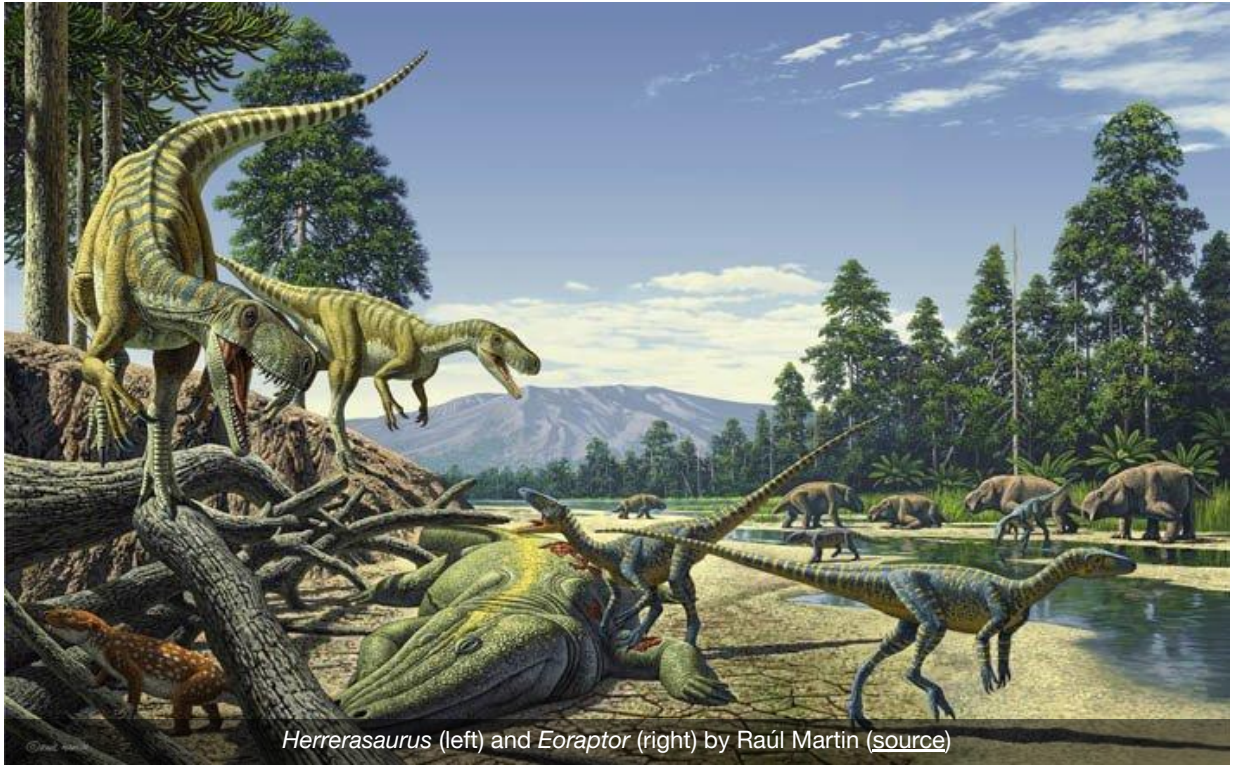
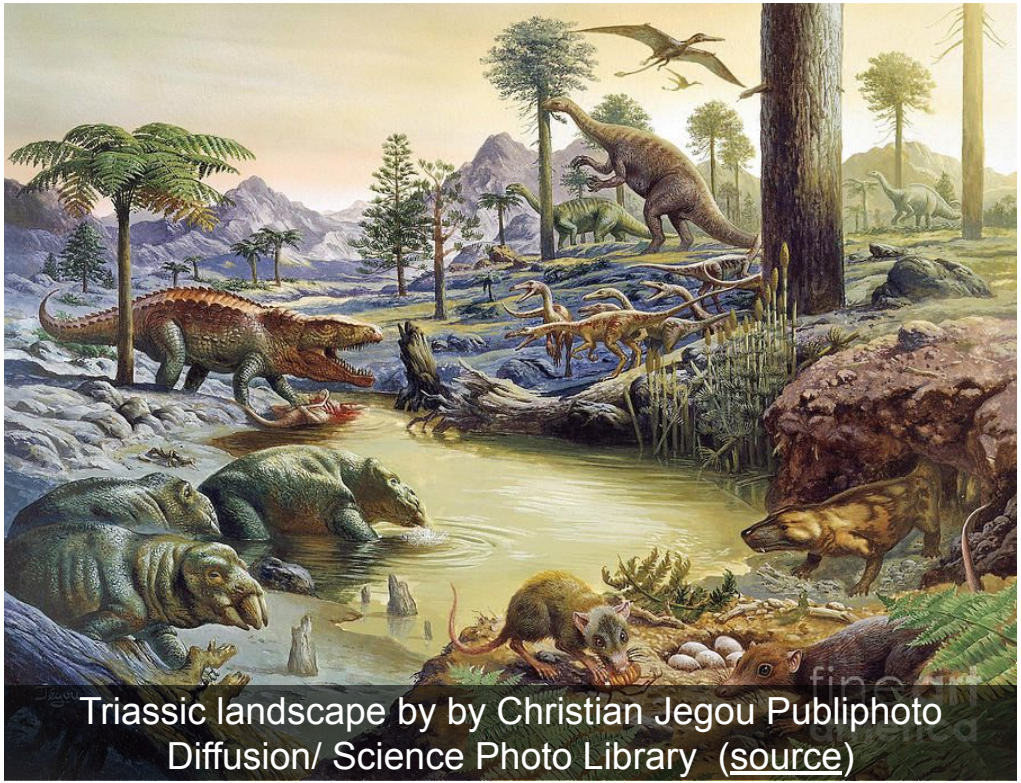
Lecture 11: Triassic 2



Herrerasaurus (left) and *Eoraptor* (right) by Raúl Martin (source)

Big Question: Why did dinosaurs become dominant?



Triassic landscape by by Christian Jegou Publiphoto Diffusion/ Science Photo Library (source)

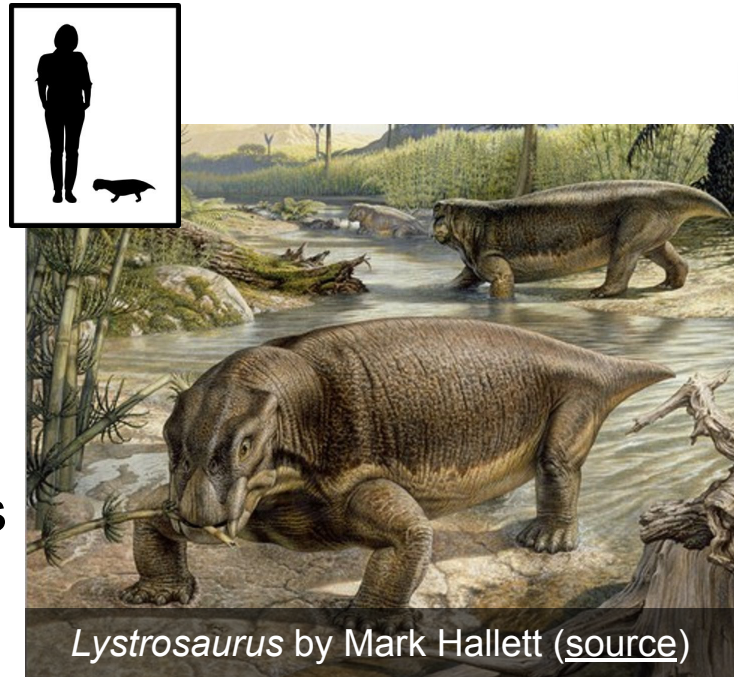
- Many groups of animals diversified through the Triassic
- Dinosaurs ultimately go on to be the dominant land animals for the next ~135My

Slow recovery from the PT extinction

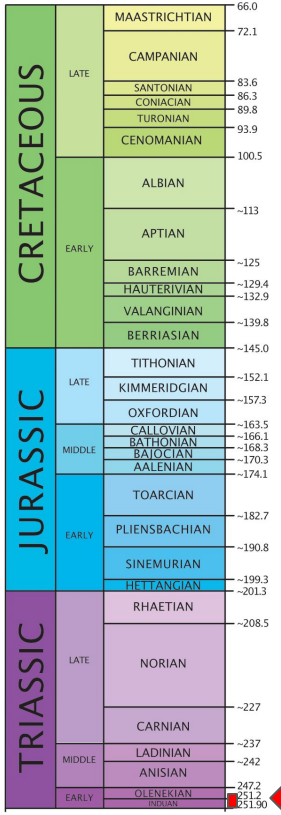
Lystrosaurus

Greek: “lystro” = tool, shovel; “saurus” = lizard

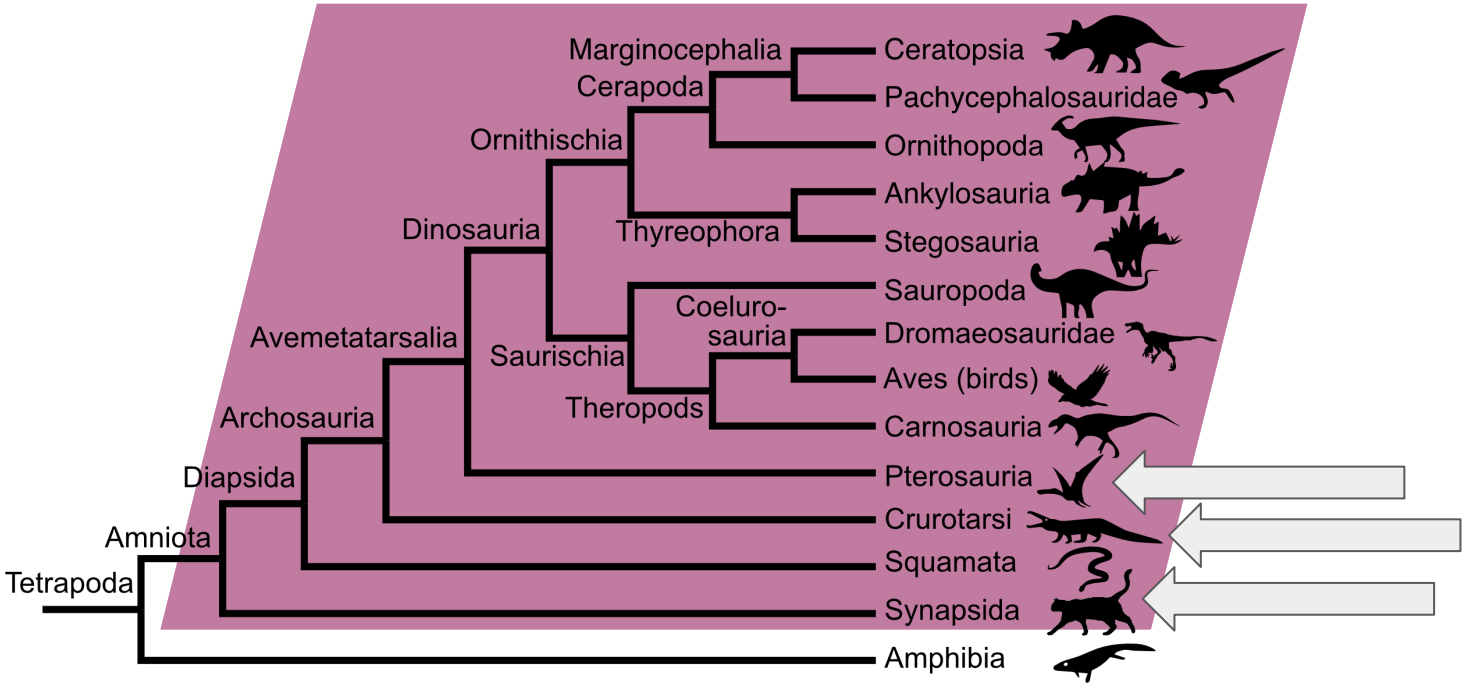
- 255-250 Ma, ~ 3ft long
- A survivor from a once-dominant group of synapsid called dicynodonts
- Primary terrestrial fossil for ~10 My



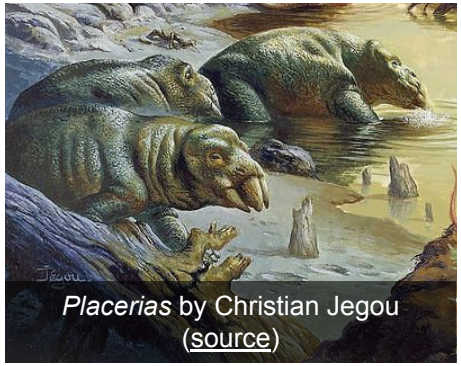
Lystrosaurus by Mark Hallett (source)



Multiple amniote groups (clades) diversify in the Triassic



Dicynodont synapsids diversity in the Triassic



Placerias by Christian Jegou (source)

- *Placerias* was a common herbivore in the late Triassic

- *Lisowicia,* described in 2019, was a late-Triassic synapsid that reached the size of modern elephants

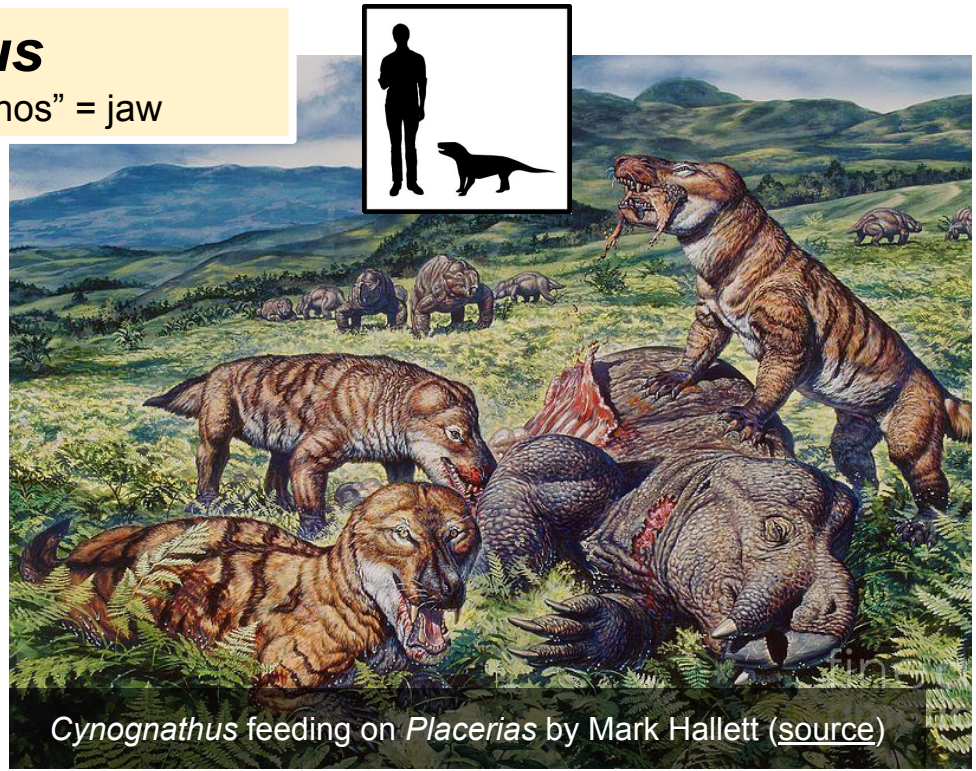
Cover art for the scientific journal describing *Lisowicia* (source)

Synapsid diversification

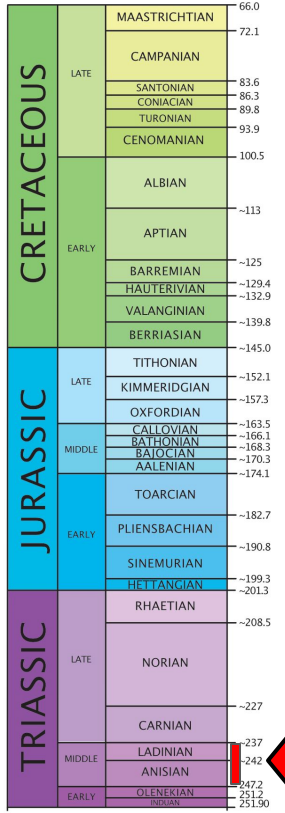
Cynognathus

Greek: “kyon” = dog; “gnathos” = jaw

- A member of the therapsid clade, a close cousin of living mammals



Cynognathus feeding on *Placerias* by Mark Hallett (source)



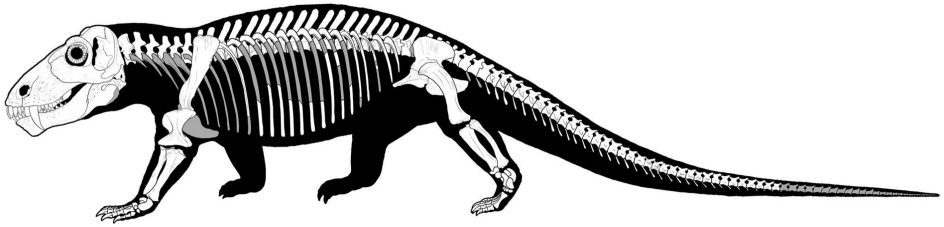
Mammalian traits in *Cynognathus*

- Three kinds of teeth in the jaw (incisors, canines, molars)
- Pits and canals in the snout indicate nerves and blood vessels (evidence of whiskers)
- Two small bones in skull have been modified into inner ear (stapes and malus)

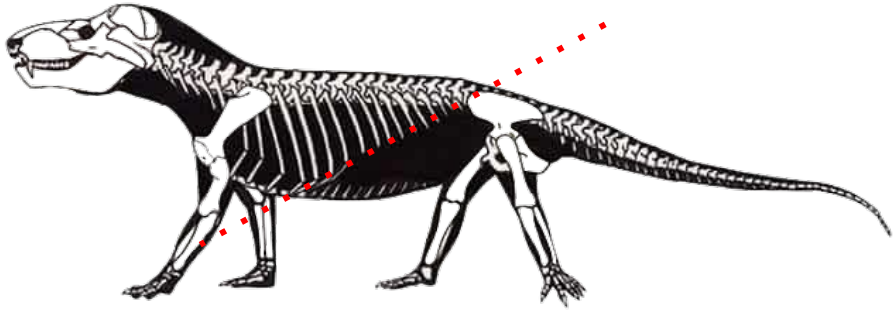
Dimetrodon (top; source) and *Cynognathus* (bottom; source)

Mammalian traits in *Cynognathus*

- Triassic synapsids had a semi-sprawling gate, with an erect forelimb posture
- This has important physiological implications, because it allows mammalian respiration

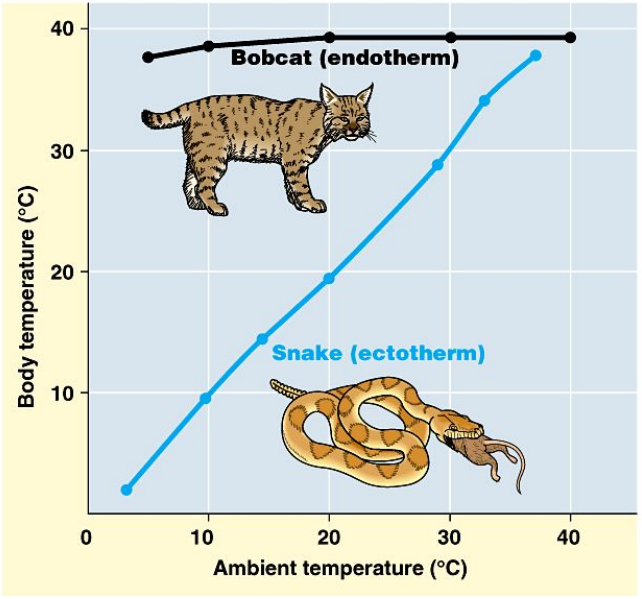


Skeleton of the Permian therapsid *Titanophoneus* (source)



Cynognathus skeleton (source)

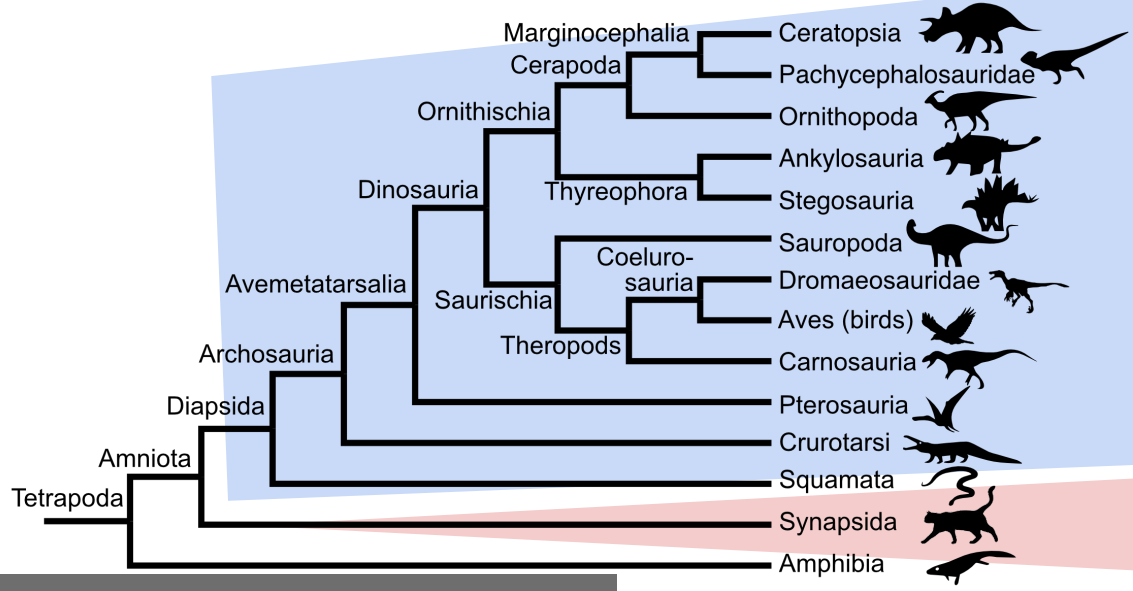
The rise of mammalian thermoregulation

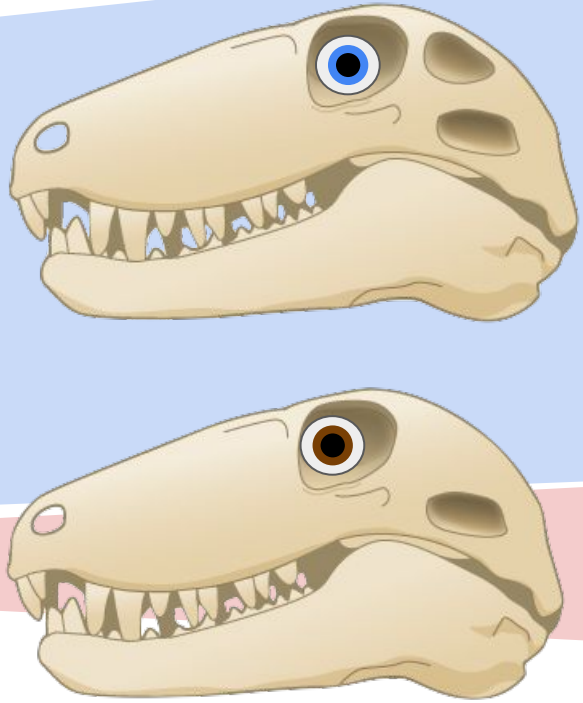


Relationships between ambient and body temperature of ectotherms and endotherms (source)

- Thermoregulation: the ability of an organism to keep its body temperature within boundaries needed for chemical **metabolism**
- **Ectotherms**: use external sources of energy for thermoregulation
- **Endotherms**: use metabolic processes to control thermoregulation

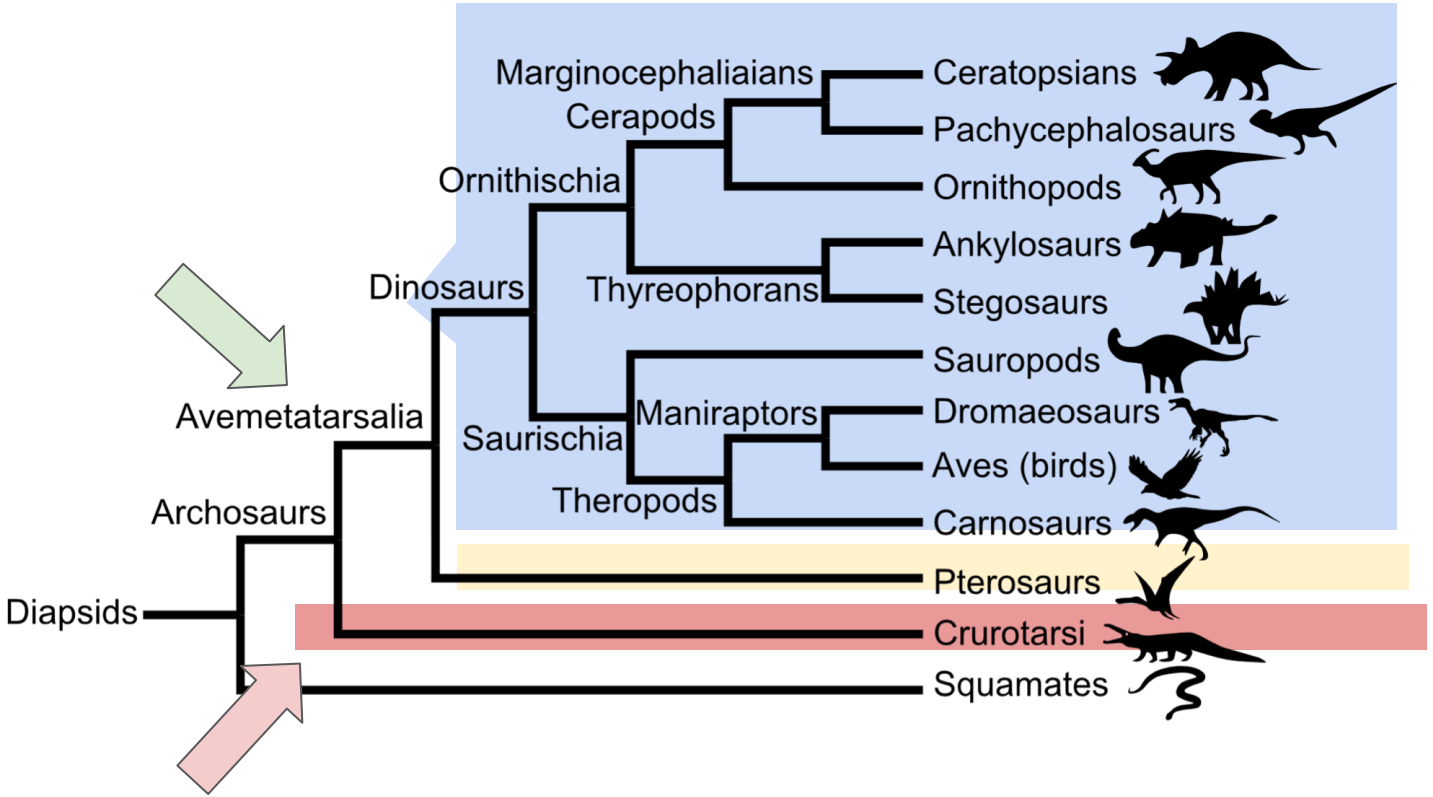
Radiation of diapsids





Skulls adapted from CNX OpenStax.

Three clades of diapsids

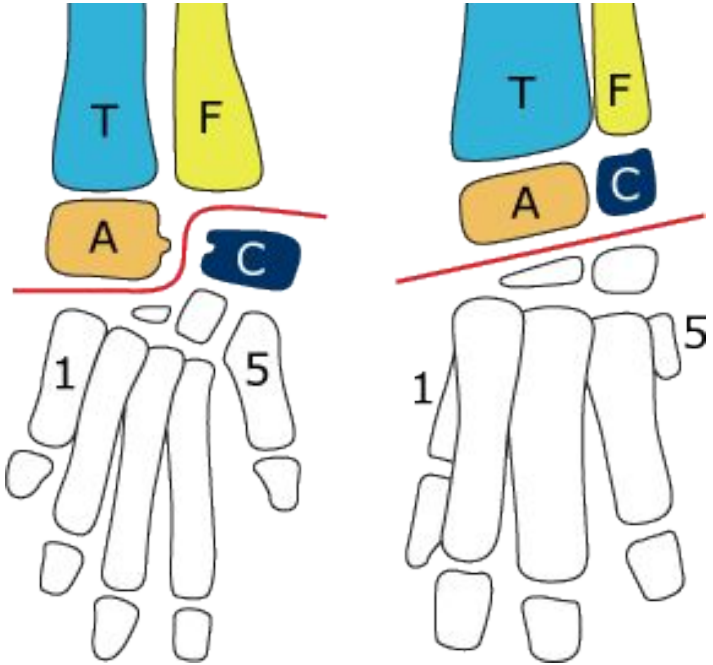


Clade Crurotarsi

Crurotarsi

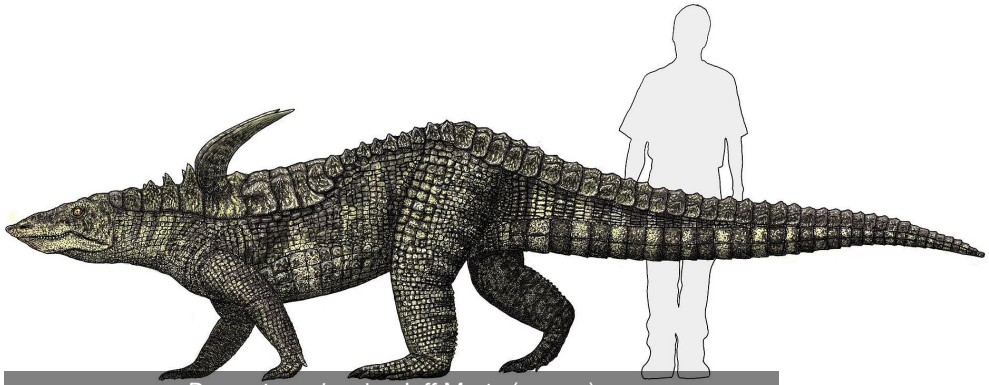
Latin: “cruro” = lower leg; “tarsi” = ankle

- Includes the living crocodilians and their extinct relatives
- Named after their unusual ankle joints
- Potentially synonymous with the clade Pseudosuchia

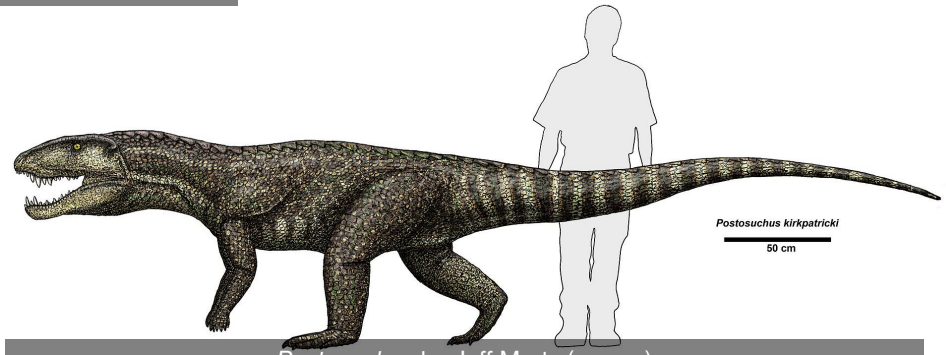


The ankles of crurotarsi (left) and avemetatarsalia (right). The red line in each image shows the plane of the ankle hinge. T=tibia, F=fibula, A=astragalus, C=calcaneum. (source)

Radiation of crurotarsi



Desmatosuchus by Jeff Martz (source)



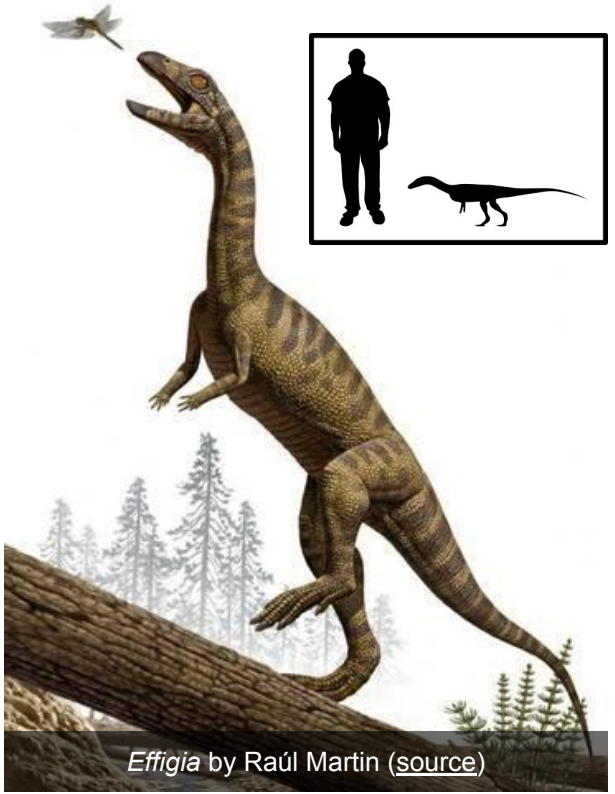
Postosuchus by Jeff Martz (source)

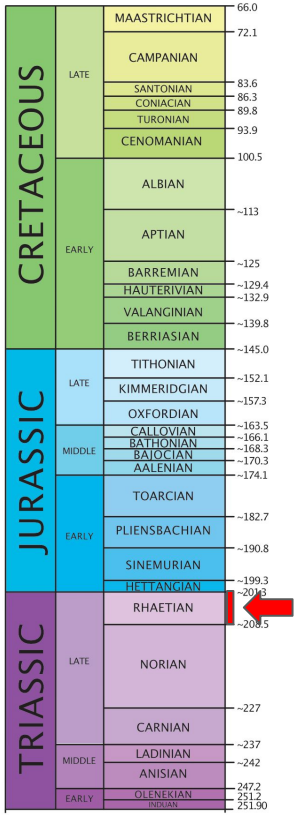
Effigia

Effigia okeeffeae

Latin: “effigia” = ghost; “okeeffeae” = in honour of Georgia O'Keeffe for her paintings of the badlands at Ghost Ranch

- ~7 ft long, lived at the end of the Triassic
- **Convergent evolution**: the independent evolution of similar forms (not present in the last common ancestor)



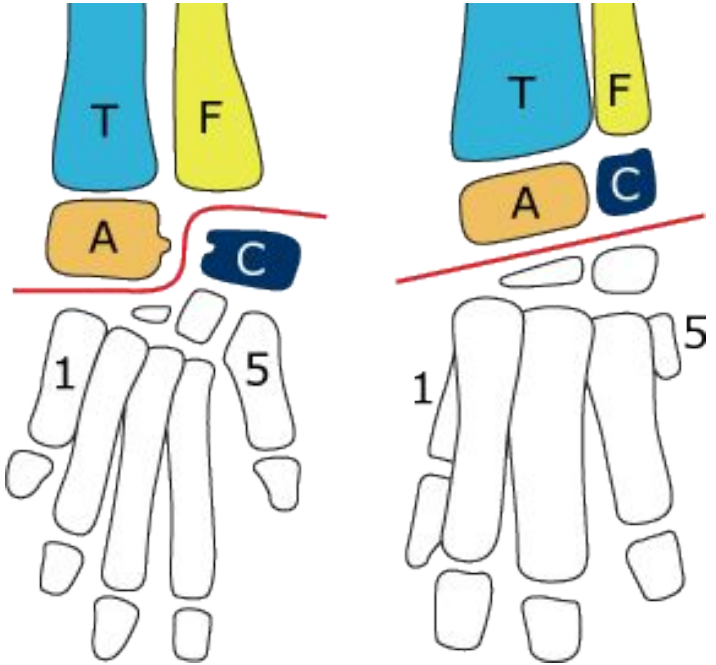


Clade Avemetatarsalia

Avemetatarsalia

Latin: “ave” = bird; “metatarsalia” = lower ankle

- Includes the living birds and their extinct relatives
- Named after their unusual ankle joints



The ankles of crurotarsi (left) and avemetatarsalia (right). The red line in each image shows the plane of the ankle hinge. T=tibia, F=fibula, A=astragalus, C=calcaneum. (source)

Diapsids take to the air

- **Pterosaurs**: a clade of extinct flying diapsids that existed during the Mesozoic

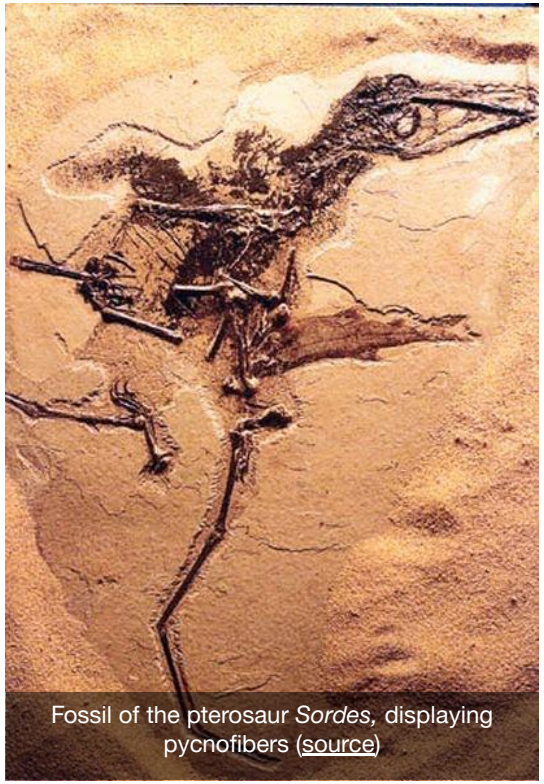
- A strong wing supported by a single, elongated fourth finger

Eudimorphodon by Vitor Silva (source)

Pterosaurs

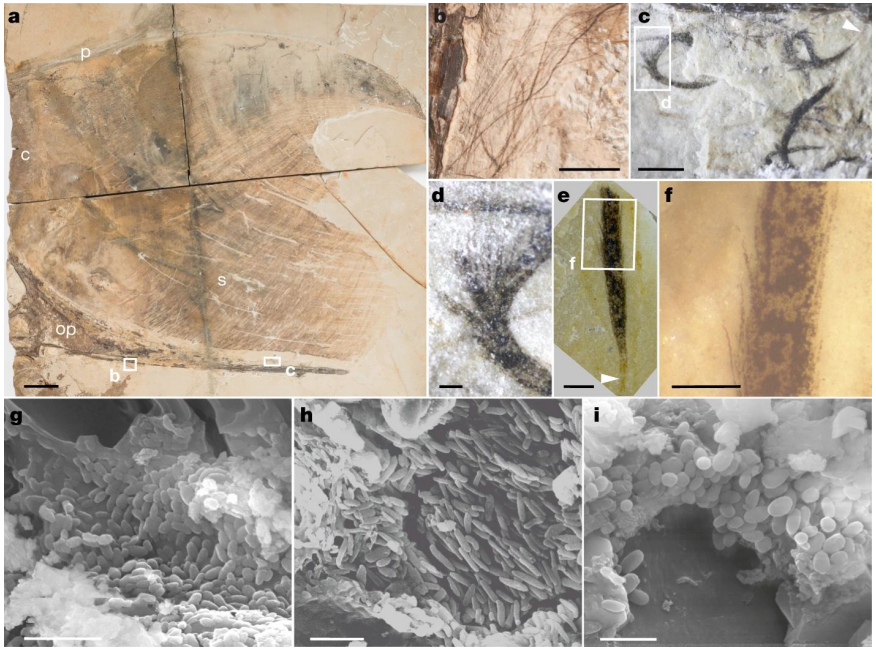
- Flight requires a fast metabolism, which encourages the evolution of a filamentous coat

- Pterosaur **pycnofibers** (filamentous coat) are commonly cited as an example of **convergent evolution** with mammalian fur



Fossil of the pterosaur *Sordes,* displaying pycnofibers (source)

Pterosaurs possessed feathers?



- Several pterosaurs have been described with well-preserved pycnofibres that resemble feathers
- Melanosomes preserved in one specimen provide a **molecular fossil** for feather color

Cincotta, Aude, et al. "Pterosaur melanosomes support signalling functions for early feathers." *Nature* 604.7907 (2022): 684-688.

Pterosaurs possessed feathers?

Artist's reconstruction of *Tupandactylus imperator* by Bob Nicholls (source)

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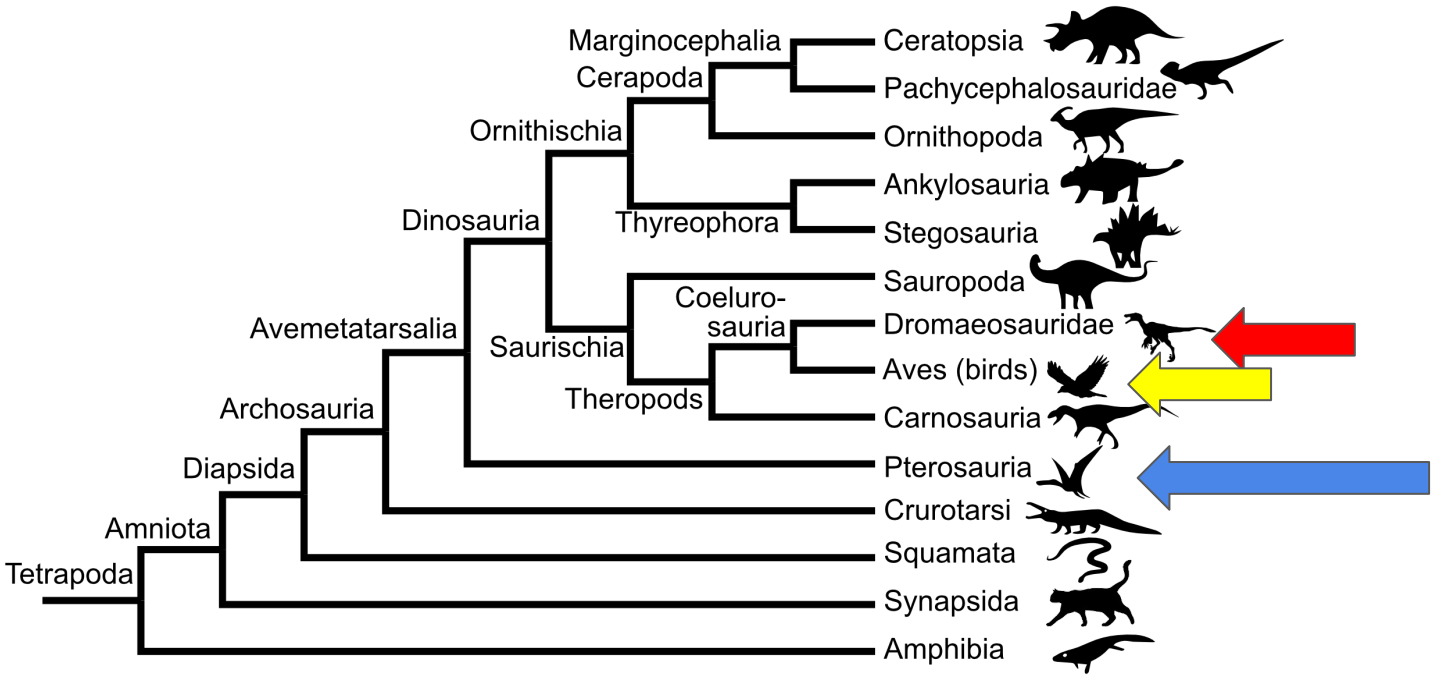
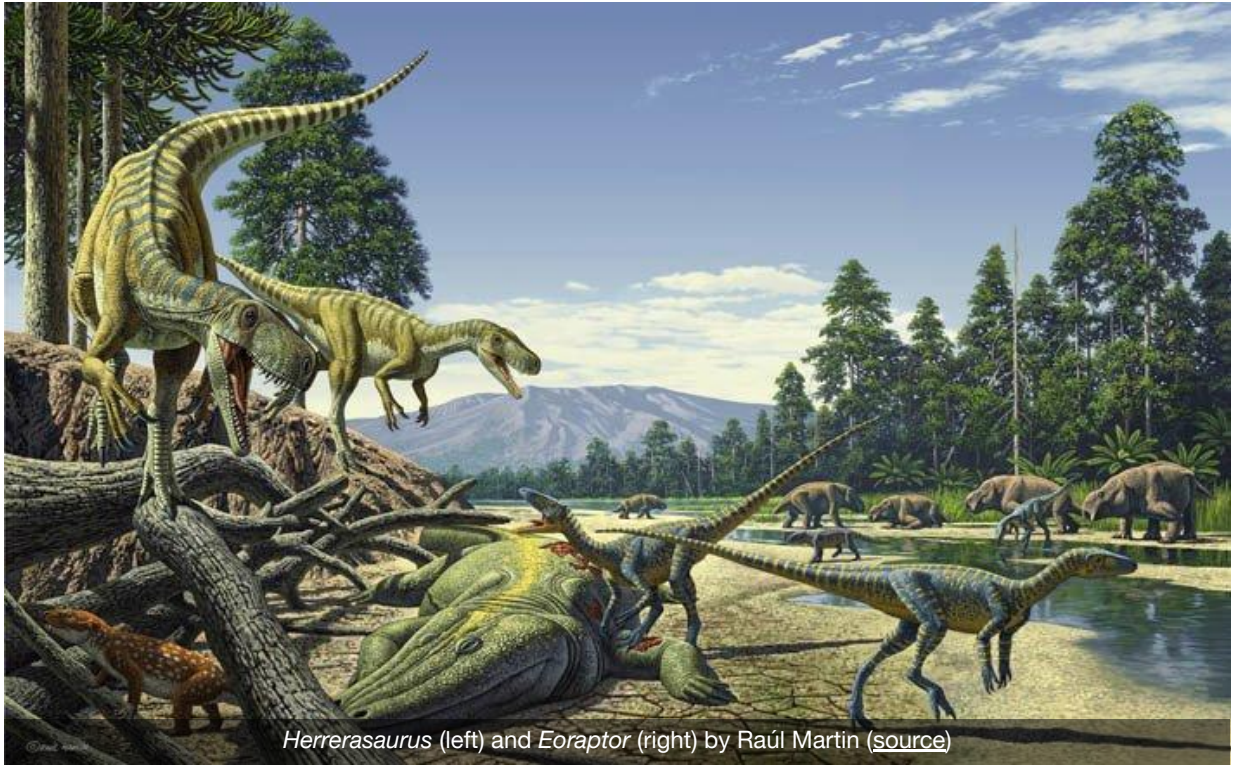
Participation Time!



Conclusions



Herrerasaurus (left) and *Eoraptor* (right) by Raúl Martin (source)

- The middle Triassic was a time of rampant convergent evolution
- Dinosaurs started out small and rare

Next class

Plateosaurus by Raúl Martin (source)