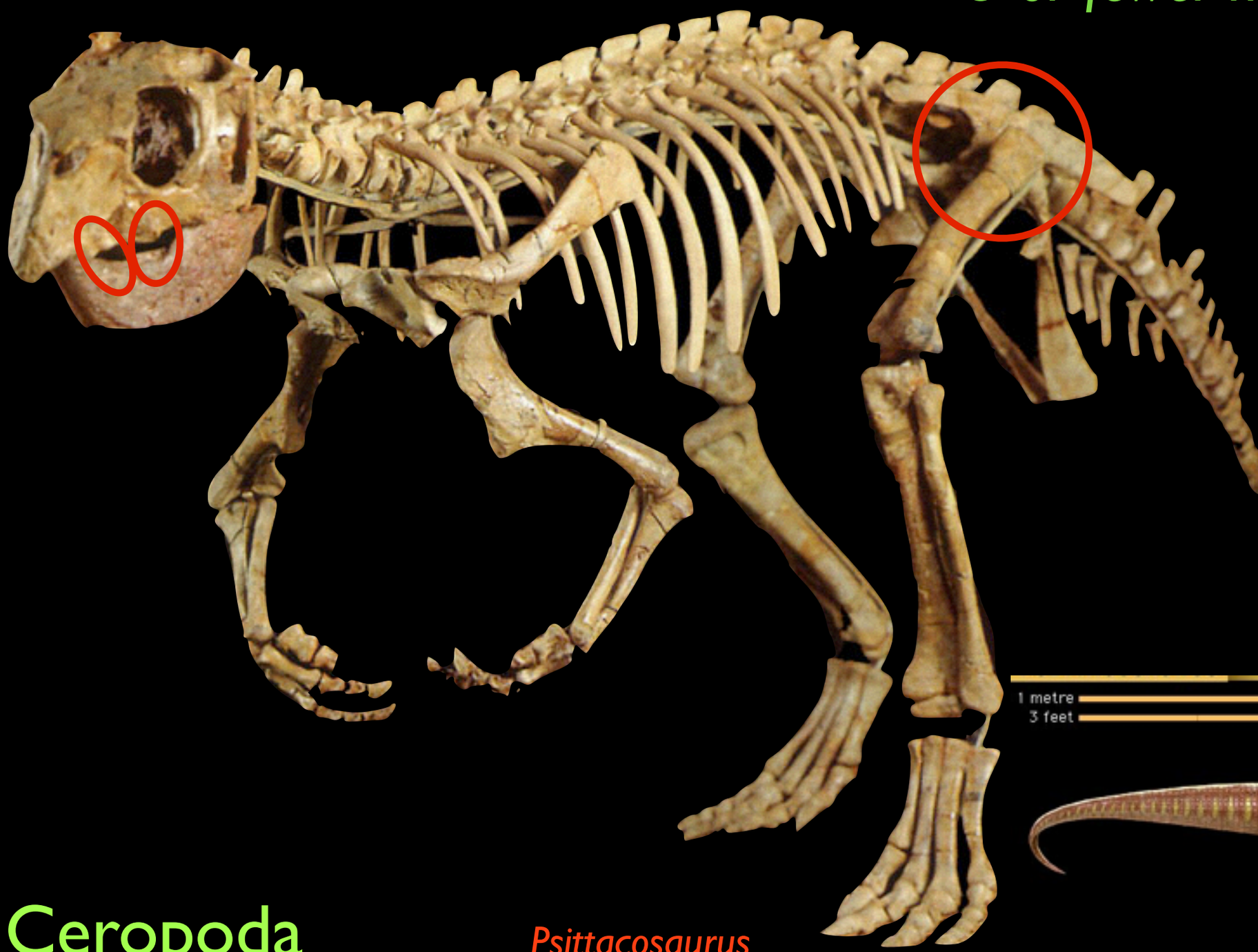
Cerapoda

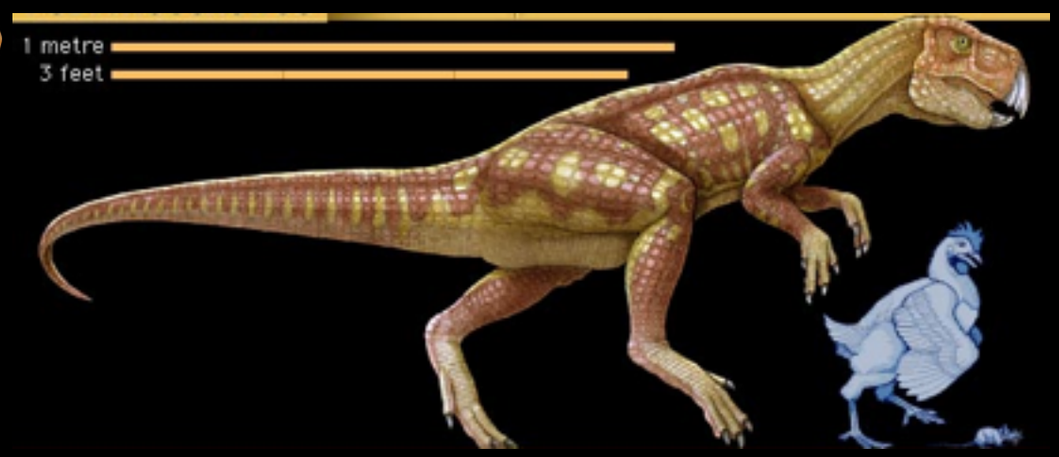
Shared, derived characteristics

Significant Diastem

Widely spaced hip sockets

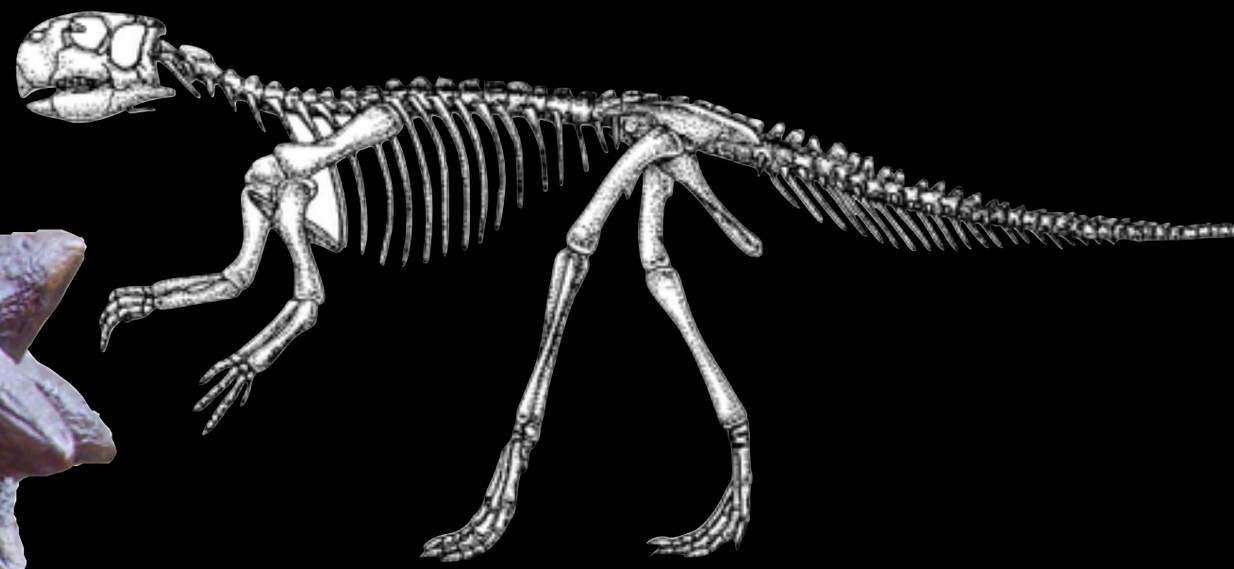
5 or fewer maxillary teeth





Ceropoda

Psittacosaurus

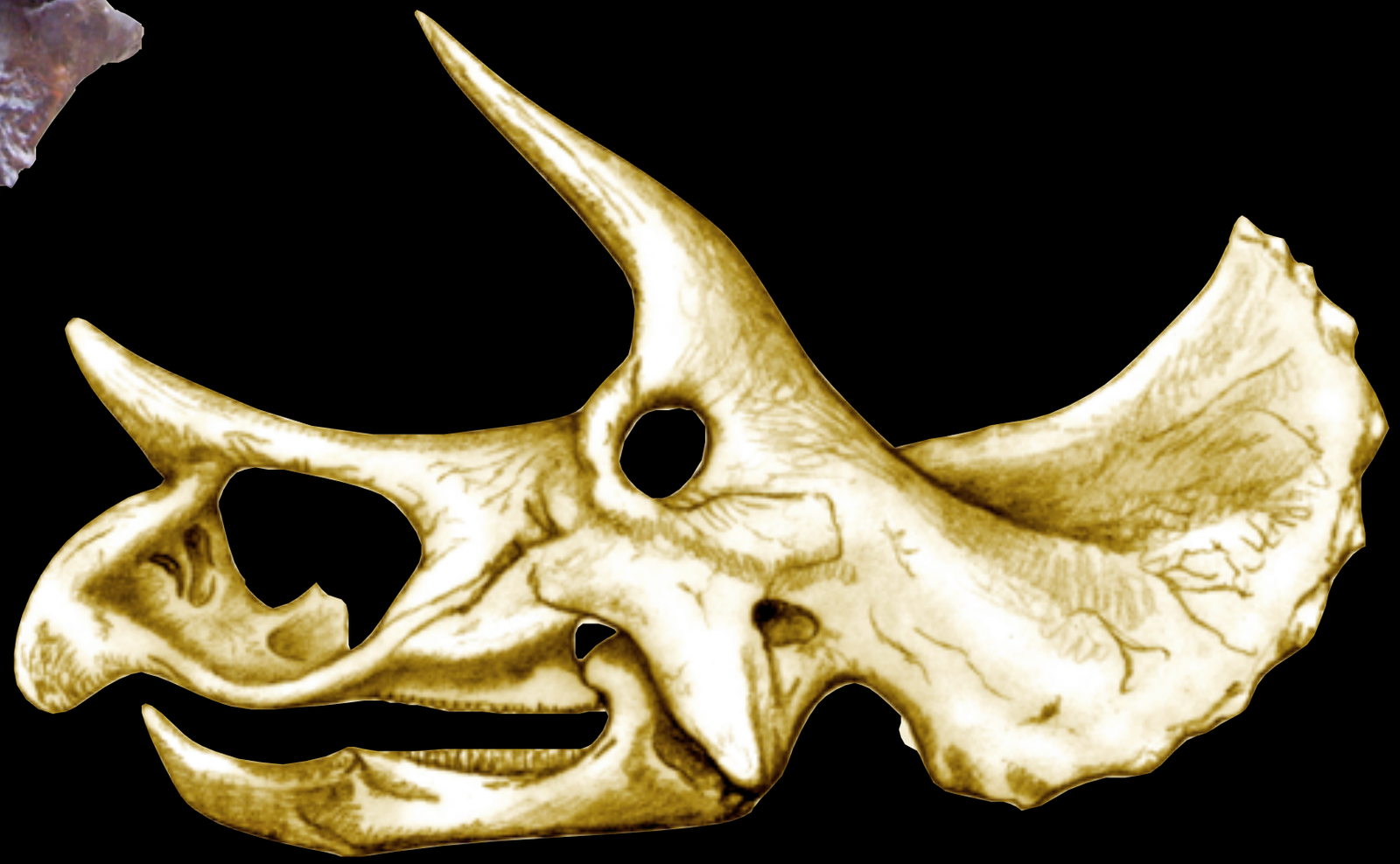


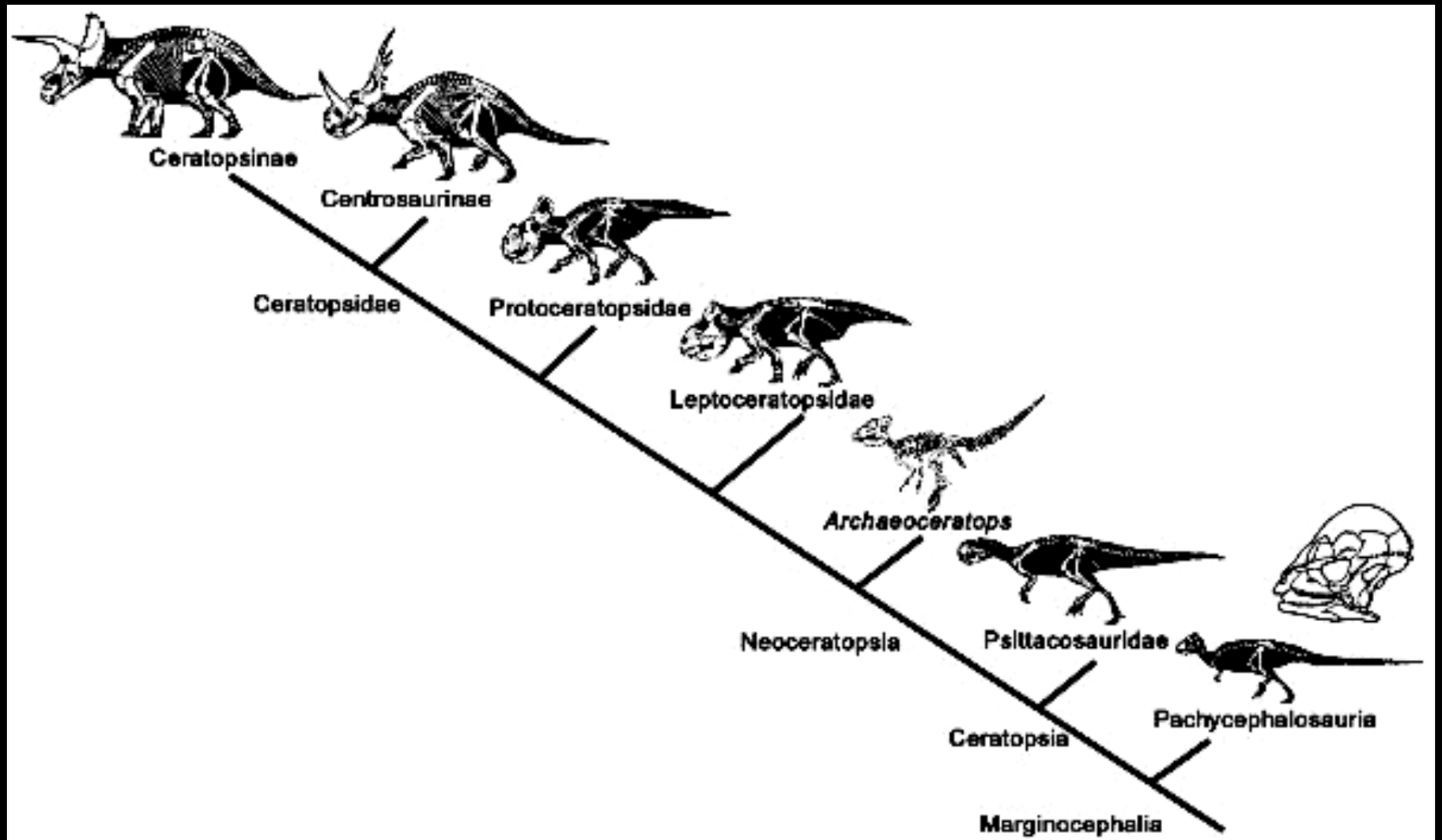
Shared, derived characteristics

Overhanging shelf, or MARGIN

Short Pubis

Marginocephalia




Ceratopsinae
Centrosaurinae
Ceratopsidae
Protoceratopsidae
Leptoceratopsidae
Archaeoceratops
Neoceratopsia
Psittacosauridae
Pachycephalosauria
Ceratopsia
Marginocephalia

Ornithischia
Genosauria
Ceropoda
Marginocephalia
Pachycephalosauria

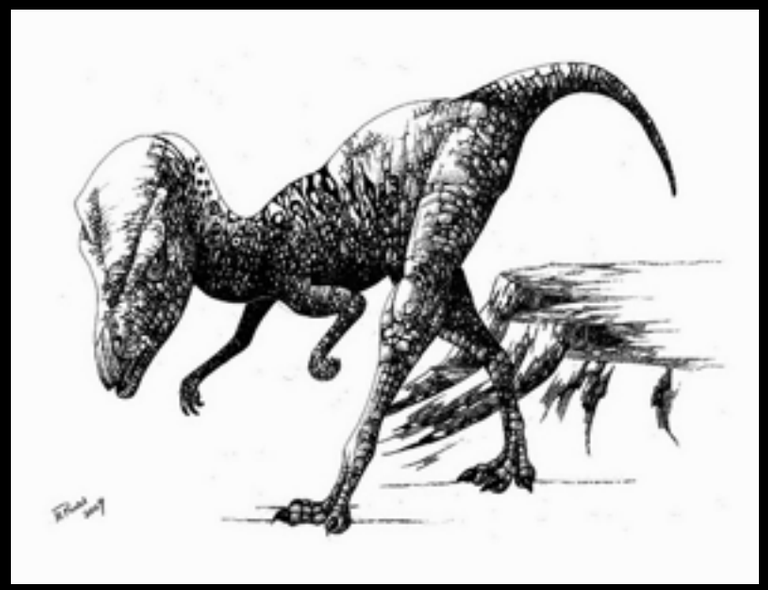
Shared, derived characteristics
Thickened skull roof
Ornamentation of ext. skull
Ridges/Grooves on vertebrae
Ossified tendons at end of tail

Primitive characteristics:
Pronounced diastem
Expanded skull Margin

Stegoceras

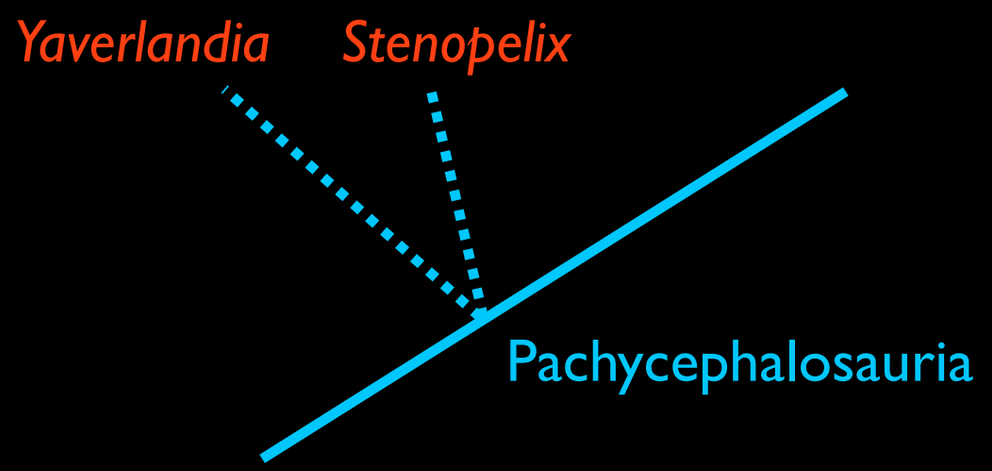
Primitive Pachycephalosaurs

Yaverlandia? *Stenopelix*



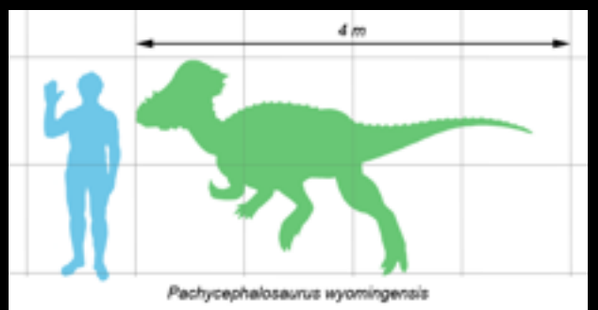
Yaverlandia
- Early Cretaceous
- Partial skull

Stenopelix
- Early Cretaceous
- Lacked skull
- Doubt regarding it's classification



Derived Pachycephalosaurs

Pachycephalosaurus



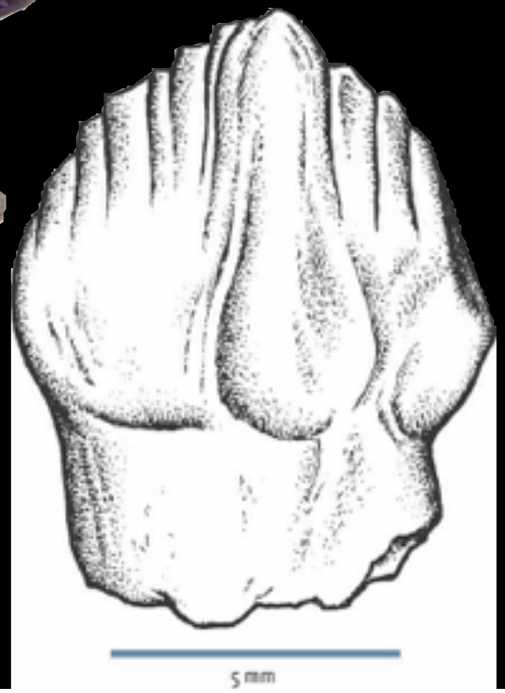
Derived Pachycephalosaurs

Thickened skull roof
Eventual loss of upper temporal fenestra

Expanded cheek bones

Extensive network of ossified tendons

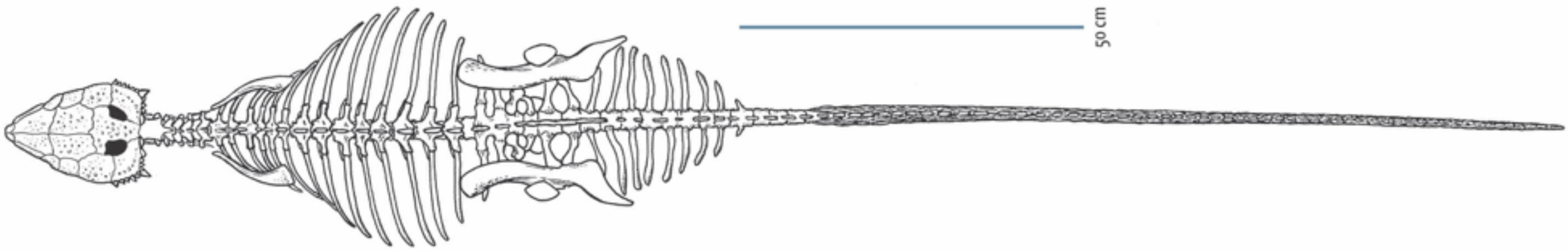
Diet



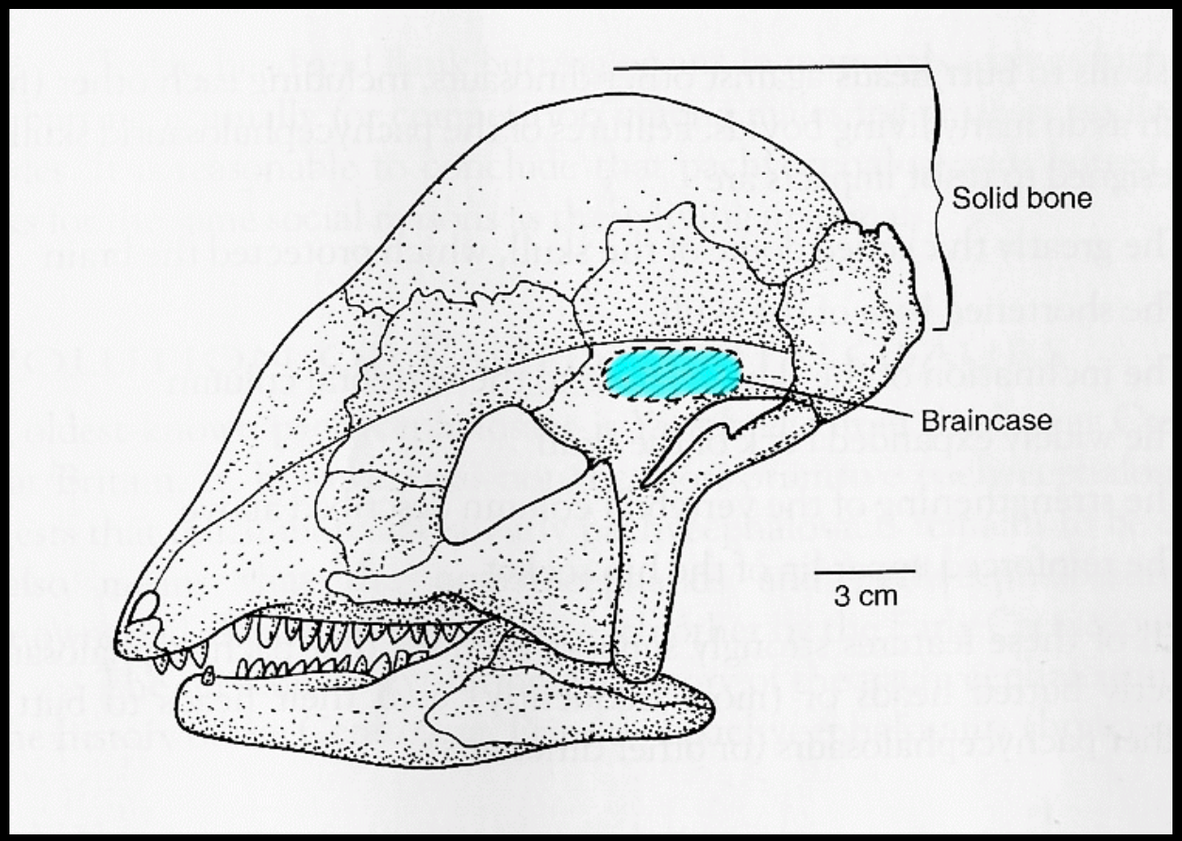
Typical Ornithischian teeth: herbivore
Front jaws: peg-like gripping teeth
surrounded by small beak
Small, canine-type teeth in front
Diastem is emphasized
Cheek teeth uniformly shaped

BROAD rib cage
Extended to base of tail
Indicates that the digestive organs were positioned around the hind legs
Food digested less by chewing, more by fermentation (similar to Thyreophorans)

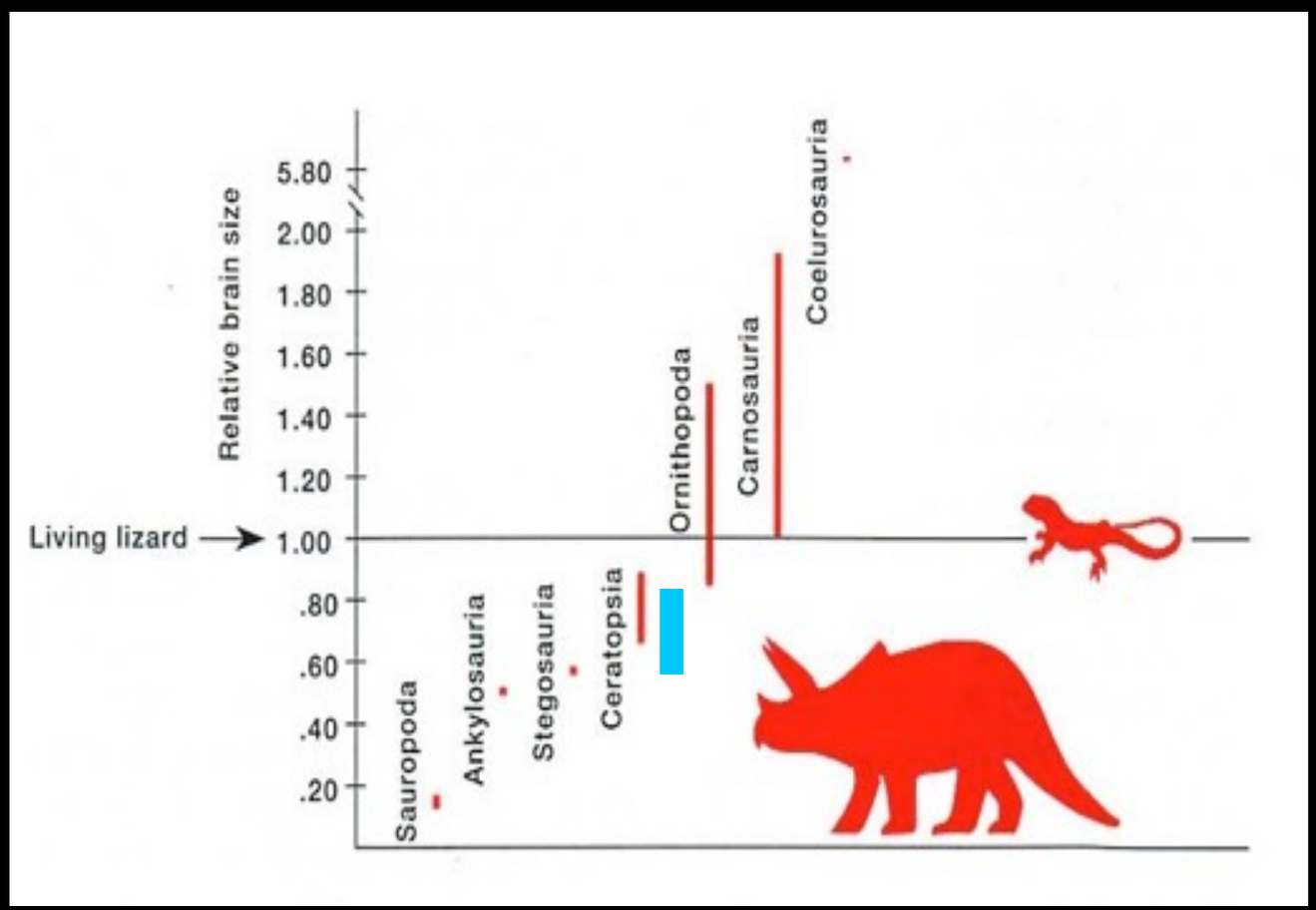
Homalocephale

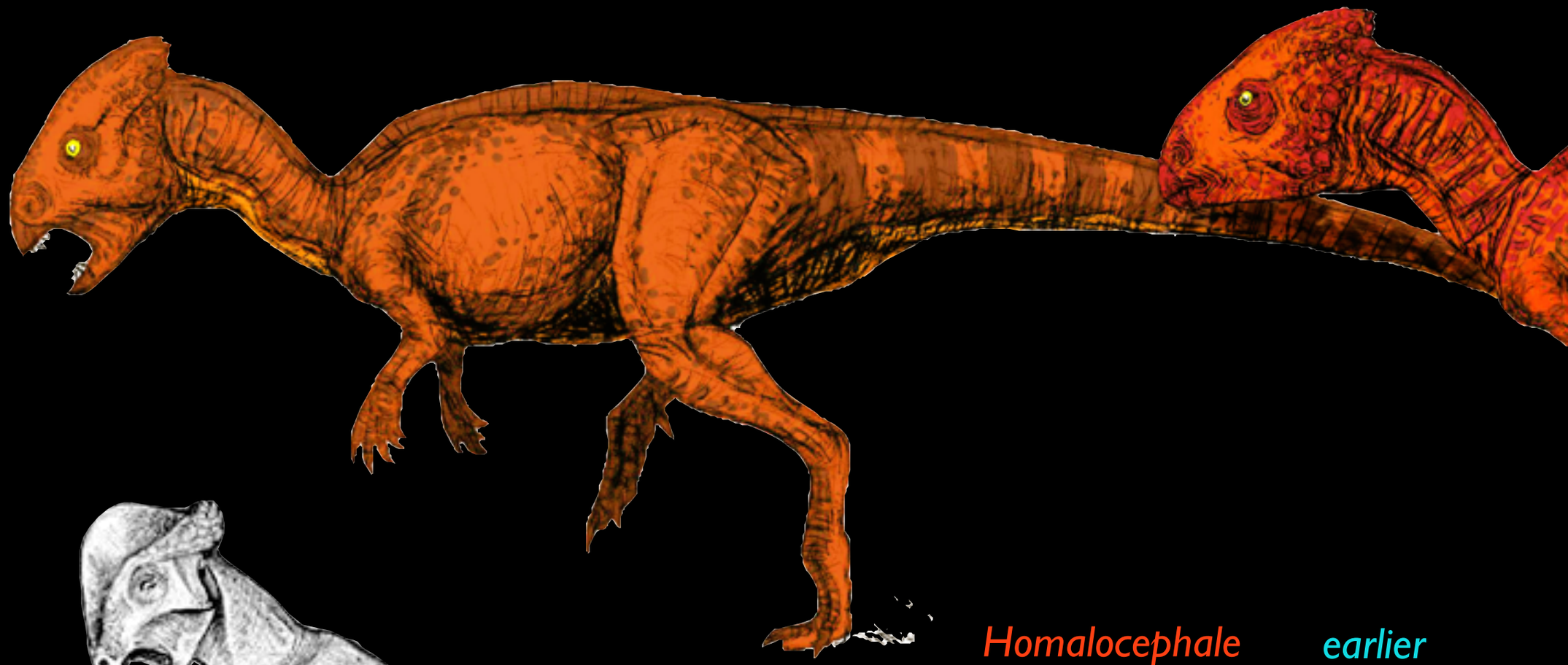


Brain Size



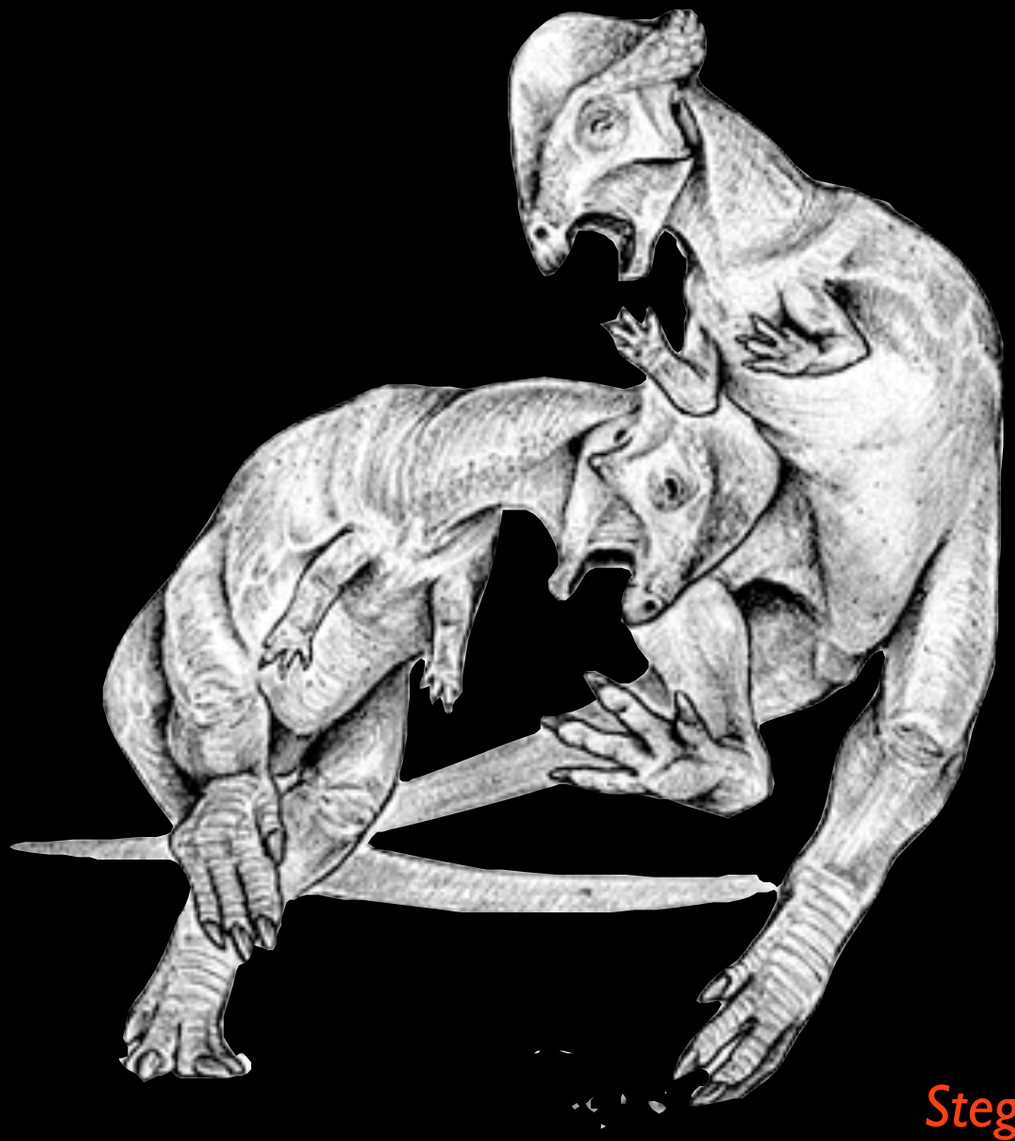
Moderate/small braincase
Enlarged Olfcatory Lobes
Large groove indicating thick optic nerve
Indicates good eyesight





Homalocephale

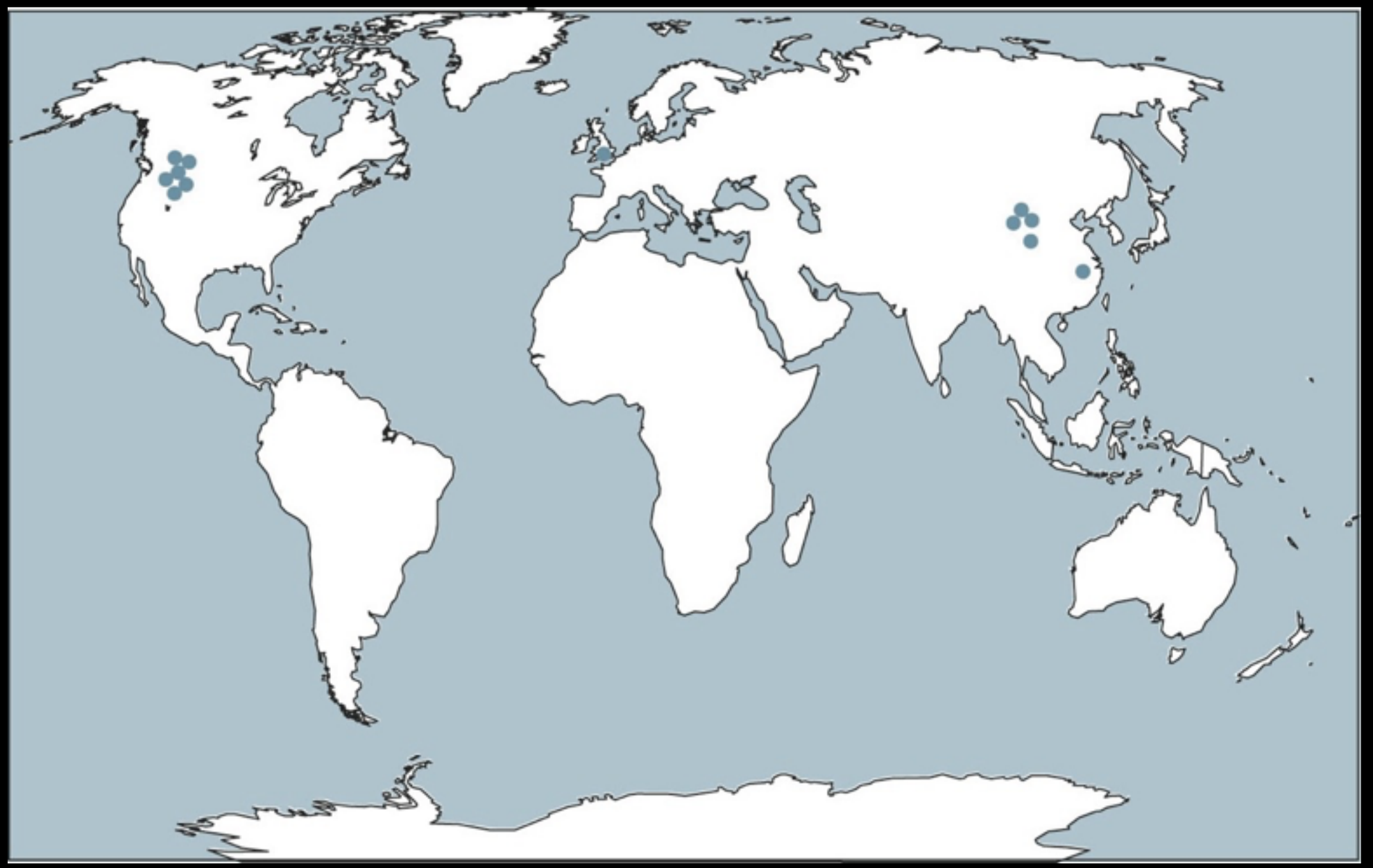
earlier
'flat'

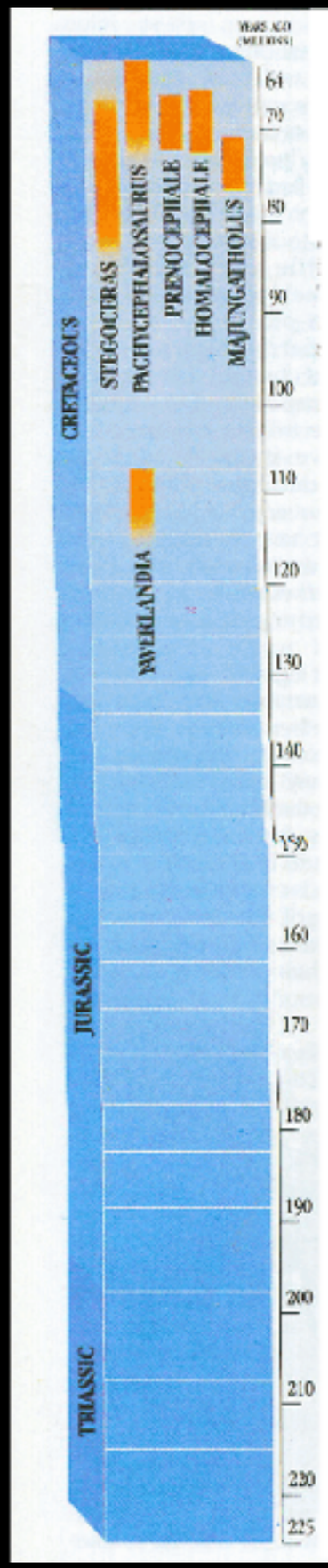


Stegoceras

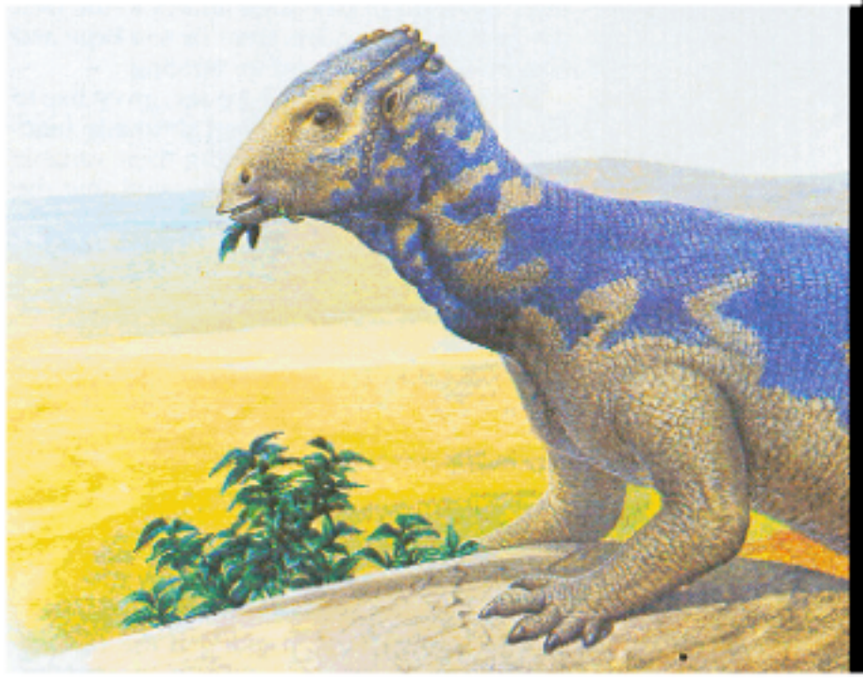
derived
'round'

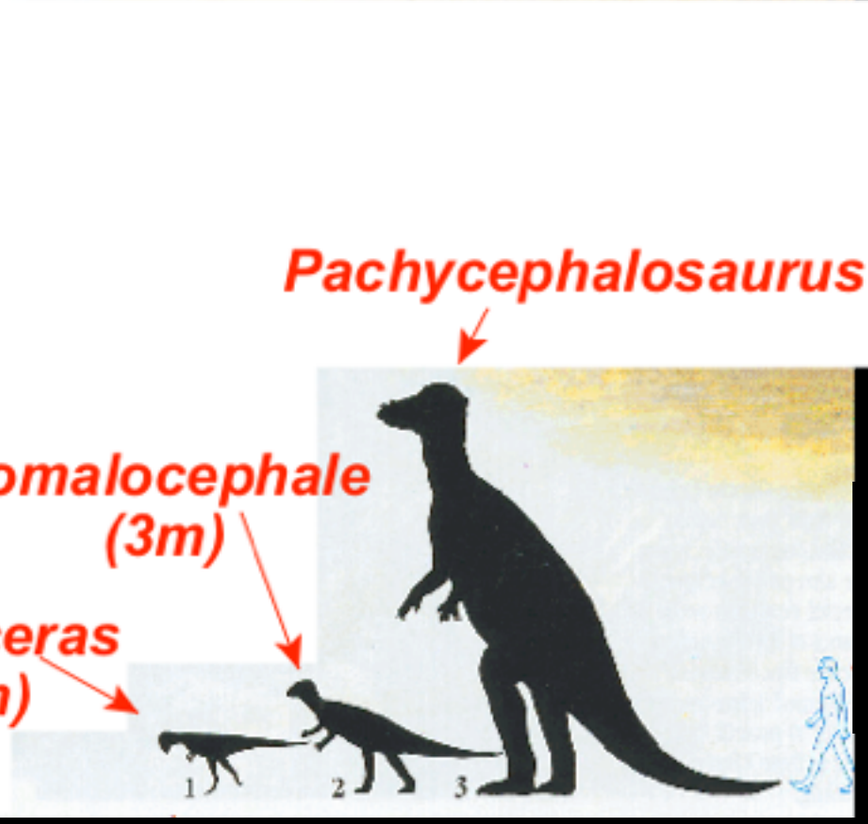
Distribution in Space and Time



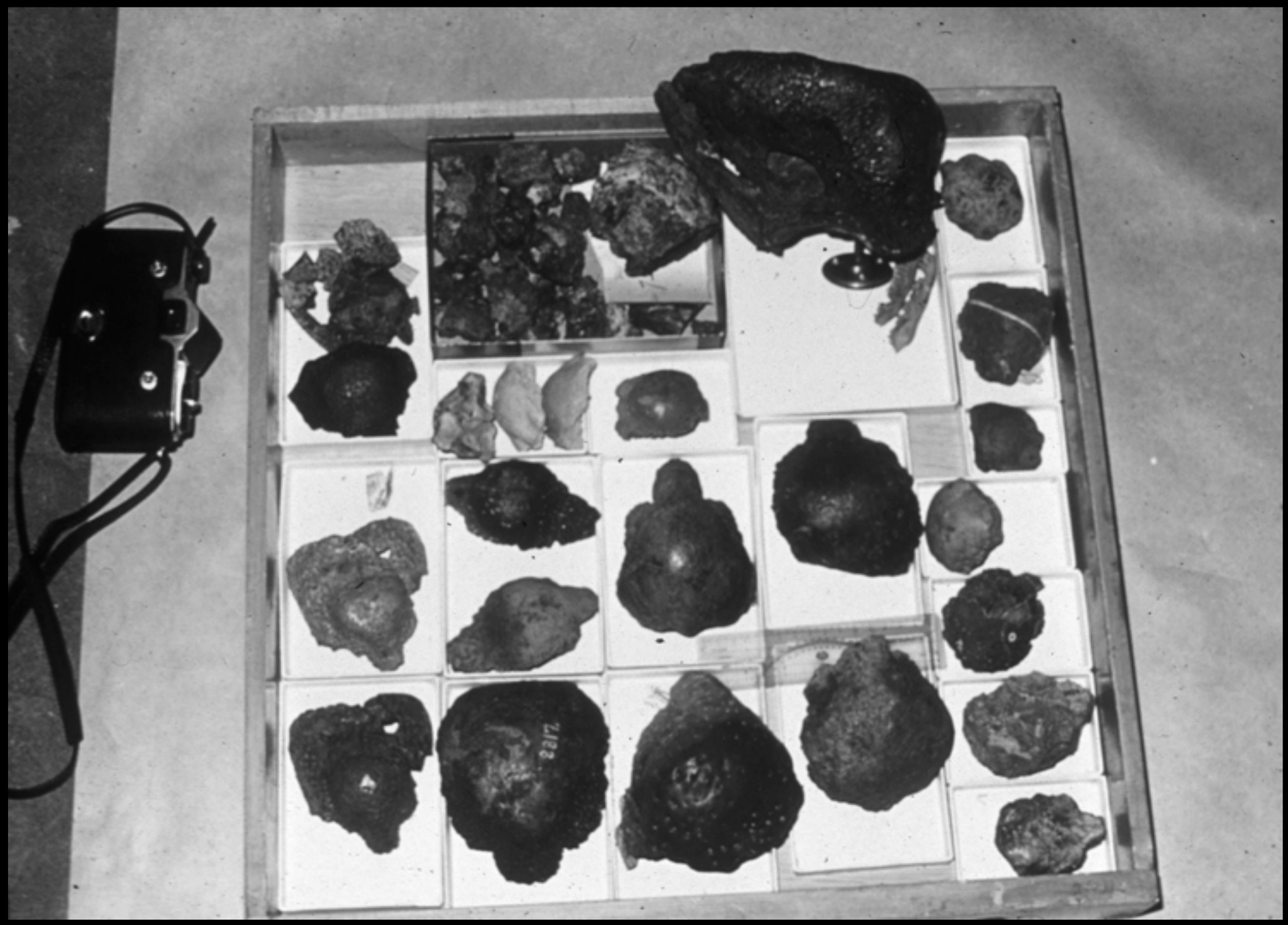


~10% of dino fauna



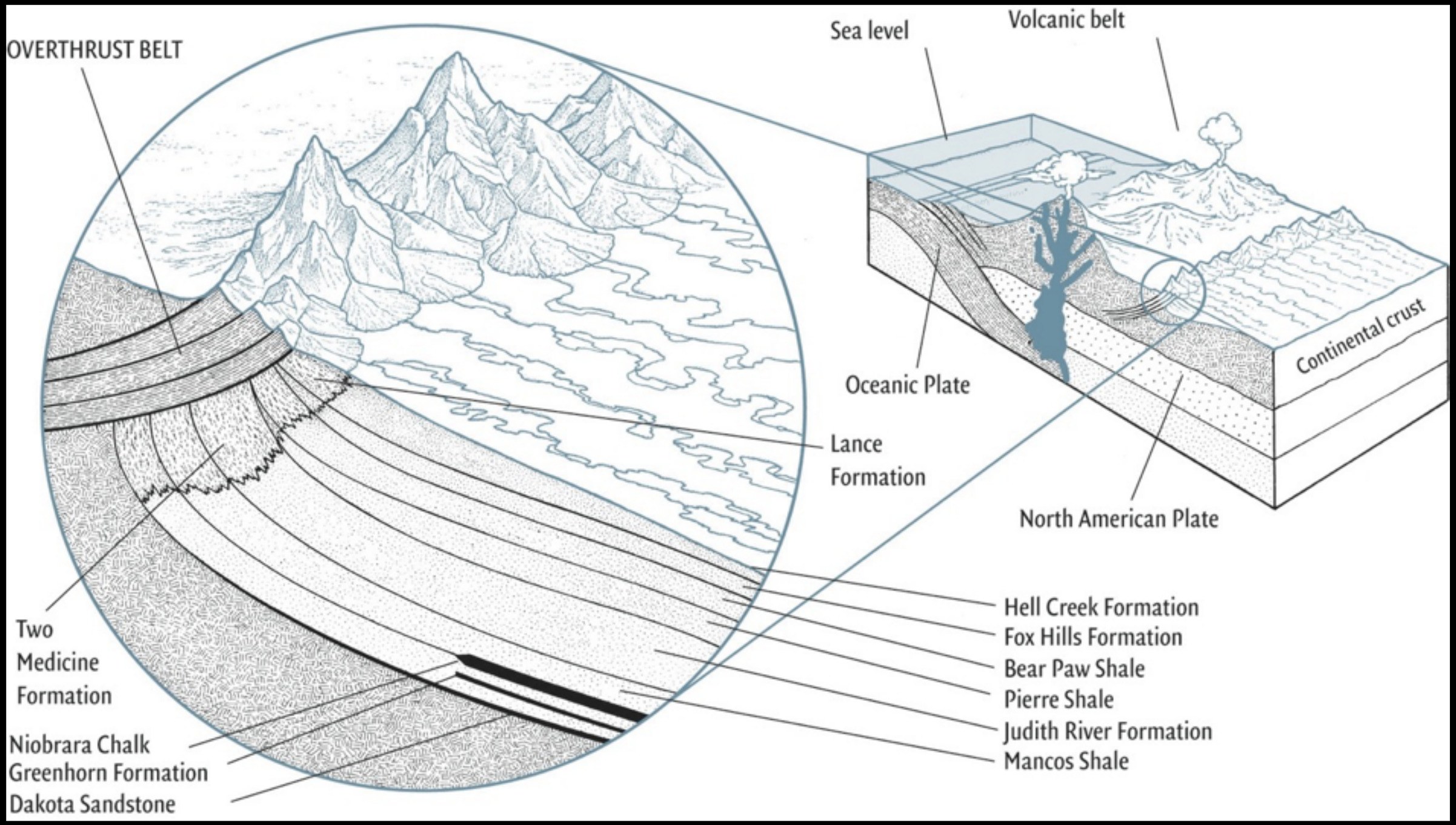


Taphonomy

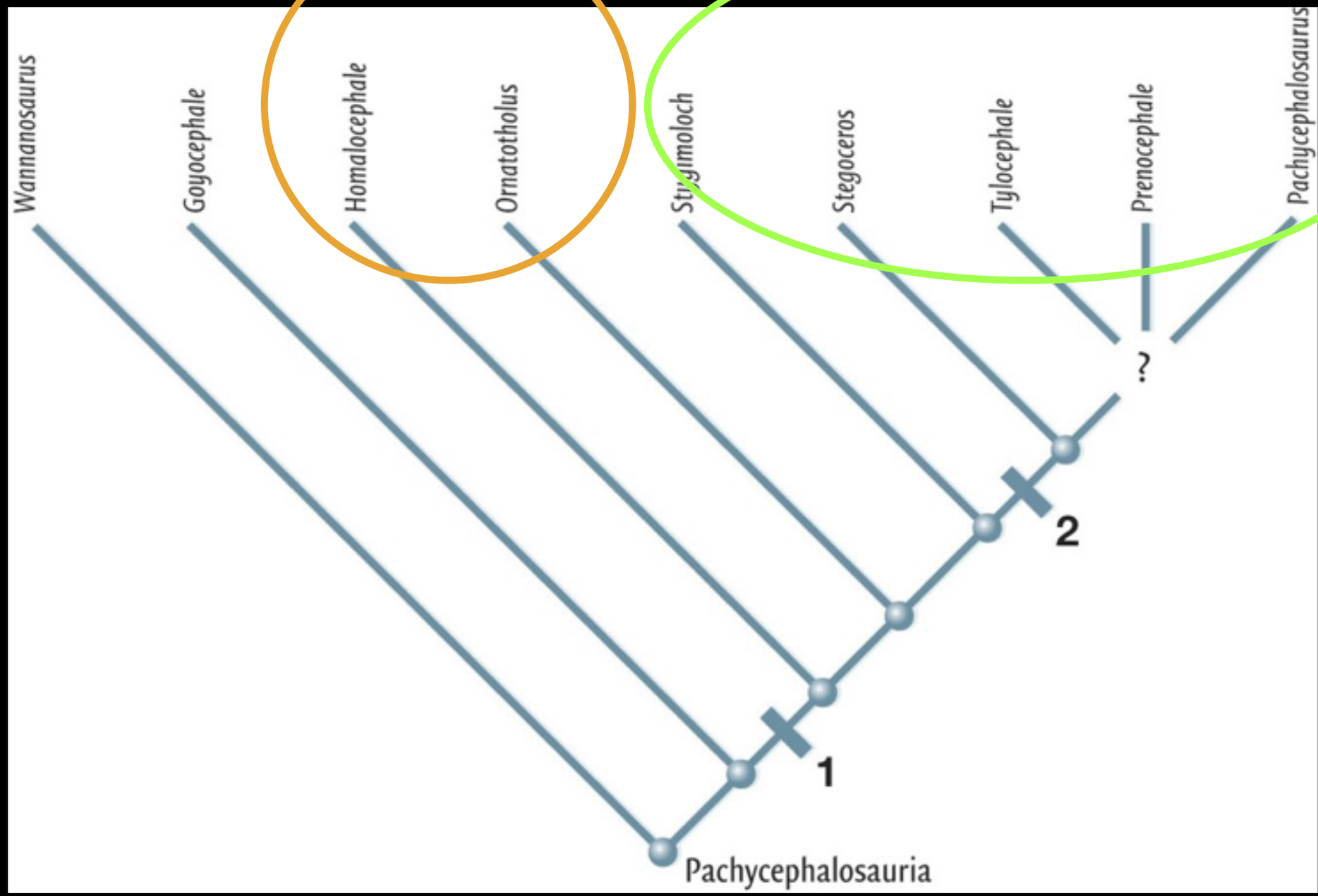


North America: Skull Caps
Asia: Some skeletal remains: no complete!

Taphonomy



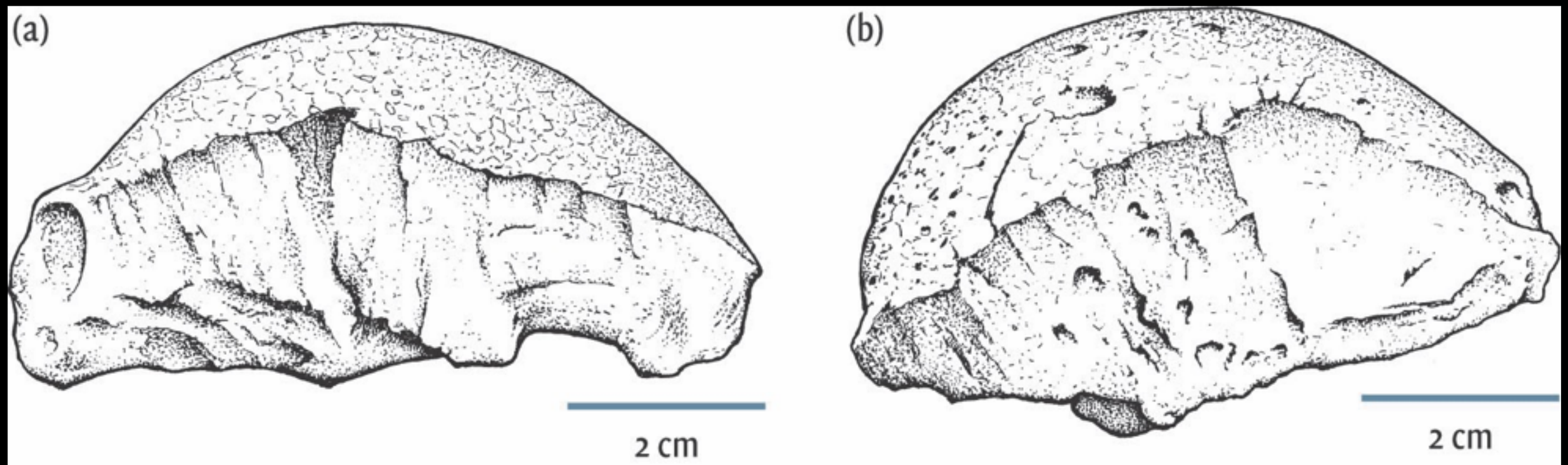
Why are there no skeletal remains other than skull caps found in North America? *Allochthonous*



Flat Heads
Basal Homalocephaloids
2 temporal fenestrae
Asia
Up to 1.5 m long

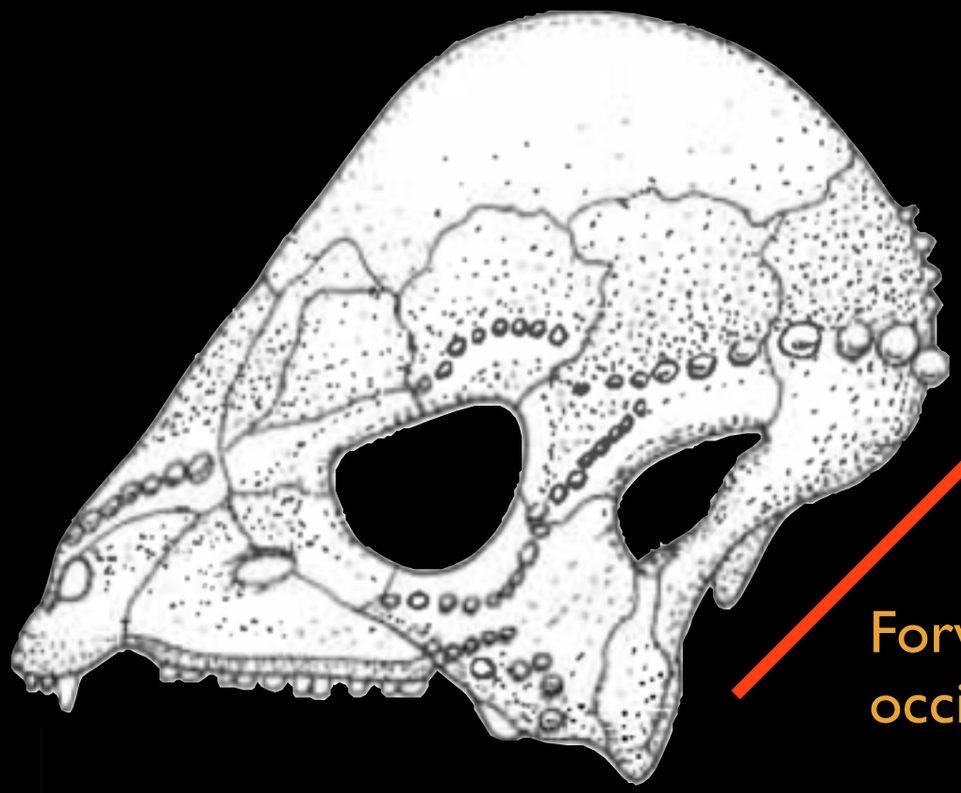
Fat Heads
Pachycephalosaurids
1 temporal fenestra
Asia & N. America
Up to 8 m long

A Battering Ram?



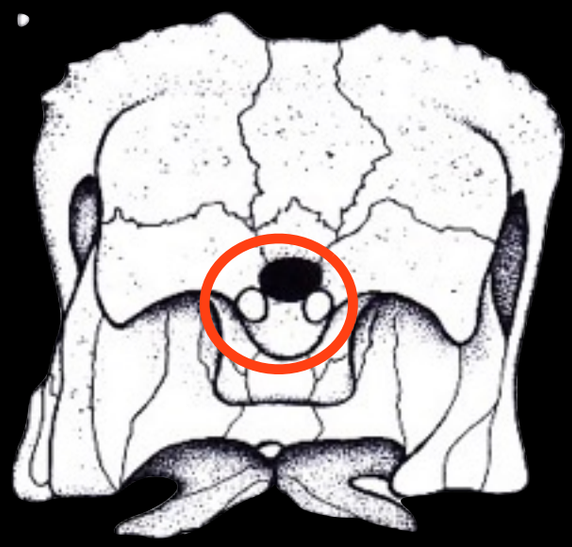
Pachycephalosaurs: Bone Cap
Up to 9 inches of bone
Composed of two primary bones; FRONTAL, PARIETAL
Adjacent bones often form prominent tubercles

A Battering Ram?



Forward rotation of occipital region

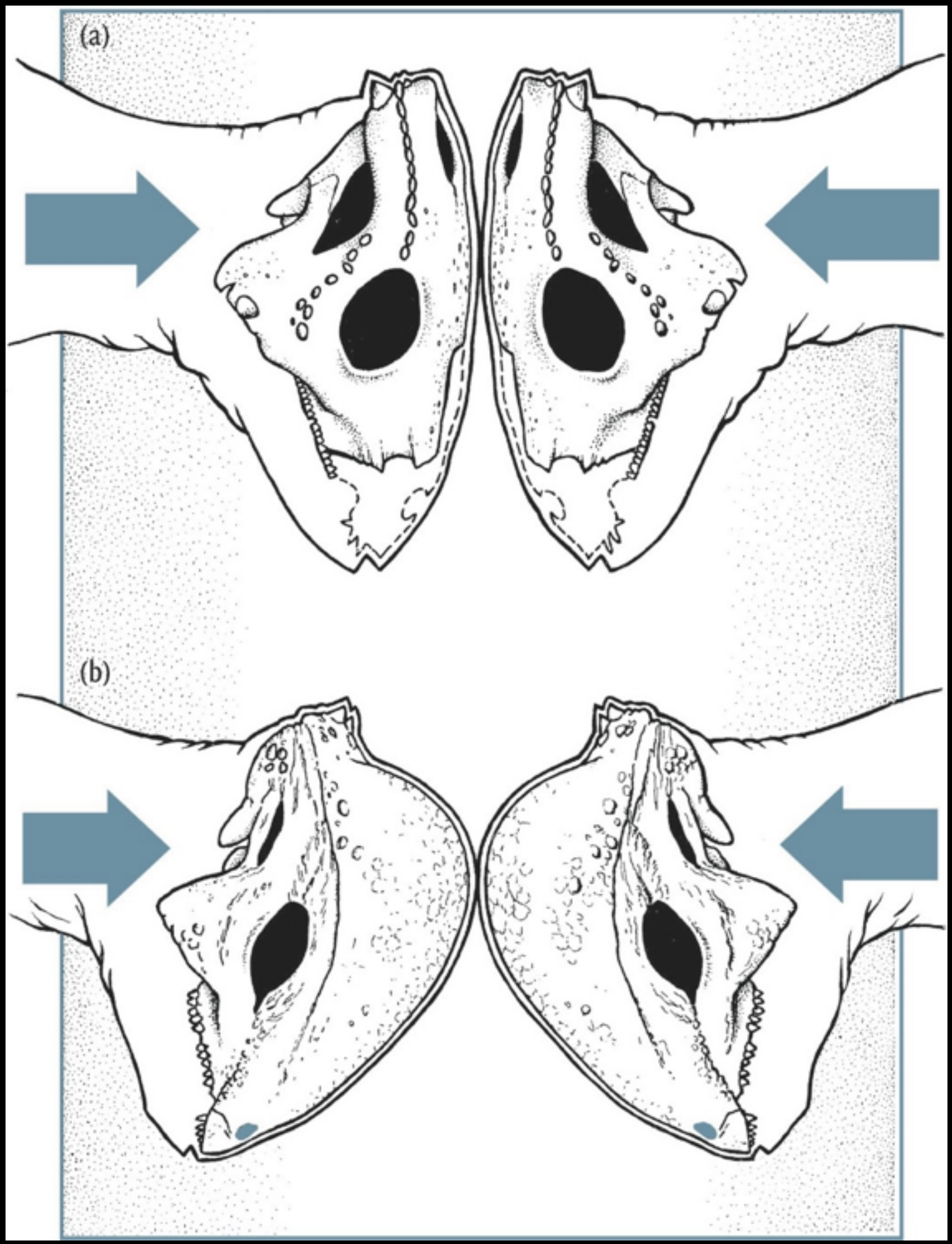
Homalocephale



Stegoceras

V-shaped articulation with spinal column
Why? Limit side-to-side motions

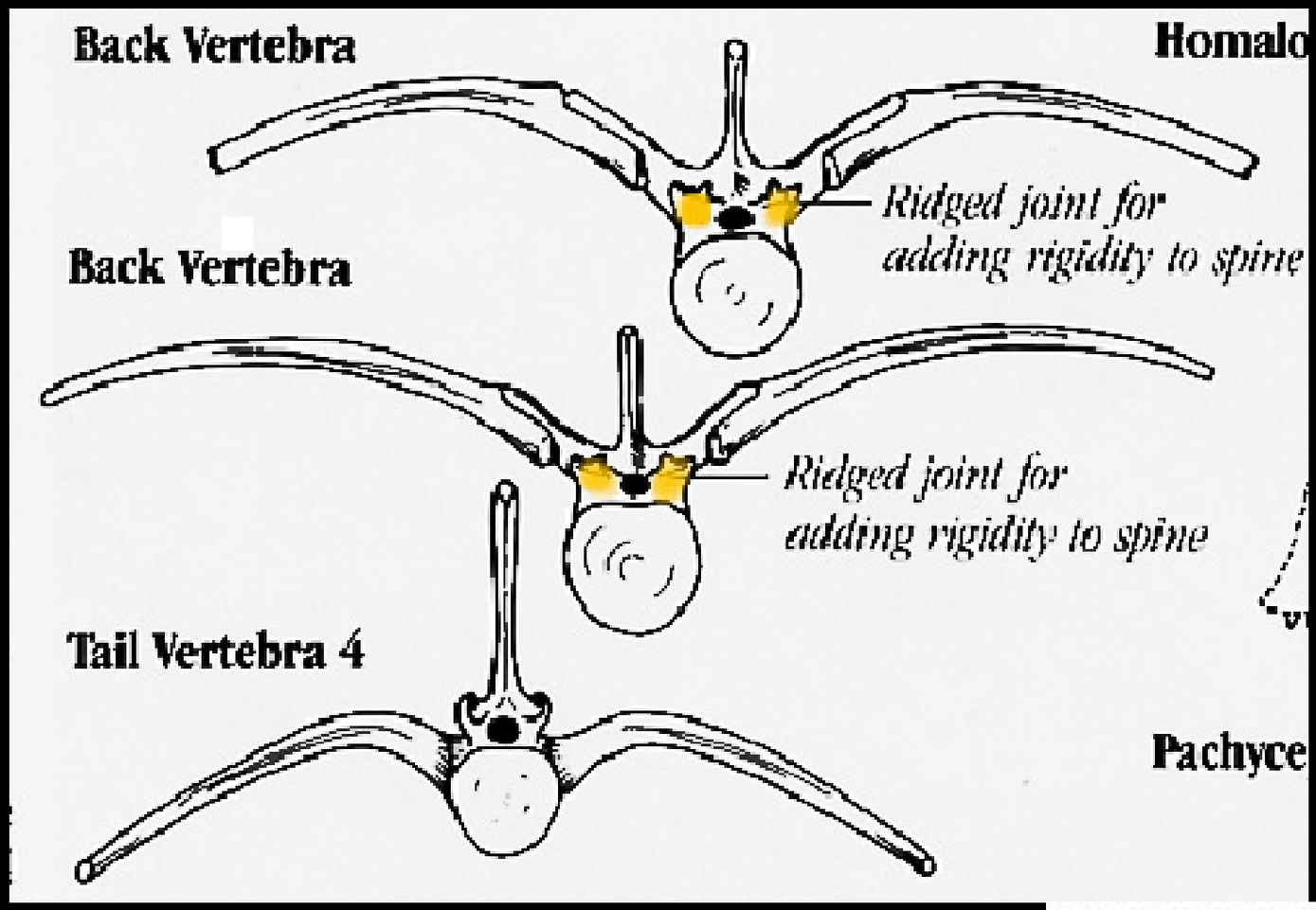
Linear transfer of force



Homalocephale
(Flat head)

Stegoceras
(Fat head)

A Battering Ram?



Tongue and Groove morphology of
Back and Tail vertebrae
Ridged joint for adding rigidity to spine

A Battering Ram?

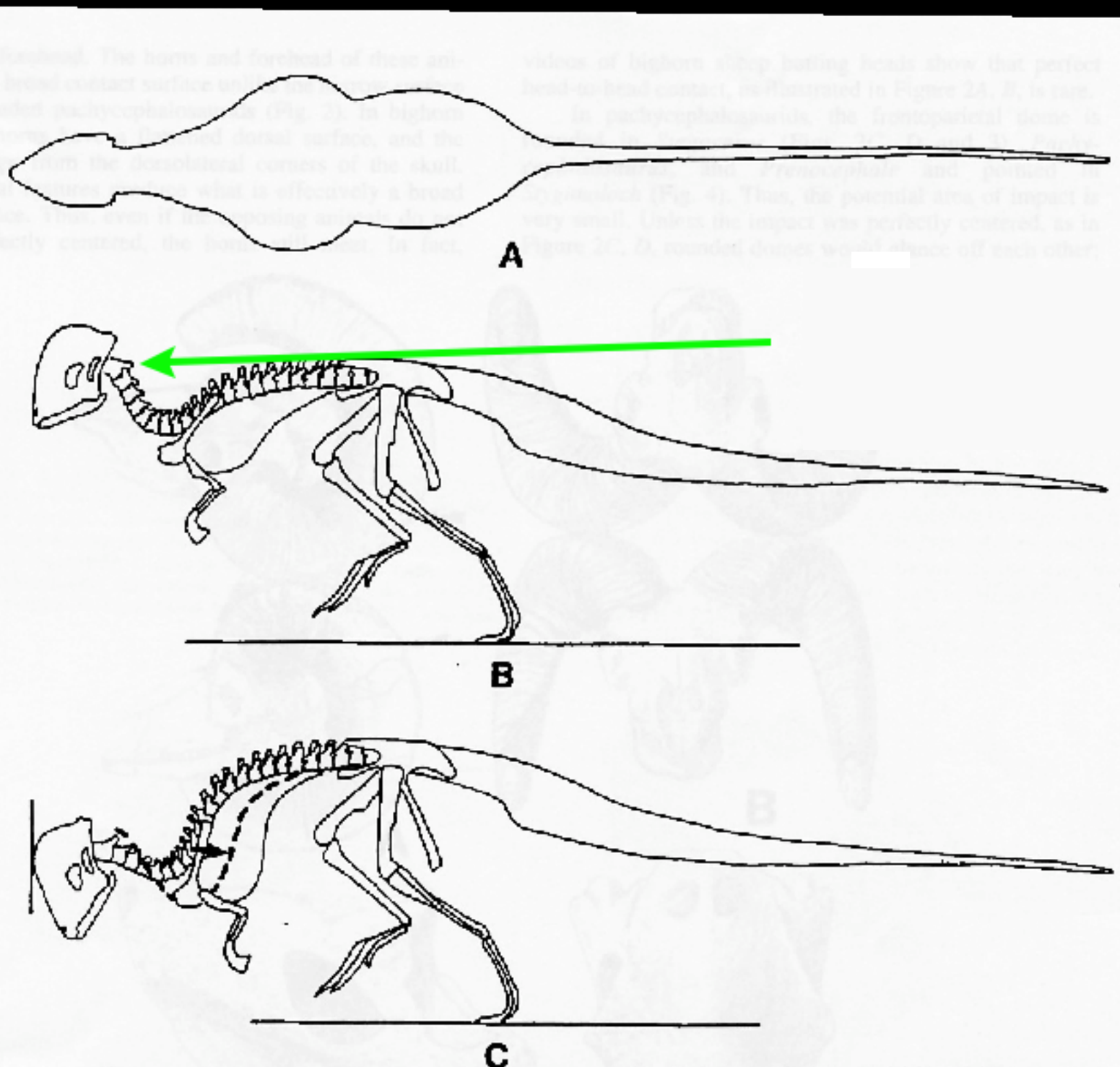
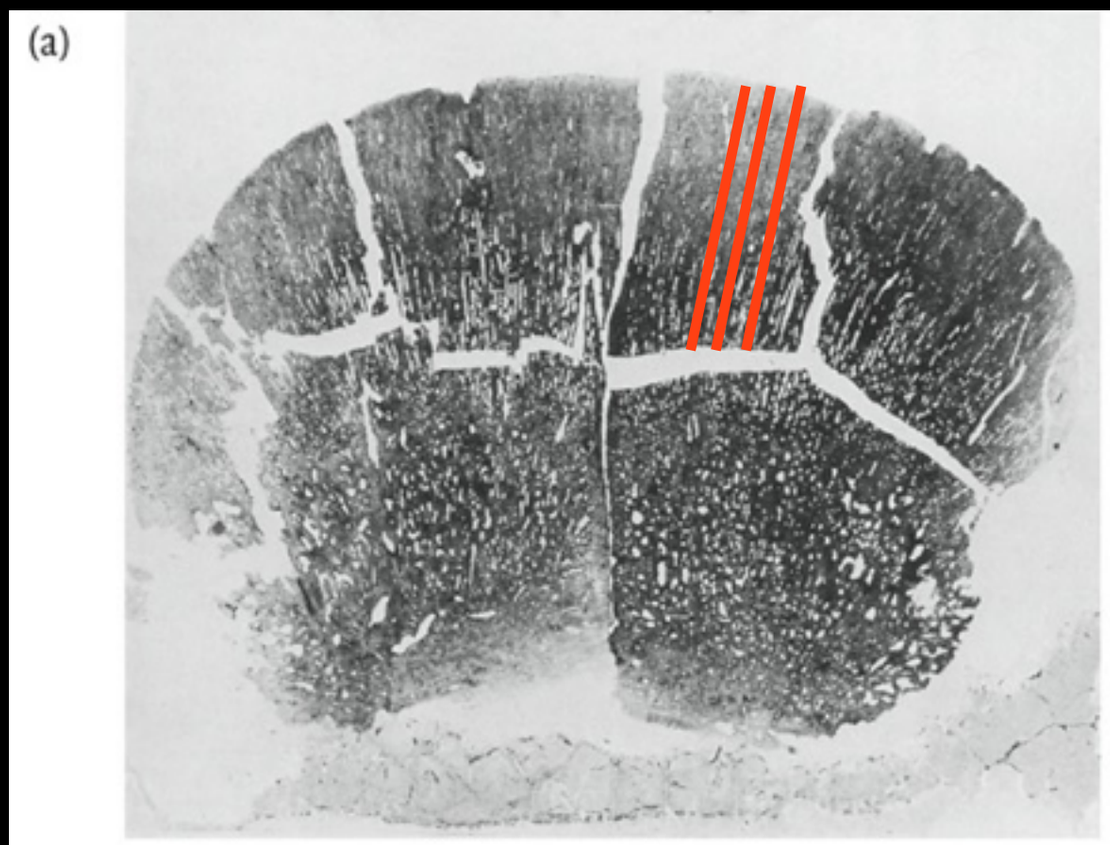


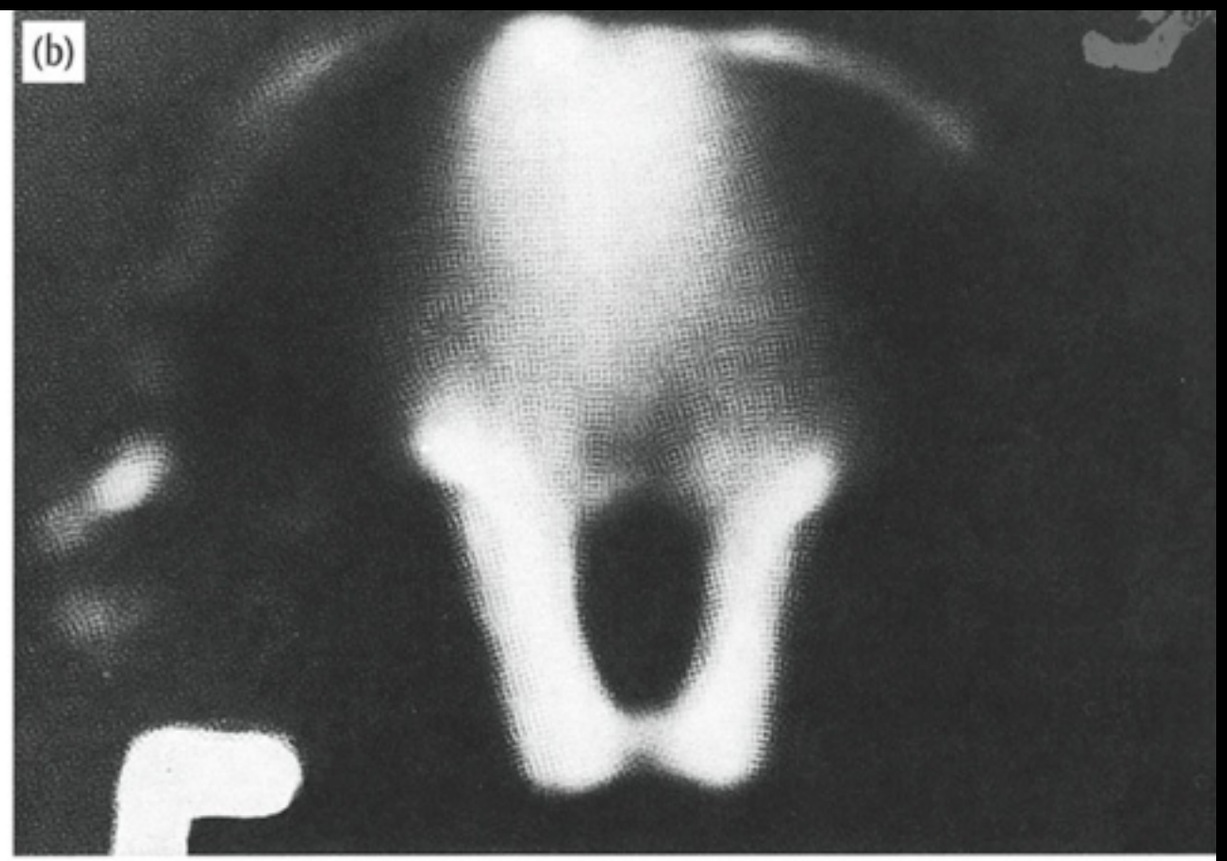
Figure 1A. Outline of the body of the pachycephalosaur *Homalocephale* in dorsal view, showing the great width of the body. Figure 1B. *Stegoceras* showing the probable arched back and curved neck; cervical ribs not shown. Figure 1C. Position of the head in "head-butting" below the level of the vertebral column; heavy dashed line shows probable position of neck and back upon impact of head-butting; vertical line shows that the impact point is opposite the occipital condyle, as required by the Colbert-Galton head-butting model. Skeletons and body outlines based on *Homalocephale* from Paul (1987). The pachycephalosaurid skeleton discovered recently by Mike Triebold shows that pachycephalosaurs were conservative in their skeletons, thus use of the *Homalocephale* skeleton is acceptable for this study.

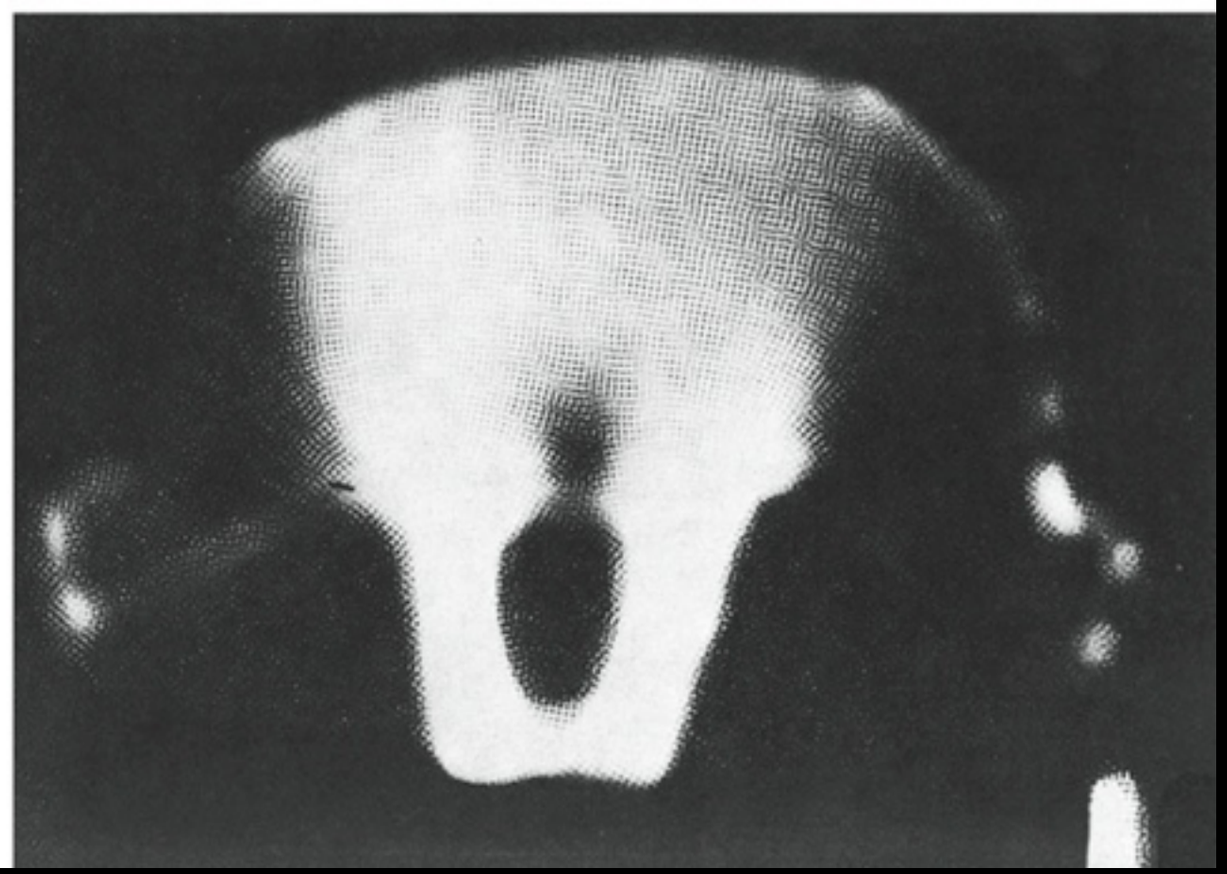
S-shaped shock absorbing vertebral column

A Battering Ram?



Internal bone: radial organization





A Battering Ram?

All evidence suggests that Pachycephalosaur skulls were built to withstand extreme forces

- 9 inches of solid bone
- Bone organized in a radial arrangement- structural support
- Articulation btw back of skull and vertebrae oriented to transfer forces linearly
- Articulation btw back of skull and vertebral column built to withstand sideways forces
- Vertebral column has tongue and groove articulations
- Spinal column is an S-shaped shock absorber

BUT

- There is no 'locking' mechanism on skull to keep battering heads aligned
- Some Pachycephalosaurs have imprinted blood vessels on dome
- These factors suggests that head-butting may not be likely

Intraspecies Competition (typically male-male)

Females are typically choosey
- Why?
- Because they have more to loose

Common rule in biology: Females are expensive to lose, males are cheap (e.g. deer hunting)
Females choose the male most likely to provide the most successful offspring

Males compete with each other for access to female vs. female chooses the strongest male

Choosey females // Strong males have more offspring => SEXUAL selection

Many ways to do this...
But: In general, maximize competition and minimize accidental deaths (= no fitness)

http://www.metacafe.com/watch/1941236/giraffe_fight/

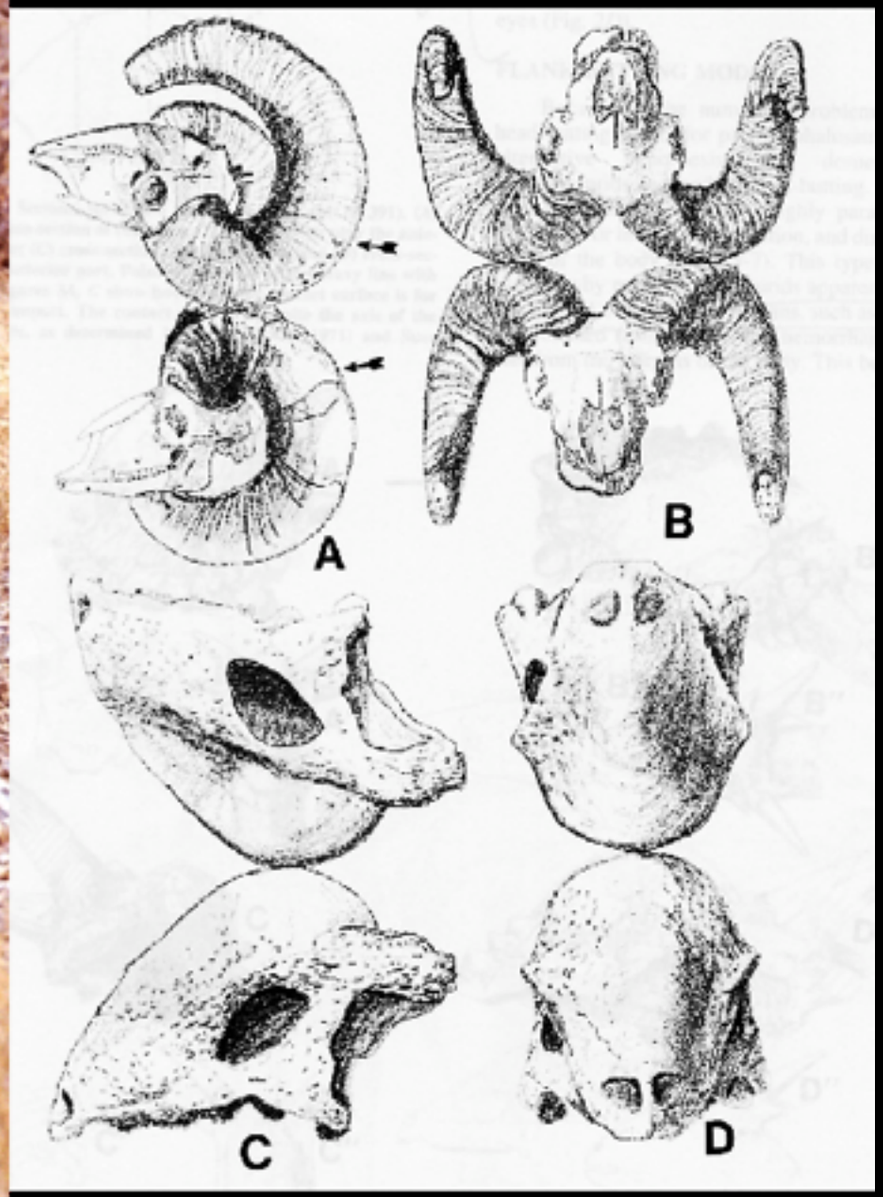
http://www.youtube.com/watch?v=PontCXFgs0M

http://www.youtube.com/watch?
http://www.youtube.com/watch?v=DYDx1y38vGw


They dont show you this on the TV


13:54
24. 7. 2005

http://www.youtube.com/watch?v=ULRtdk-3Yh4


A
B
C
D