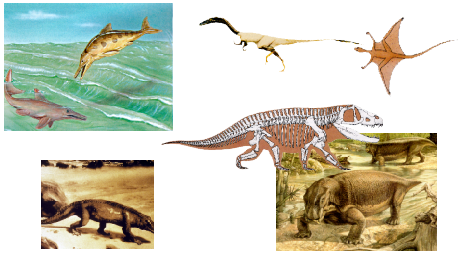
Life of the Triassic



1

Five Major Invertebrate Groups of the Mesozoic

Mollusca
Cephalopoda
Ammonoidea

Mollusca
Gastropoda

Mollusca
Pelecypoda

Echinodermata
Echinoidea

Arthropoda
Crustacea

2

Actinopterygians continue to evolve and diversify.

3

Though the first frogs and toads appear in the Triassic (the first salamanders had appeared in the Permian) the last of the large Paleozoic amphibians lasted through the Triassic in the Southern Hemisphere (Australia and New Zeland).

4

Earliest known frogs
Triadobatrachus

5

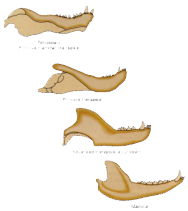
Thrinaxodon

One family (cynodonts) of therapsids survived into the Triassic, eventually giving rise to mammals in the mid-Triassic.

Diarthrognathus = "Two jointed jaws"

6

Mammals rear their ugly furry heads!



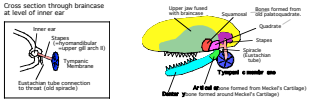
- Heterodont teeth (incisors, canines, premolars, molars)
- Single bone in lower jaw (dentary)
- Squamosal-Dentary jaw joint
- Large Brain
- 3 ear (auditory) ossicles
- Milk
- Hair
- Endothermic

Endothermic = can generate own body heat by internal physiological mechanisms

7

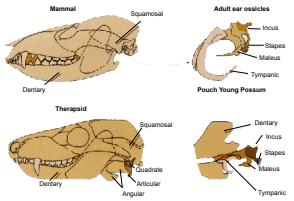
Mammal

Reptile



8

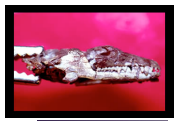
Therapsid to Mammal



9

Triassic mammals

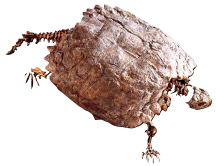
Morganucodon



- **Allotheria** - late Triassic to early Jurassic forms including the diverse **Multituberculates** which survived into the Tertiary (extinct at 35 ma)
  - Mode of reproduction unknown
  - Many good climbers
  - Common in Laurasia
  - Specialized molars and gnawing teeth

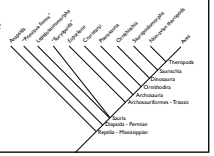
10

Anapsid reptiles survive - but only as Chelonians (Turtles).



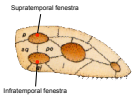
Most turtles have shells composed of boney plates that are fused to their ribs. A few aquatic forms loose almost all the boney plates.

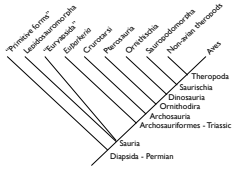
Proganochelys - oldest known turtle



11

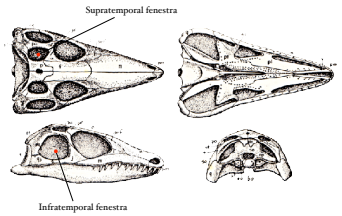
Diapsid Reptiles reign supreme





12

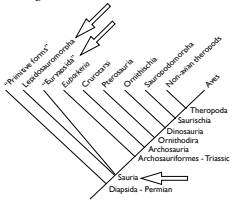
"Primitive forms"



13

Sauria

The Lepidosaurs (lizards +snakes [Cret.]) and "Euryapsids" form an unresolved dichotomy off the Sauria. They have lightly built skulls that have lost the lower bar of the infratemporal fenestra and have become very mobile or kinetic. The Archosauriformes are the other great branch of the Sauria.



14

"Euryapsida"

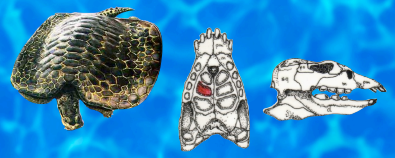
Though many primitive diapsids stayed on land, a wide variety moved back to living in the sea. These are modified diapsid with unclear relationships to lepidosaurs.

- Placodonts
- Nothosaurs
- Plesiosaurs
- Icthyosaurs

15

Placodonts were marine diapsids that had flat, plate-like crushing teeth and ate mollusks (such as snails and clams).

They are only found in the Triassic.



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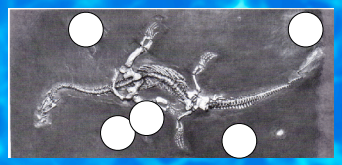


Nothosaurs show marine adaptations - feet are starting to look like paddles. Note the baby nothosaurs here.

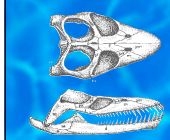
They are only found in the Triassic.

17

Plesiosaurs were of the long necked or short-necked variety. They were much more adapted living at sea.

They lived from the Triassic Period until the Cretaceous Period.

18



Elasmosaurus platyurus Cope 1868

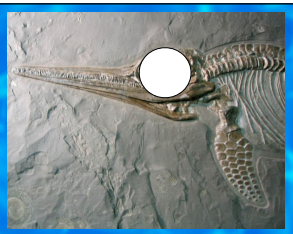
19

Icthyosaurs were the most aquatically adapted reptiles. They were convergent on fish shapes. Though the first are found in the Triassic Period they survived until the Cretaceous Period. Some were as long as 50 feet!

20

We know from a number of skeletons that Icthyosaurs gave birth to live babies. They were even born tail first - as in modern whales and dolphins.

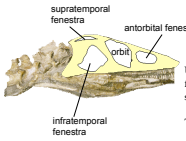
21

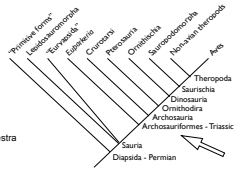


Note the very large orbits. This anatomical feature suggests that Icthyosaurs frequented great depths where there was little light. The notion of living at great depth is also supported by the boney plates in the eyes - for support against pressure change.

22

Archosauriformes = 'ruling reptiles'!!



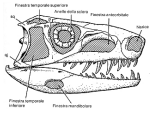


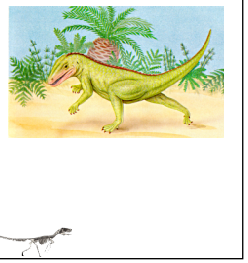
Unless modified, archosauriformids have an antorbital fenestra in front of the orbit that housed a gland or sinus in life.

They also have boney plates in the skin called scutes.

23

Euparkaria

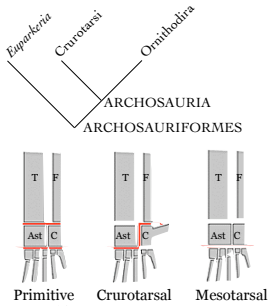




24

Euparkaria

25

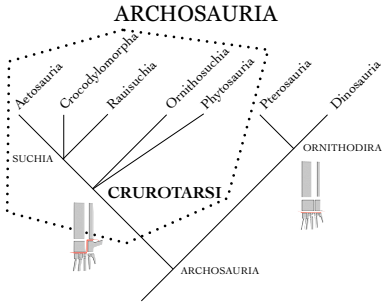


26

Two Archosaur Groups

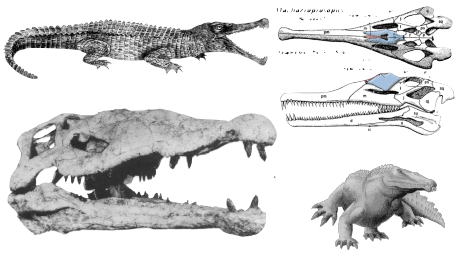
- Archosauria
  - Crurotarsi
    - Includes small to large, quadrapedal to bipedal forms.
    - Includes the modern Crocodilia
  - Ornithodira
    - Includes the Pterosaurs
    - Includes the Dinosaurs

27



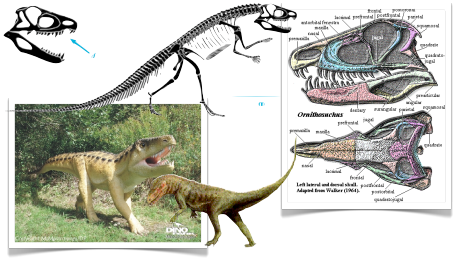
28

Phytosauria



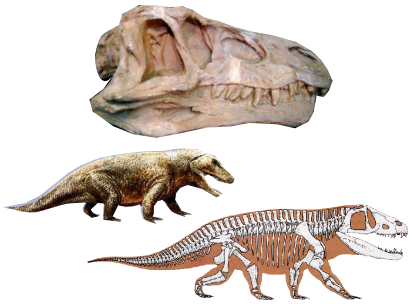
29

Ornithosuchia



30

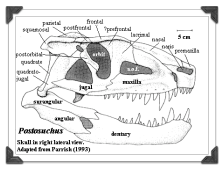
Erythrosuchus - S. Africa



31

Suchia

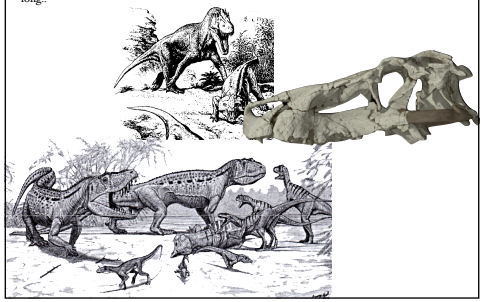
- Reduced and triangular lower temporal opening
- Rauisuchia
- Aetosauria
- Crocodylomorpha



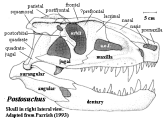
32

RAUISUCHIA

Saurosuchus, the large quadraped pictured below showing a fauna from Argentina, was 25 feet long!!



33



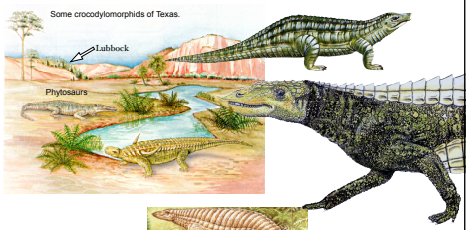
Postosuchus

Rauisuchia

Lubbock in Spring - *Postosuchus* threatens herbivorous therapsids

34

Desmatosuchia



Armored herbivores

35

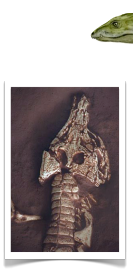
Crocodilymorpha

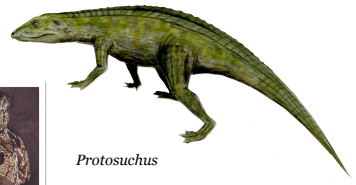
- First members of the group that includes modern crocodilians were small, lightly built quadrupedal and bipedal forms.

Hesperosuchus

Peditcosaurus

36





Protosuchus

37

Two Archosaur Groups

- Archosauria
  - Crurotarsi
    - Includes small to large, quadrapedal to bipedal forms.
    - Includes the modern Crocodilia
  - Ornithodira
    - Includes the Pterosaurs
    - Includes the Dinosaurs

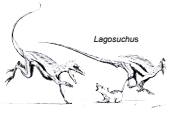
38

Ornithodira

- Group that includes the flying reptiles (Pterosaurs) and the Dinosaurs
- Small lightly built bipedal forms
- Mesotarsal ankle

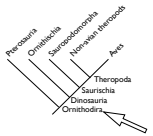
On line to pterosaurs

Scleromochlus



Lagosuchus

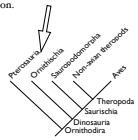
On line to dinosaurs



39

Pterosauria

These flying archosaurs first appeared in the Triassic and persisted until the very end of the Cretaceous. Their wings were unlike those of bats and birds (see figure to right). The Triassic pterosaurs were relatively small - the largest being no larger than a large pigeon.



Like birds, pterosaurs had very thin hollow bones to minimize their weight.

Some early diapsids had various 'wings' and may be the ancestors of pterosaurs.

40

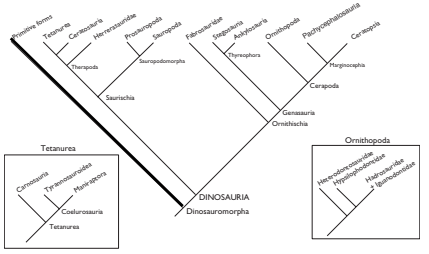
Some Triassic Pterosaurs

Peteinosaurus

Eudimorphodon

41

PHYLOGENY OF THE DINOSAURS



Tyrannosauroidea = Tyrannosaurs + Ornithomimosaurs
Maniraptora = Dromaeosauridae + Aviales
Carnosauria = Allosaurus and relatives

Dr. Arthur Busbey
2/18/2008

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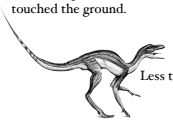
Lagerpeton
Oldest dinosauromorphid, less than 1 meter long

The oldest dinosaurs were small, lightly built carnivores that were mainly bipedal - their hind limbs always being larger than their forelimbs. The distal high limbs are elongated, indicating that they walked on their toes, not on their flat feet like bipedal thecodonts did. Only 3 toes touched the ground.



Marasuchus
Less than 0.5 meters long

Eoraptor
Middle Triassic carnivore right at branching point between ornithischian and saurischian dinosaurs

43

DINOSAURIA

Primitive reptiles and synapsids

Primitive Archosaurs and dinosaur forelimbs

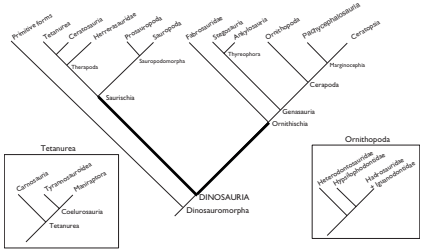
Dinosaur (hindlimbs)

Another key feature of the dinosaurs is in their hind legs.

They have a fully erect gait, in which the femur is held directly under the body. This is quite different from more primitive archosaurs in which there is only a semi-erect gait.

44

PHYLOGENY OF THE DINOSAURS



Tyrannosauroidea = Tyrannosaurs + Ornithomimosaurs
Maniraptora = Dromaeosauridae + Aviales
Carnosauria = Allosaurus and relatives

Dr. Arthur Busbey
2/18/2008

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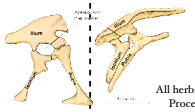
DINOSAURIA
The Two Groups of Dinosaurs

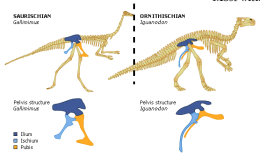


Saurischia
=
"lizard hipped"

Herbivores & Carnivores
Herbivores process food in stomach.

Ornithischia
=
"bird hipped"

All herbivores
Process food in mouth
Muscular cheeks
Most with no anterior teeth



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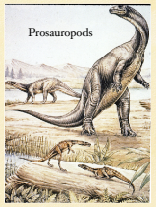
Saurischia of the Triassic

Sauropodomorpha

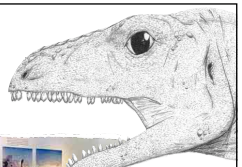
Prosauropods



Prosauropods are found in the Triassic and just make it into the Jurassic. At the Triassic-Jurassic boundary they gave rise to the lineage of true giants - the **Sauropods**. Prosauropods were mostly quadrupedal, but some could probably walk bipedally if they needed to. The skull and skeleton reflect many characters further amplified in sauropods.

47

Coloradisaurus



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Plateosaurus

49

Prosauropod distribution

50

Saurischia of the Triassic

Staurikosaurus

The oldest carnivorous saurischia are the *Herrerasauridae*.

Herrerasaurus

51

Herrerasaurus

52

Saurischia of the Triassic

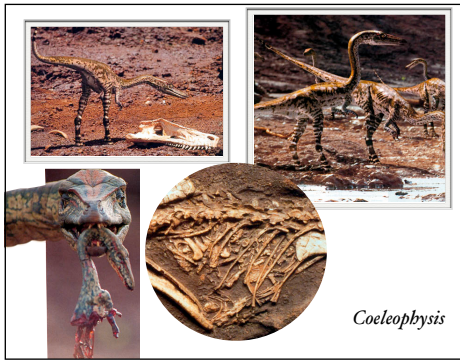
The Ceratosaurs were more specialized than the Herrerasaurs. The oldest forms, such as *Coelophysis* (pictured below), were small, lightly built carnivores. The ceratosaurs were important carnivores in the late Triassic but had greatly diminished in number by the middle Jurassic. By the Cretaceous they had vanished from the Northern Hemisphere. They tend to be lightly built and their low numbers either represent low diversity or poor preservation.

53

Coeleophysis

The best known *Coeleophysis* remains are from the Chinle Formation on Ghost Ranch. Many skeletons were found together and may represent a 'flock' (illustrated above).

54



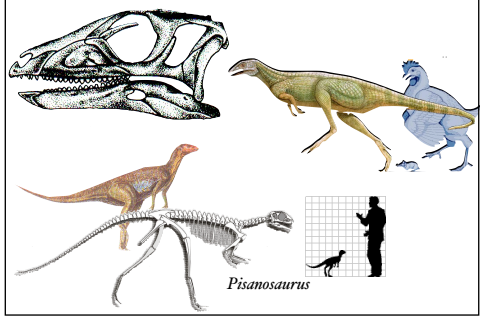
Coeleophysis

55

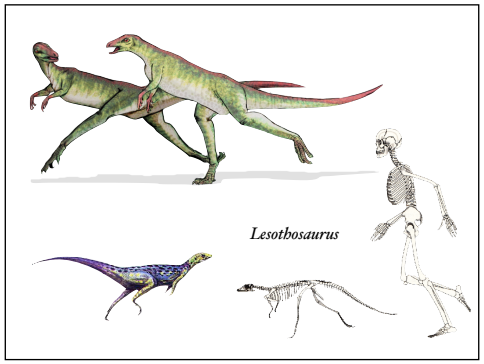
Coeleophysis

56

Triassic Ornithischians



57



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Early Dinosaur Evolution

- Major trends include:
  - Streamlining the distal part of the hindlimb and strengthening the ankle
  - Increase power to the hindlimb and support vertical posture
  - Lengthen the hind leg, increasing the adductive power of the forelimb, concentrating and lightening the body and deepening the skull.
- The earliest differentiation of dinosaurs occurred in the 10 million years right after the Permo-Triassic boundary. This is a time that is coal-free, reef-free and virtually fossil-free in the wake of the biggest extinction in history. So the origin of all ornithodirans is in this poorly fossilized time.

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Dinosaur Ascendency

- At start of Triassic the land was dominated by synapsids
- From the middle Triassic until its end the land was dominated by herbivorous and carnivorous archosaurs
- By the Late Triassic dinosaurs had became the most dominant and diverse group of land animals
- What caused the pattern that resulted in dinosaurs being the dominant land animals by the end of the Triassic?
- Did dinosaurs have a competitive edge over synapsids and more 'primitive' archosaurs such as rauiisuchids or ornithosuchids?

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Dinosaur Ascendency

- It has been suggested that the fully erect posture of dinosaurs gave them a competitive edge (evolutionary advantage). But mammals and cynodonts already had a fully erect posture
- Bakker proposed that dinosaurs were warmed-blooded and thus had a competitive edge over other archosaurs. As we will see, this is a much more complex and contentious problem as there is no simple "warm bloodedness". Even if dinosaurs had the metabolic machinery of mammals, mammals were also warm-blooded, providing no competitive edge on this point
- So did dinosaurs become successful because they had a competitive edge or was it 'something else'?

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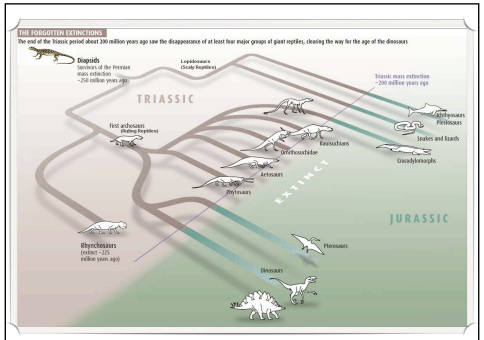

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Dinosaur Ascendency

- At the transition from middle to late Triassic (225 ma) a mass extinction occurred in which the majority of synapsids went extinct (except for mammals) and many archosaurs vanished (only ornithodires, crocodiles and a few ancient genera survived). There was also a mass extinction of plants.
- Dinosaurs became diverse and abundant prior to a terminal Triassic extinction and only became dominant after withstanding the stresses of the extinction event.
- This implies that the success of dinosaurs wasn't really due to any competitive edge over synapsids or early archosaurs; it was opportunistic. They survived climatic or environmental changes that killed off other major terrestrial groups.

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Triassic and Jurassic Forests

Ginko

The foreground vegetation is dominated by cycads, cycadeoids and ferns. In the distance there are conifers.

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During the Triassic conifer trees (some as much as 200 feet high) came to dominate the upper stories of the forests.

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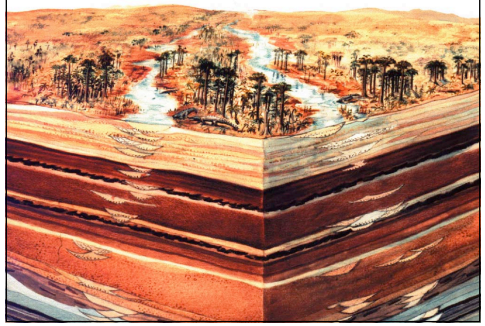
Petrified Forest National Monument



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Next - Jurassic Life

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