Paleontologia 2020 (Aula 11):
Dinossauros

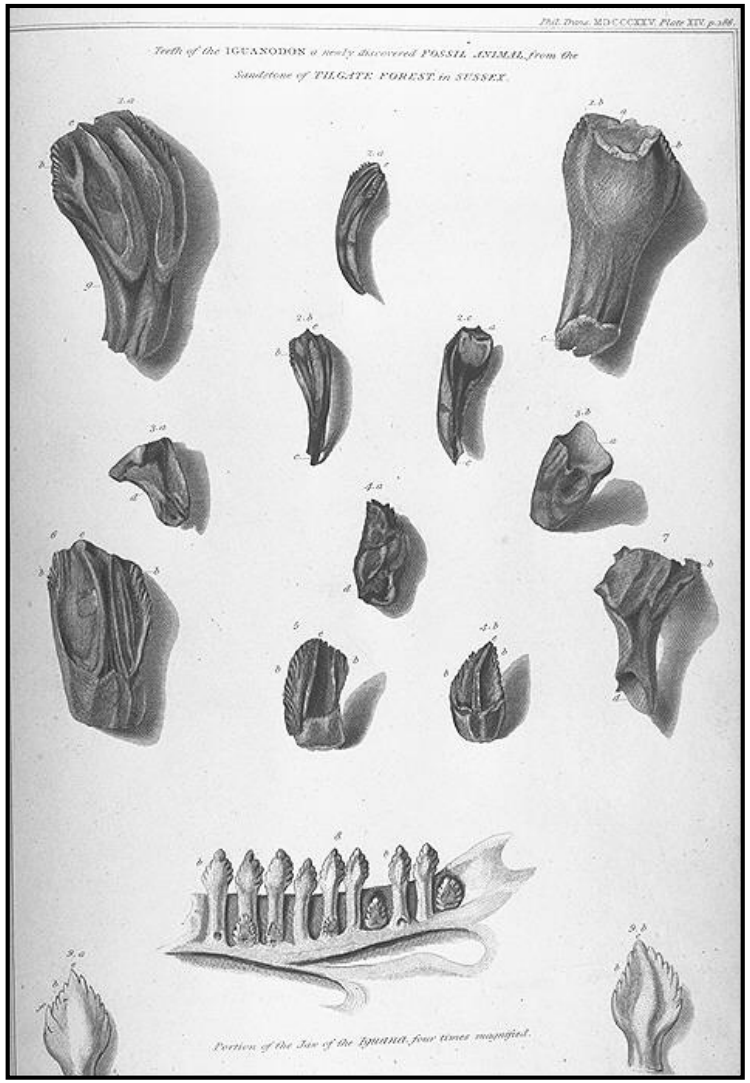
Perspectiva histórica do estudo dos dinossauros

Rev. William Buckland: descreve em 1824 a mandíbula de um "grande réptil carnívoro extinto" coletado em 1815, em Oxfordshire

Megalosaurus

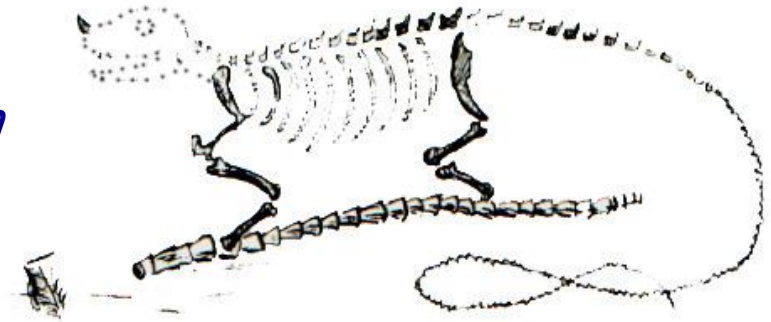
Perspectiva histórica do estudo dos dinossauros

Gideon Mantell: descreve em 1825 dentes de um "grande réptil herbívoro extinto" coletado em Wealden, Sussex



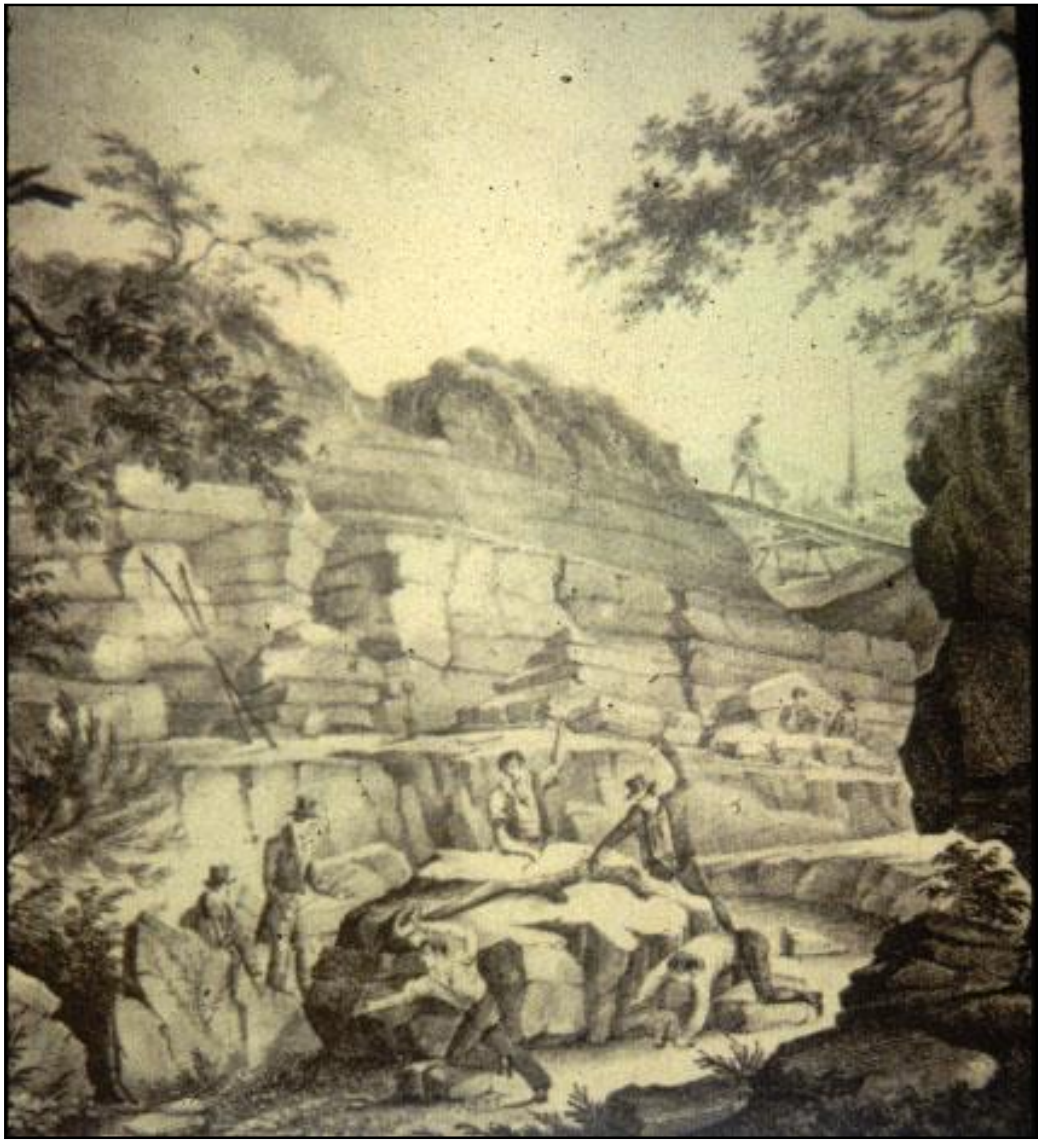
Gideon e Mary-Ann Mantell

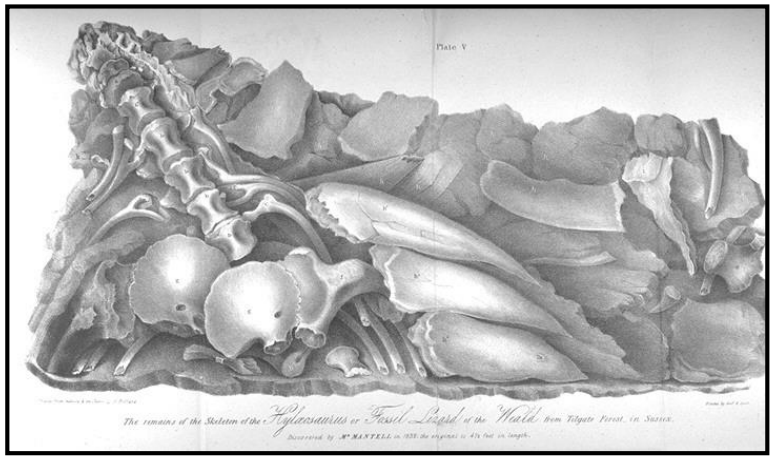
Iguanodon



Perspectiva histórica do estudo dos dinossauros

Gideon Mantell: outros répteis do Wealden de Sussex





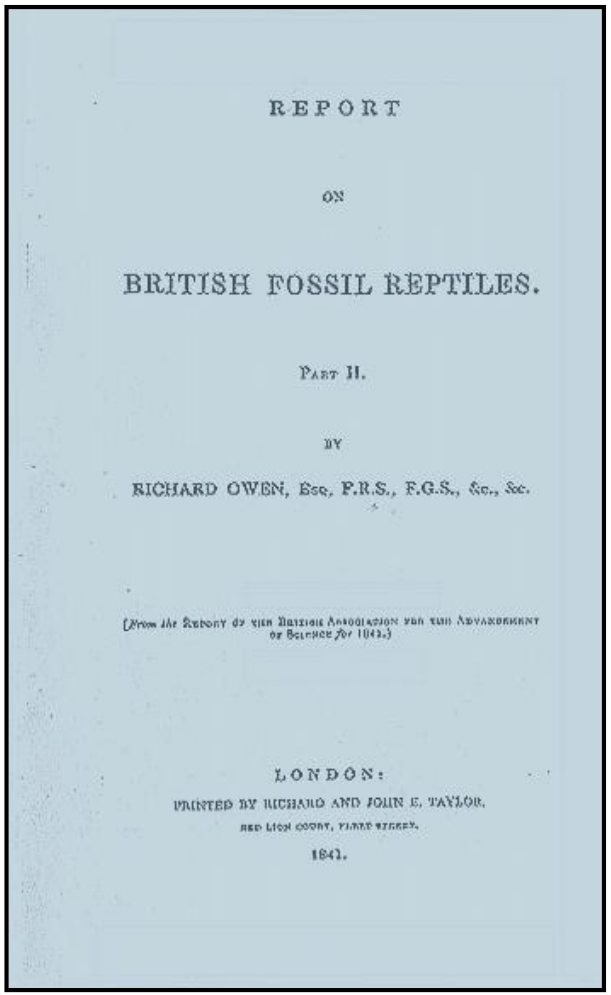
Hylaeosaurus Mantel 1833

Cuckfield Quarry

Perspectiva histórica do estudo dos dinossauros

Richard Owen 1842: propõe o nome Dinosauria - *fearfully great Lizards*

Do grego *Deinós* = assustador, e *Saûros* = lagarto



REPORT

ON

BRITISH FOSSIL REPTILES.

PART II.

BY

RICHARD OWEN, Esq, F.R.S., F.G.S., &c., &c.

(From the Report of the British Association for the Advancement of Science for 1842.)

LONDON:

PRINTED BY RICHARD AND JOHN E. TAYLOR,

RED LION COURT, FLEET STREET.

1842.

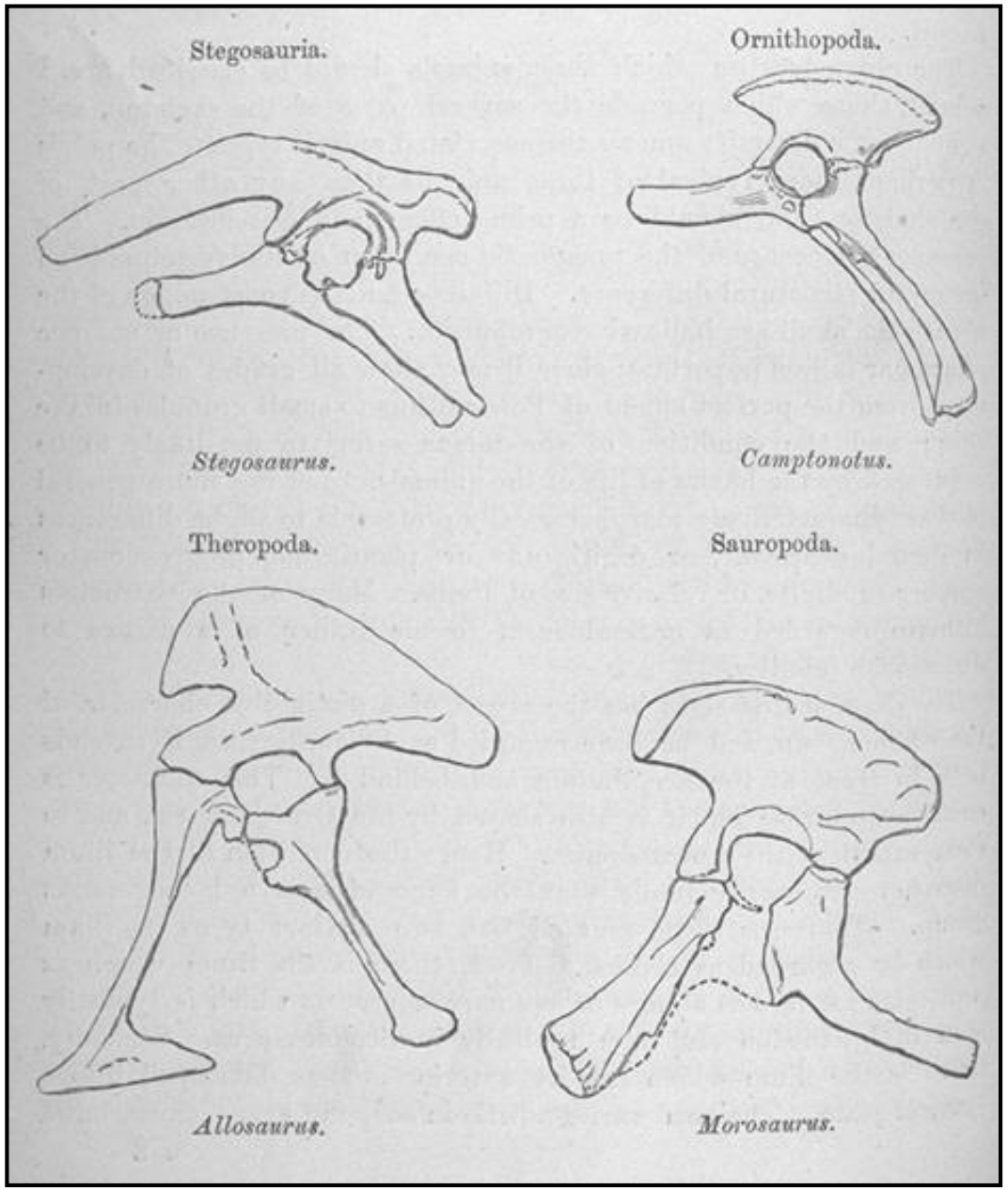
Perspectiva histórica do estudo dos dinossauros

Richard Owen 1842: propõe o nome Dinosauria - *fearfully great Lizards*

Do grego *Deinós* = assustador, e *Saûros* = lagarto

"A combinação de tais caracteres, alguns, como os ossos sacrais, completamente peculiares dentre os répteis, outros "emprestados", como os foram, de grupos atualmente distintos entre si, e todos apresentados por criaturas que em muito ultrapassam em tamanho os maiores répteis atuais, será, presumivelmente, considerada de suficiente significância para o estabelecimento de uma distinta tribo ou subordem de répreis sáurios, para a qual eu proporia o nome Dinosauria."

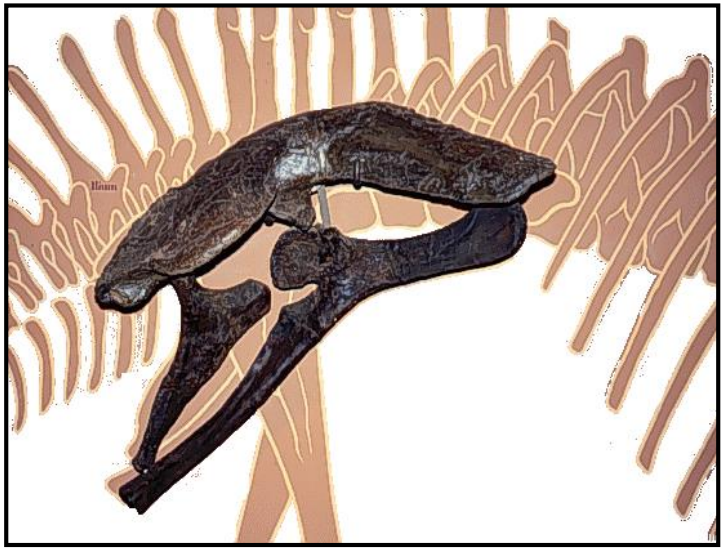
Saurischia e Ornithischia *sensu* Seeley 1887

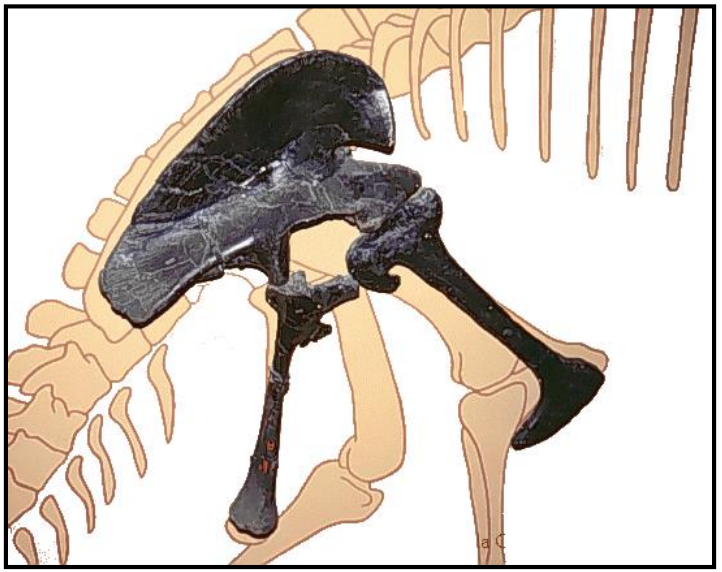


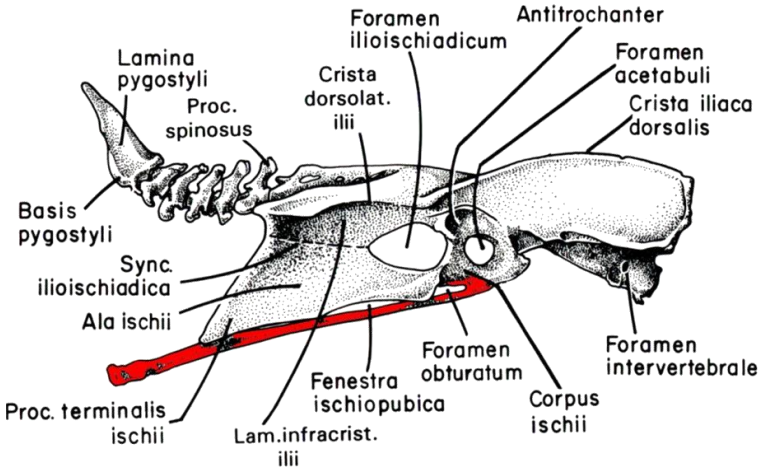
Construções distintas da pelve
(orientação do púbis)

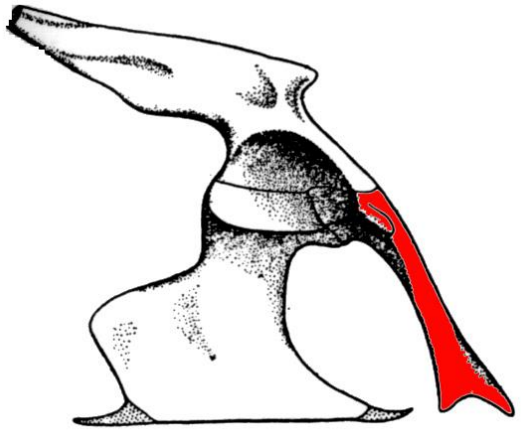
Saurischia e Ornithischia *sensu* Seeley 1887

Ornithischia ("pelve de ave") – Saurischia ("pelve de lagarto")



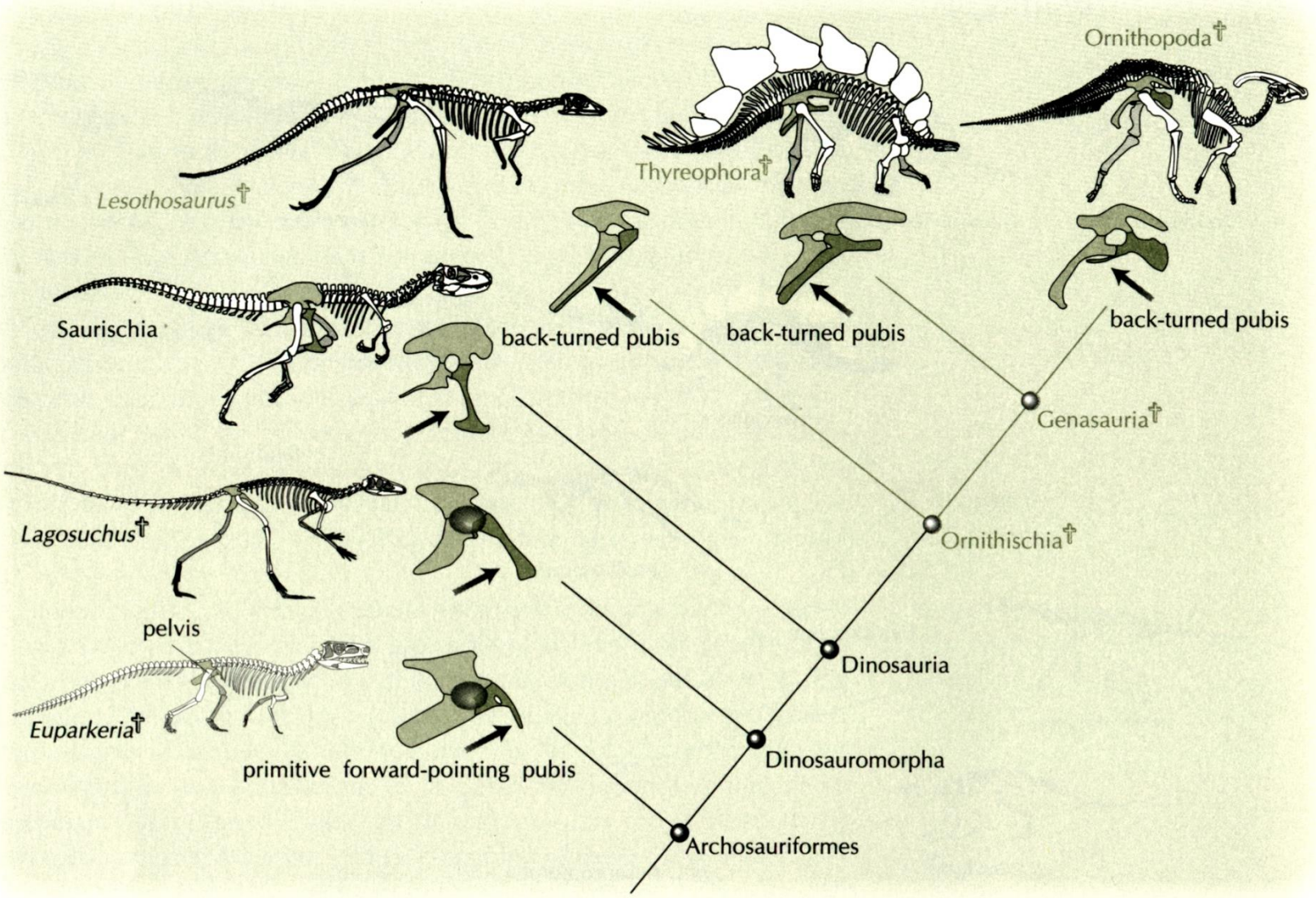




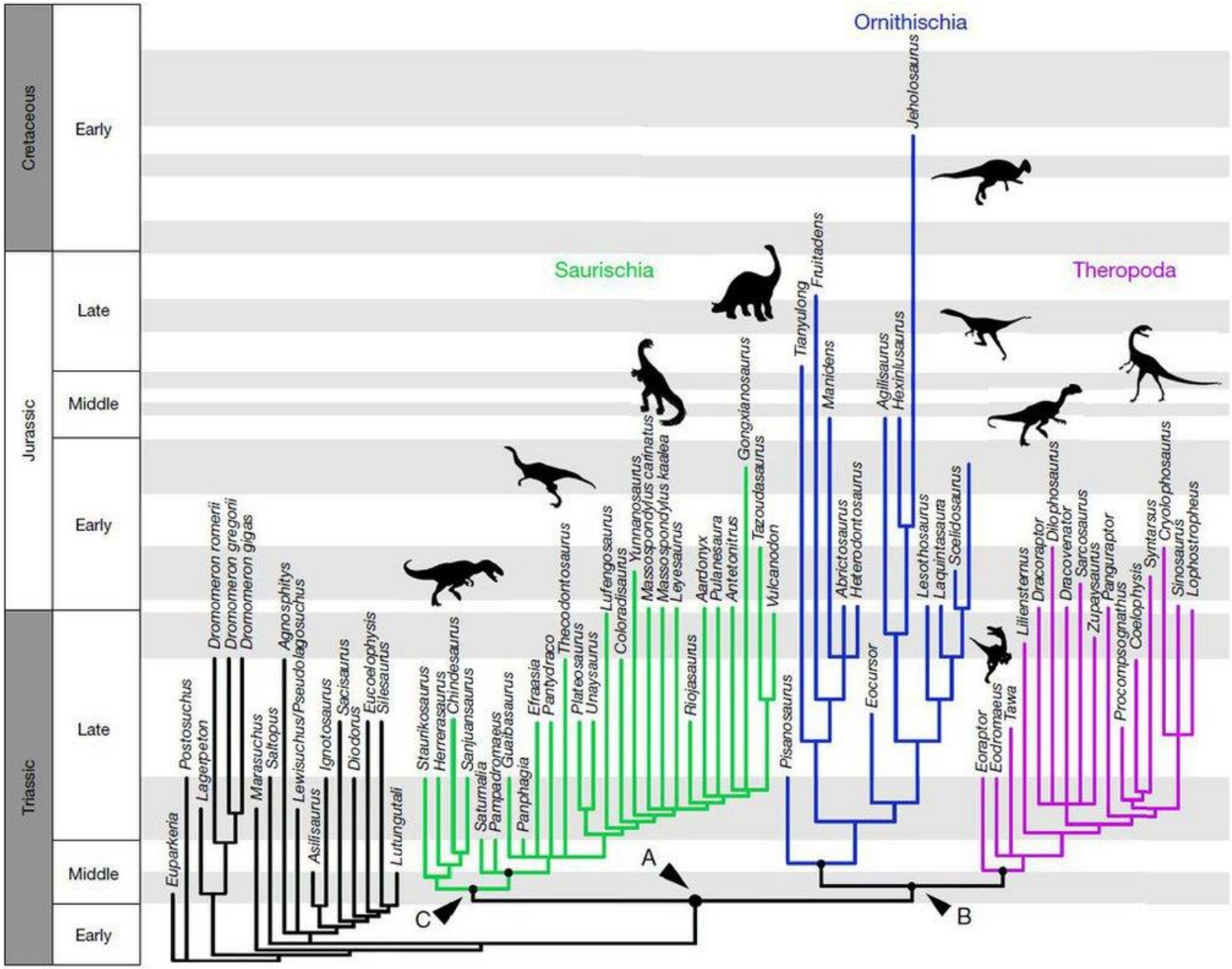


Saurischia e Ornithischia *sensu* Seeley 1887

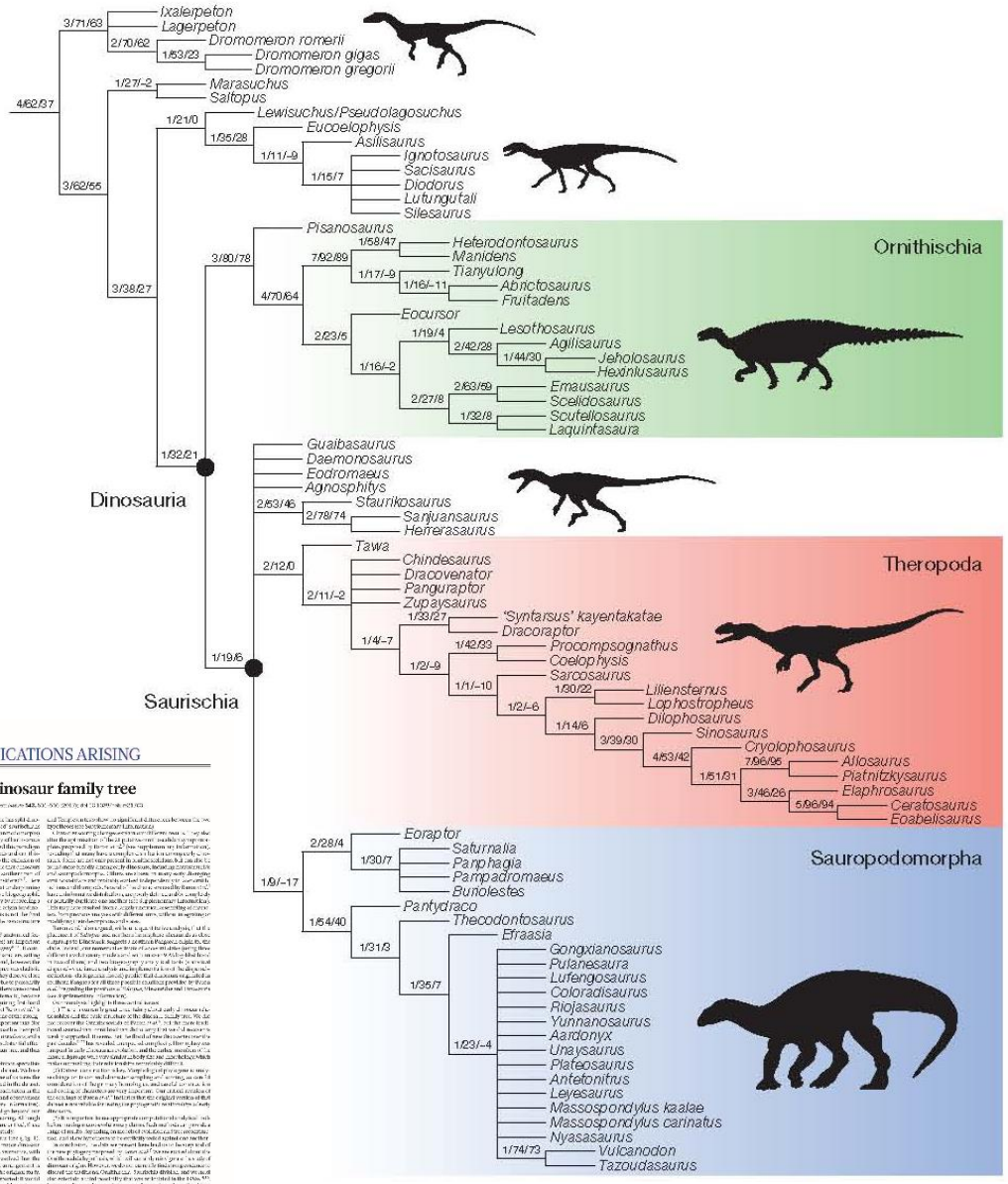
Pelve "saurískchia" é plesiomórfica



Ornithoscelida *sensu* Huxley 1870 (Baron et al. 2017)



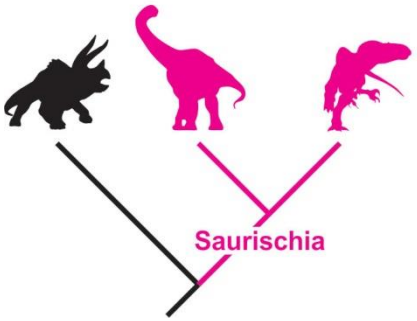
Ornithoscelida *sensu* Huxley 1870 (Baron et al. 2017)



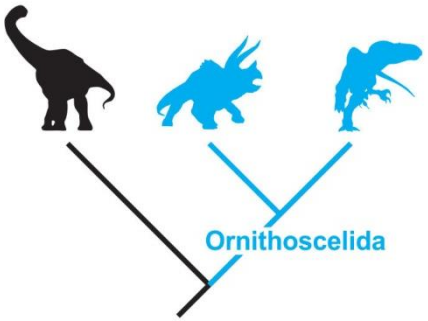
BRIEF COMMUNICATIONS ARISING

Untangling the dinosaur family tree

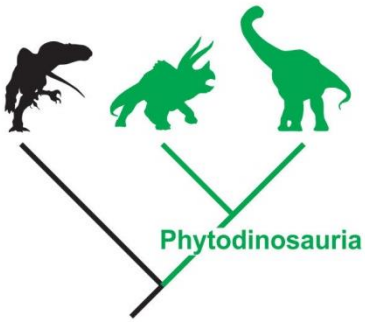
Traditional View



New Hypothesis

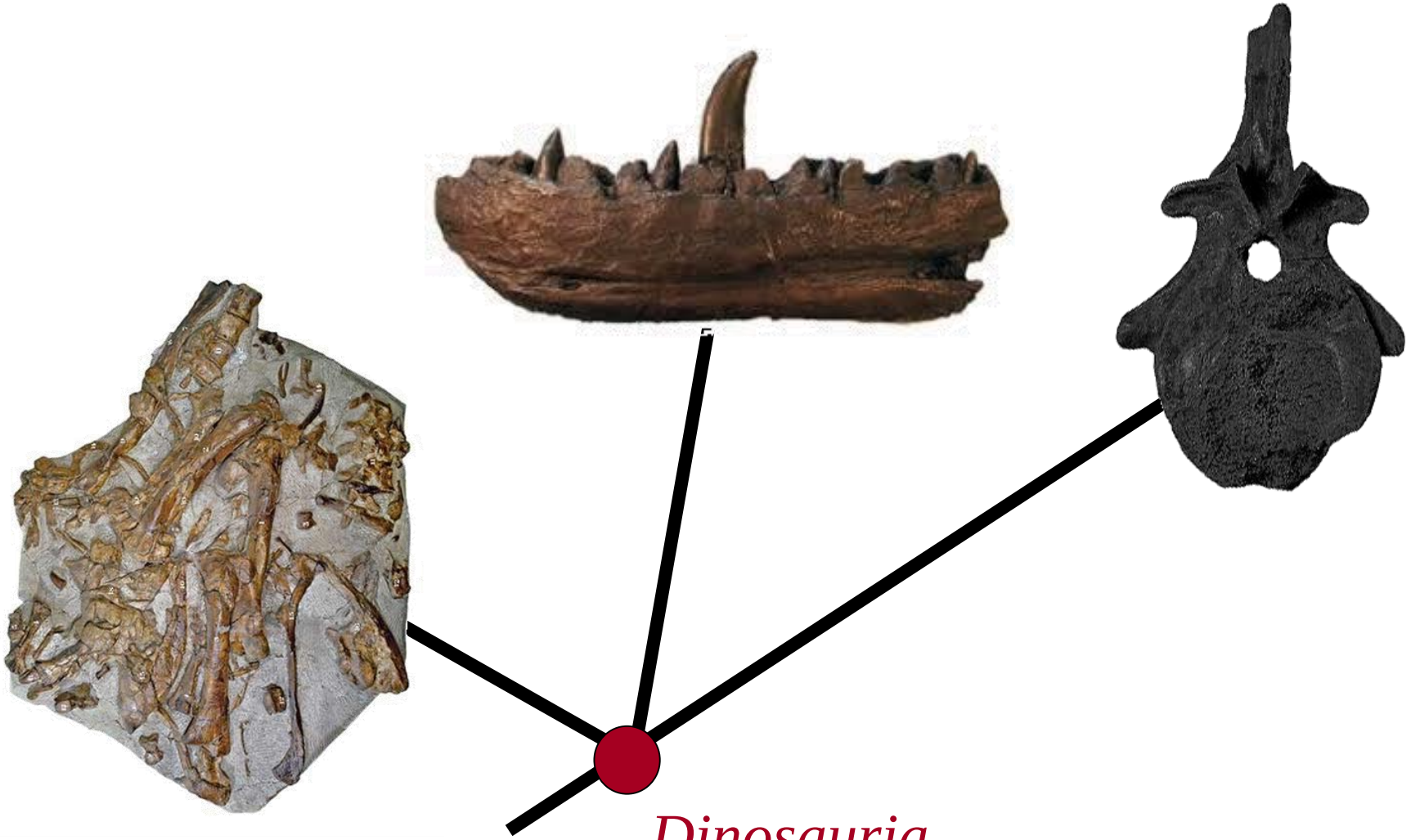


Long-Forgotten Hypothesis



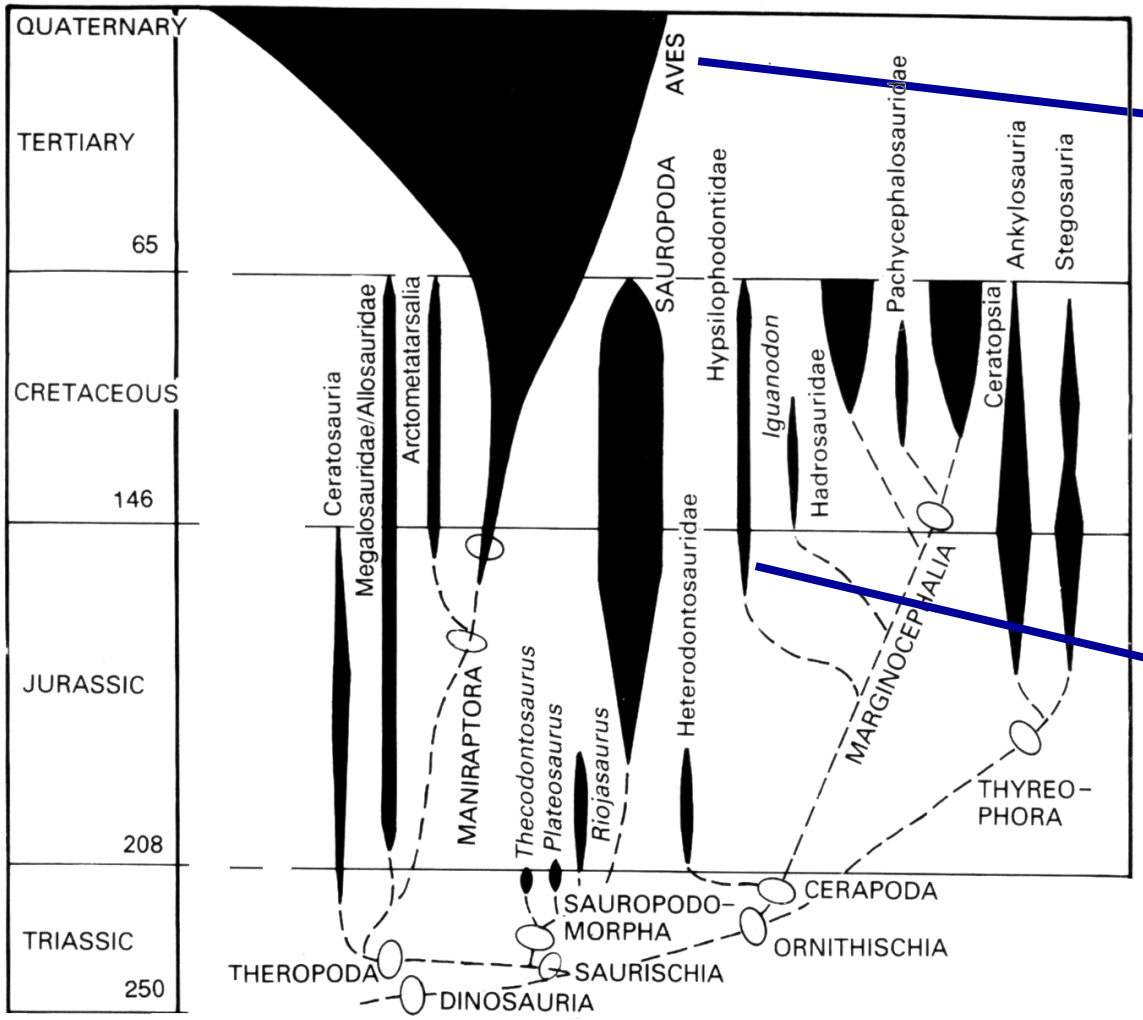
Definindo Dinosauria *sensu* Owen 1842

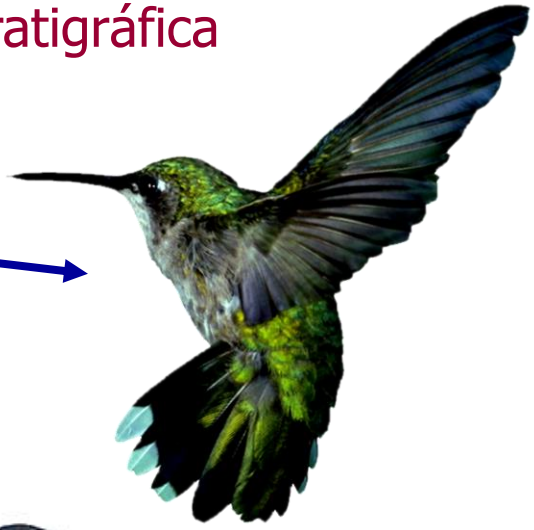
"Todos descendentes do ancestral comum mais recente de *Iguanodon*, *Megalosaurus* e *Cetiosaurus*"

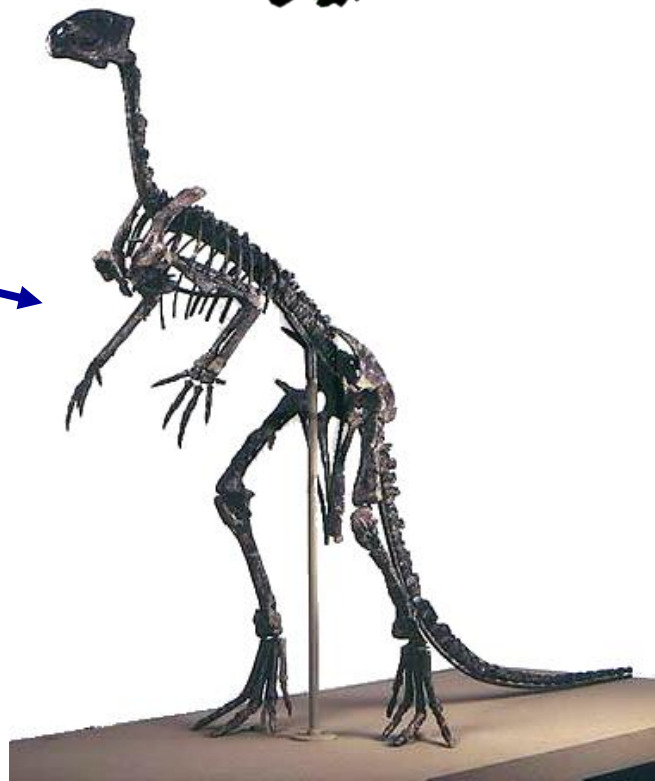


Saurischia e Ornithischia *sensu* Seeley 1887

Saurischia e Ornithischia: distribuição estratigráfica





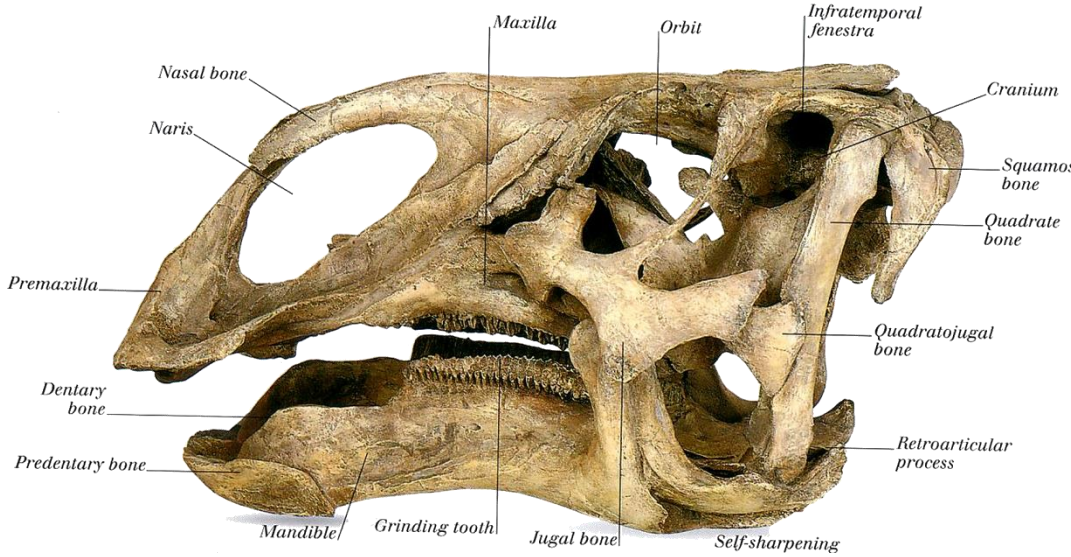


Ornithischia: paleobiologia

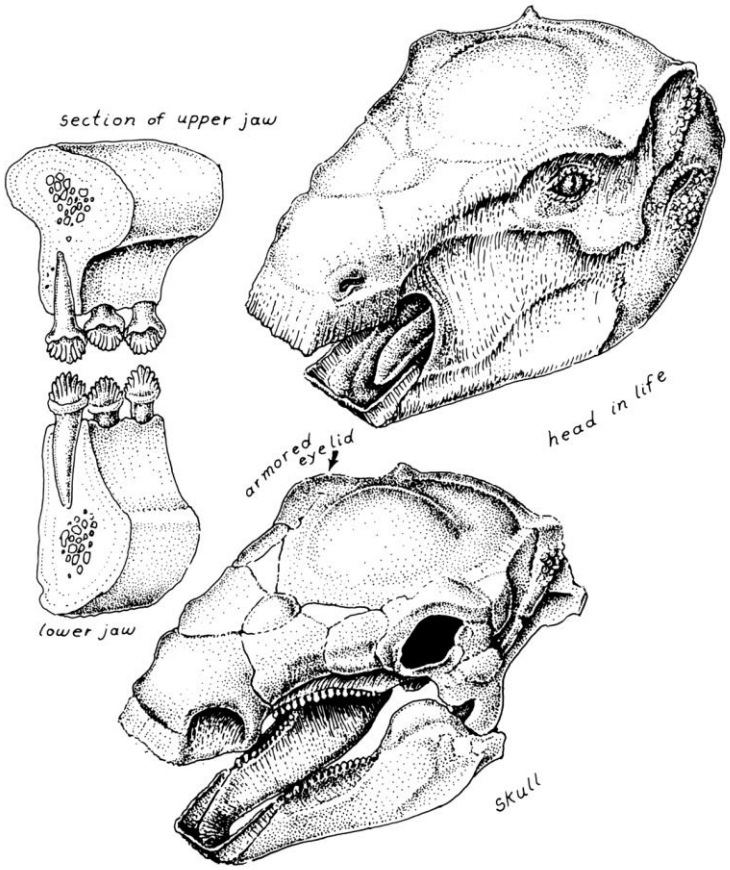
Tamanhos variados e tanto bípedes quanto quadrúpedes

Triceratops e *Fruitadens*
aproximadamente na mesma escala

Ornithischia: adaptações à herbiovoria



Brachylophosaurus

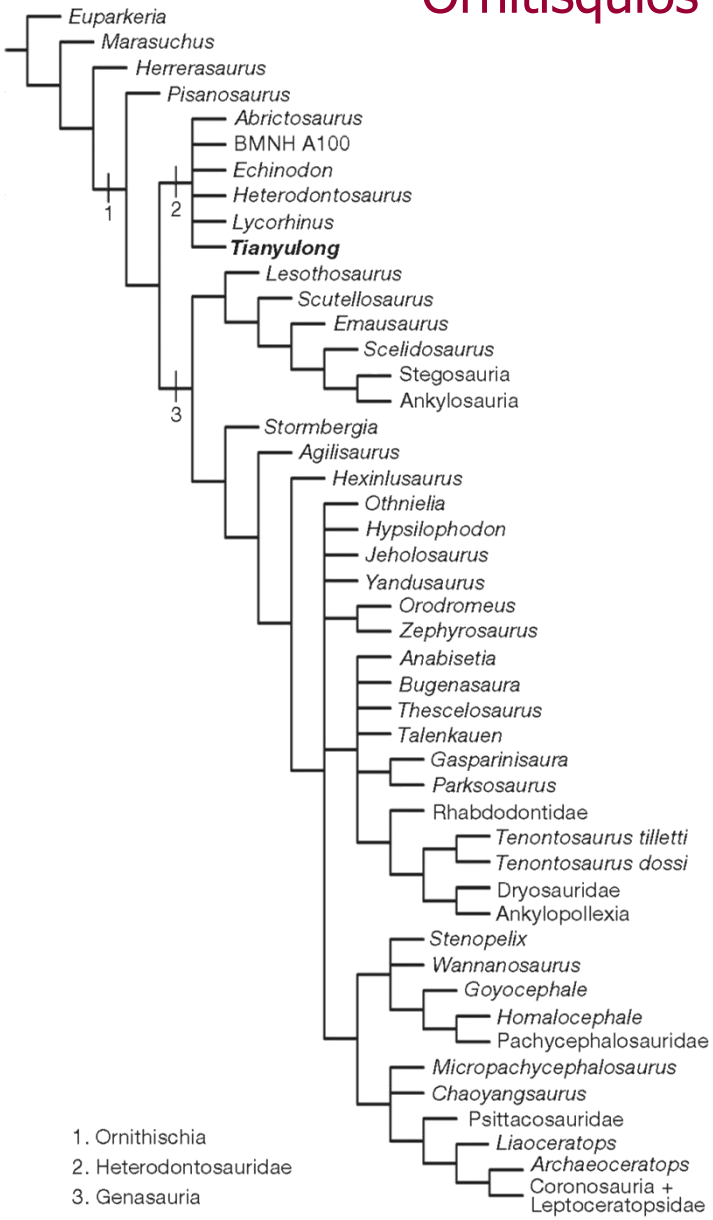


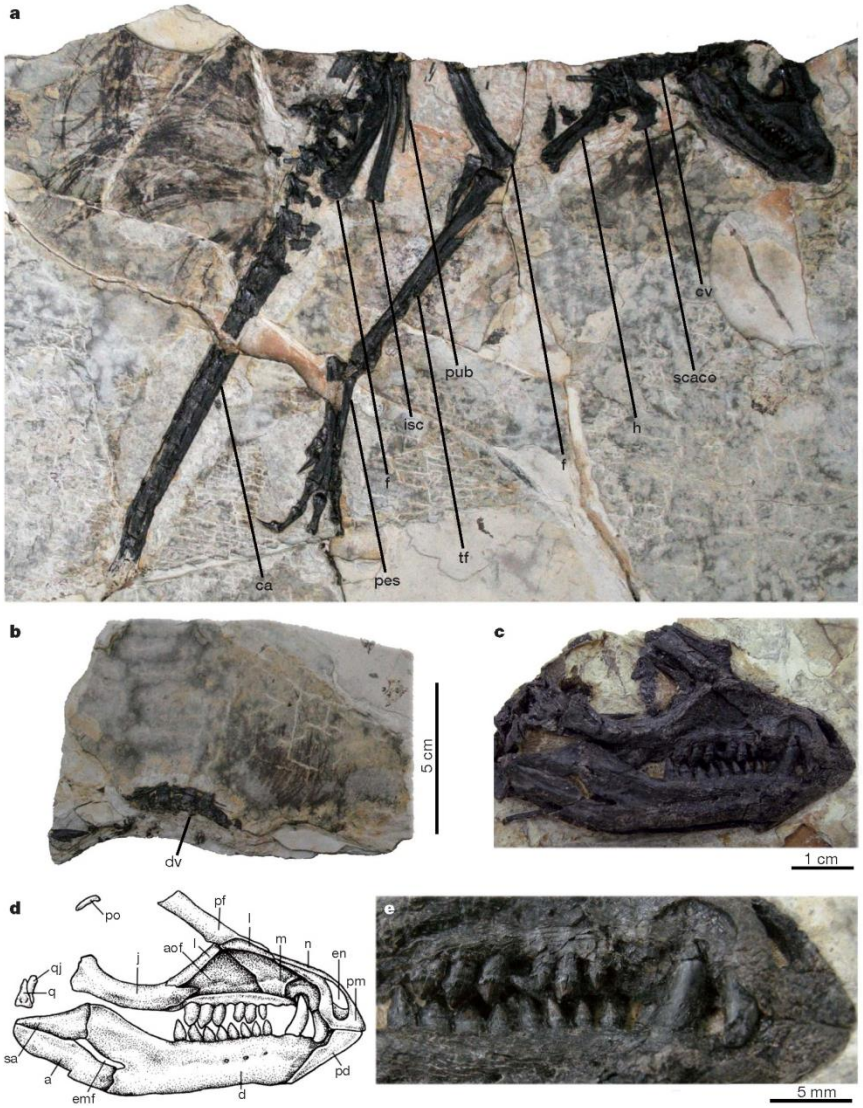
Edmontonia

Dentes não-cortantes,
osso pré dentário (apomorfia),
bico córneo, cristas no maxilar e
dentário (bochecha) e
articulação maxilo-mandibular baixa

Heterodontosauridae: (Triássico sup.- Cretáceo inf.)

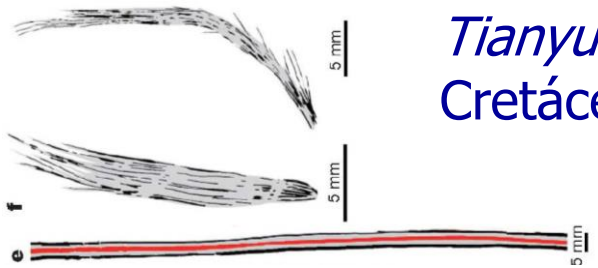
Ornitísquios basais ou ornitópodos





Heterodontosauridae: (Triássico sup.- Cretáceo inf.)

Forma com "penas filiformes"



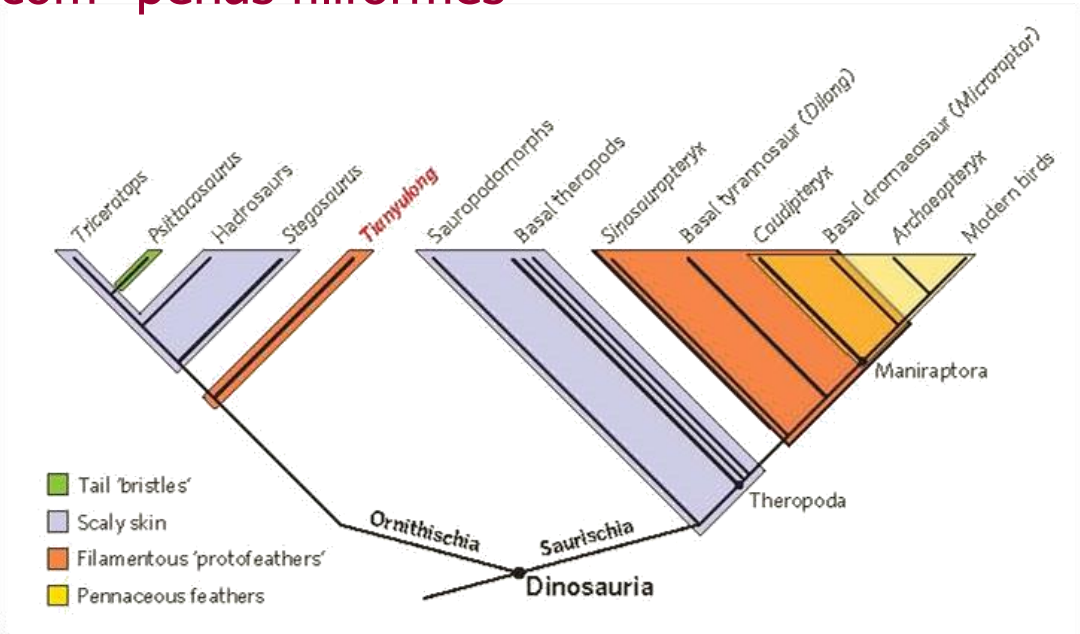
Tianyulong confuciusi
Cretáceo inf. de Liaoning

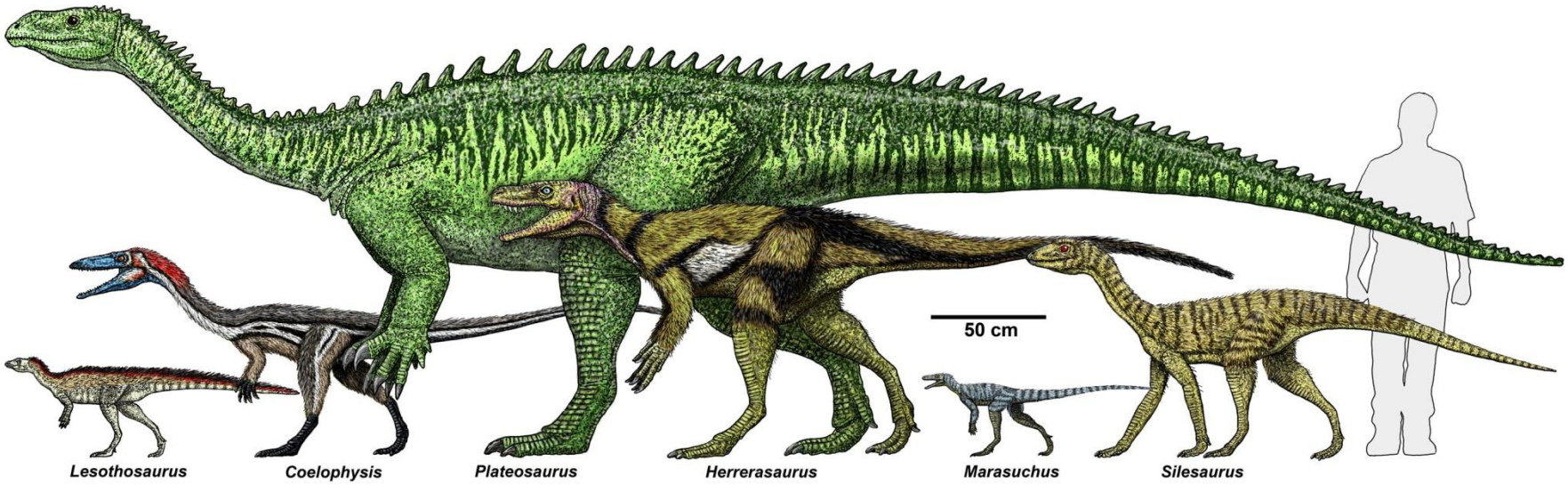
Heterodontosauridae: (Triássico sup.- Cretáceo inf.)

Forma com "penas filiformes"

Heterodontosauridae: (Triássico sup.- Cretáceo inf.)

Forma com "penas filiformes"

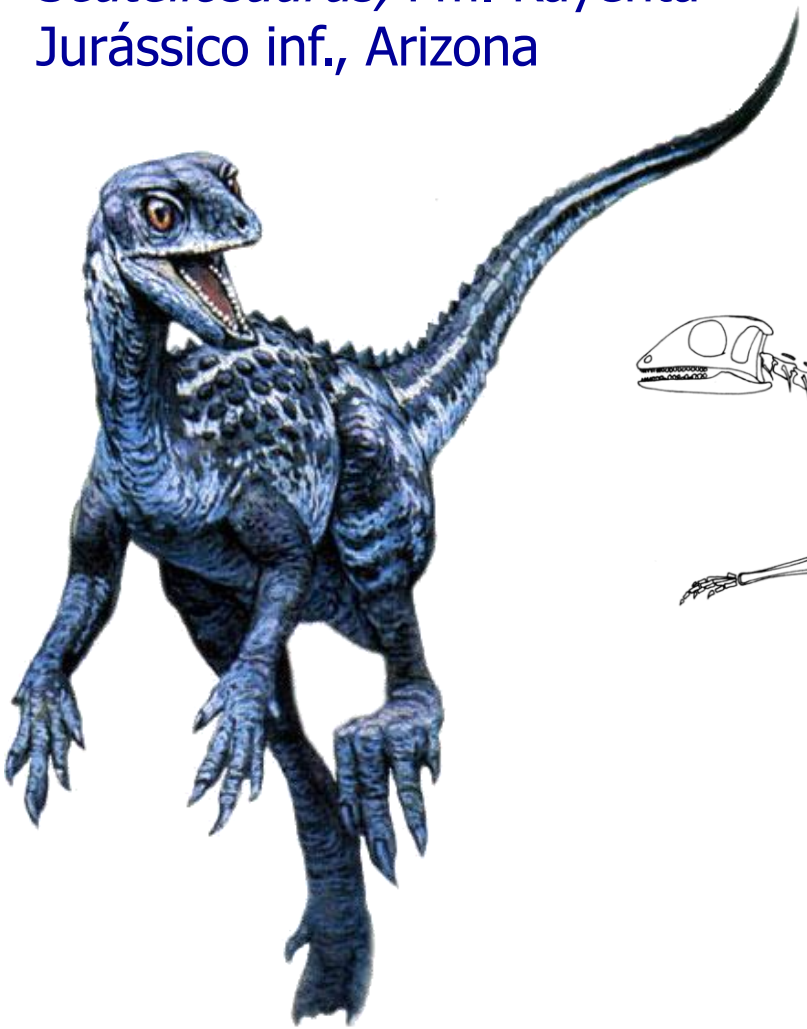


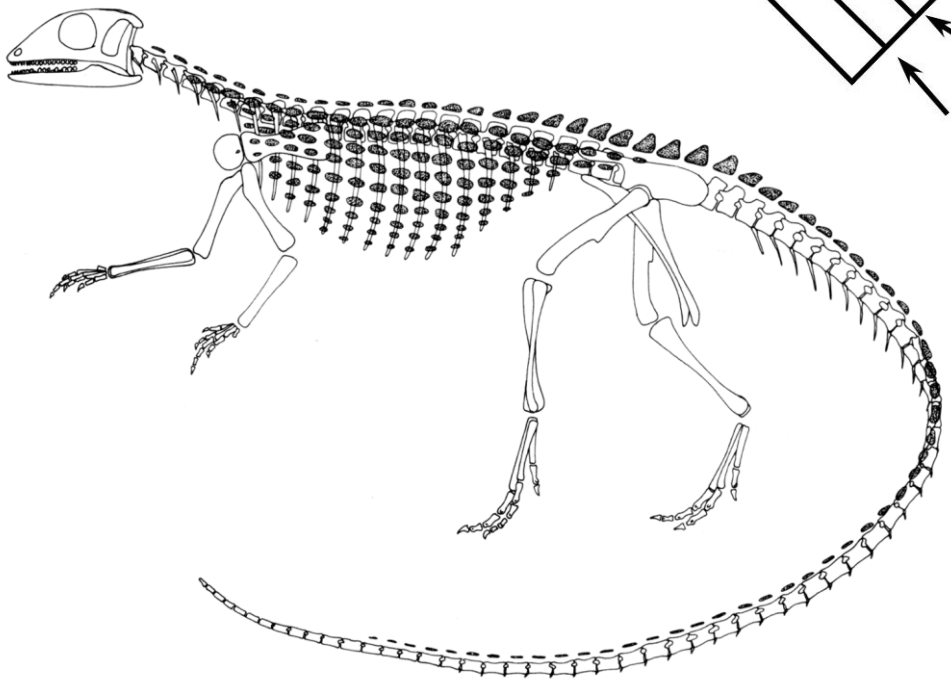


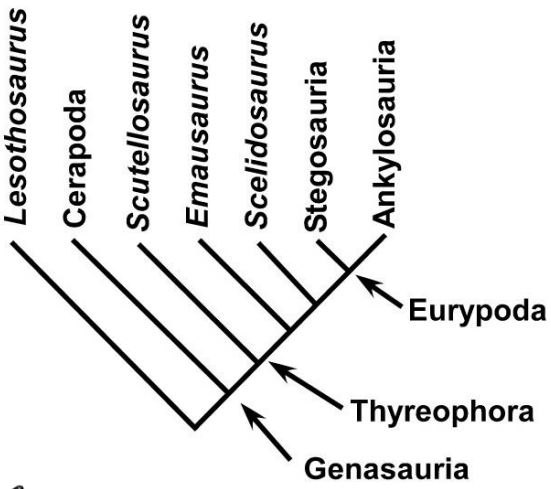
Ornithischia (Triássico sup. – Cretáceo sup.)

Thyreophora = cobertura de osteodermas

Scutellosaurus, Fm. Kayenta
Jurássico inf., Arizona

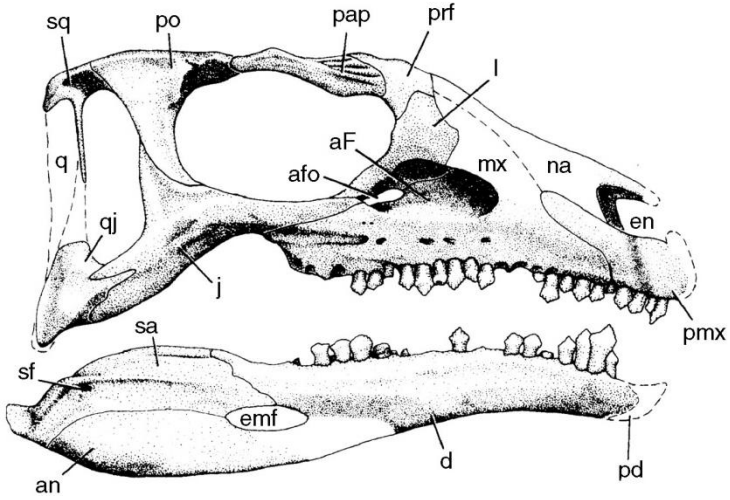




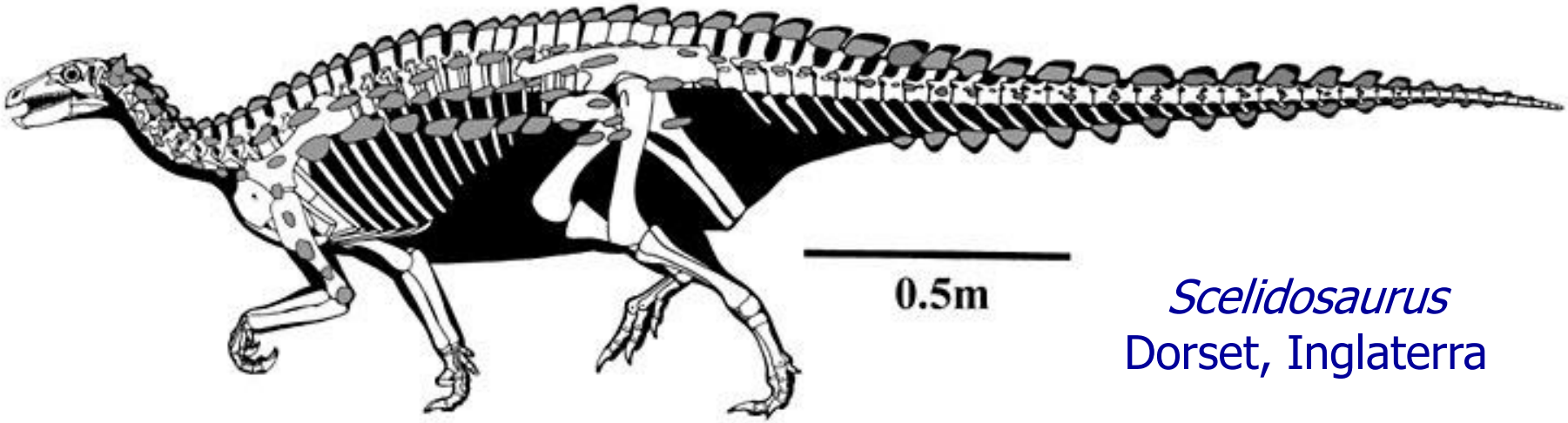


Thyreophora (Jurássico inf. – Cretáceo sup.)

Inclui formas basais (*Emausaurus* e *Scelidosaurus*) + Eurypoda



Emausaurus
Mecklenberg, Alemanha

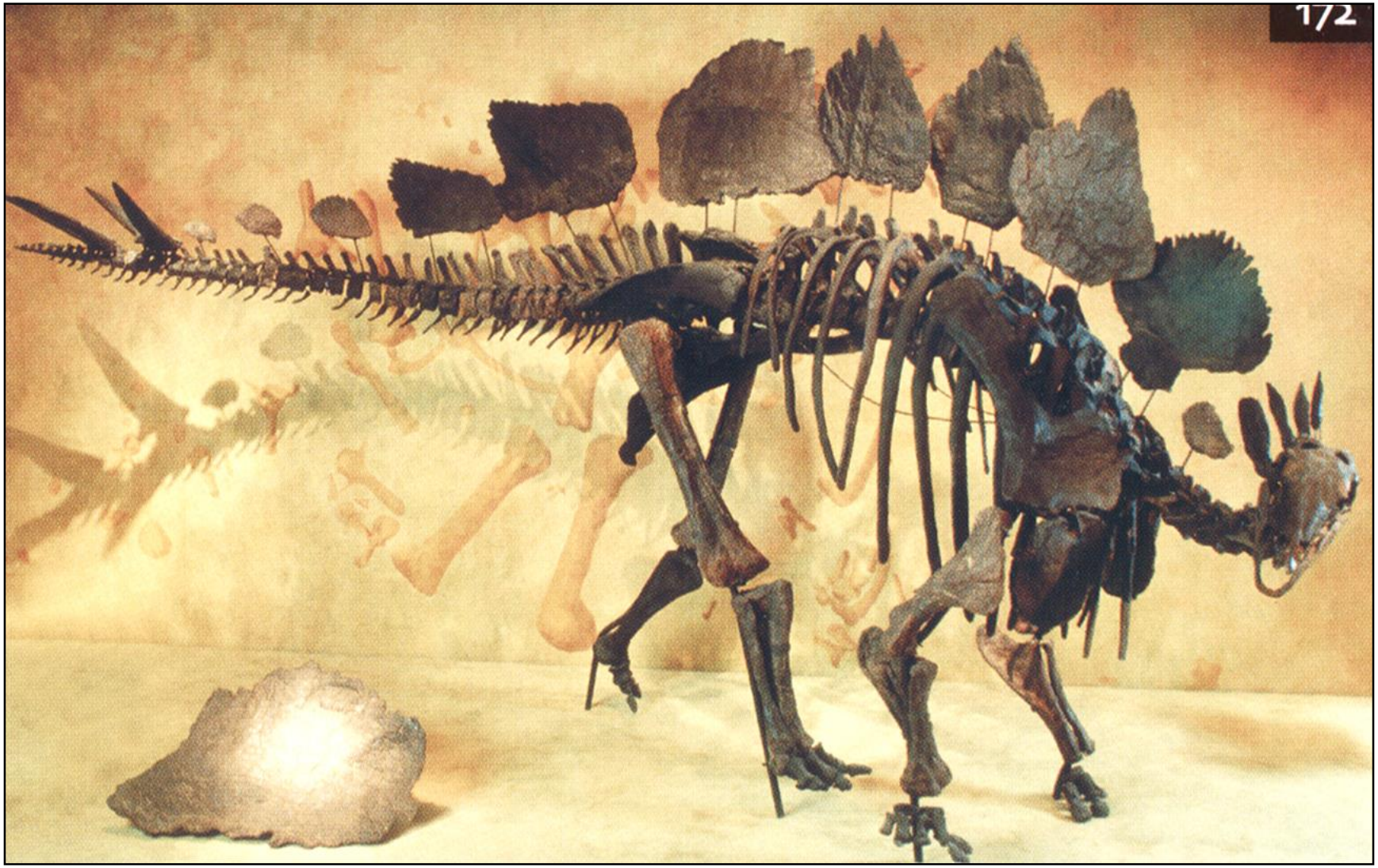


Scelidosaurus
Dorset, Inglaterra

Thyreophora (Jurássico inf. – Cretáceo sup.)

Stegosauria (Jurássico médio - Cretáceo inf.): *Stegosaurus*, Fm. Morrison

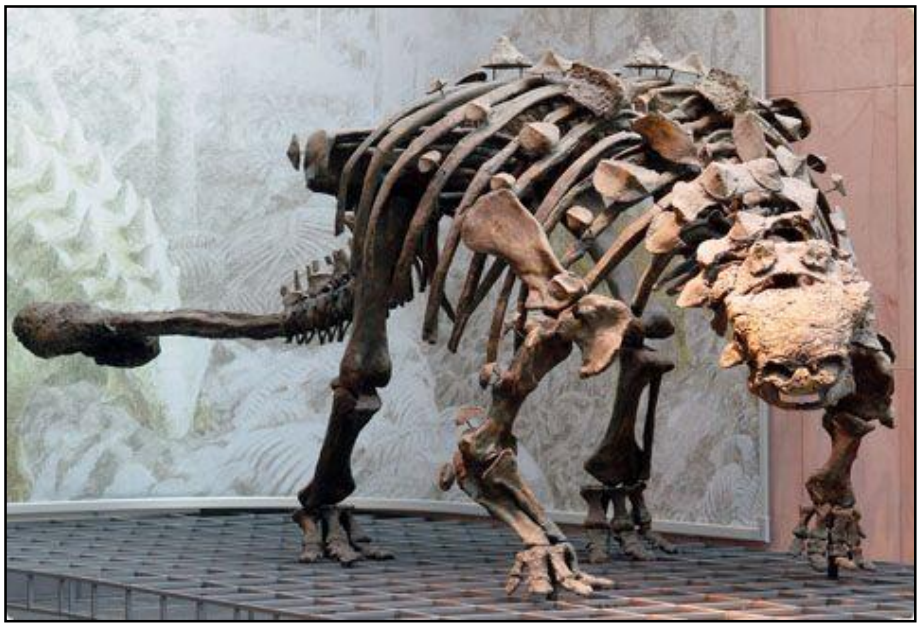
Placas dérmicas para display, proteção ou termoregulação



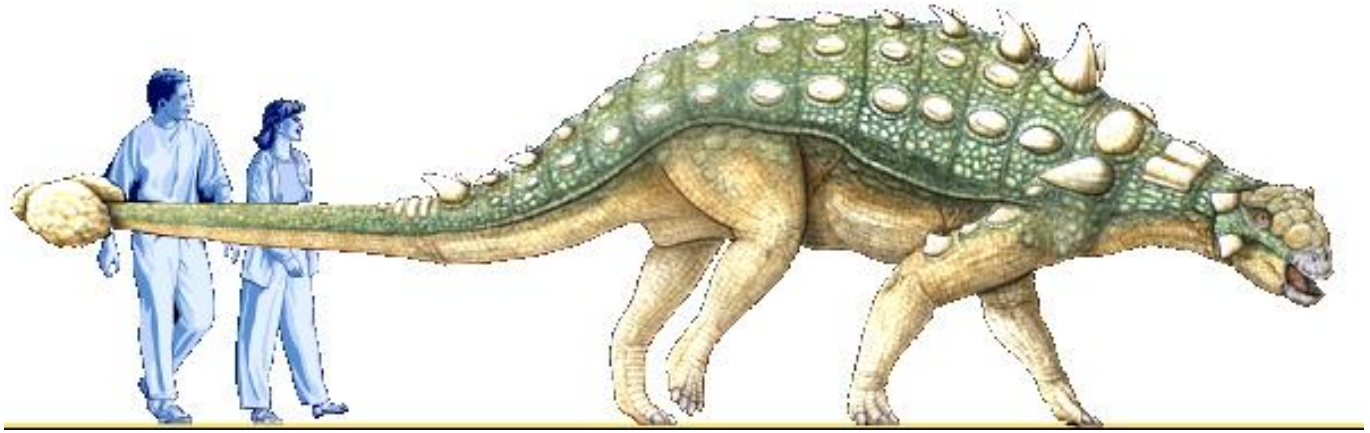
Thyreophora (Jurássico inf. – Cretáceo sup.)

Ankylosauridae (Jurássico sup. - Cretáceo sup.)

Formas derivadas com massa na cauda (vértebras e osteodermas fuzionados)



Euoplocephalus
Cretáceo sup, América Norte

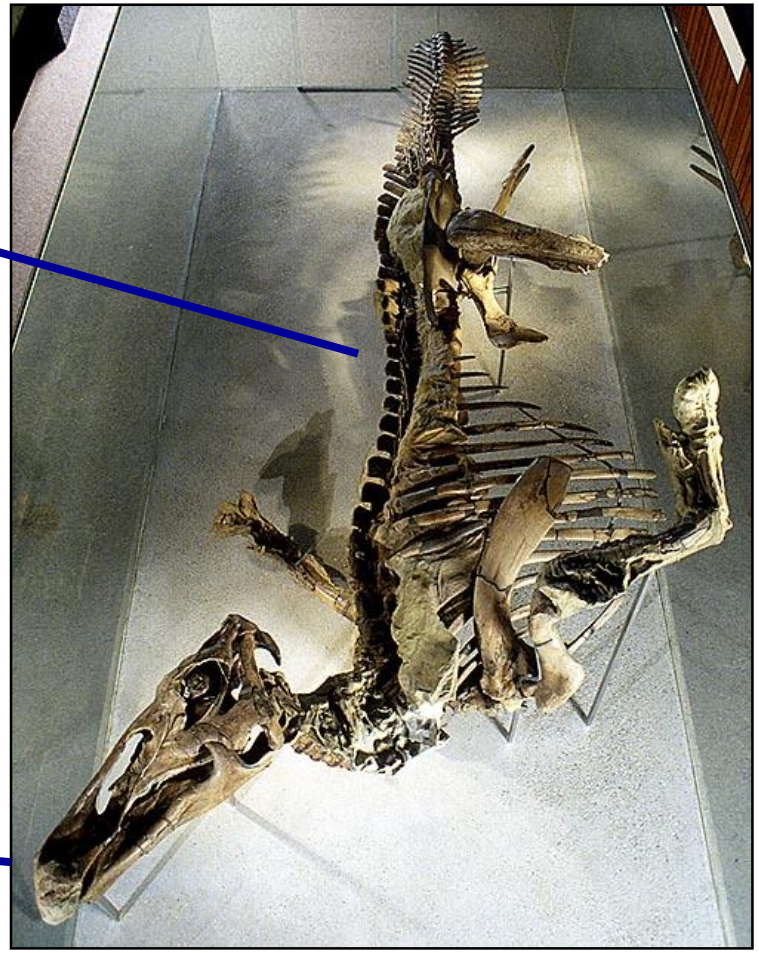


Cerapoda (Triássico sup. – Cretáceo sup.)

Inclui Ornithopoda + Marginocephalia

Ornithopoda (Jurássico médio – Cretáceo sup.)

Apomorfias: pré-maxila sem dentes e tendões dorsais ossificados



Edmontosaurus

Cretáceo sup., Canada-EUA

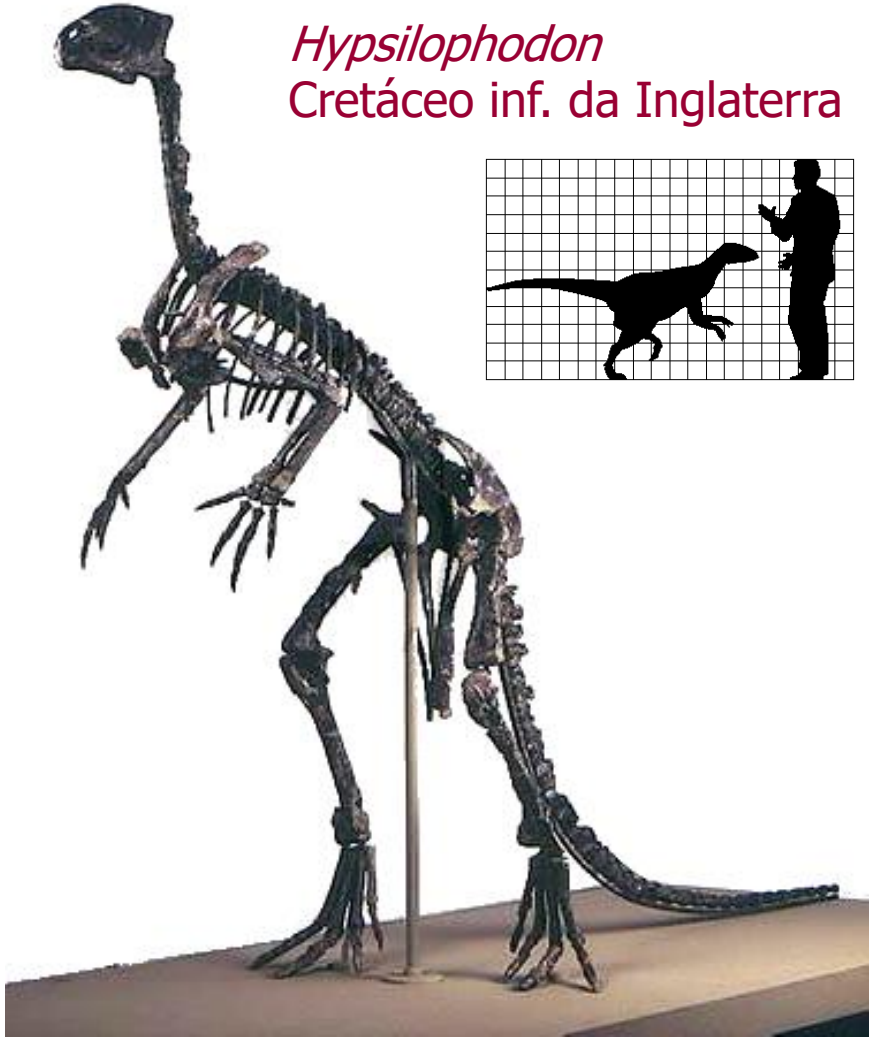
Ornitópodos basais (não-Iguanodontia)

Podem formar Hypsilophodontidae monofilético ou representar grupos irmãos sucessivos de Iguanodontia ou Cerapoda

Orodromeus - Cretáceo sup., América do Norte

Agilisaurus - Jurássico médio, Sichuan

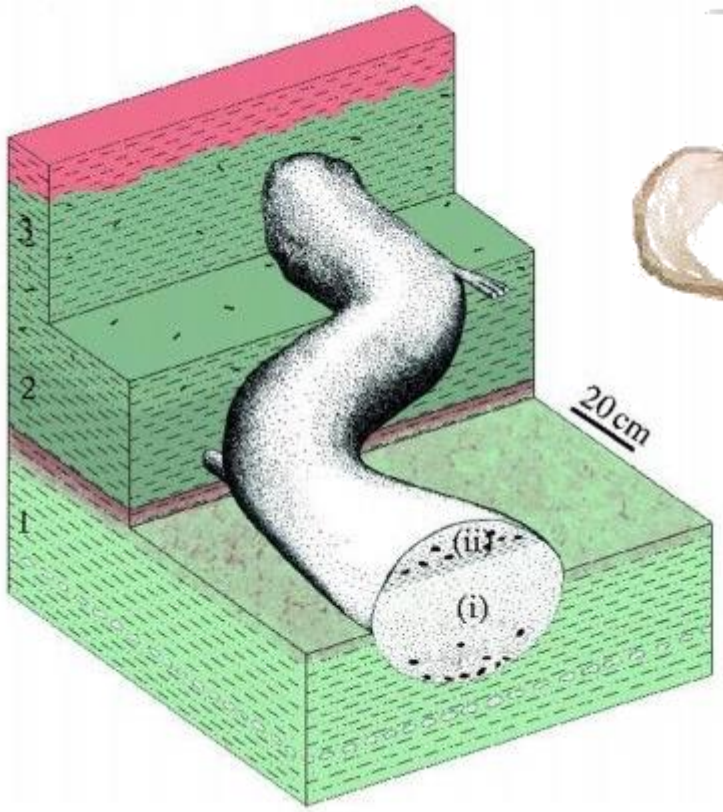
Hypsilophodon
Cretáceo inf. da Inglaterra



Ornitópodos basais (não-Iguanodontia)

Oryctodromeus cubicularis: Cretáceo média de Montana

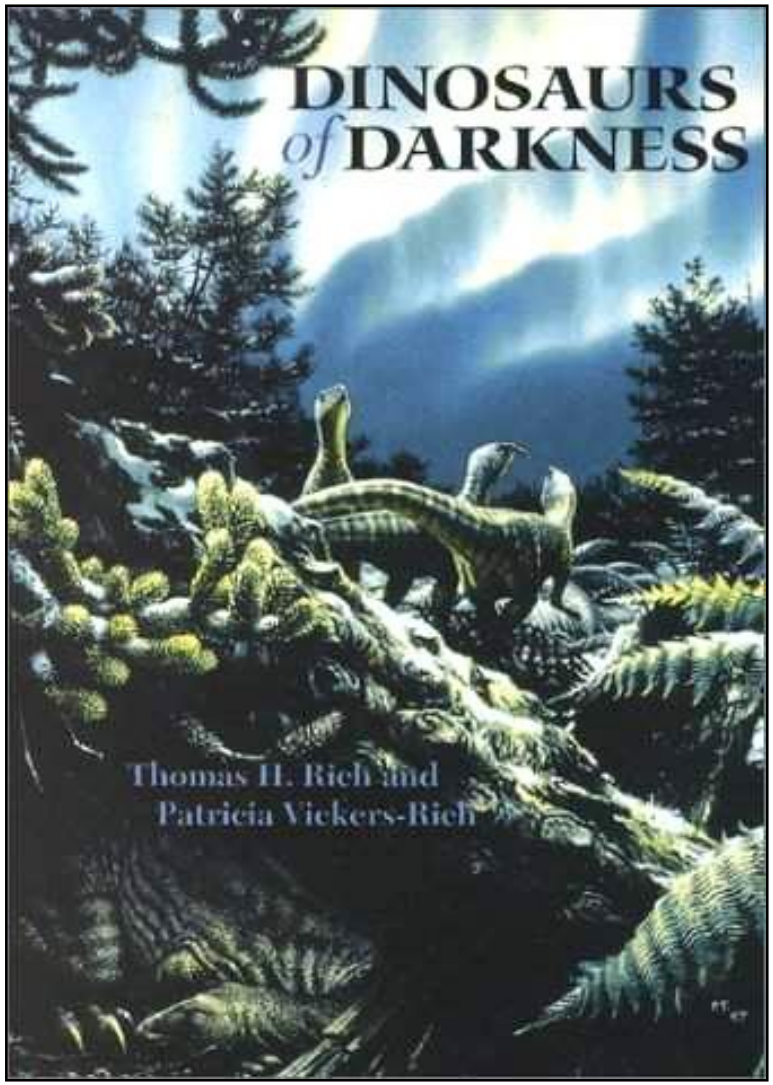
Forma possivelmente cavadora



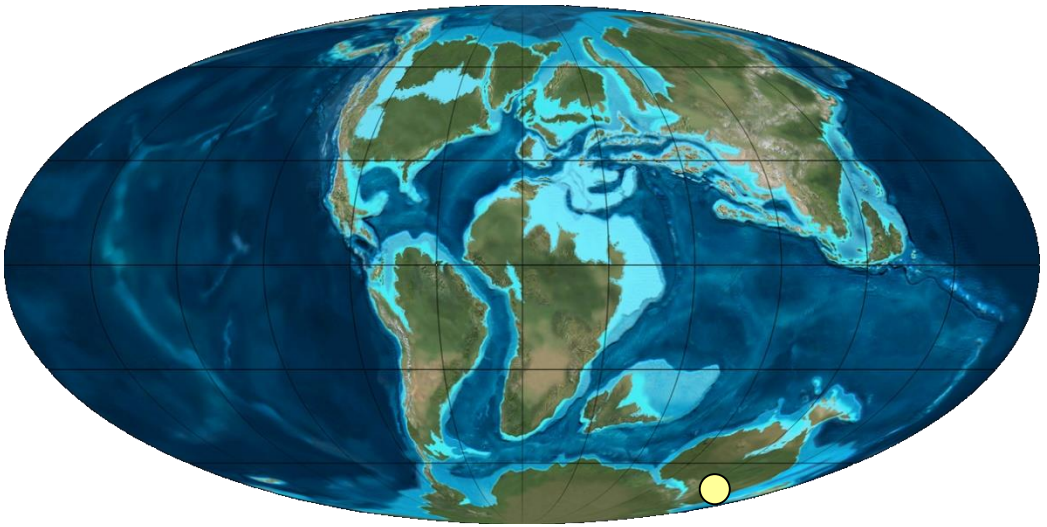
Ornitópodos basais (não-Iguanodontia)

Leaellynasaura (Fm. Eumeralla, Albiano, Victoria)

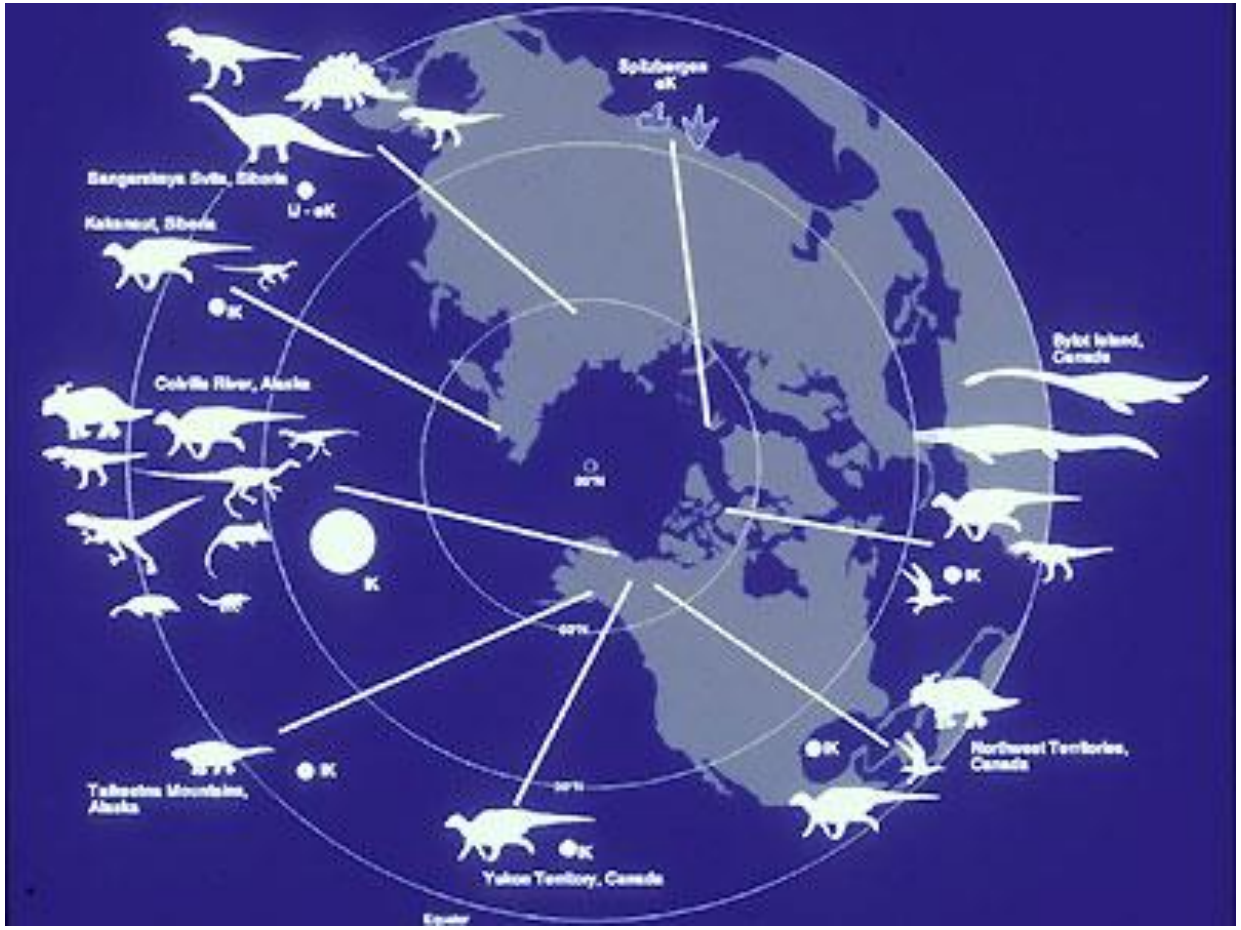
Maior acuidade visual: hábitos "noturnos"



Lobo óptico

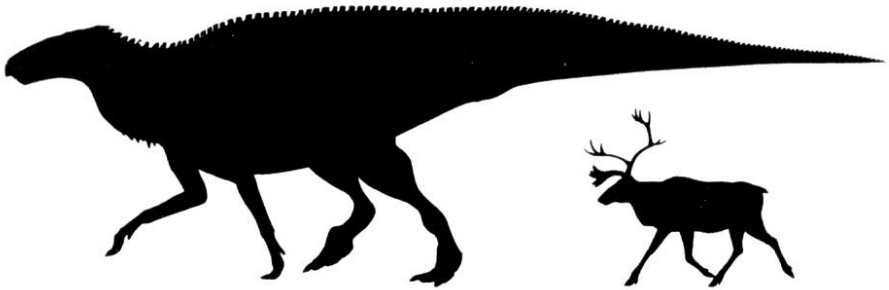


Cretáceo sup. do Alasca: vários dinossauros e mamíferos, sem registros de formas ectotérmicas (crocodilos, lagartos e anfíbios)



Clima mais ameno ou
evidência de endotermia dinossauriana?

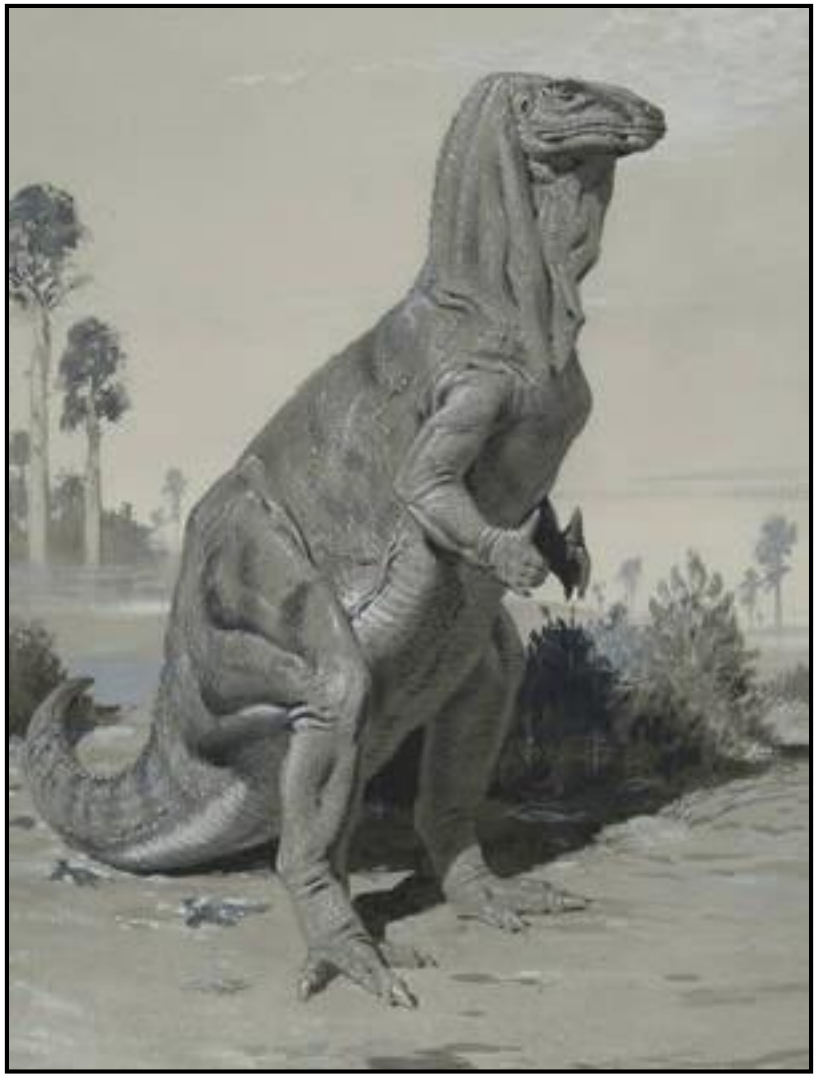
Pegadas ao longo do "Mar Interior Norte Americano" sugerem a existência de grandes rotas de migração Norte-Sul no Juro-Cretáceo

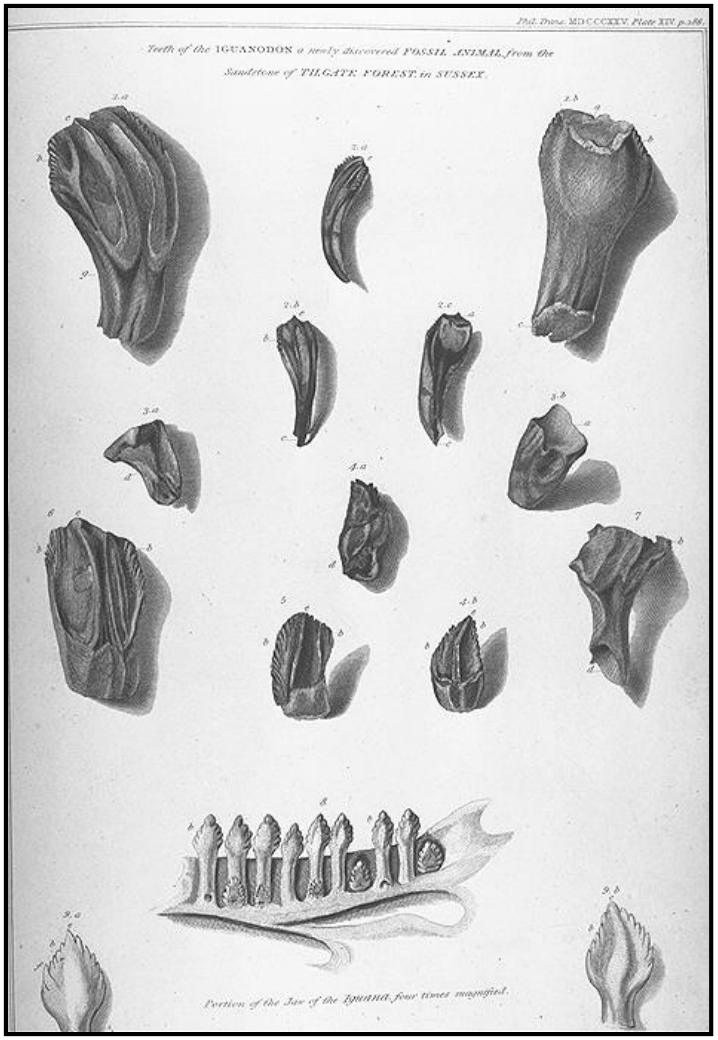


"Dinosaur Freeway"
Clayton-Lake,
Grupo Dakota
K inf., Novo México

Iguanodontia (Jurássico sup. – Cretáceo sup)

Iguanodon: Cretáceo inf. da Europa (Inglaterra, Bélgica, França, Espanha, Alemanha), EUA e Mongólia





Iguanodontia (Jurássico sup. – Cretáceo sup)

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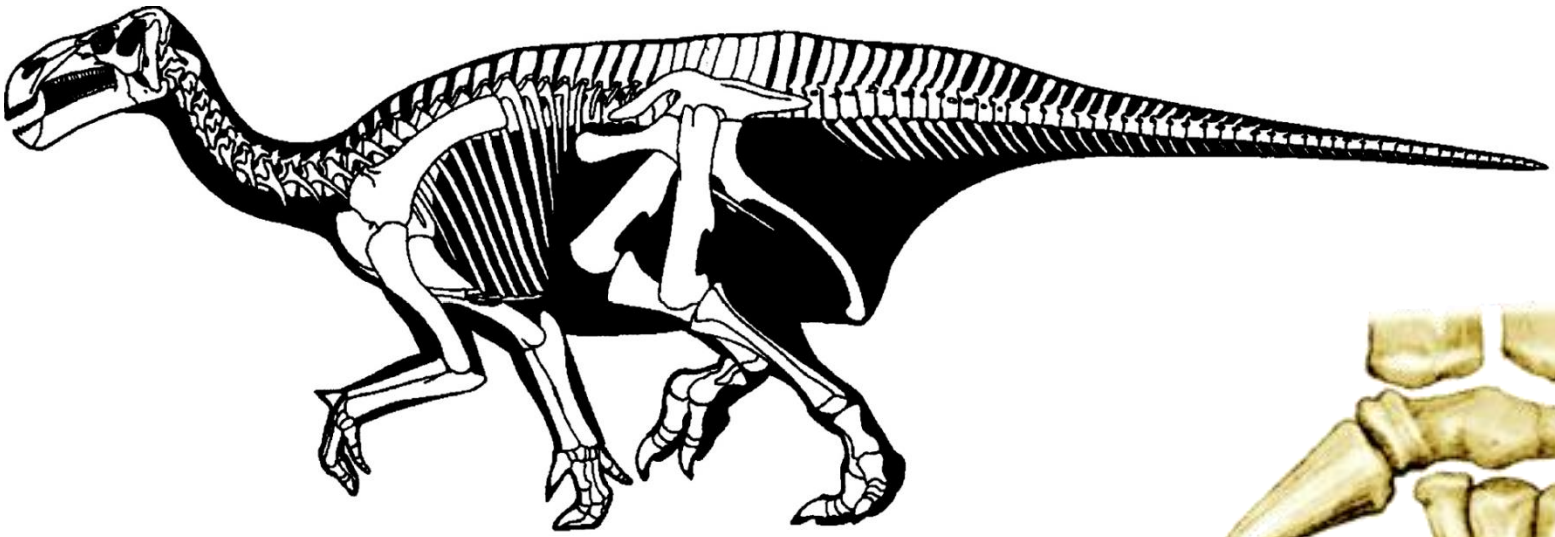
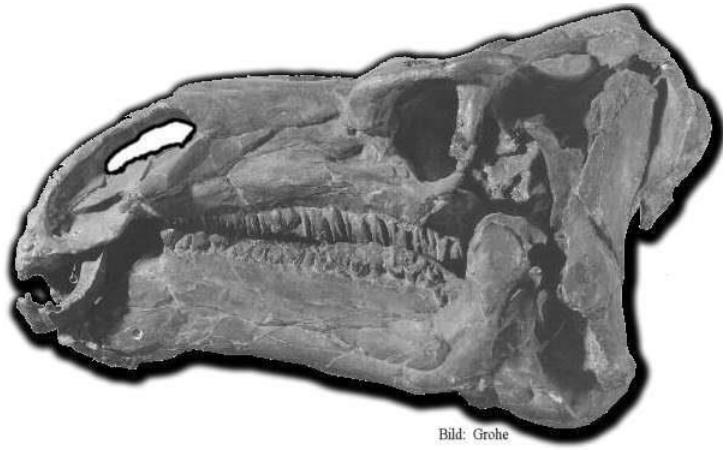
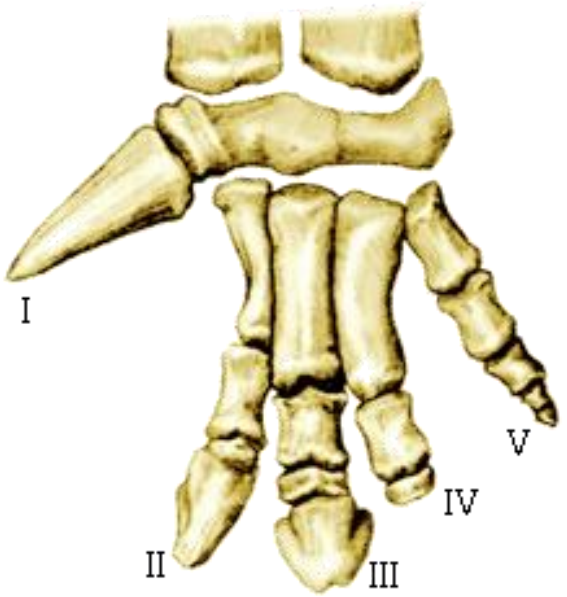
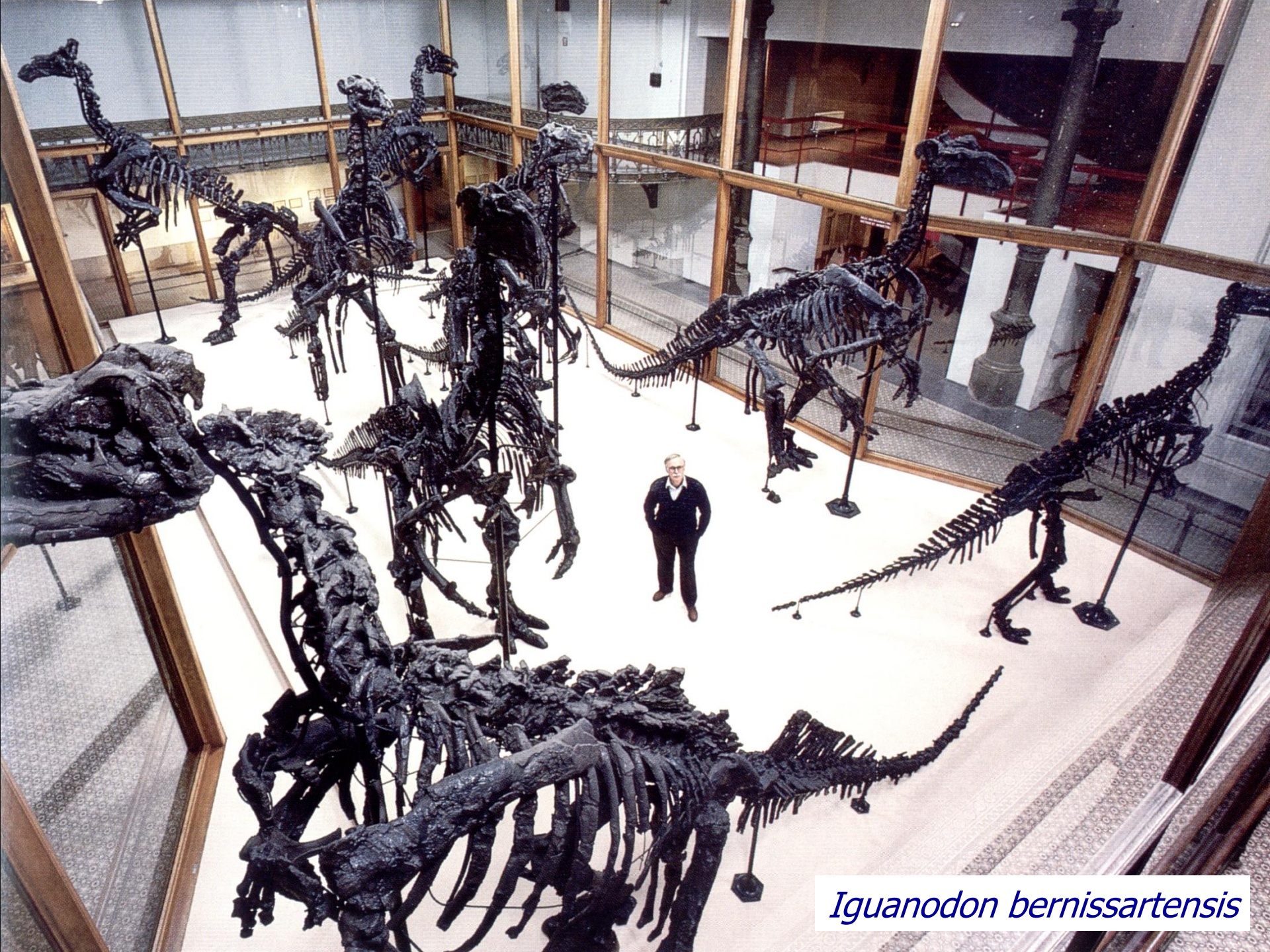






Pata anterior:
defesa e locomoção

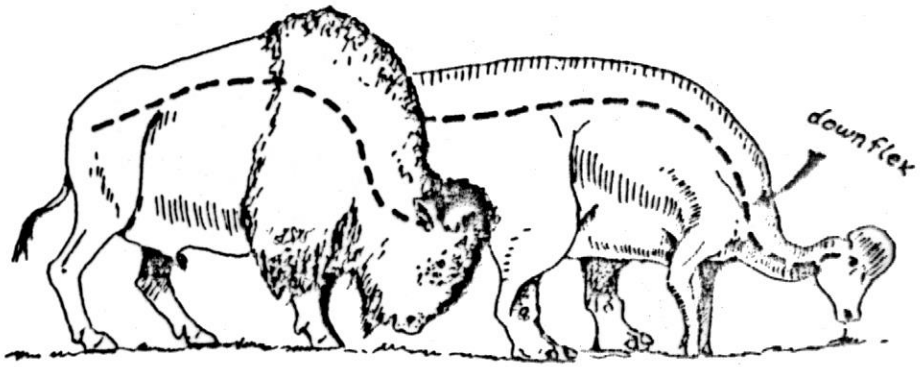


Iguanodon bernissartensis

Hadrosauridae (Cretáceo sup.): "dinossauros bico-de-pato"

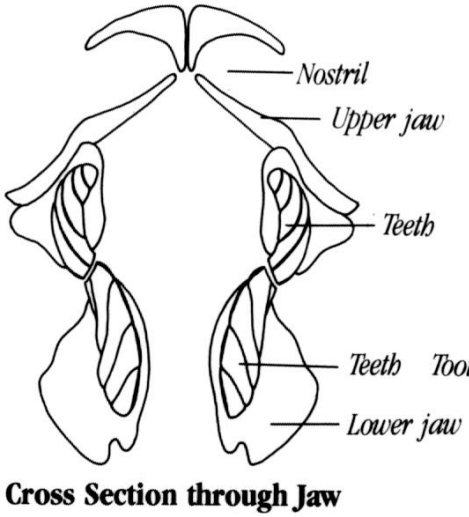
"Bico": maxila e pré-maxila alargadas (sugere hábito semi-aquático)

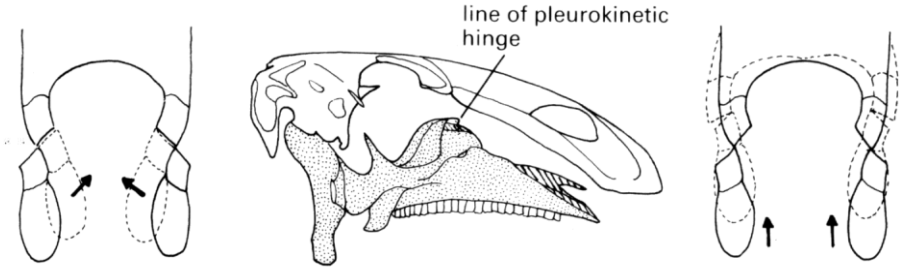
Adaptações a vida terrestre e coníferas em conteúdo estomacal

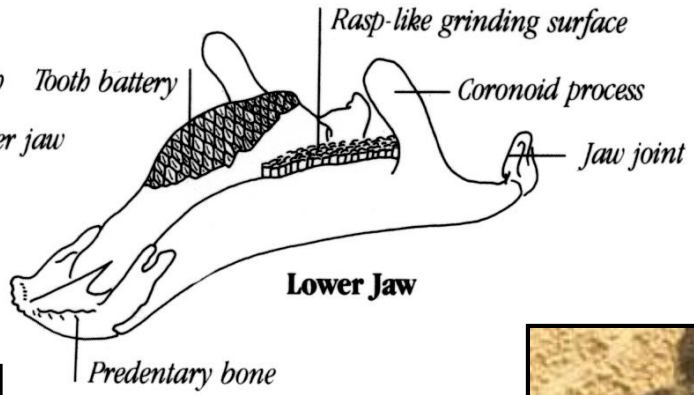


Hadrosauridae (Cretáceo sup.): paleobiologia

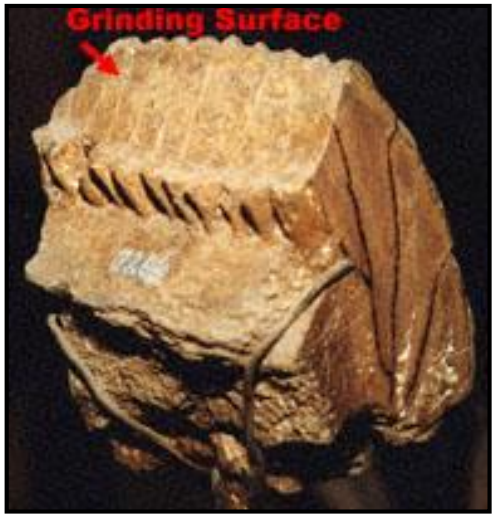
Significativas adaptações à herbivoria



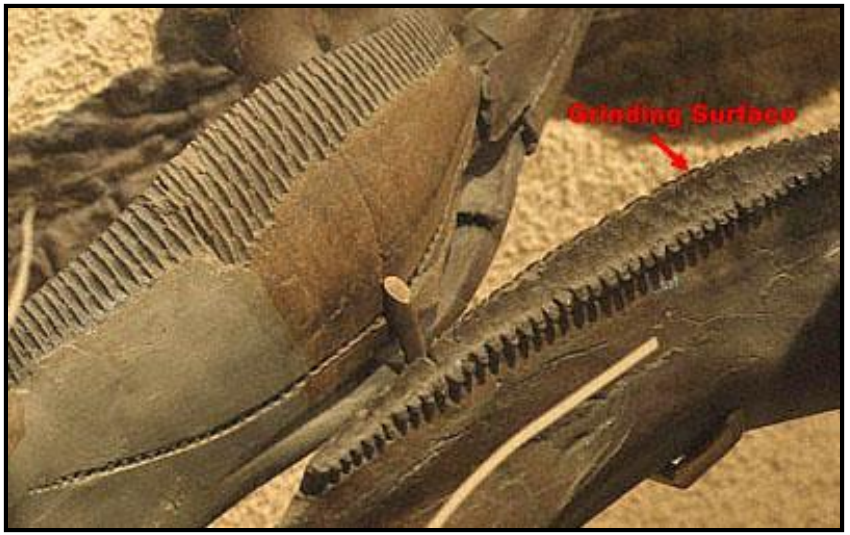




Articulação pleurocinética
Sem rotação da mandíbula
como nos mamíferos

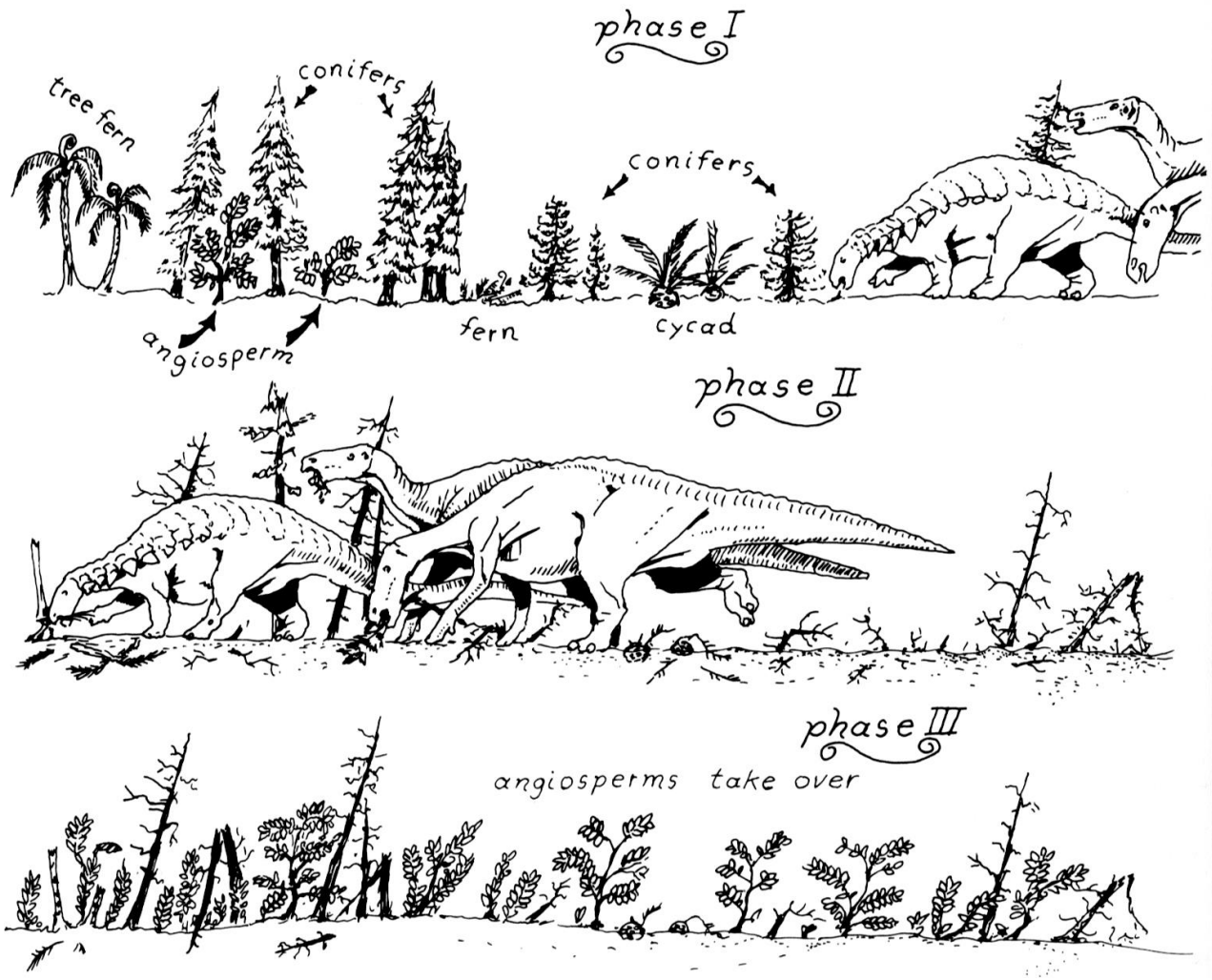


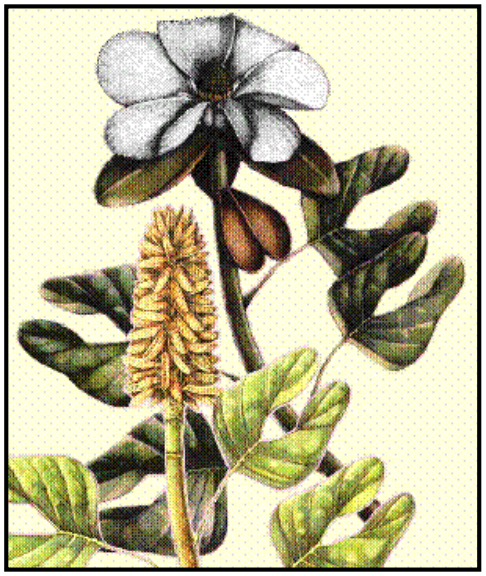
Baterias de dentes
e superfície
de maceração



Quando os dinossauros "inventaram" as flores

Interação ecológica com angiospermas?

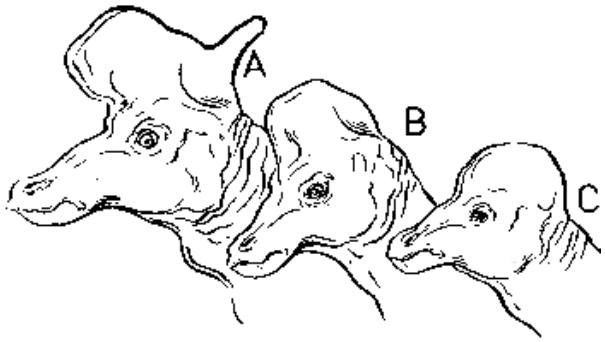




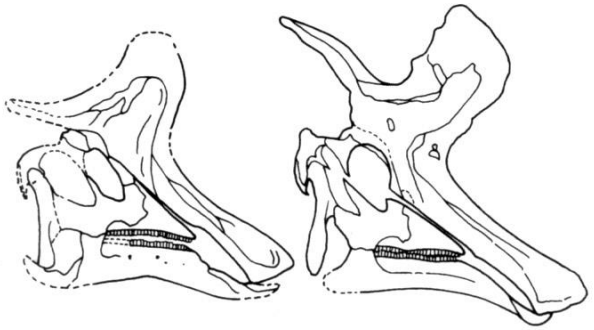
Lambeosaurinae (Cretáceo sup.)

Cristas ocas: *display* (diferentes em machos, fêmeas e juvenis)

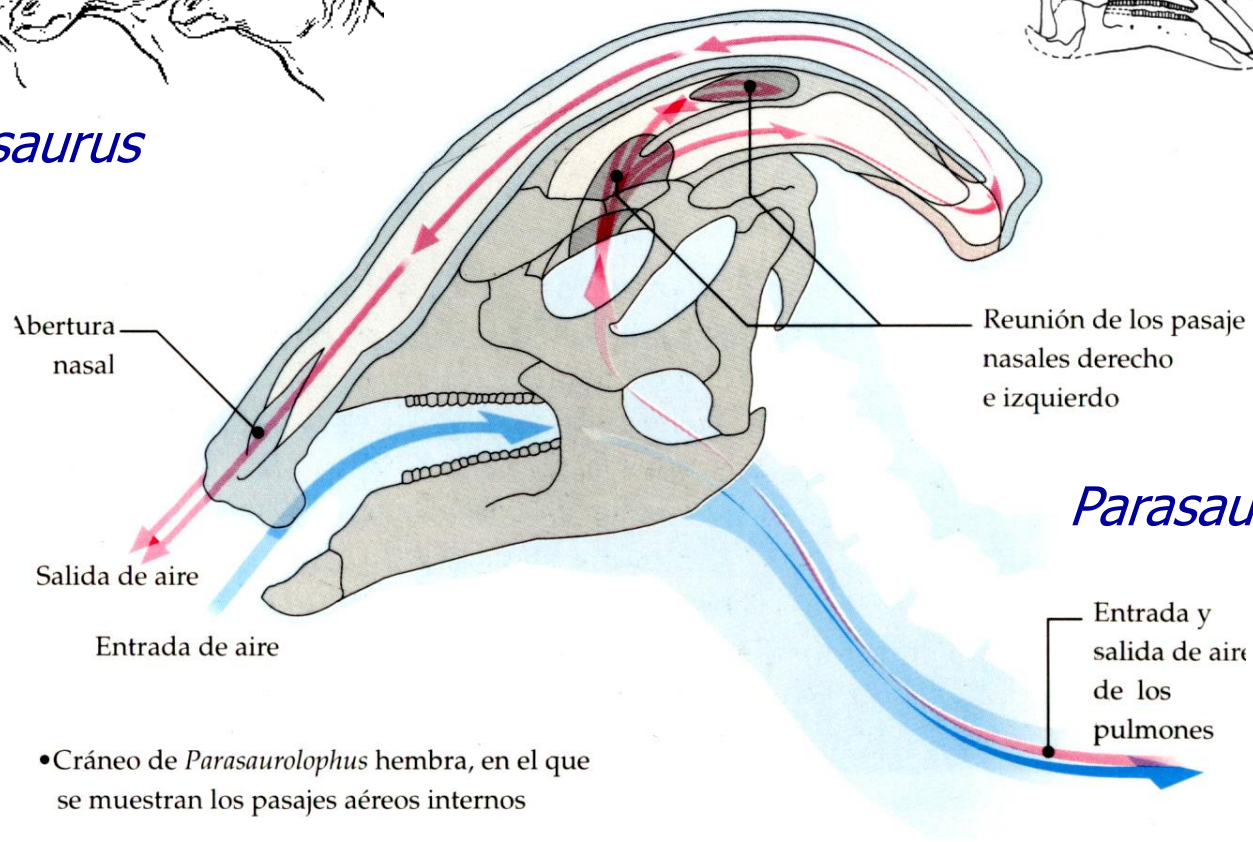
possivelmente sonoro (tubo ligado às narinas)



Lambeosaurus



Lambeosaurus

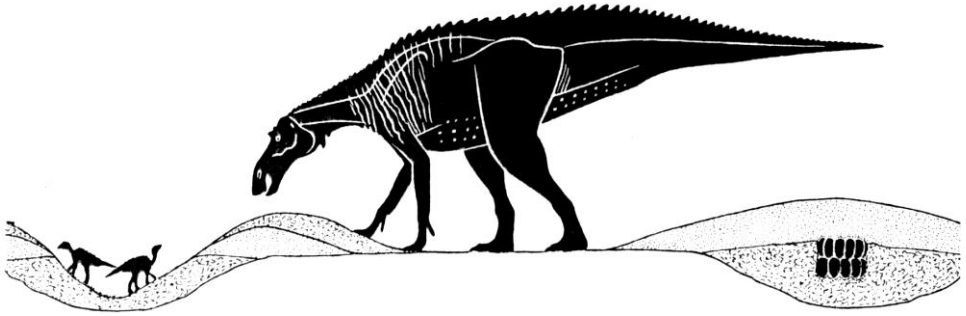


Parasaurolophus

•Cráneo de *Parasaurolophus* hembra, en el que se muestran los pasajes aéreos internos

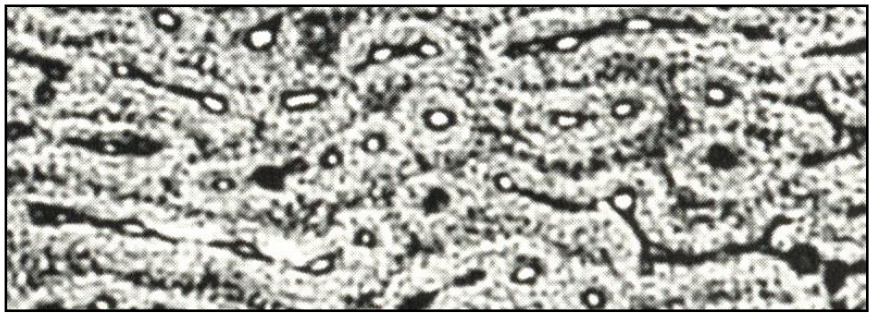
Hadrosaurinae (Cretáceo sup.)

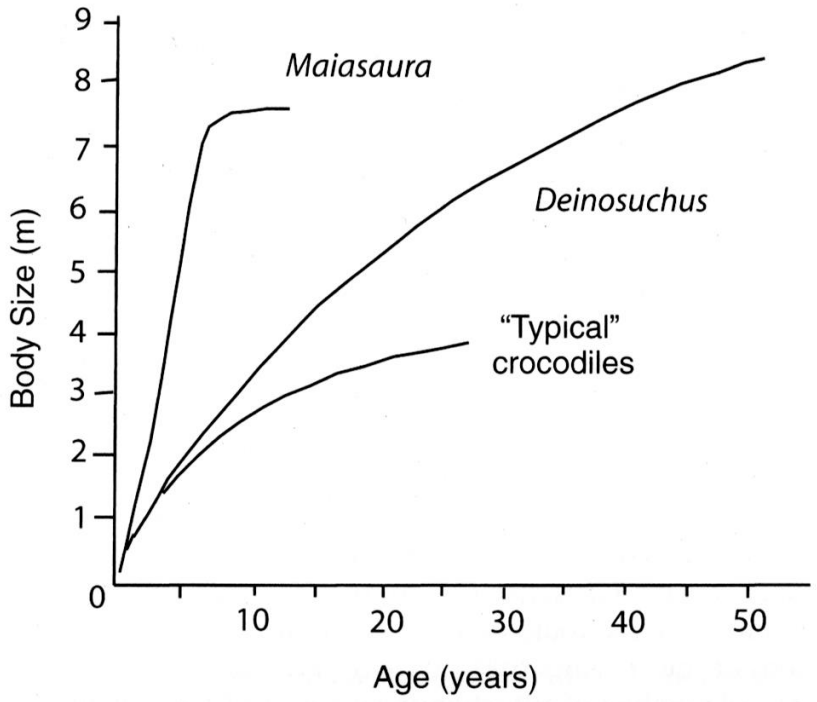
Maiasaura: Ninhos com ovipostura em massa, hábito gregário mas cuidado parental mínimo (grupo de juvenis com desgaste dentário)

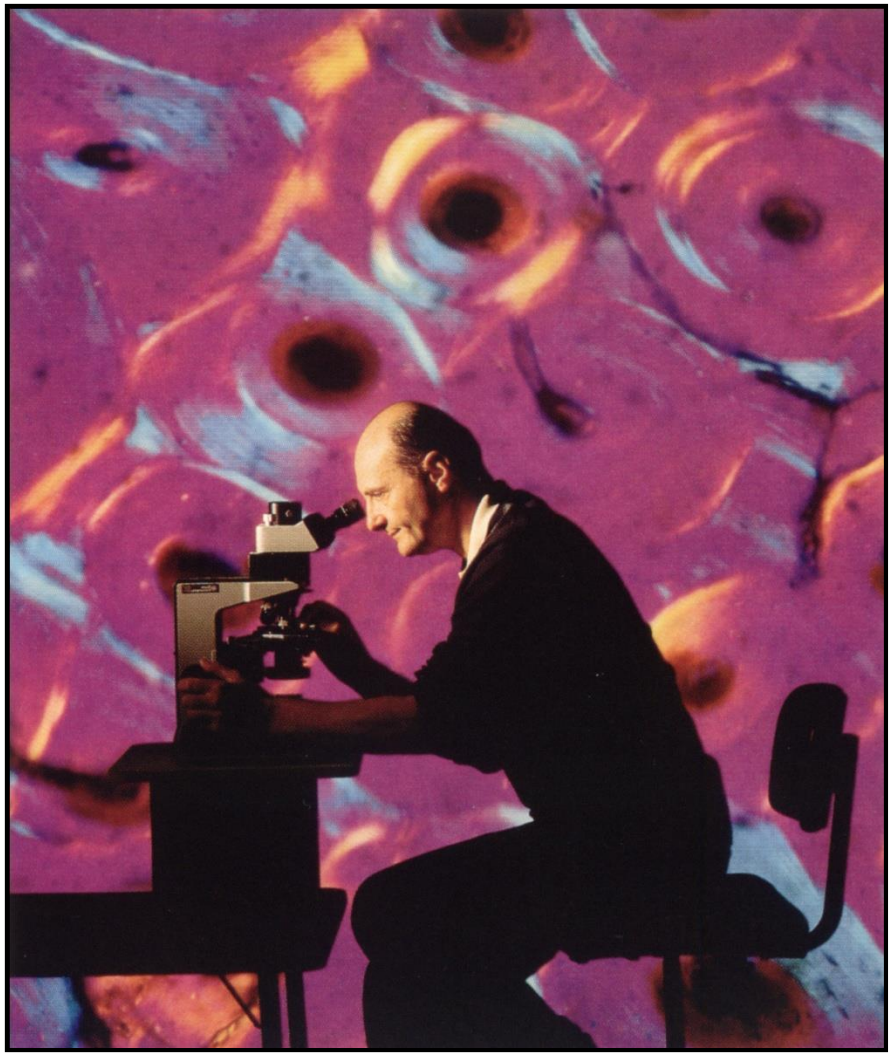


Hadrosaurinae (Cretáceo sup.)

Maiasaura: estudos paleohistológicos indicam presença de osso fibrolamelar (crescimento rápido)







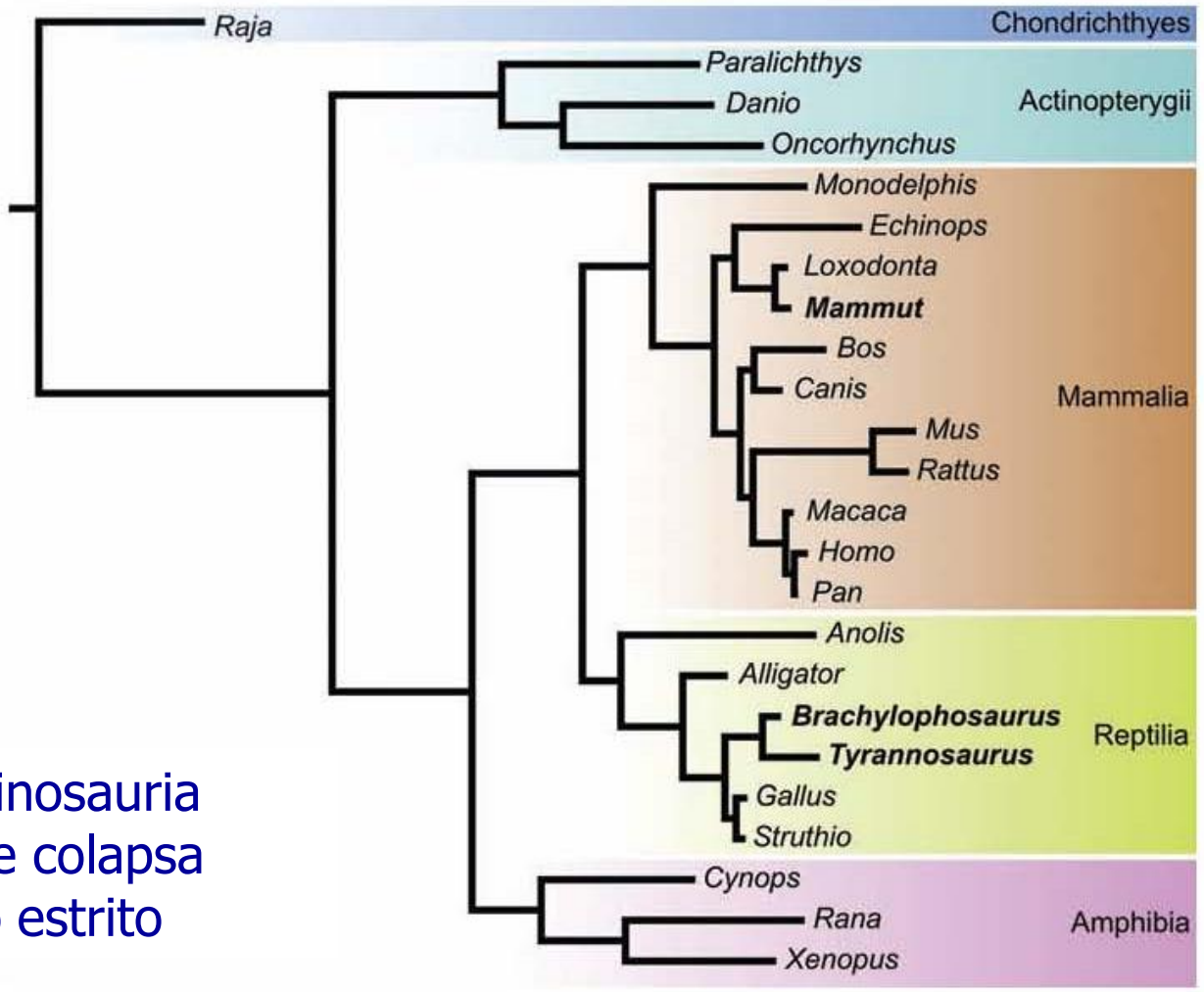
Hadrosaurinae (Cretáceo sup.)

Edmontosaurus e *Brachylophosaurus* – pele preservada em múmia fossilizada

Pavimentos de pequenas placas poligonais interconectadas

Hadrosaurinae (Cretáceo sup.)

Brachylophosaurus – sequenciamento de possível colágeno preservado

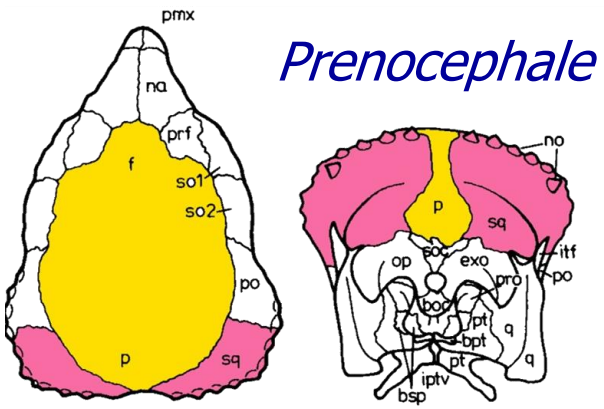


Monofilia de Dinosauria *sensu stricto* se colapsa em consenso estrito

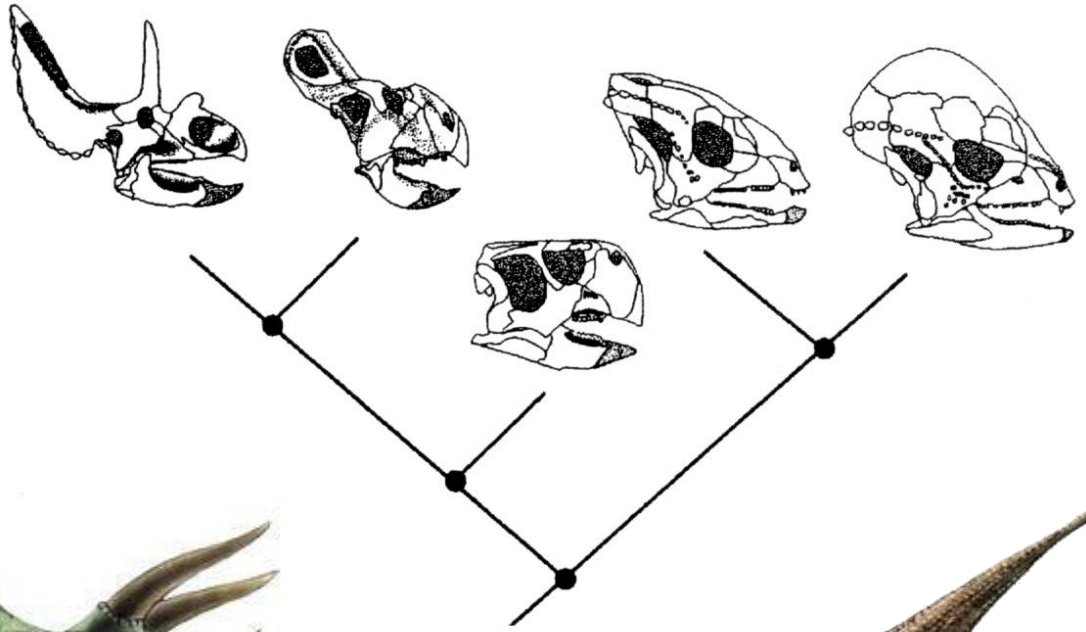
Marginocephalia (Cretáceo inf. – sup.)

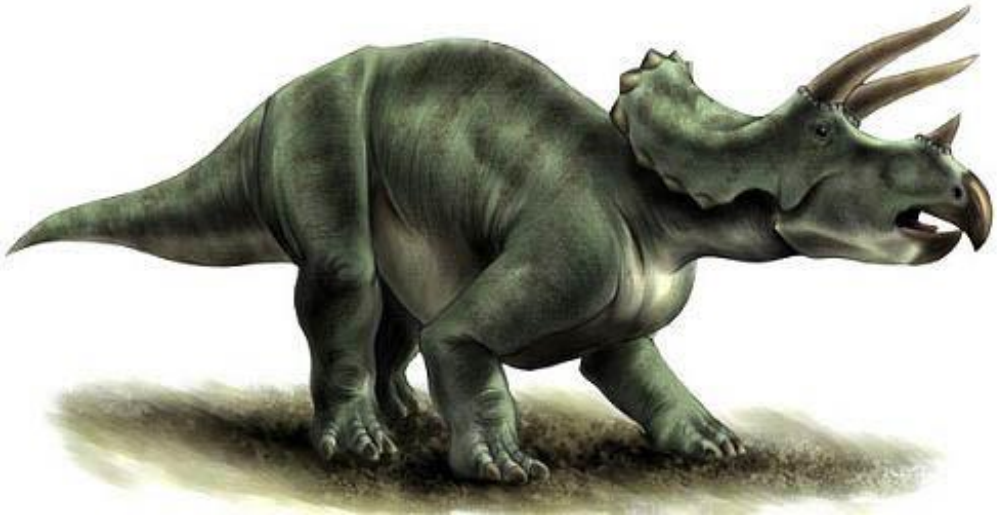
Dois grandes grupos: Ceratopsia e Pachycephalosauria

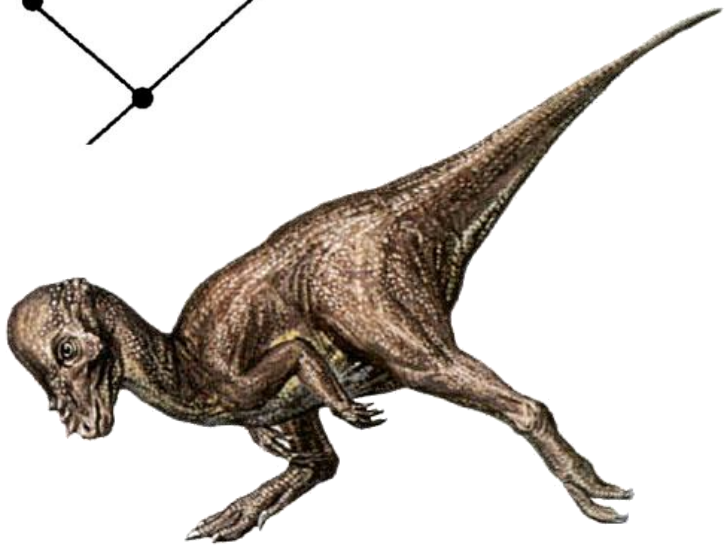
"Aba" formada por parietal e esquamosal na parte caudal do crânio



Prenocephale







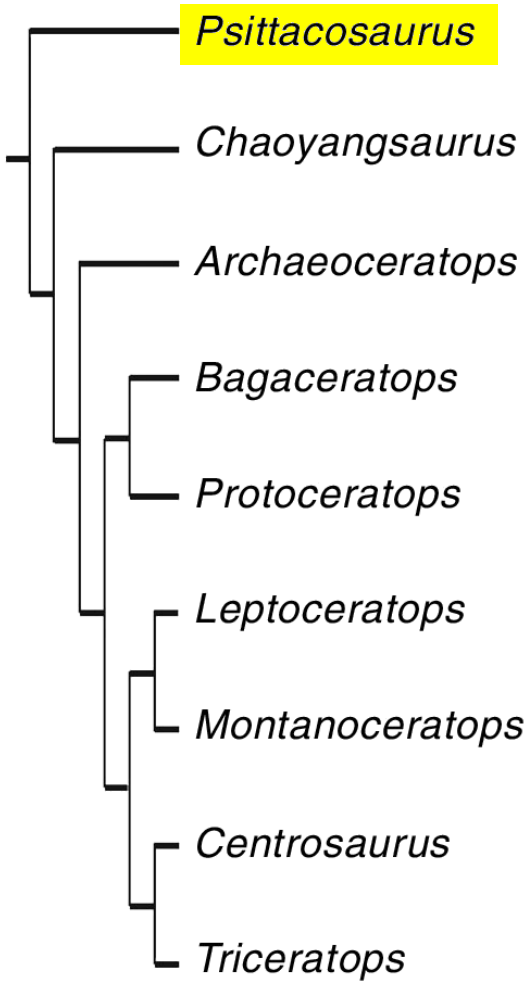
Marginocephalia (Cretáceo inf. – sup.)

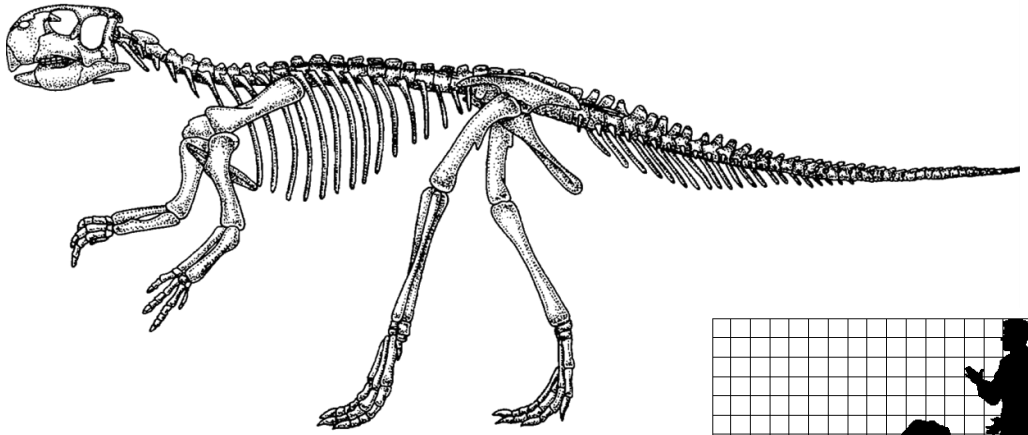
Pachycephalosaurus (Maastrichtiano, USA)

crânio 62 cm de altura
e 22 cm de espessura

Ceratopsia (Jurássico sup. - Cretáceo inf.)

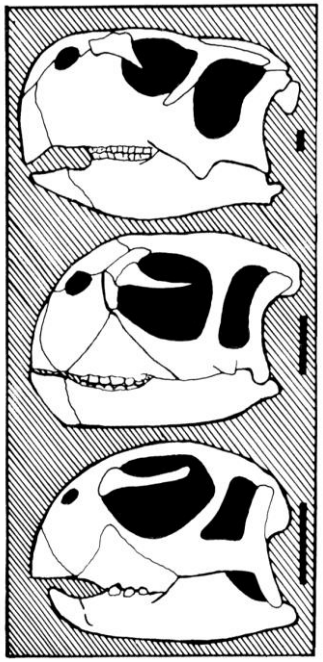
Bico córneo bem desenvolvido

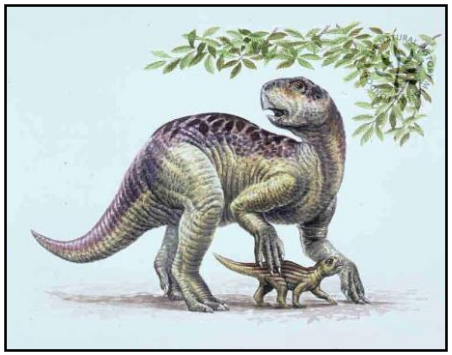




Ceratopsia (Jurássico sup. - Cretáceo inf.)

Psittacosaurus – Cretáceo inf. (China, Rússia e Mongólia)

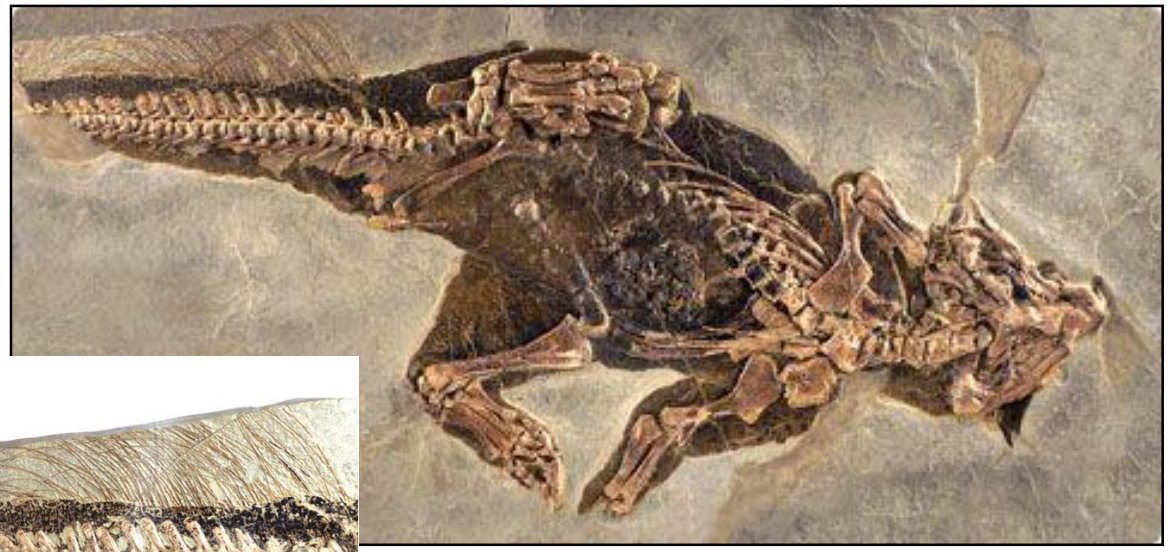


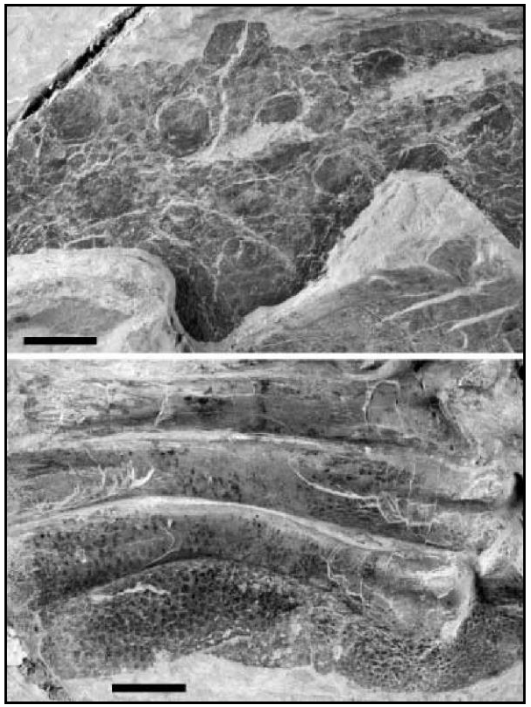


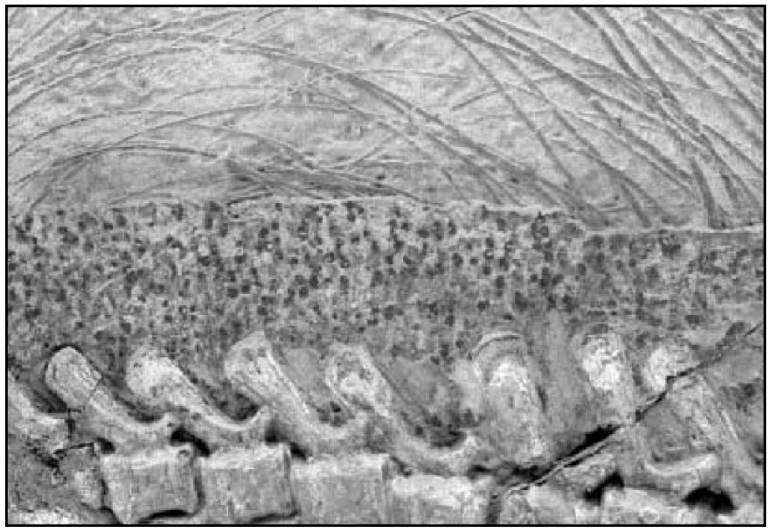
Série ontogenética e cuidado parental

Ceratopsia (Jurássico sup. - Cretáceo inf.)

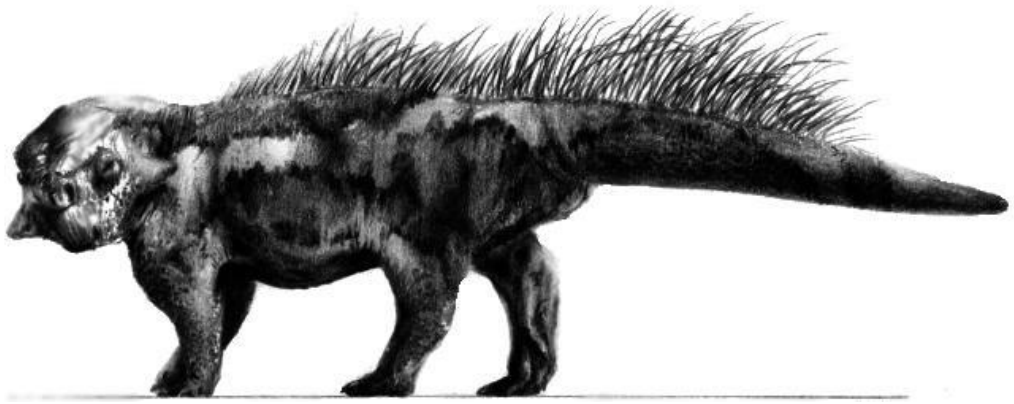
Psittacosaurus – Cretáceo inf. (China, Rússia e Mongólia)





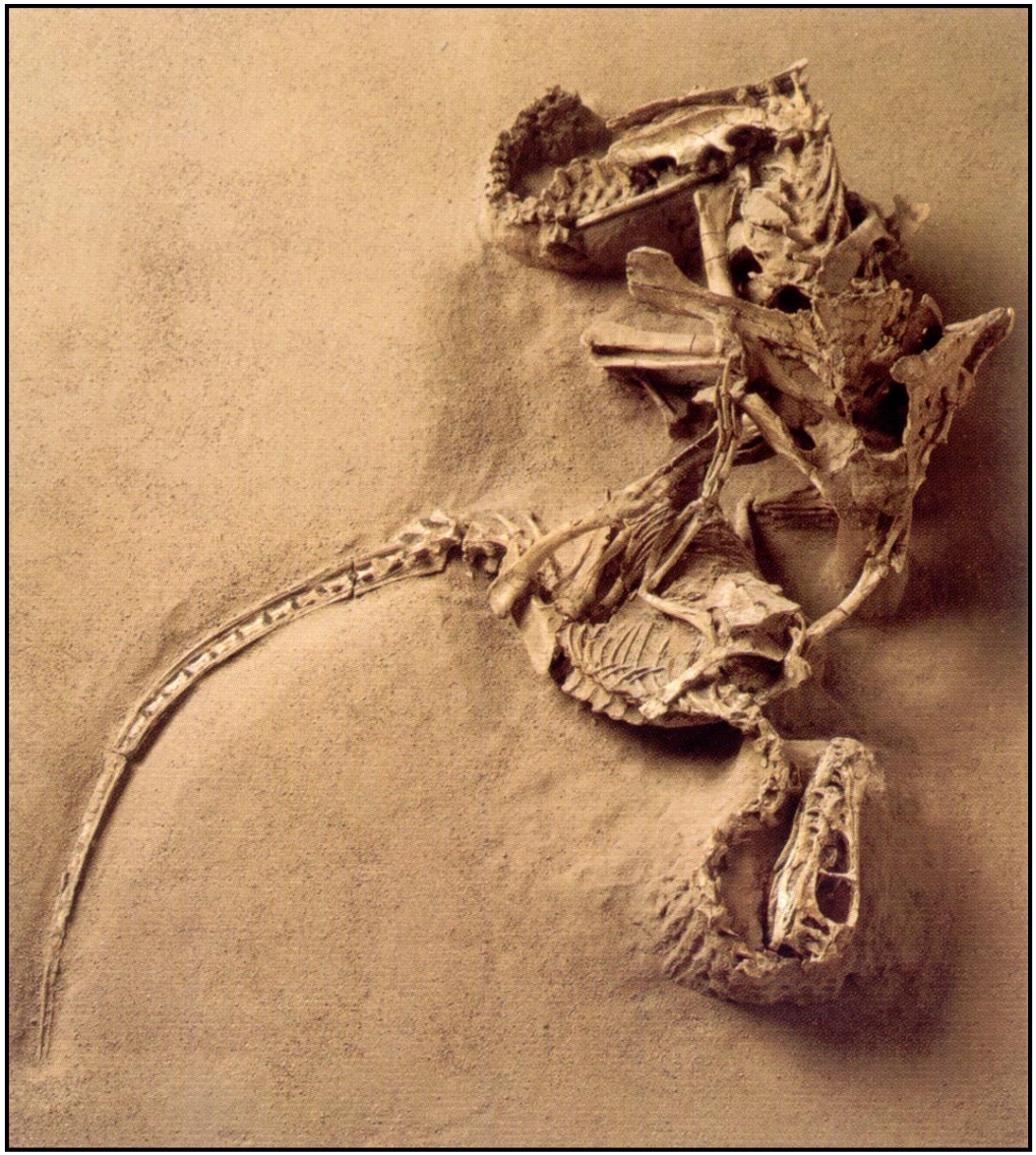


Estruturas córneas filamentosas



Ceratopsia (Jurássico sup. - Cretáceo inf.)

Protoceratops, Cretáceo sup. (China e Mongólia)



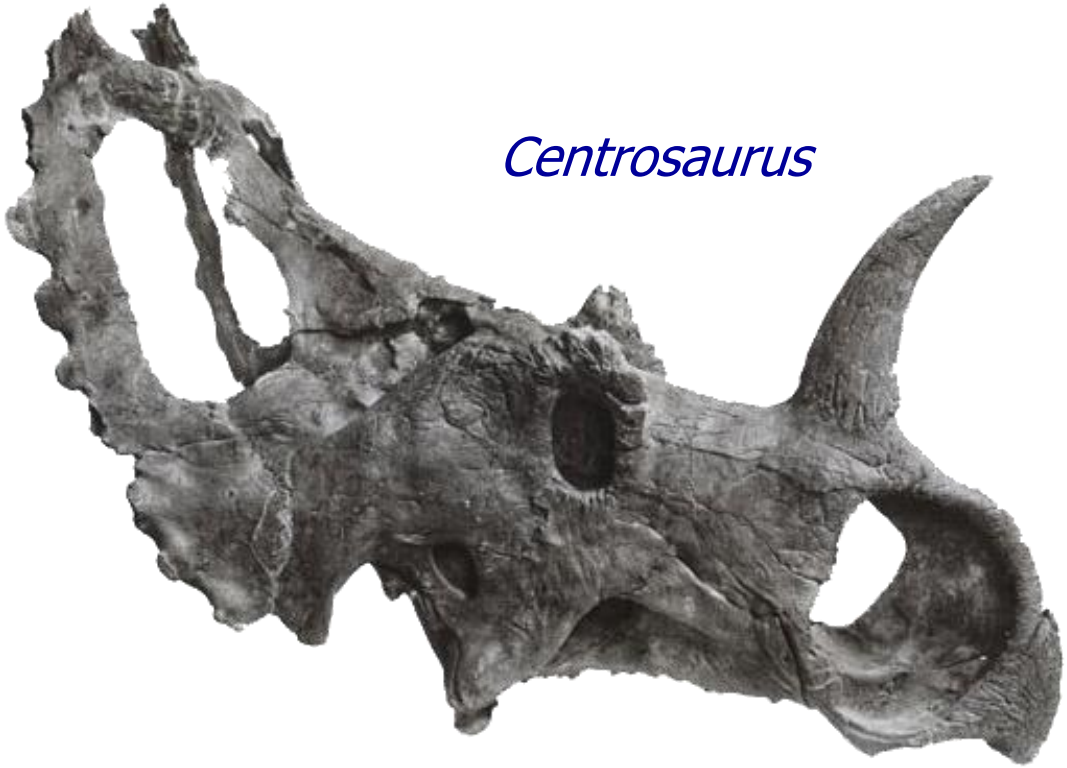
Protoceratops e *Velociraptor*
Fm. Djadochta, Mongólia

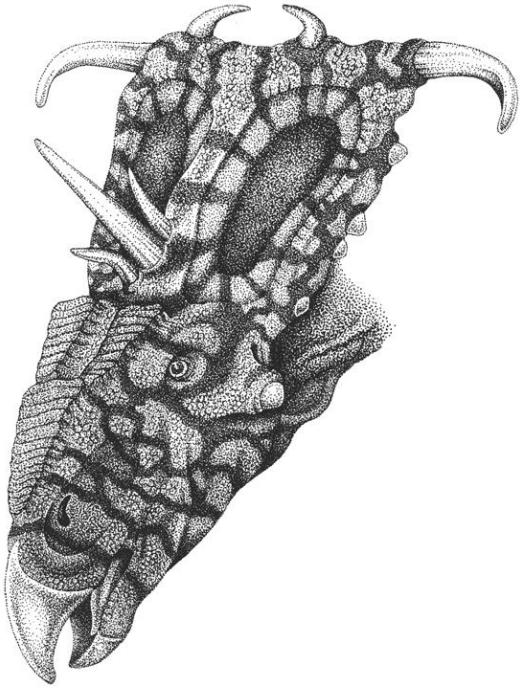
Centrosaurinae (Cretécao sup., América do Norte)

Achelosaurus

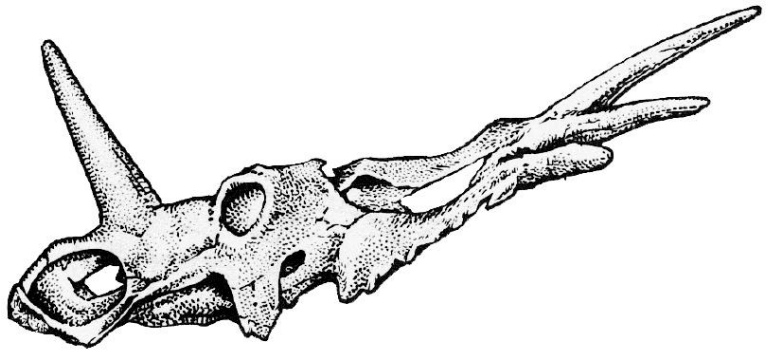
Pachyrhinosaurus

Centrosaurus





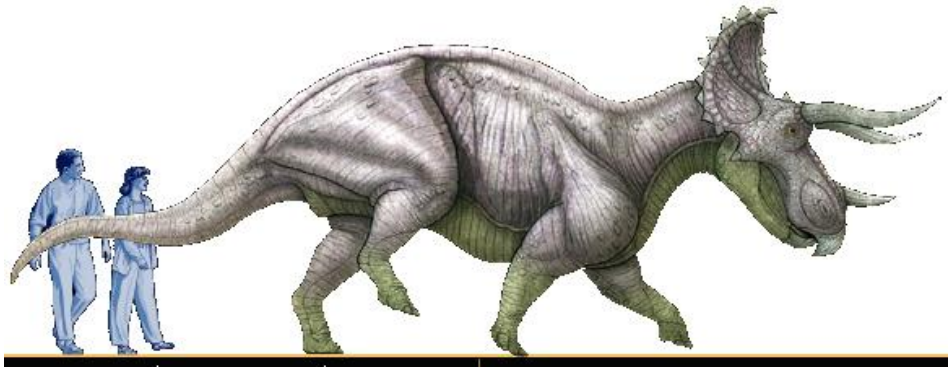
Centrosaurinae (Cretécao sup., América do Norte)

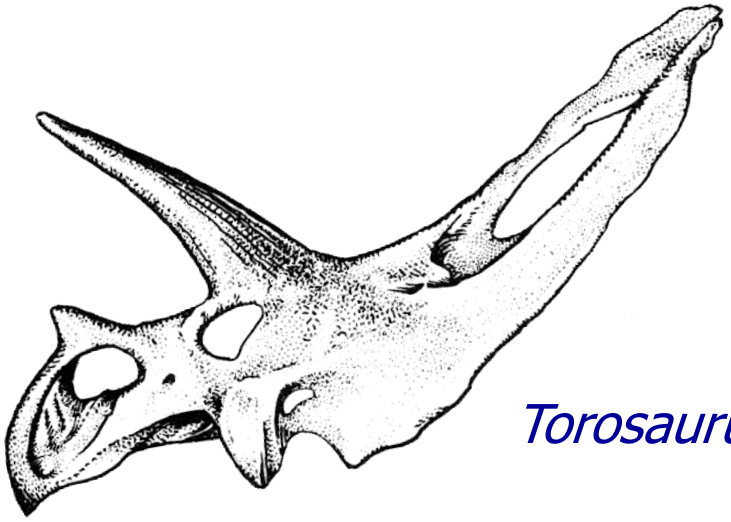


Styracosaurus

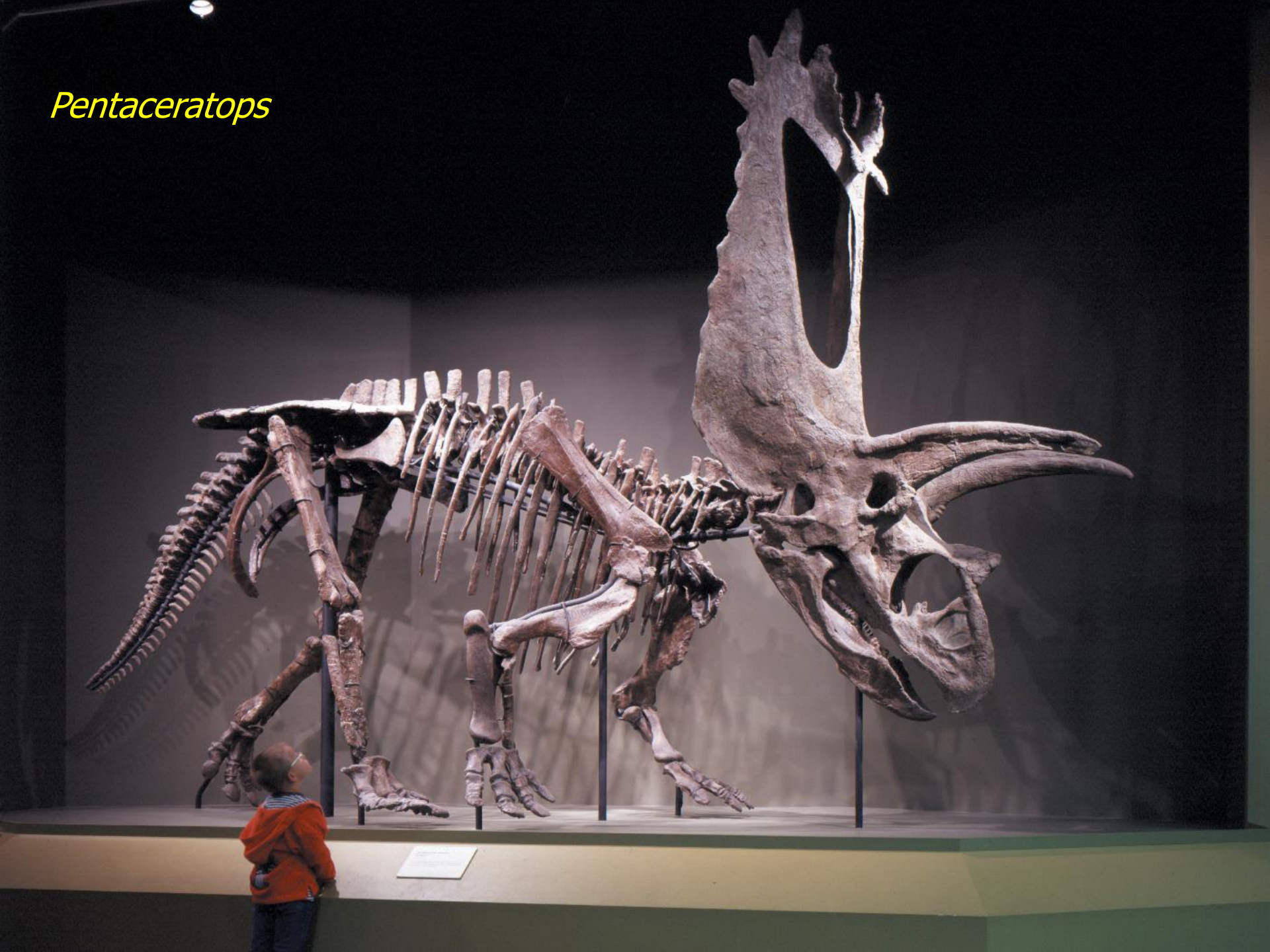
Chasmosaurinae (Cretécao sup., América do Norte)

Triceratops



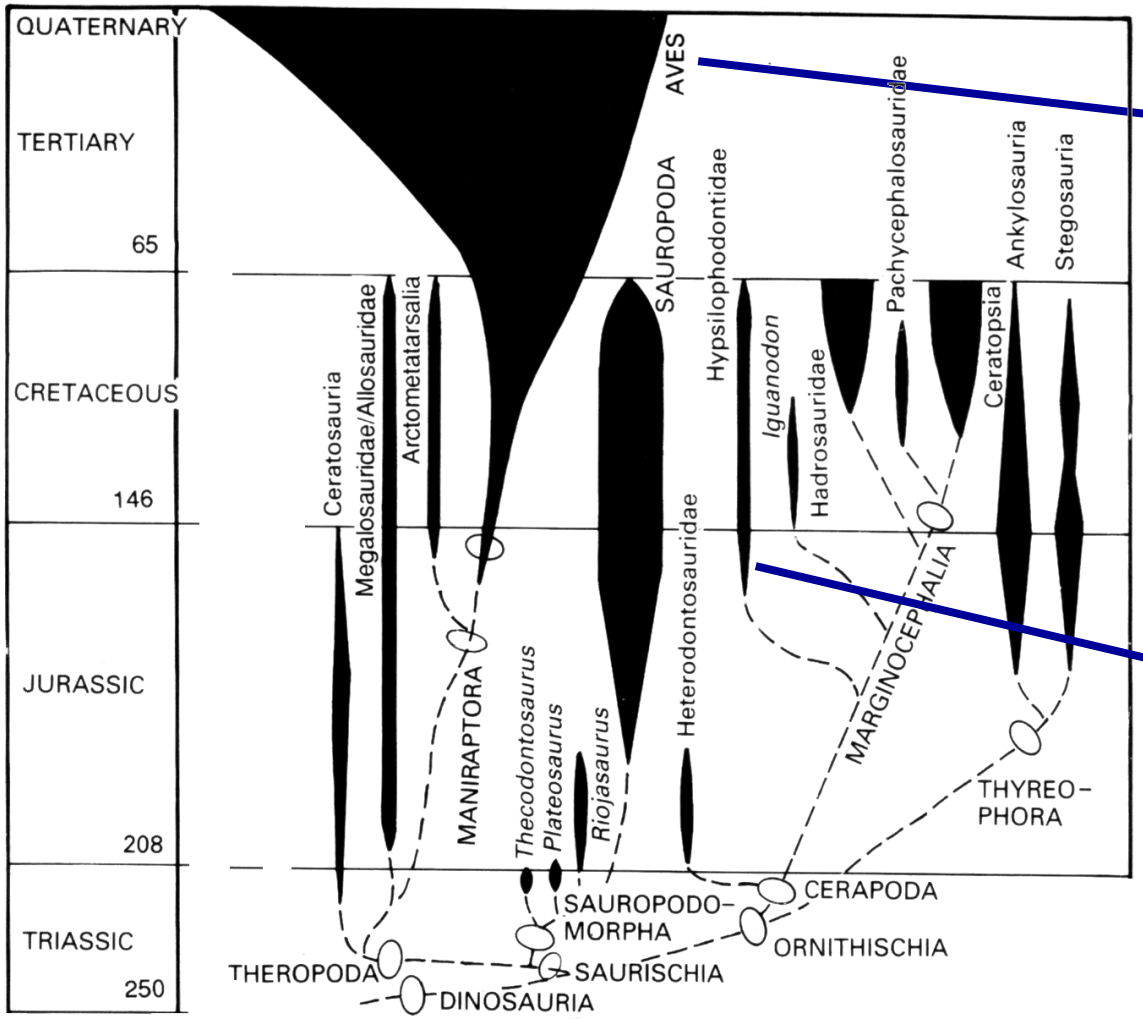


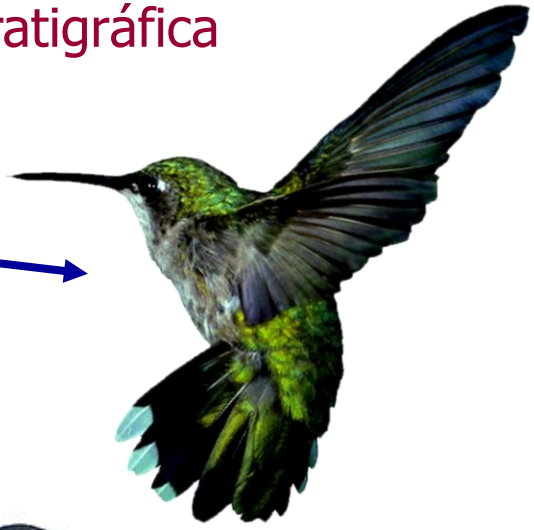
Torosaurus

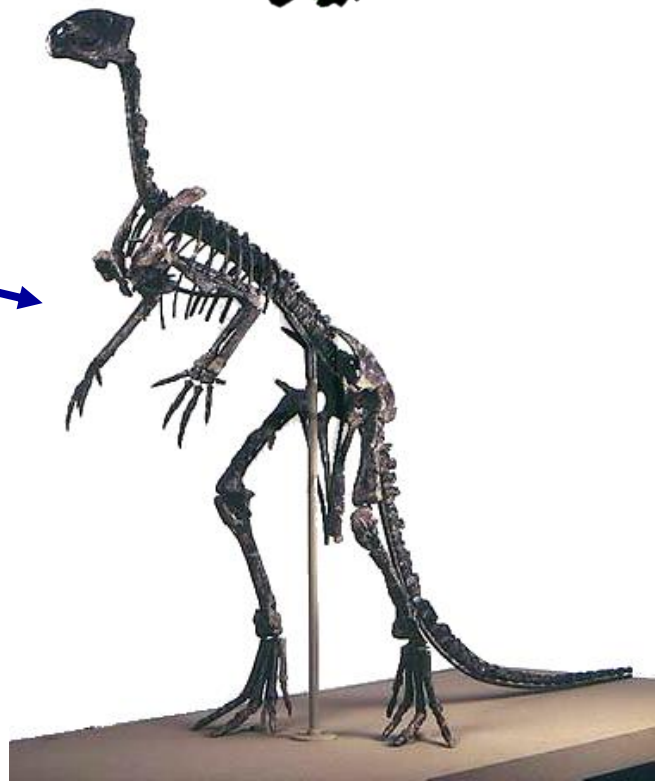

Pentaceratops

Saurischia e Ornithischia *sensu* Seeley 1887

Saurischia e Ornithischia: distribuição estratigráfica

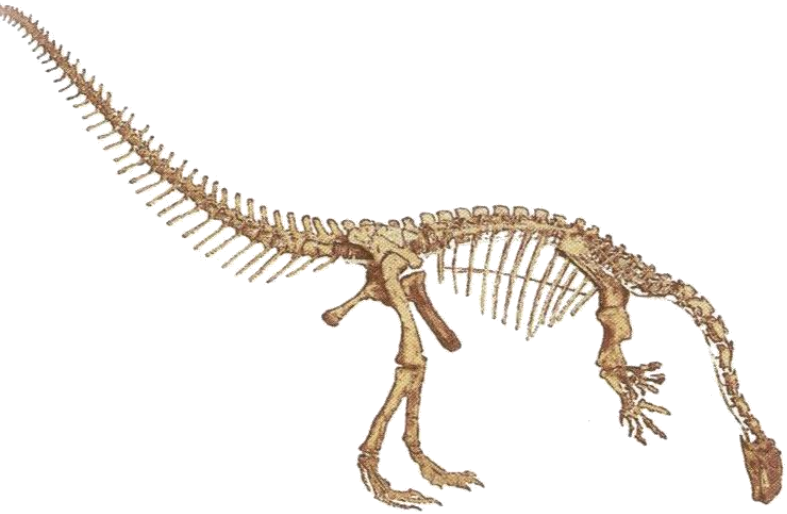




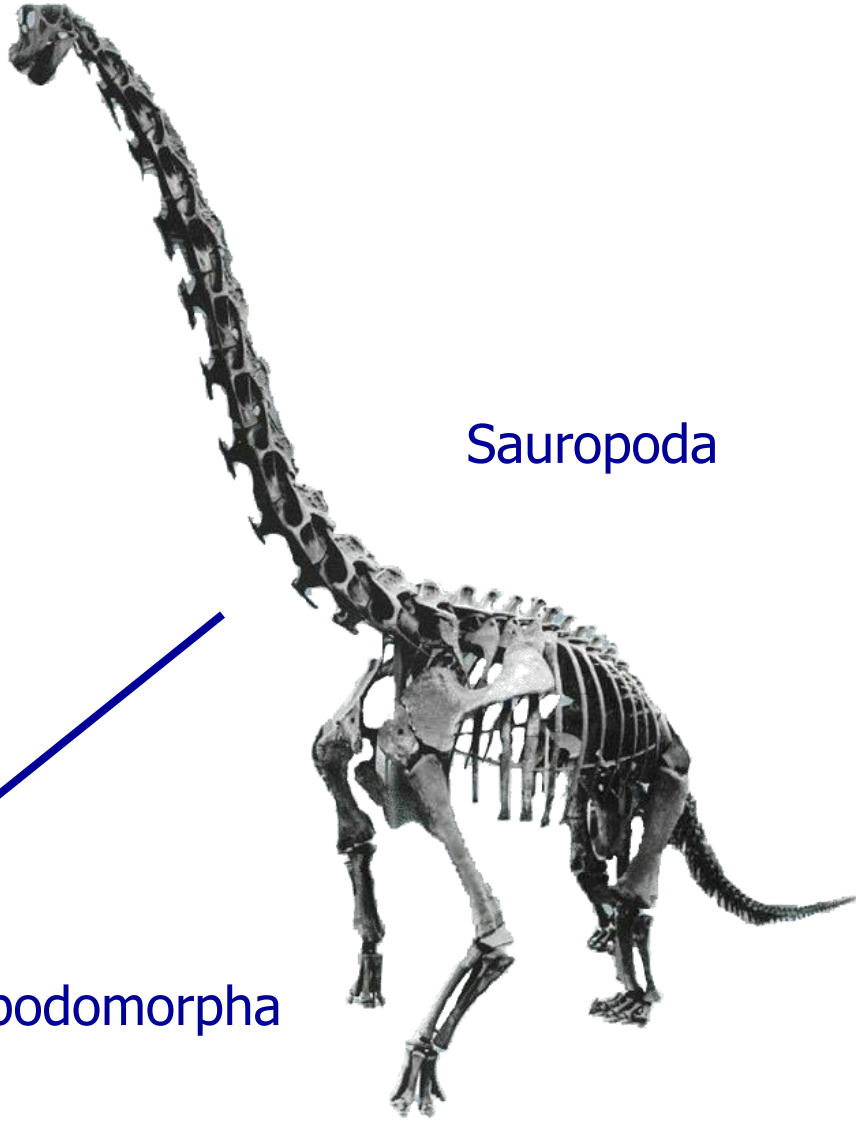


Sauropodomorpha (Triássico sup. – Cretáceo sup.)

Dois grandes grupos "Prosauropoda" e Sauropoda



"Prosauropoda"



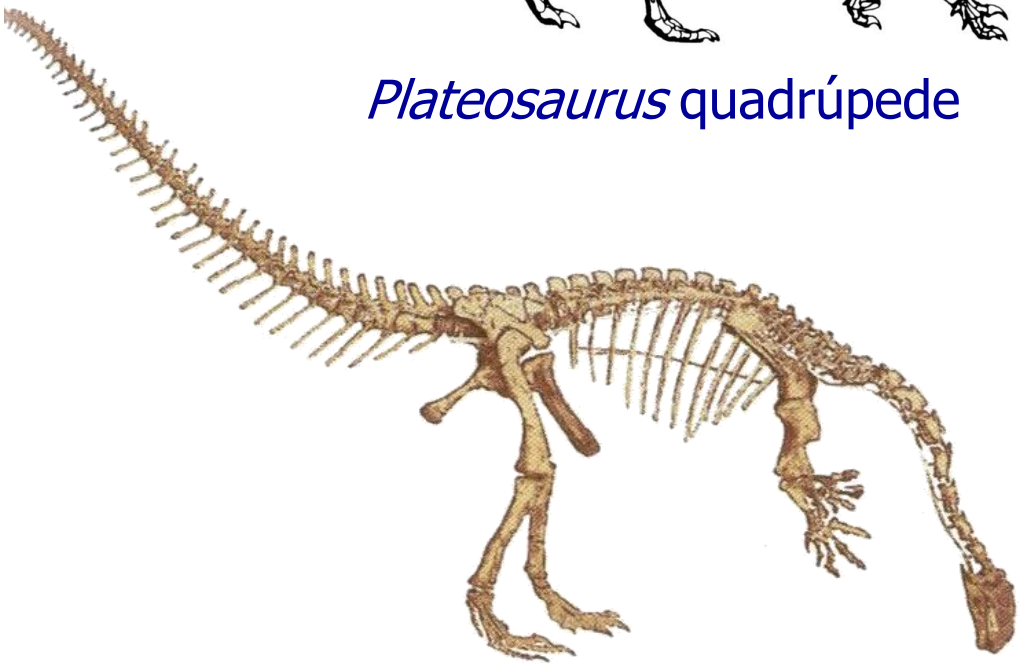
Sauropoda

Sauropodomorpha

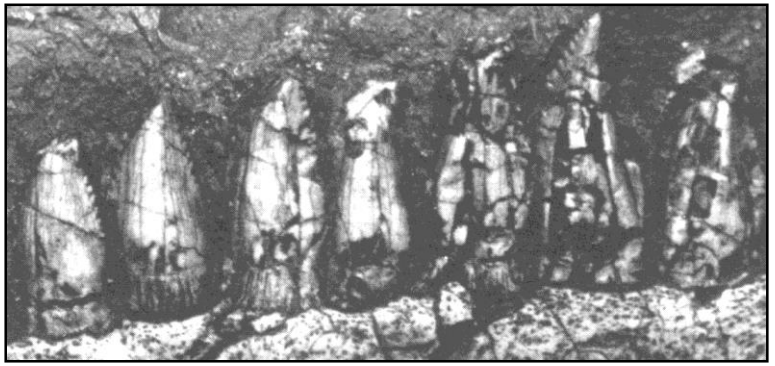
"Prosauropoda" (Triássico sup. – Jurássico inf.): paleobiologia

Bípedes facultativos e possivelmente herbívoros

Plateosaurus quadrúpede



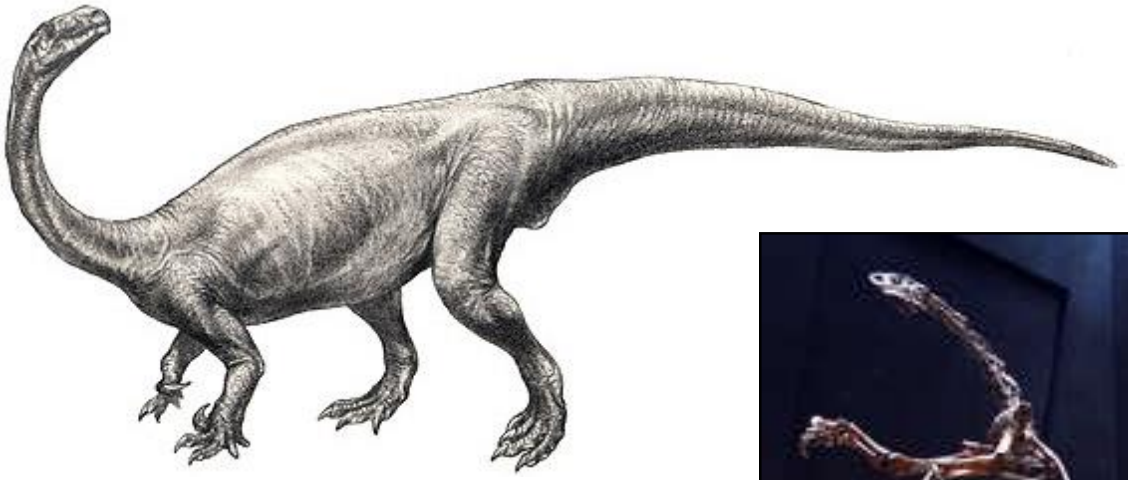
Plateosaurus bípede



"Prosauropoda" (Triássico sup. – Jurássico inf.): formas "típicas"

Plateosaurus: prossaurópodo arquétipo

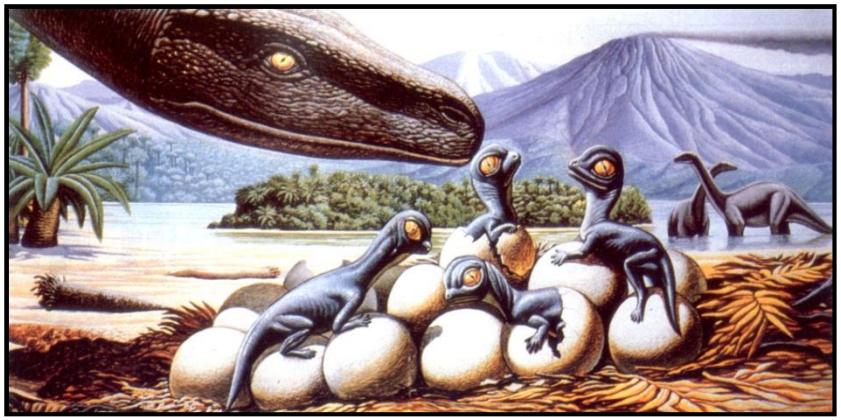
Triássico sup. da Europa (Alemanha, França e Suiça) e Groenlândia



"Prosauropoda" (Triássico sup. – Jurássico inf.): formas "típicas"

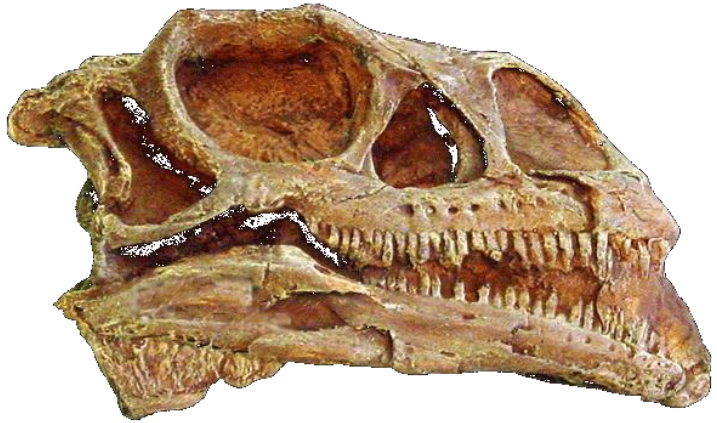
Mussaurus patagonicus (Fm. El Tranquilo, Jurássic inf. de Santa Cruz)

Grupo de juvenis
recém saídos do ovo

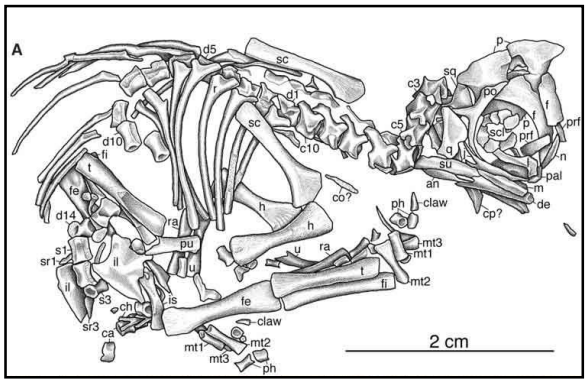


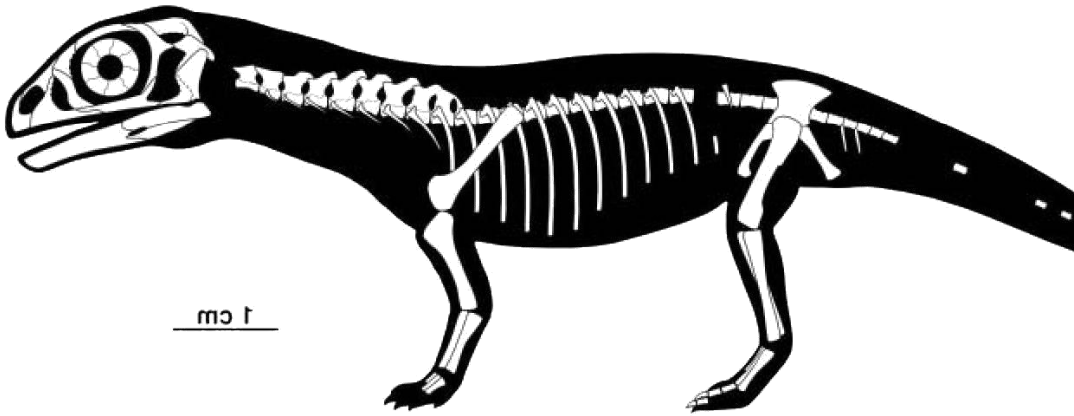
"Prosauropoda" (Triássico sup. – Jurássico inf.): formas "típicas"

Massospondylus carinatus - Fm. Elliot (Jurássic inf. da África do Sul)



Embriões *in ovo* sem dentes (cuidado parental)

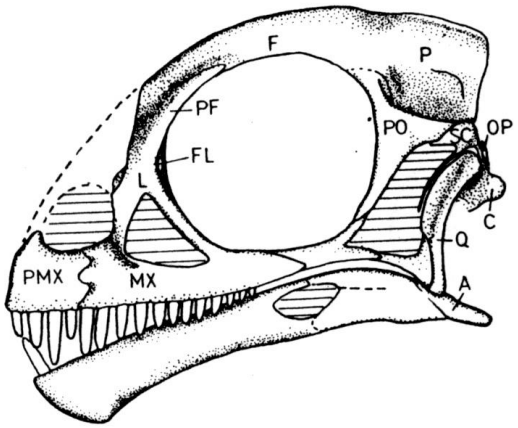




"Prosauropoda" (Triássico sup. – Jurássico inf.):

Origem pedomórfica dos Sauropoda

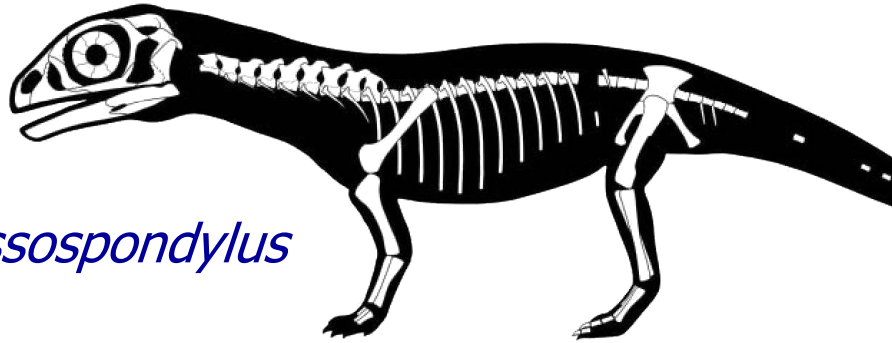
Infantis quadrúpedes (como saurópodos) e de rostro curto



Mussaurus

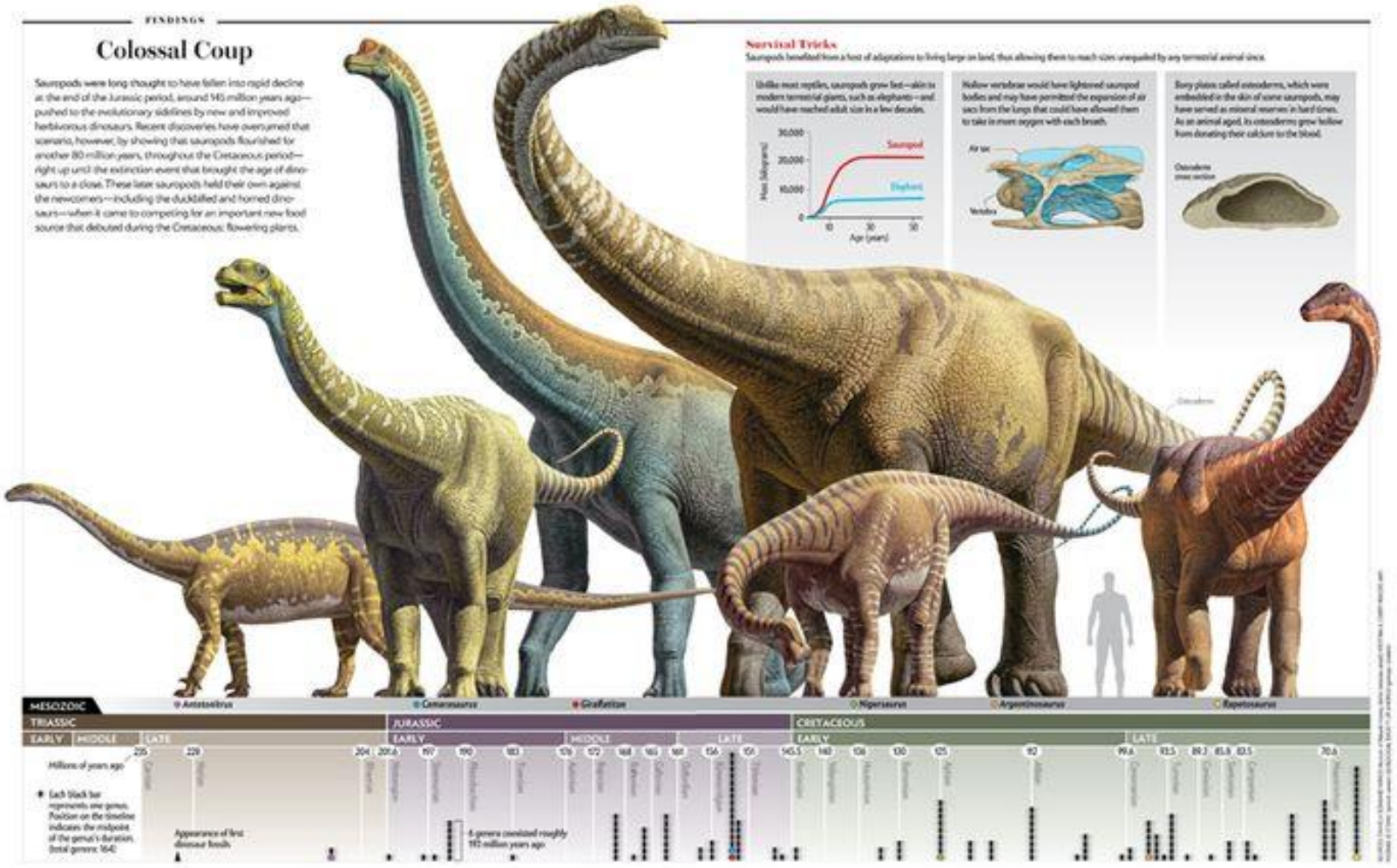
Camarasaurus

Massospondylus



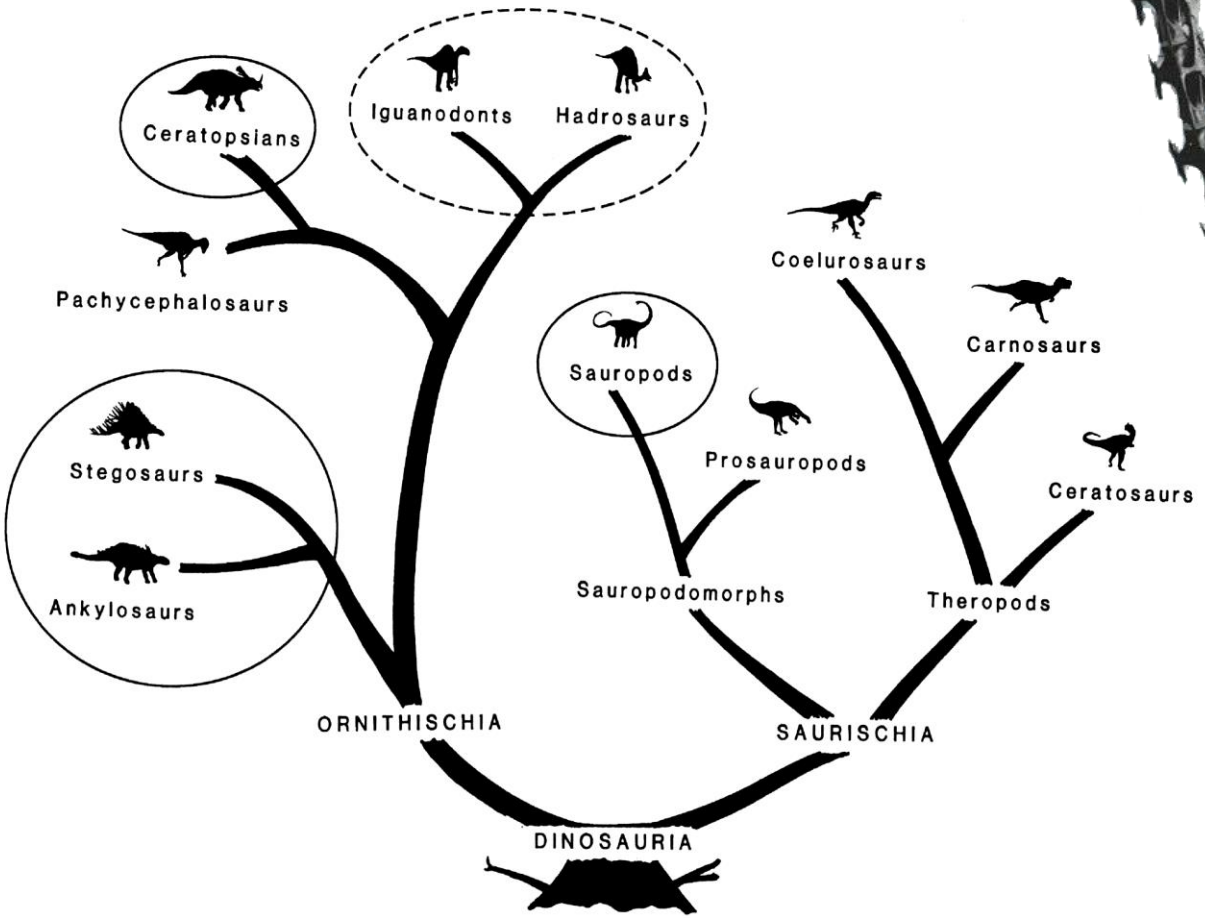
"Prosauropoda" (Triássico sup. – Jurássico inf.):

Melanorosauridae: *Antetonitrus* (Upper Elliot)



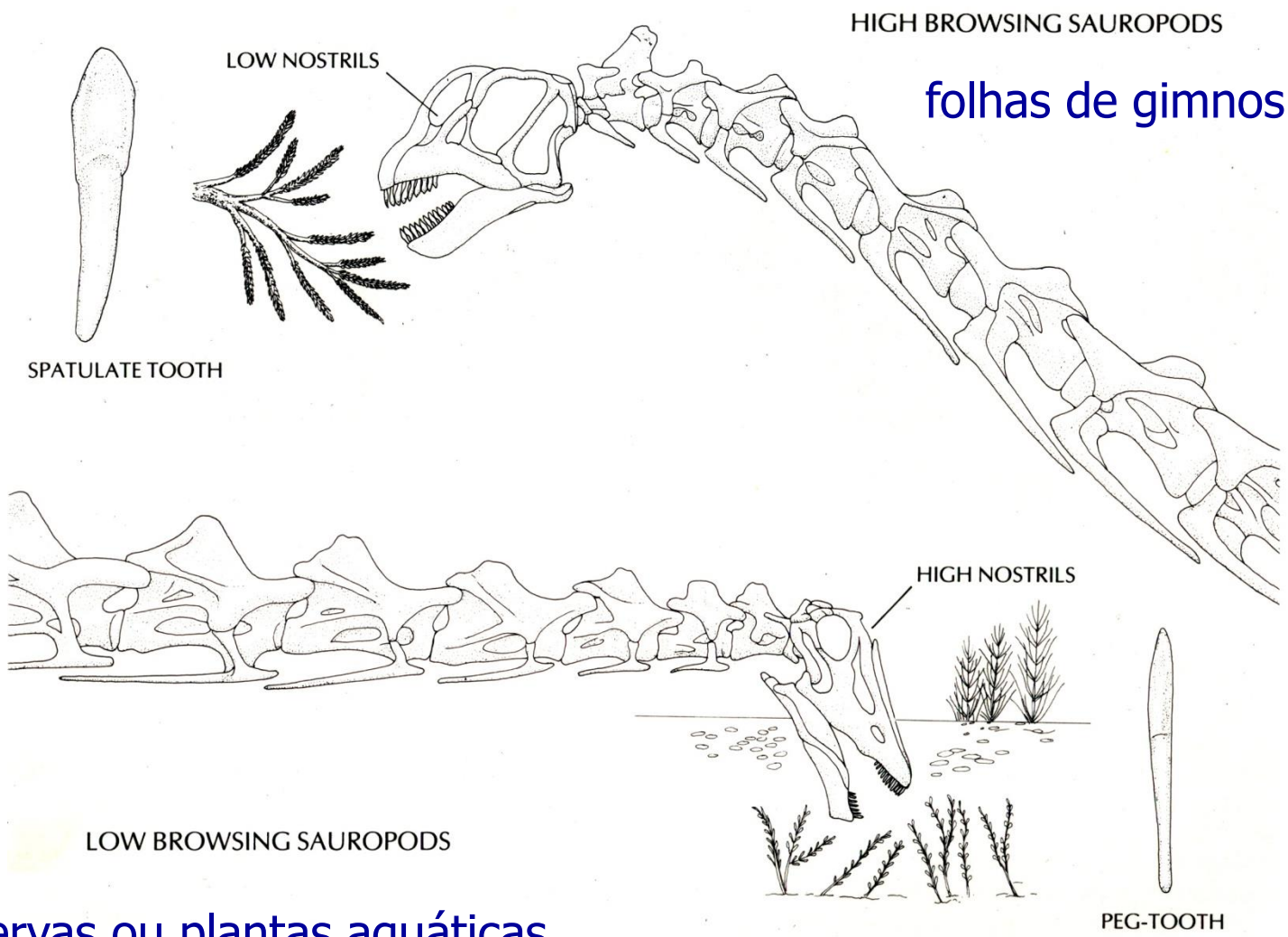
Sauropoda (Jurássico inf. – Cretáceo sup.): paleobiologia

Quadrúpedes, herbívoros e grande maioria de grande porte



Sauropoda (Jurássico inf. – Cretáceo sup.): paleobiologia

Dieta diferenciada: mais ou menos abraziva

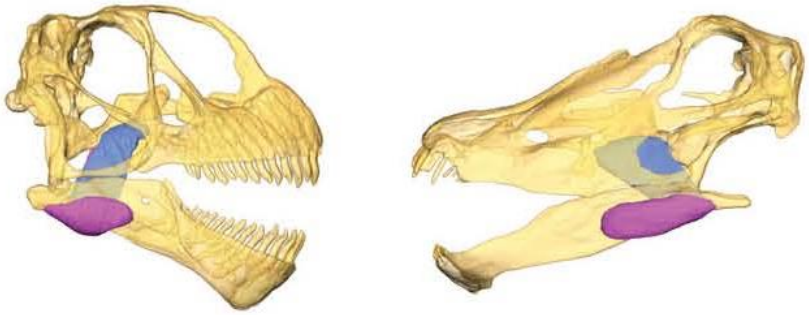


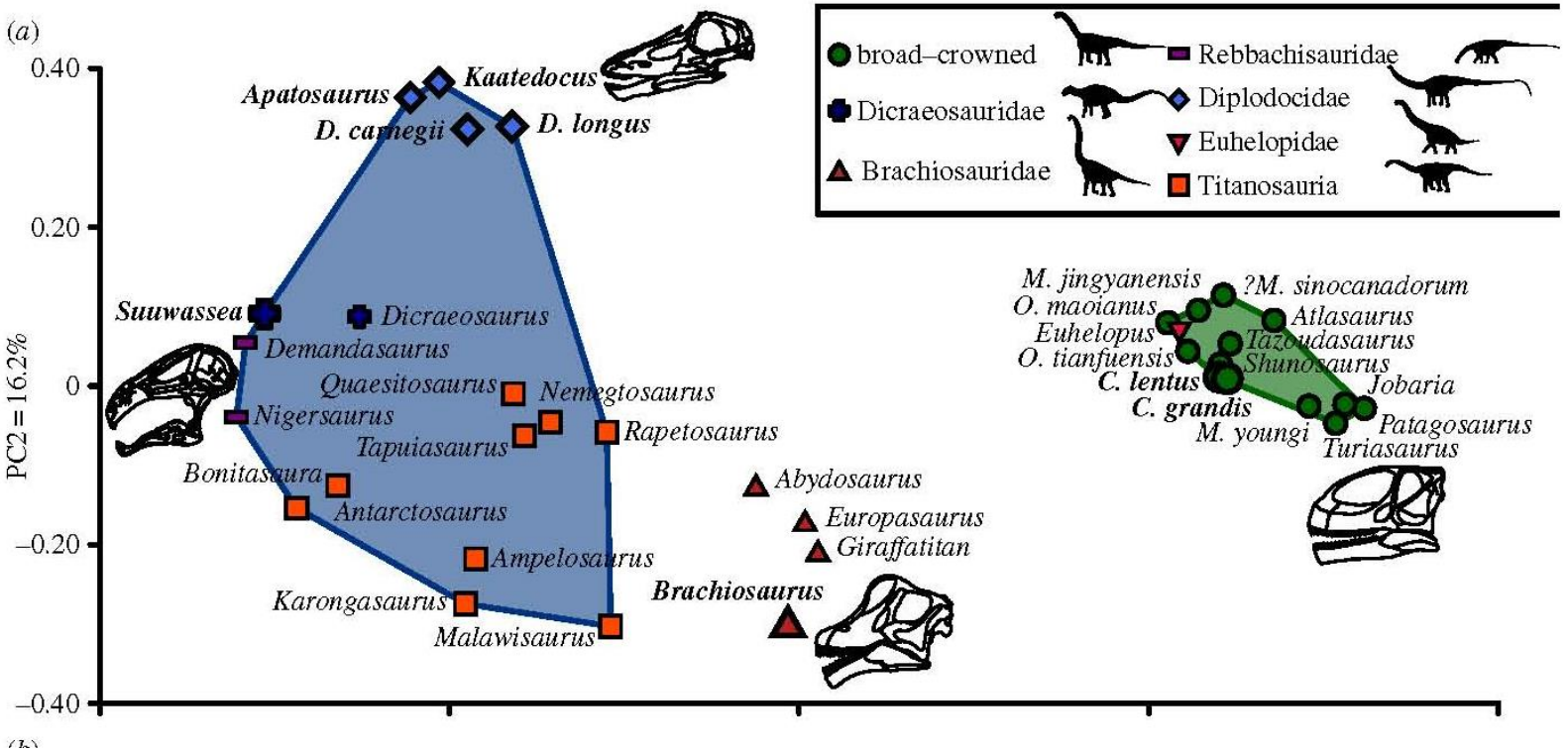
folhas de gimnospermas

ervas ou plantas aquáticas

Sauropoda (Jurássico inf. – Cretáceo sup.): paleobiologia

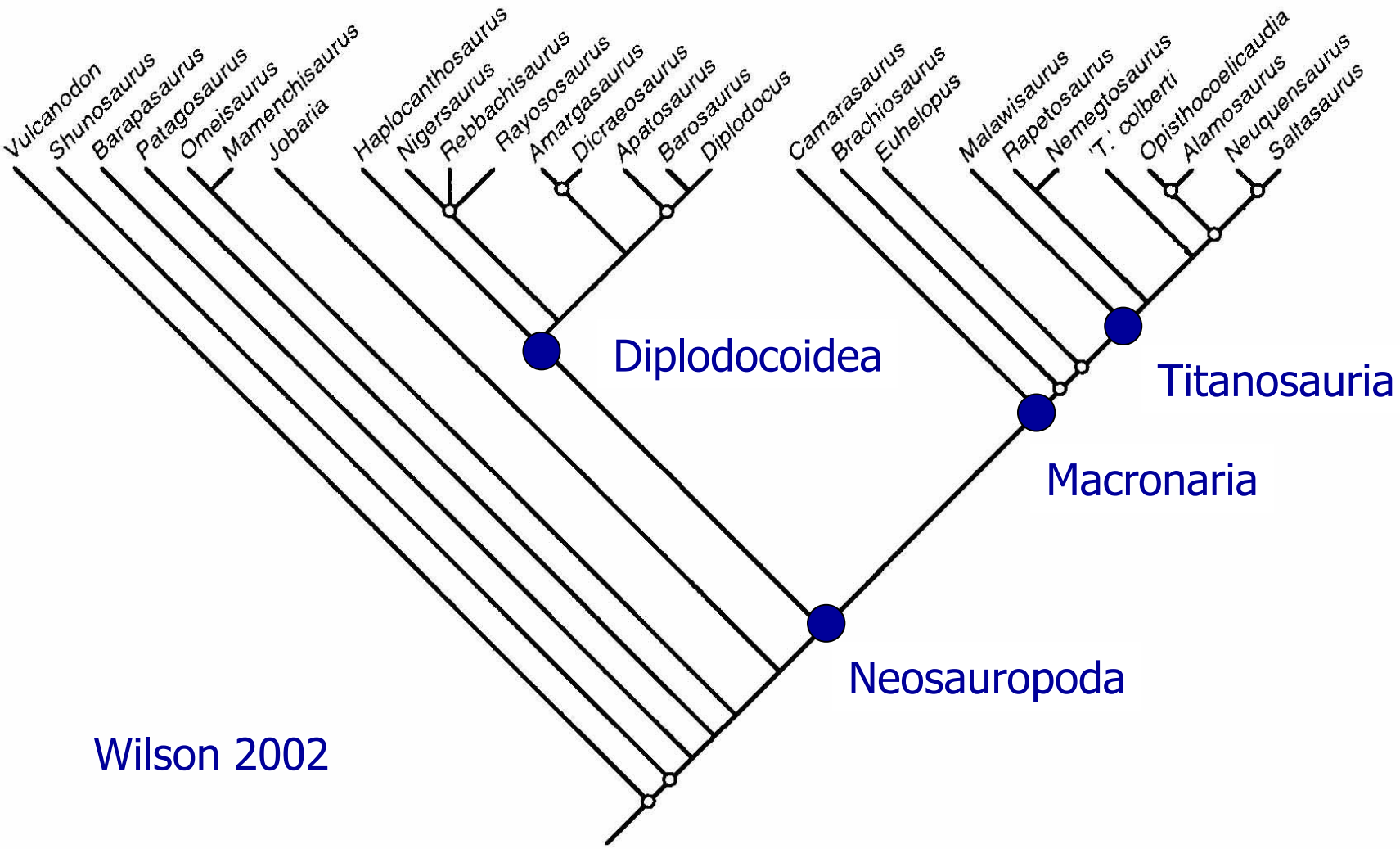
Dieta diferenciada: mais ou menos abraziva





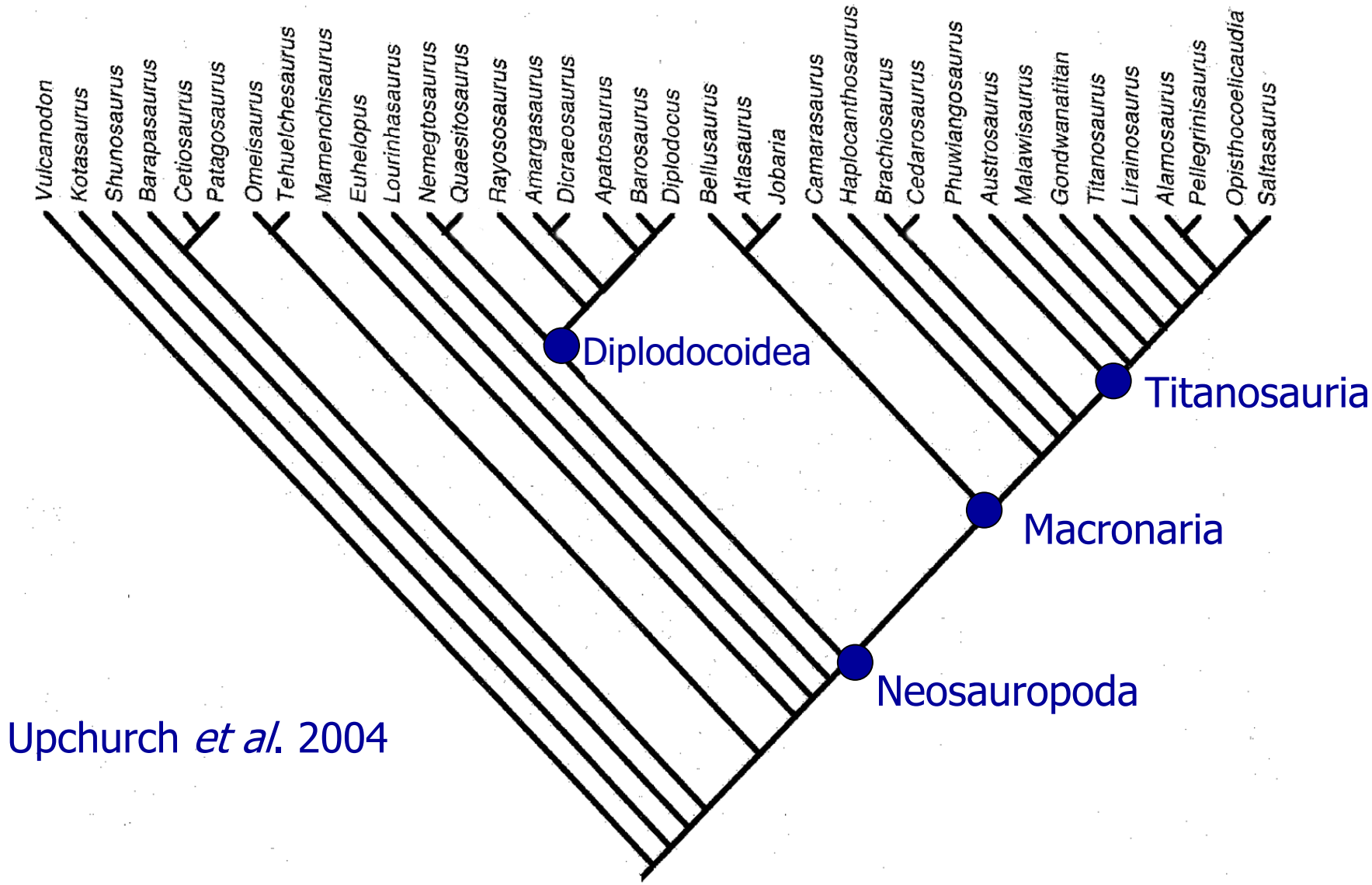
Sauropoda (Jurássico inf. – Cretáceo sup.): filogenia

Formas basais, Diplodocoidea e Macronaria (inclui Titanosauria)



Sauropoda (Jurássico inf. – Cretáceo sup.): filogenia

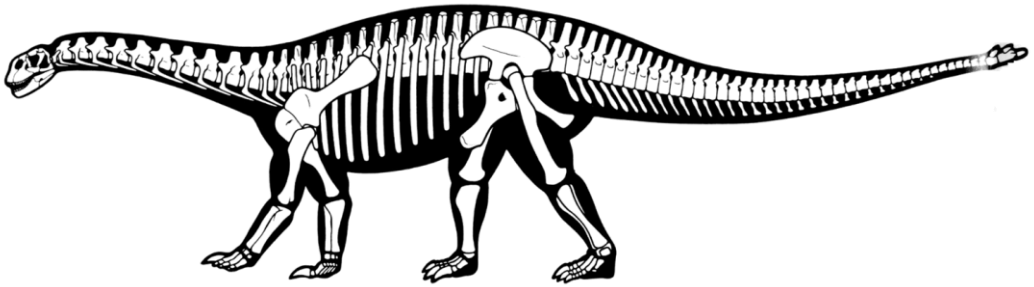
Formas basais, Diplodocoidea e Macronaria (inclui Titanosauria)



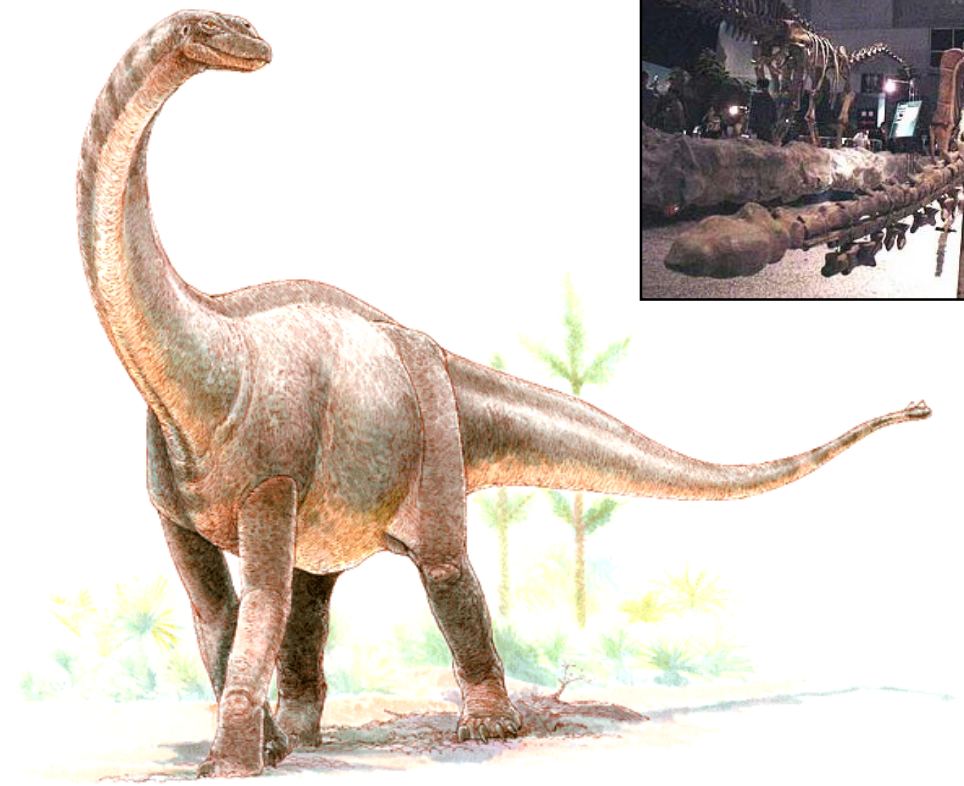
Upchurch *et al*. 2004

Sauropoda (Jurássico inf. – Cretáceo sup.)

Formas basais => não-Neosauropoda (Jurássico inf. - médio)



Shunosaurus (Fm. Shaximiao, Jurássico médio, Sichuan)

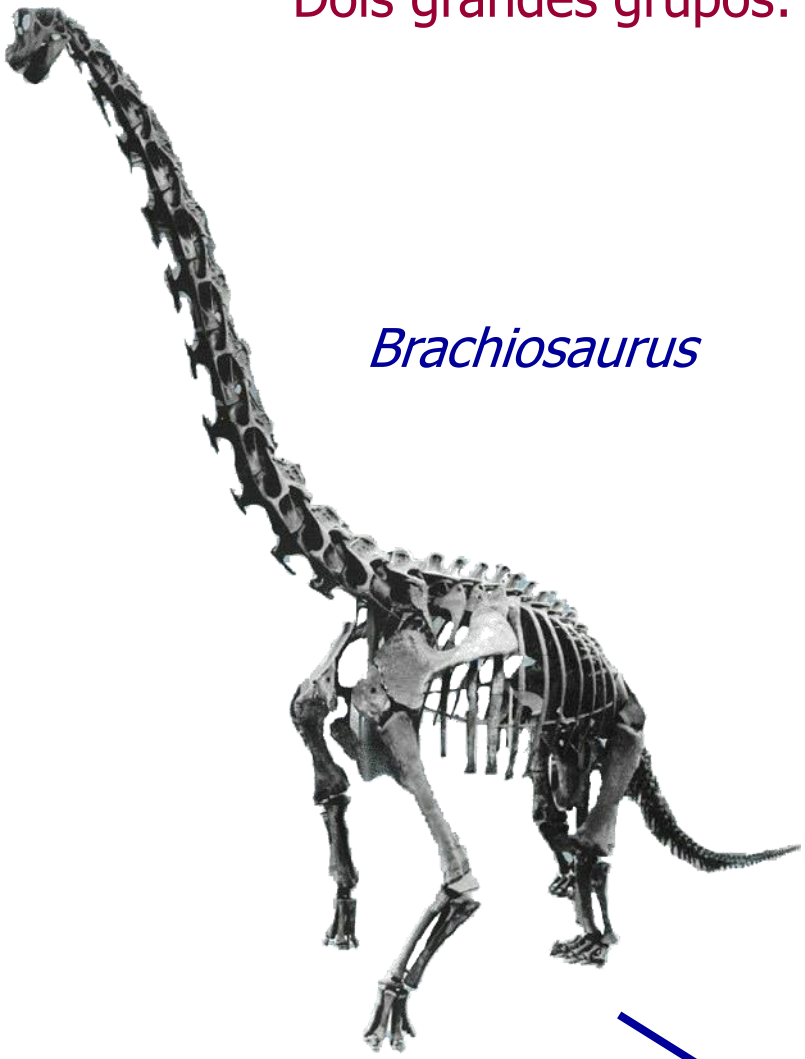


Sauropoda (Jurássico inf. – Cretáceo sup.)

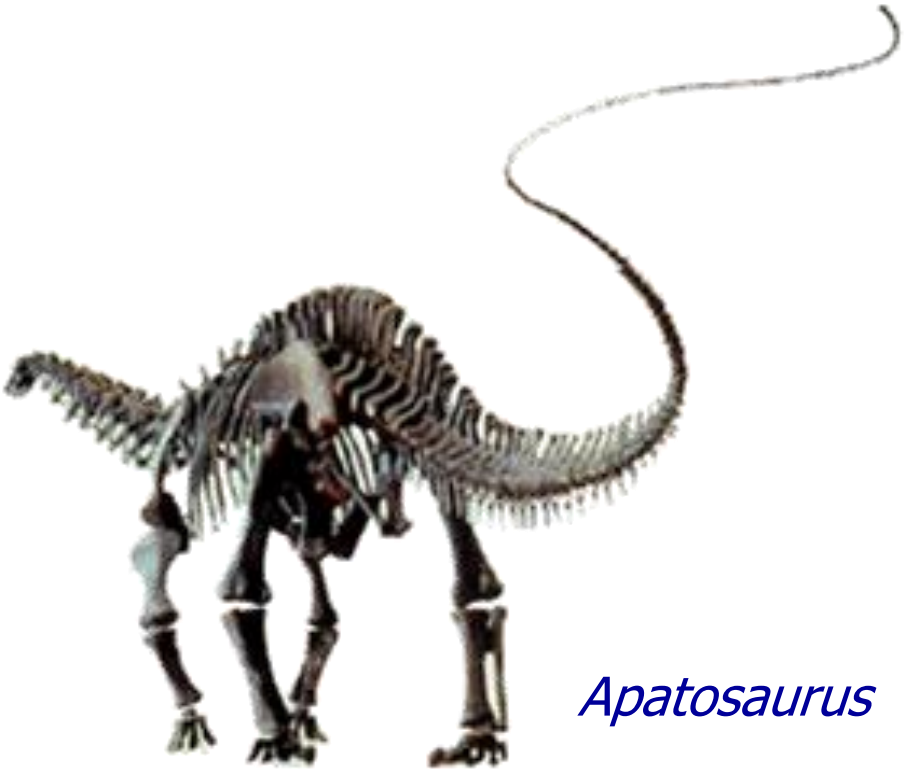
Mamenchisaurus: forma de pescoço extremamente alongado

Neosauropoda (Jurássico médio – Cretáceo sup.)

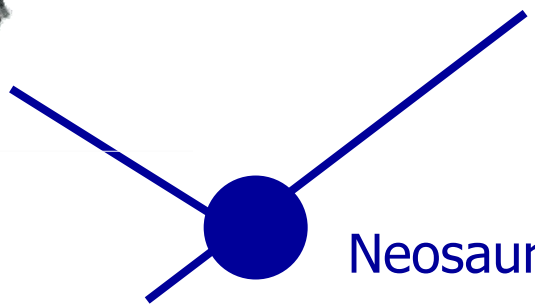
Dois grandes grupos: Diplodocoidea e Macronaria



Brachiosaurus



Apatosaurus



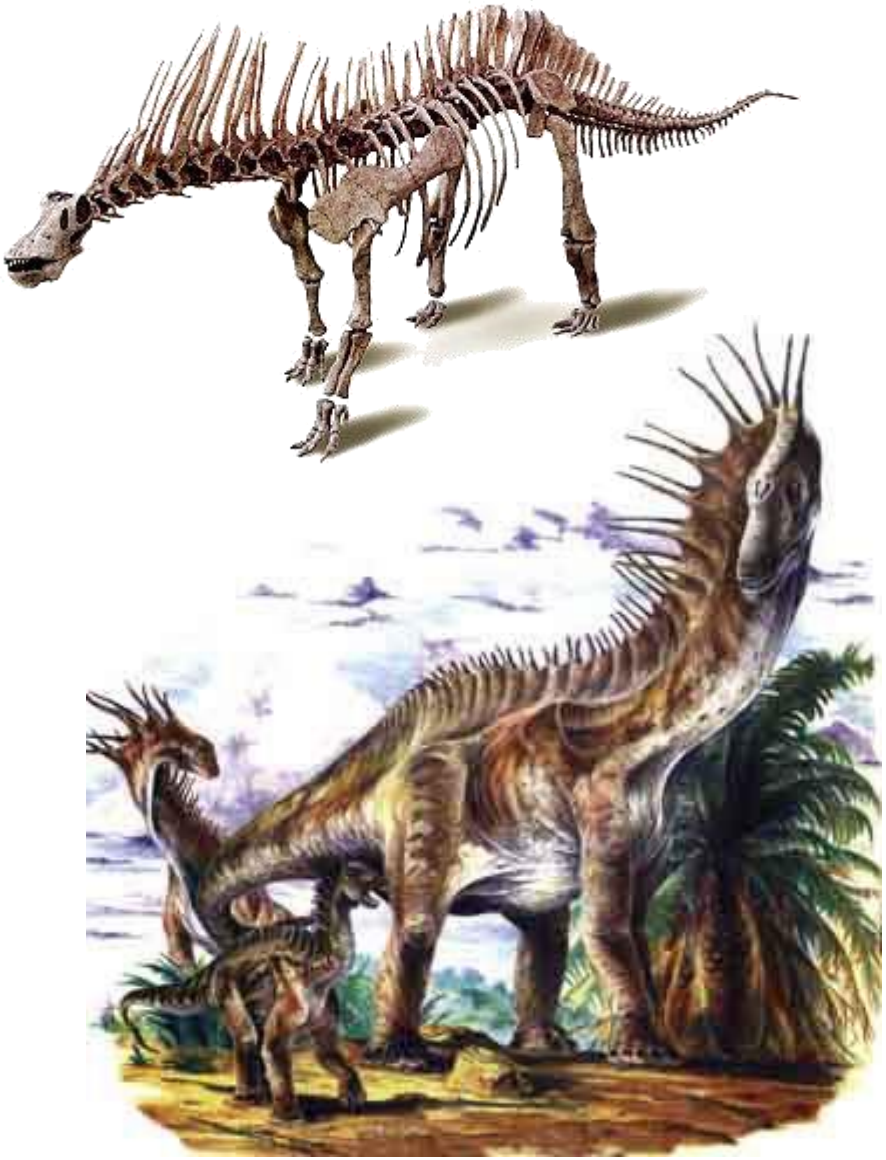
Neosauropoda

Diplodocoidea (Jurássico sup. – Cretáceo sup.)

Rebbachisauridae: Cretáceo inf. da Argentina (*Rayososaurus*) e Norte da África (*Nigersaurus* e *Rebbachisaurus*)

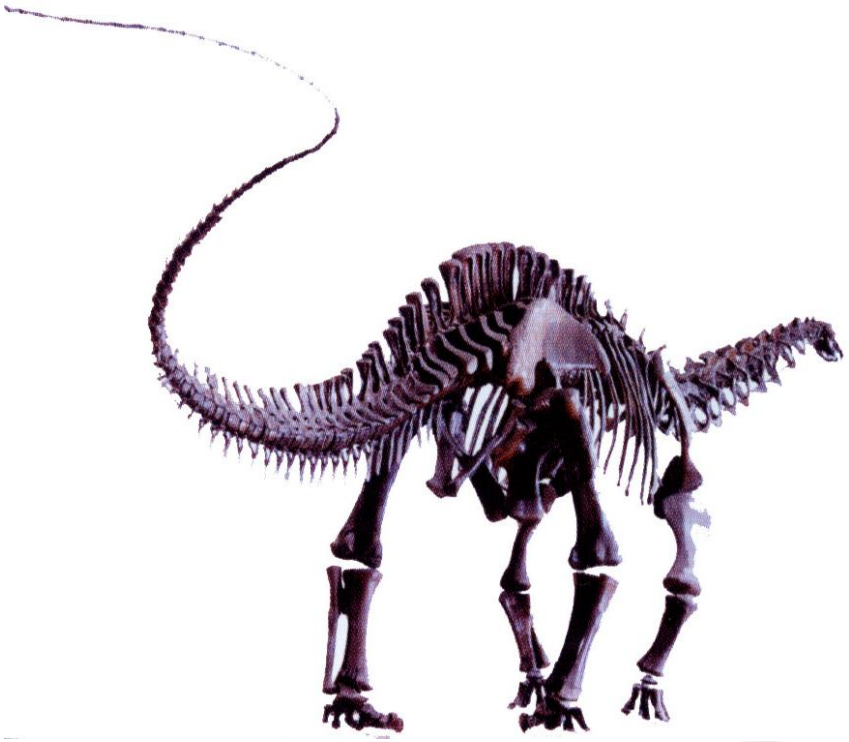
Diplodocoidea (Jurássico sup. – Cretáceo sup.)

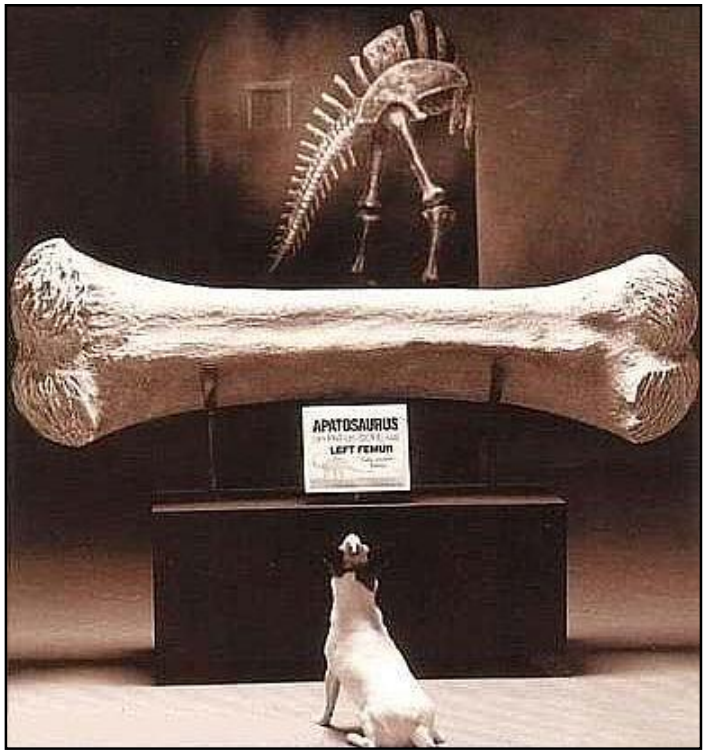
Amargasaurus – Fm. La Amarga, Cretáceo inf., Neuquén

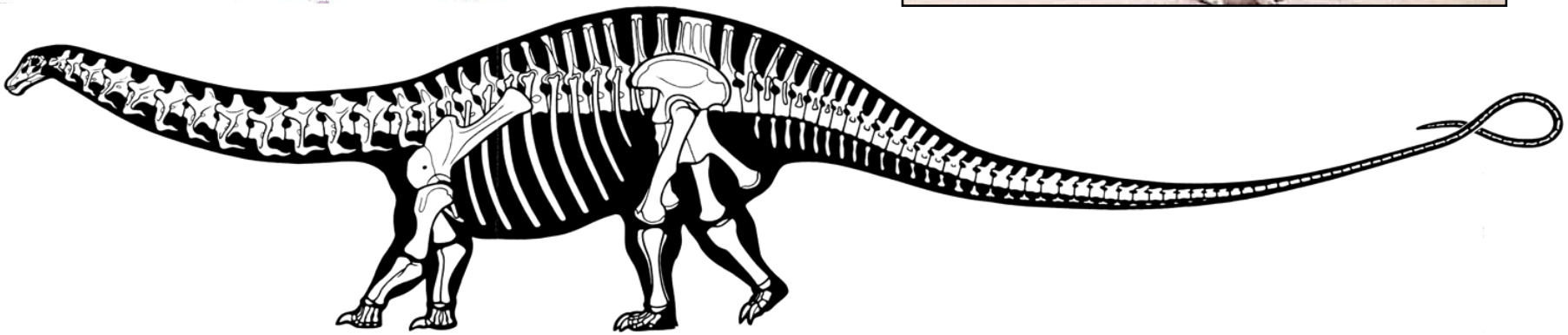


Diplodocoidea (Jurássico sup. – Cretáceo sup.)

Diplodocidae: *Apatosaurus* – Fm. Morrison, Jurássico sup., EUA

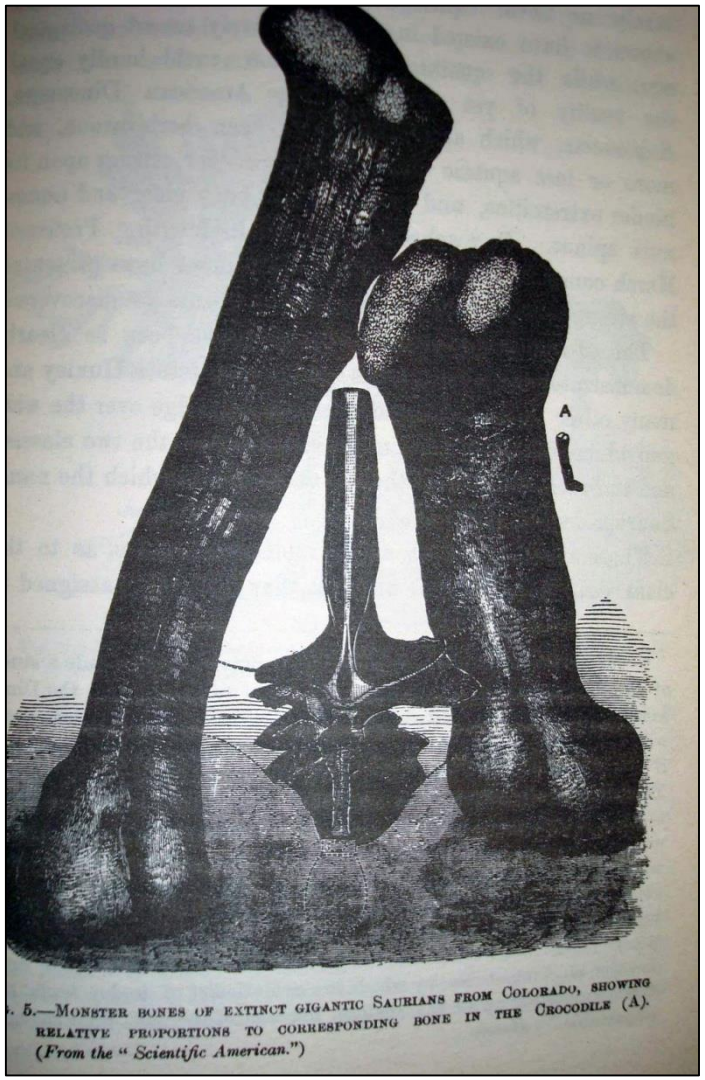




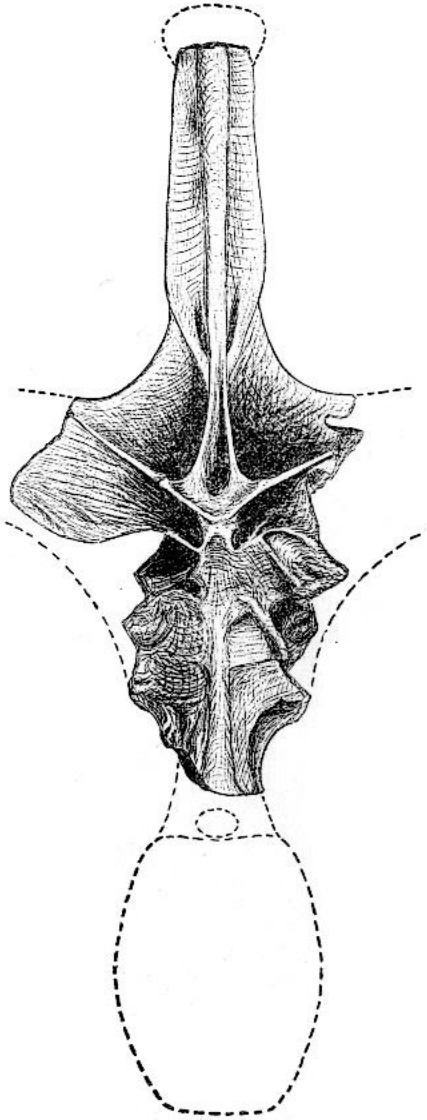


Diplodocoidea (Jurássico sup. – Cretáceo sup.)

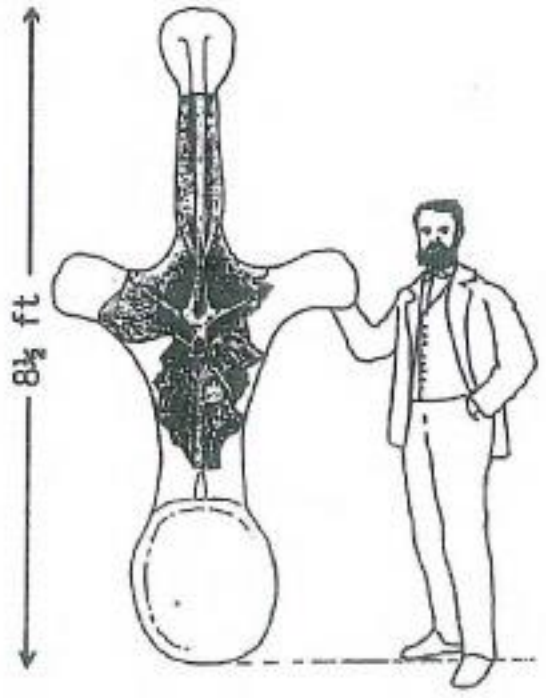
Materiais fragmentários de grande porte (Fm. Morrison, Jurássico sup.)



. 5.—Monster bones of extinct gigantic Saurians from Colorado, showing relative proportions to corresponding bone in the Crocodile (A). (*From the "Scientific American."*)



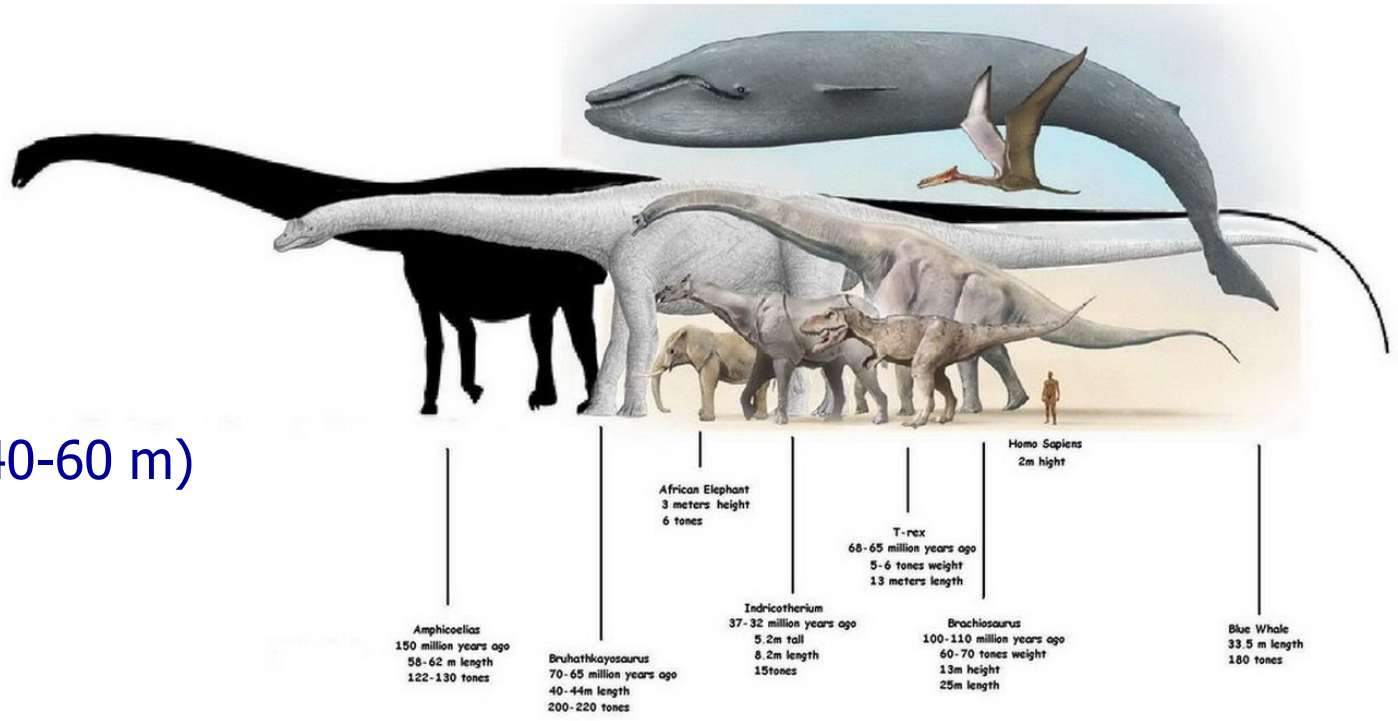
Amphicoelias

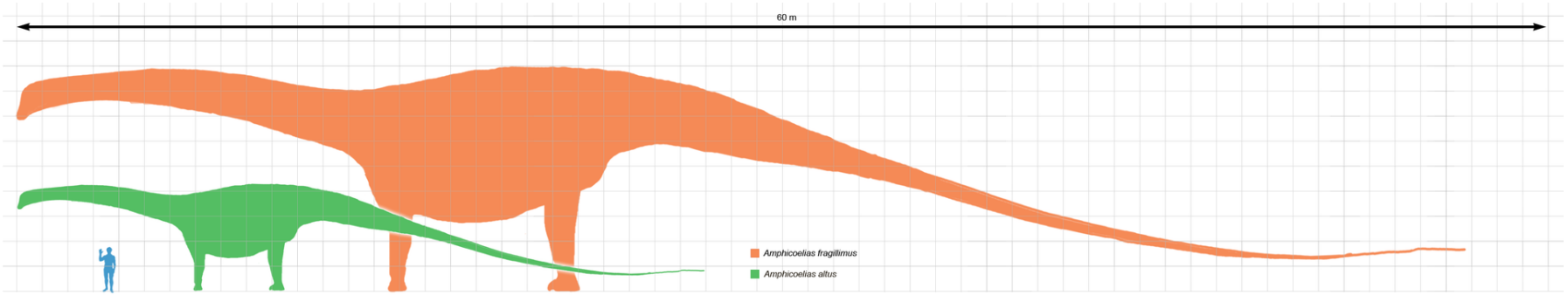


Diplodocoidea (Jurássico sup. – Cretáceo sup.)

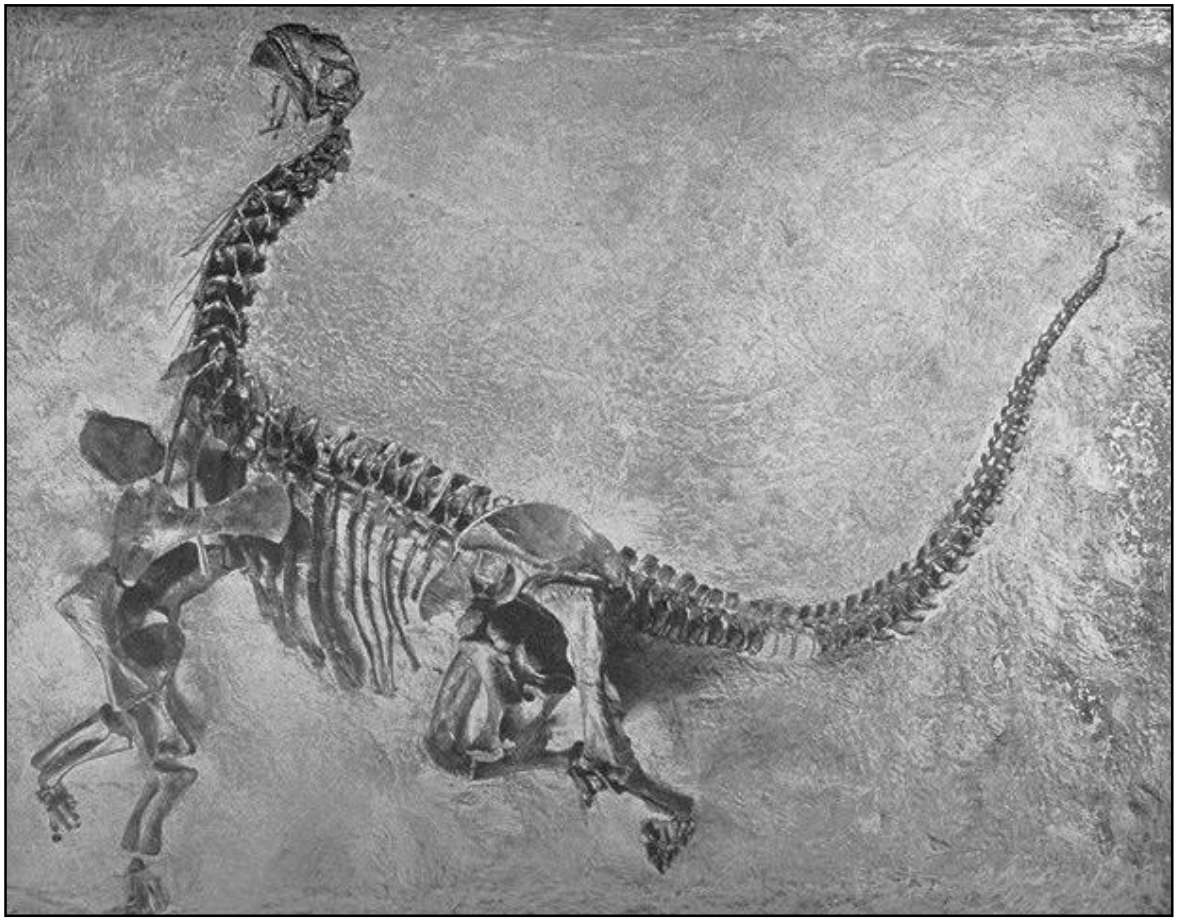
Materiais fragmentários de grande porte (Fm. Morrison, Jurássico sup.)

Amphicoelias (40-60 m)





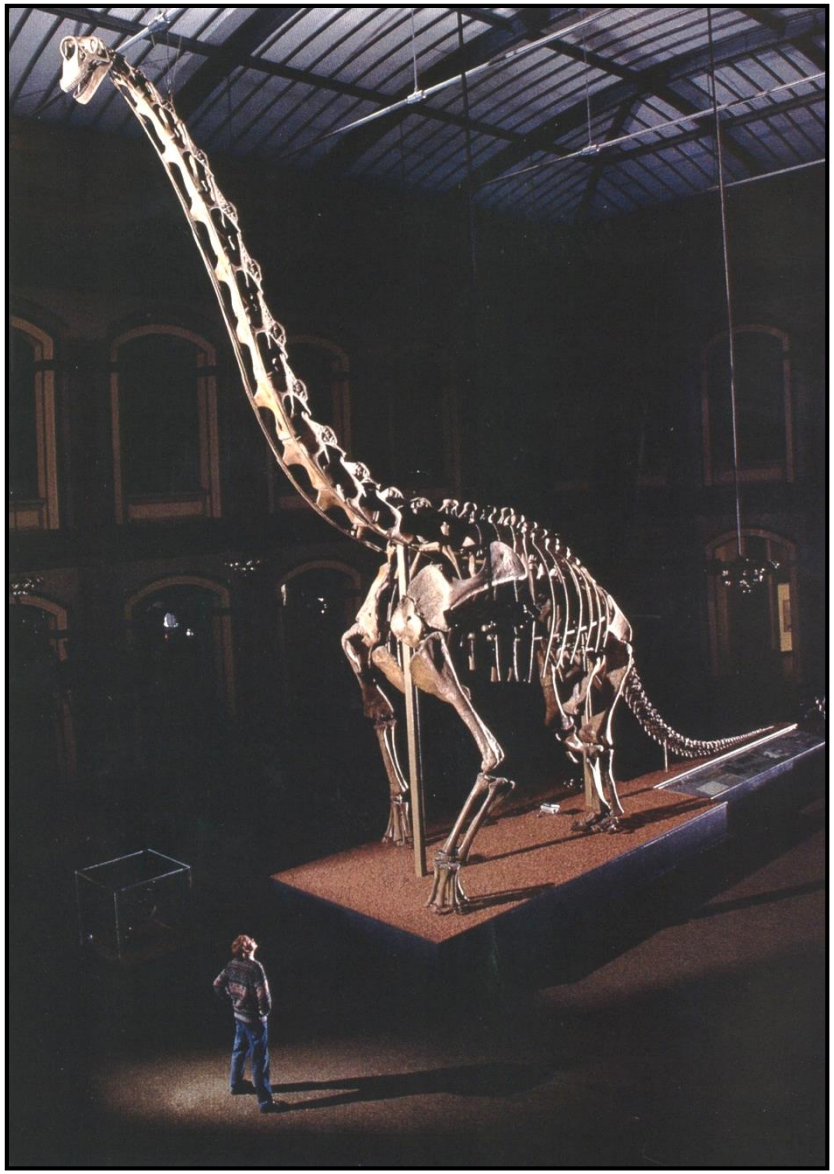
Macronaria (Jurássico médio – Cretáceo sup.)



Camarasaurus - Fm. Morrison, Jurássico sup.

Macronaria (Jurássico médio – Cretáceo sup.)

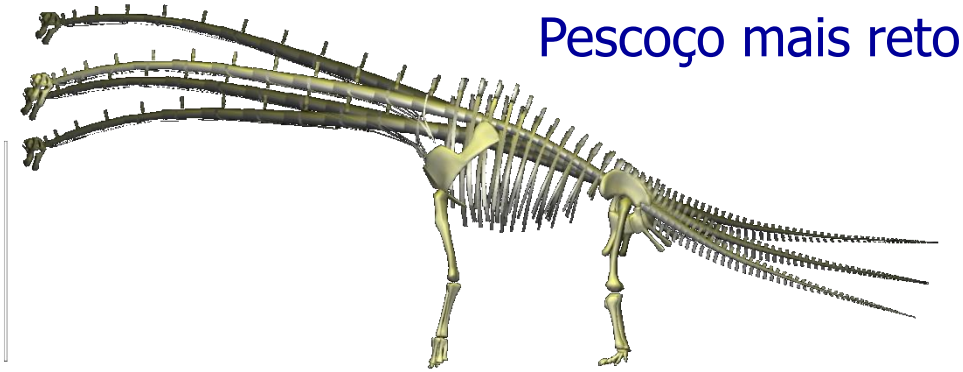
Brachiosaurus - Fm. Tendaguru, Jurássico sup., Tanzânia



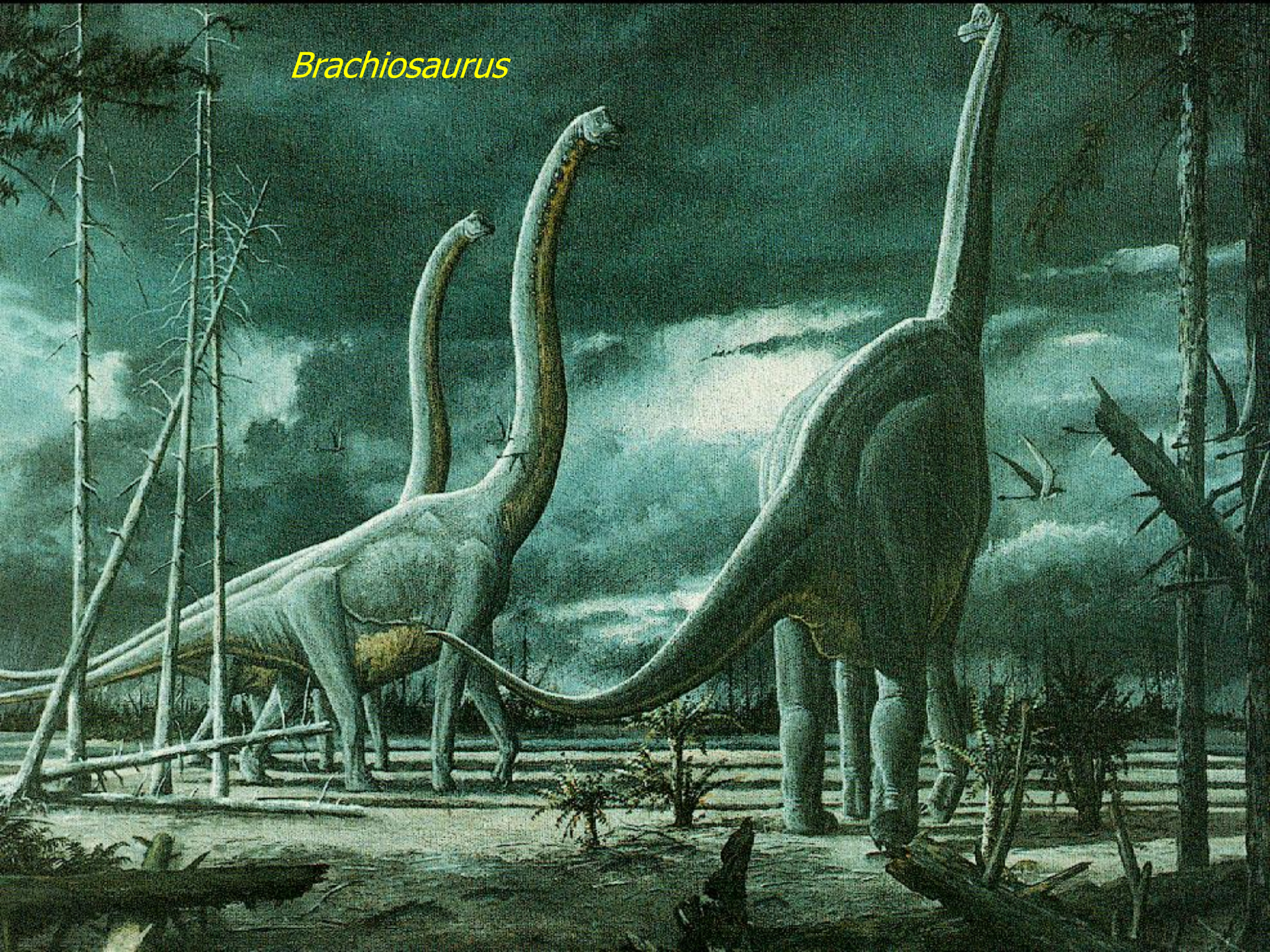
Macronaria (Jurássico médio – Cretáceo sup.)

Brachiosaurus - Fm. Tendaguru, Jurássico sup., Tanzânia

25 m, 45-50 ton.



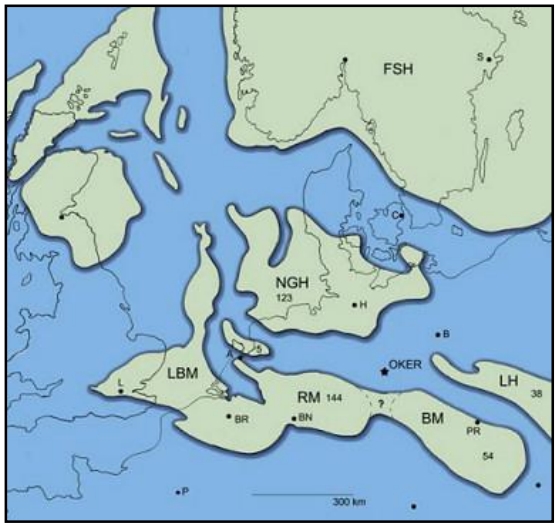
Pescoço mais reto?

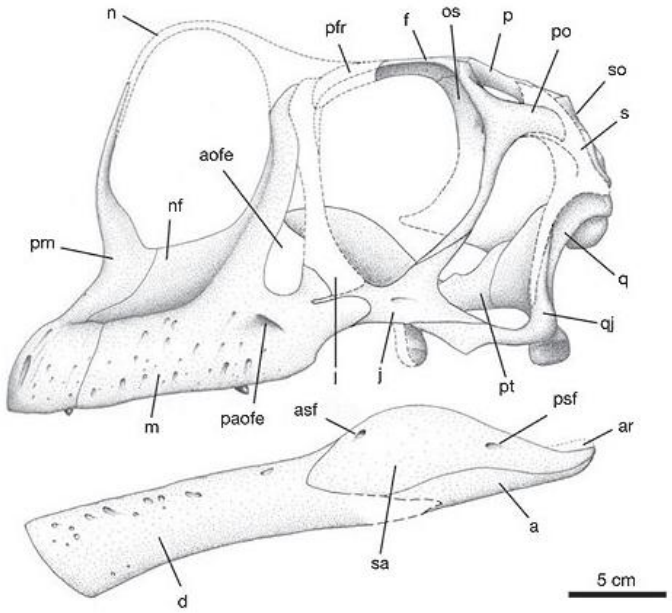

Brachiosaurus

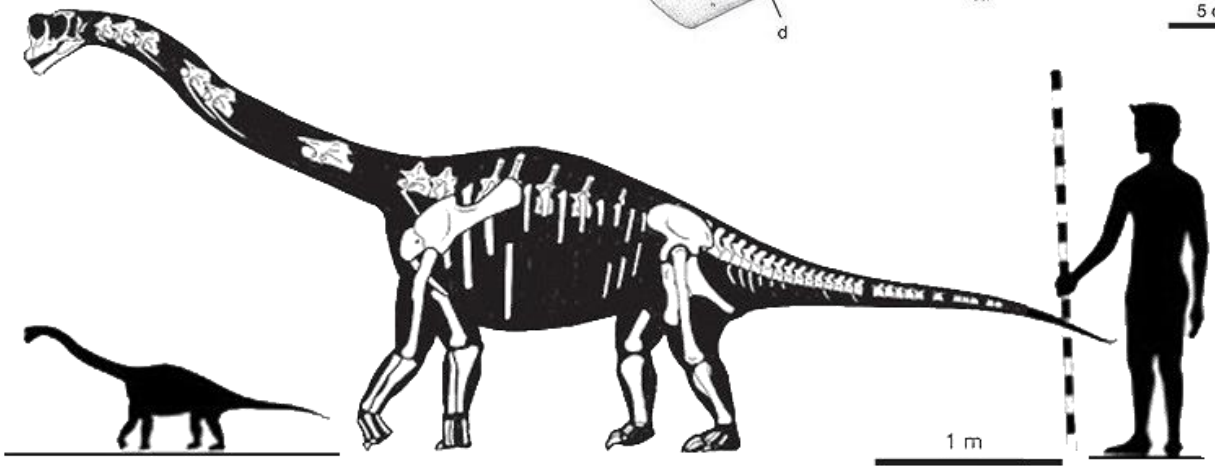
Macronaria (Jurássico médio – Cretáceo sup.)

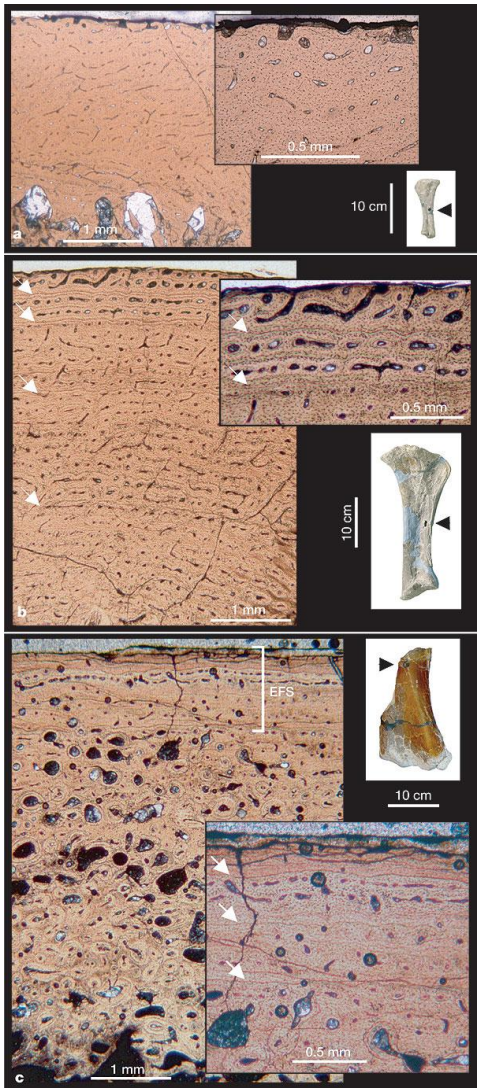
Europasaurus – depósitos marinhos do Jurássico sup. da Alemanha (Harz)

11 indivíduos de 2 à 6 m. (formas anãs insulares)



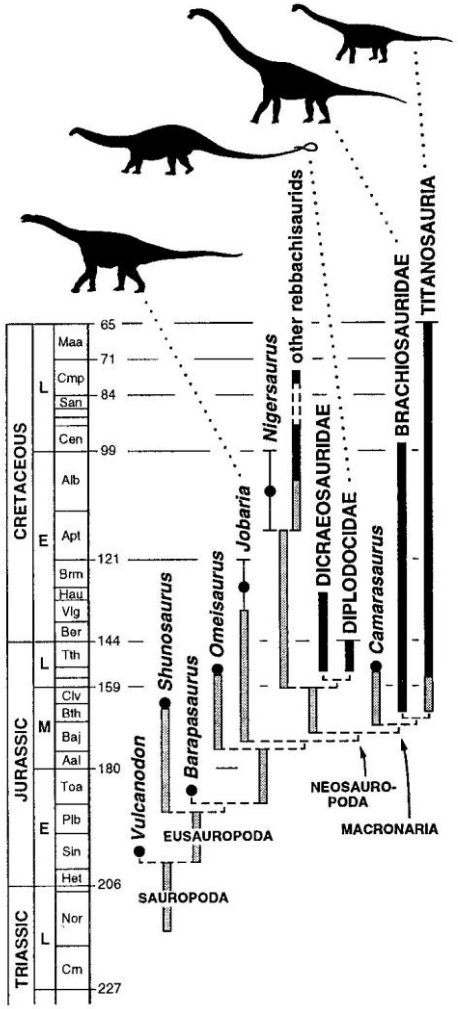




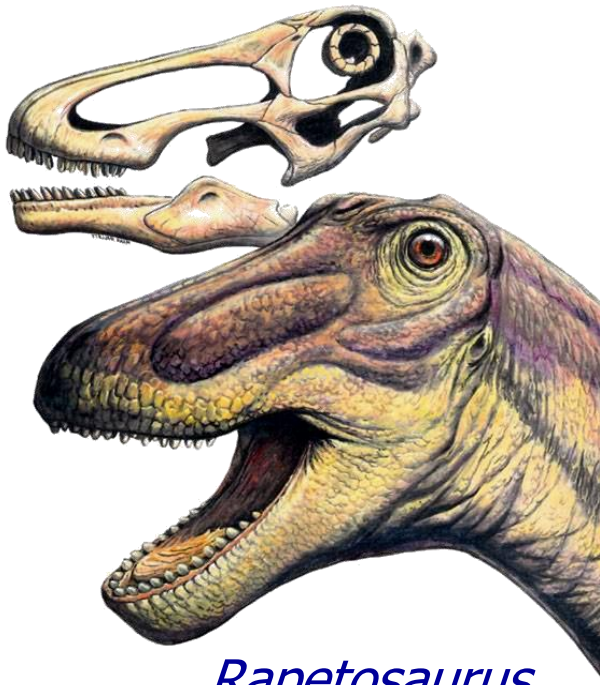


Macronaria (Jurássico médio – Cretáceo sup.)

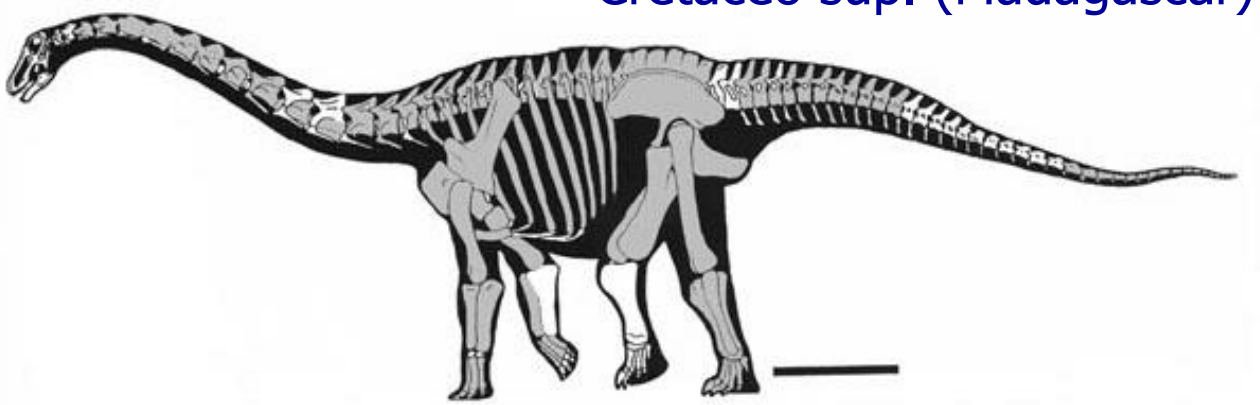
Titanosauria (Cretáceo inf. - sup.): distribuição global



"T" indicus
Cretáceo sup.
Índia



Rapetosaurus
Cretáceo sup. (Madagascar)



Macronaria (Jurássico médio – Cretáceo sup.)

Titanosauria (Cretáceo inf. - sup.): distribuição global

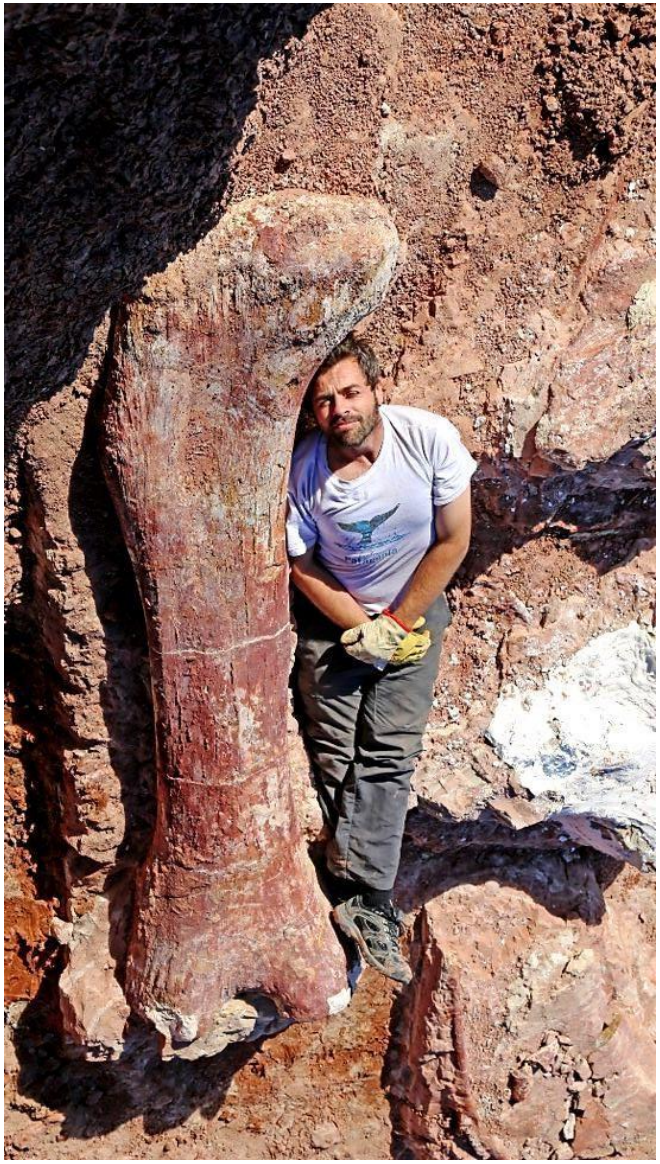
Saltasaurus
Cretáceo sup., Salta
Juvenis e osteodermas

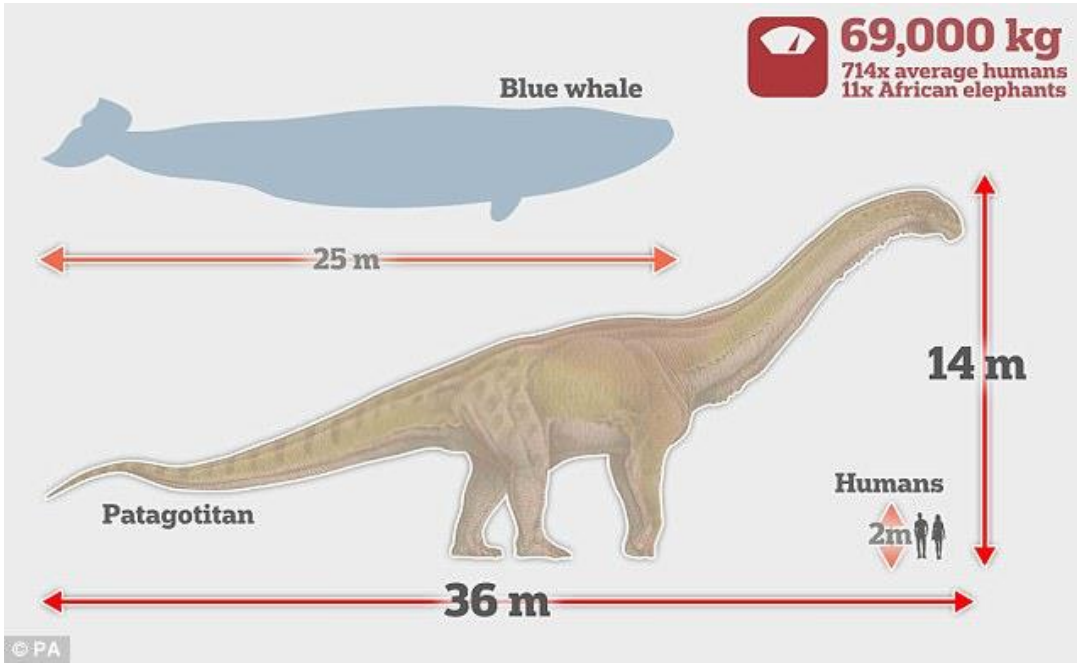
Macronaria (Jurássico médio – Cretáceo sup.)

Titanosauria (Cretáceo inf. - sup.): distribuição global

Macronaria (Jurássico médio – Cretáceo sup.)

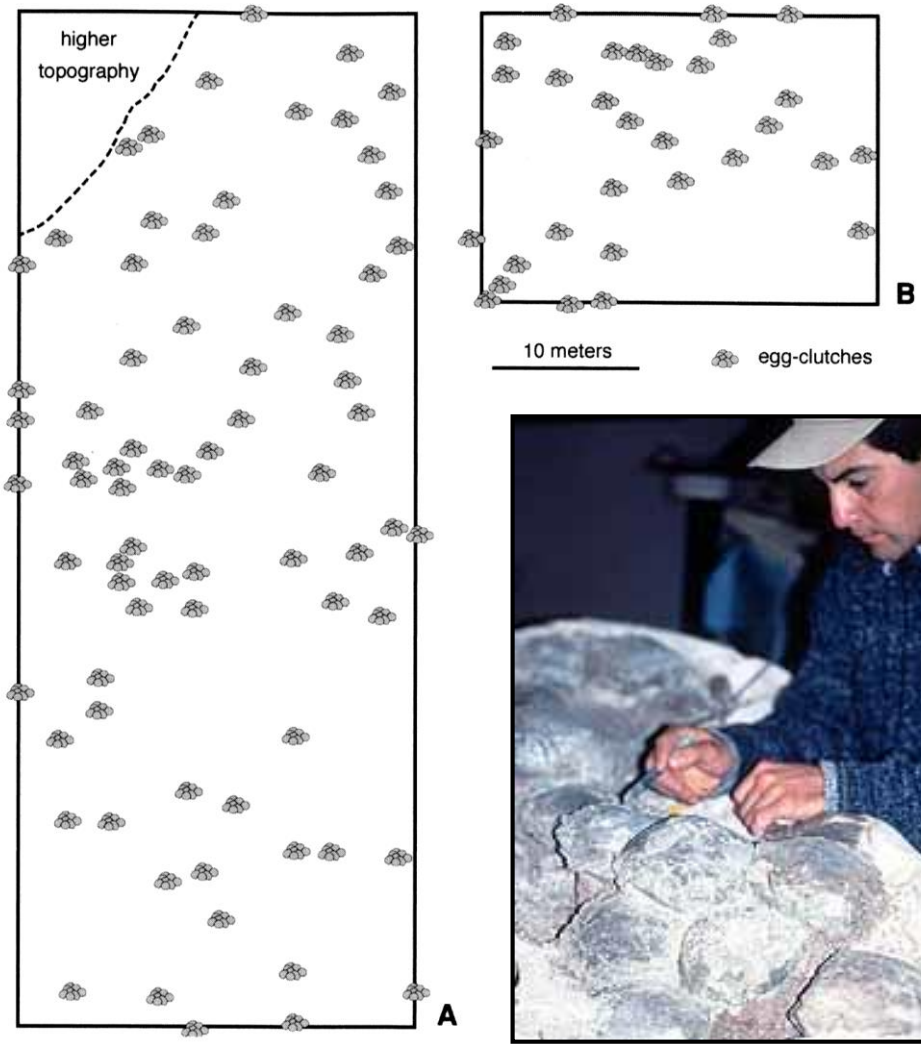
Patagotitan mayorum (K. sup., Argentina)





Titanosauria (Cretáceo inf. - sup.)

Auca Mahuevo (Cretáceo de Neuquén): Ninhos, ovos, embriões, tecido mole (pele) e evidencia de comportamento gregário



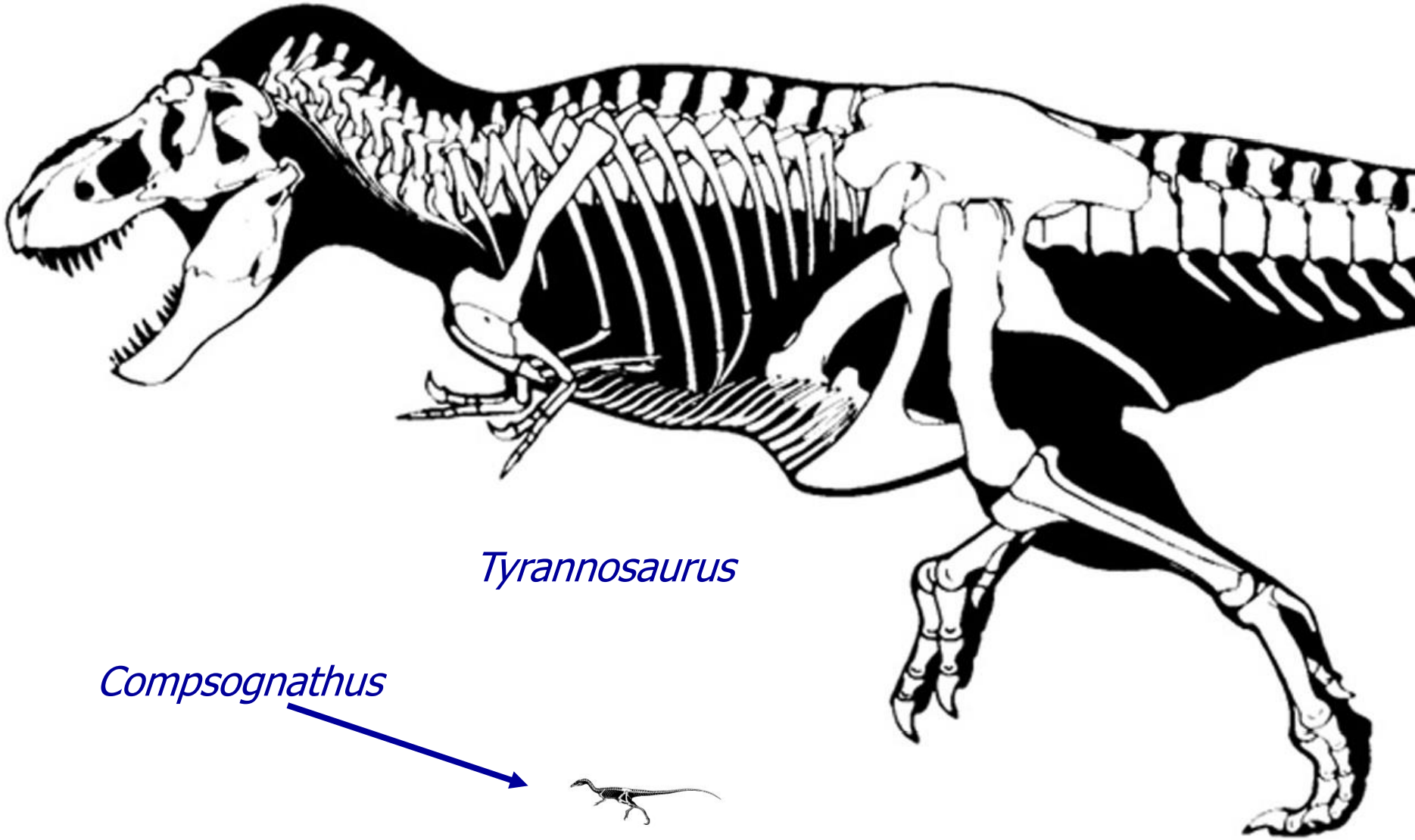
Titanosauria (Cretáceo inf. - sup.)

No Brasil: outros registros do Grupo Bauru (Cretáceo sup.)

Fm. Marília (Maastrichiano de Uberaba, Minas Gerais)

Theropoda (Triássico sup. Recente): paleobiologia

Bípedes, tamanhos variados (Lei de Cope), maioria carnívoros



Tyrannosaurus

Compsognathus

Theropoda (Triássico sup. Recente): paleobiologia

Maioria carnívoros

Gallimimus

Falcarius

Megalosaurus

Theropoda (Triássico sup. Recente): filogenia

Coelophysidae – Triássico sup. - Jurássico inf.

GHOST RANCH
ABIQUIU SANTA FE

Coelophysis
Triássico sup., Oeste dos EUA


Coelophysis

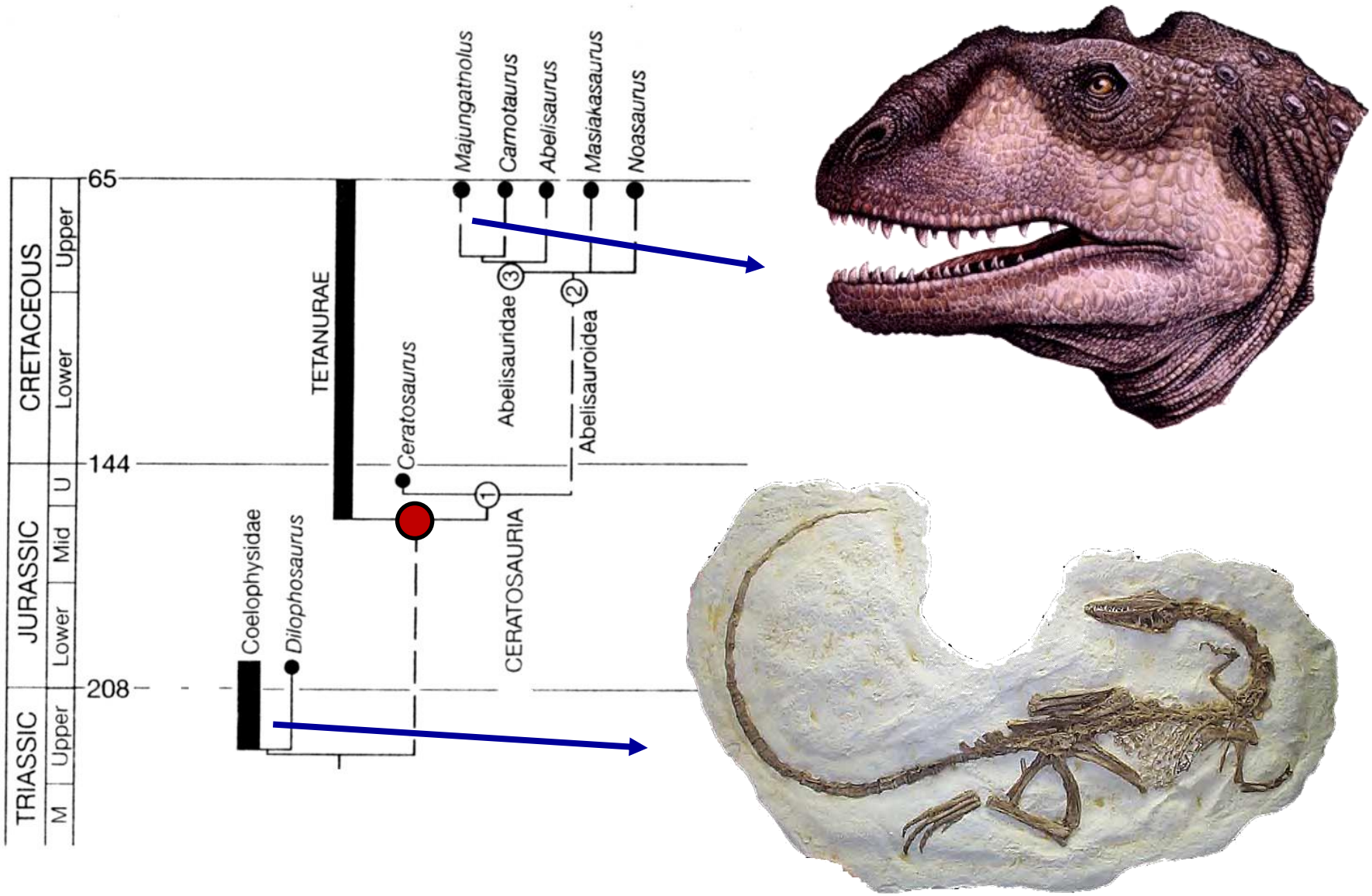
Theropoda (Triássico sup. Recente):

Clado "*Dilophosaurus*"

Dilophosaurus weterilli:
Jurássico inf. (Fm. Kayenta), Arizona

Como muitos "ceratossauros" possui projeções cranianas de display

Ceratosauria s.s. + Tetanurae = Averostra

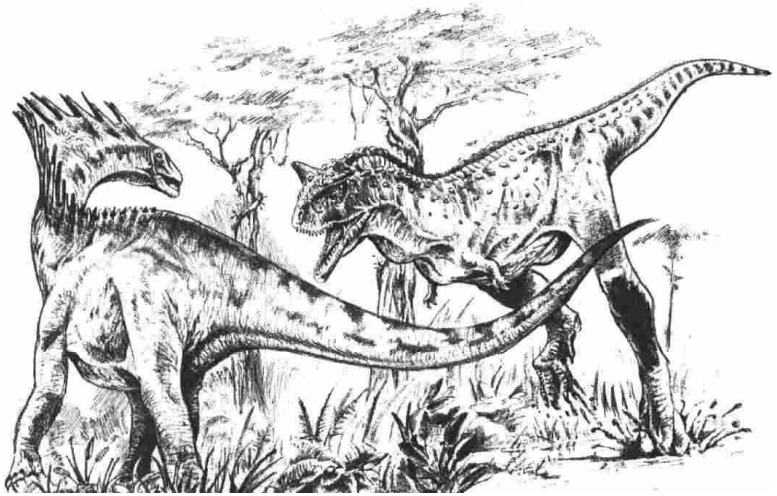


Theropoda (Triássico sup. Recente):

Vespersaurus paranaensis

Theropoda (Triássico sup. Recente):

Abelisauridae - *Carnotaurus* (Fm. La Colonia, Chubut)



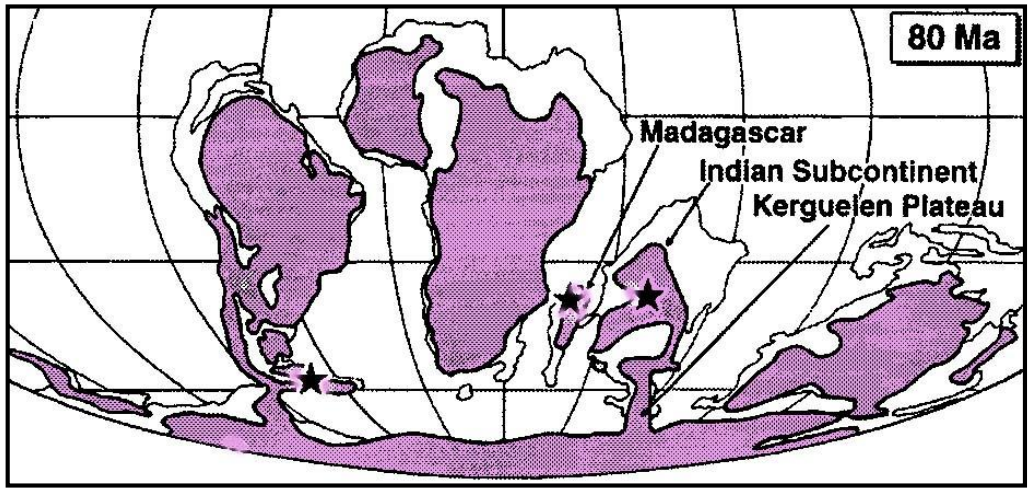
Theropoda (Triássico sup. Recente):

Abelisauridae - *Carnotaurus* (Fm. La Colonia, Chubut)

Theropoda (Triássico sup. Recente): Abelisauria

Majungatholus
(Fm. Maevarano, Madagascar)

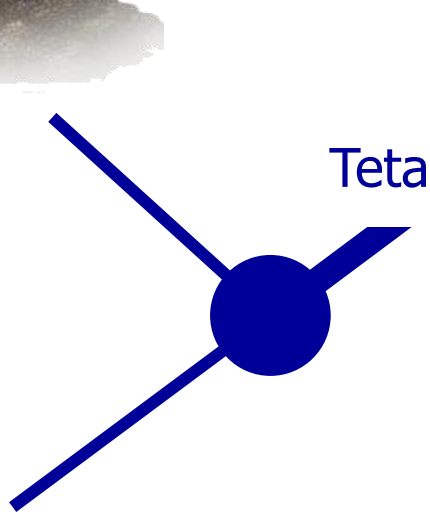
Rajasaurus
(Fm. Lameta, Índia)



Evidência de conexão Gondwânica no Cretáceo sup. (via Antártica?)

Tetanurae (Jurássico inf. - Recente)

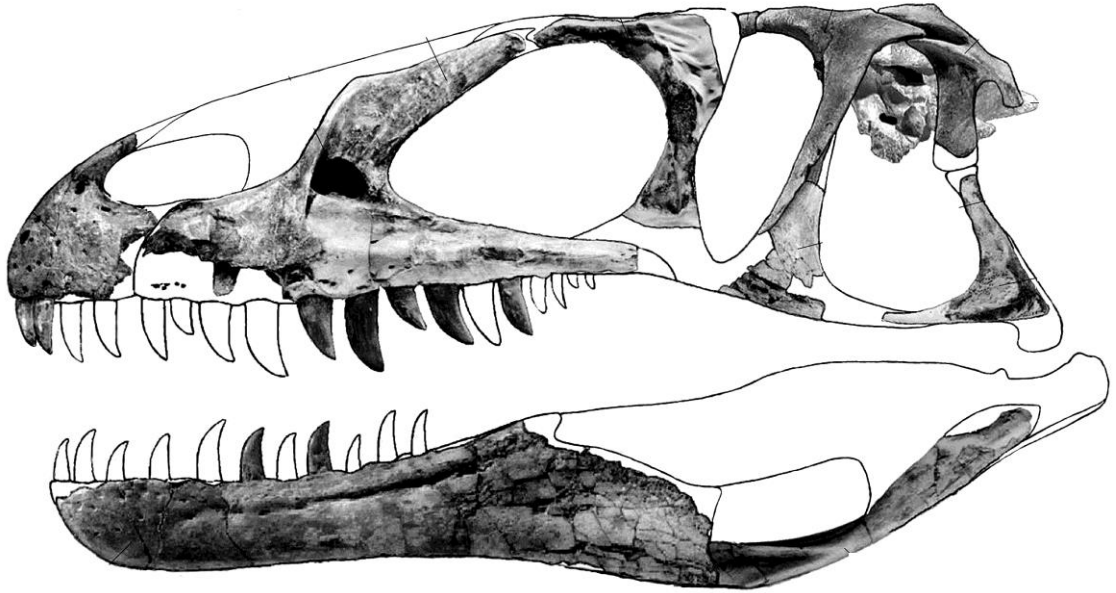
formas mais relacionadas à *Passer* que a *Ceratosaurus*



Tetanurae (Jurássico inf. - Recente)

Megalosauridae (Jurássico médio – superior)

Megalosaurus
Jurássico médio (Inglaterra)



Poekilopleuron
Jurássico médio (França)

Tetanurae (Jurássico inf. - Recente)

Megalosauridae (Jurássico médio – superior)

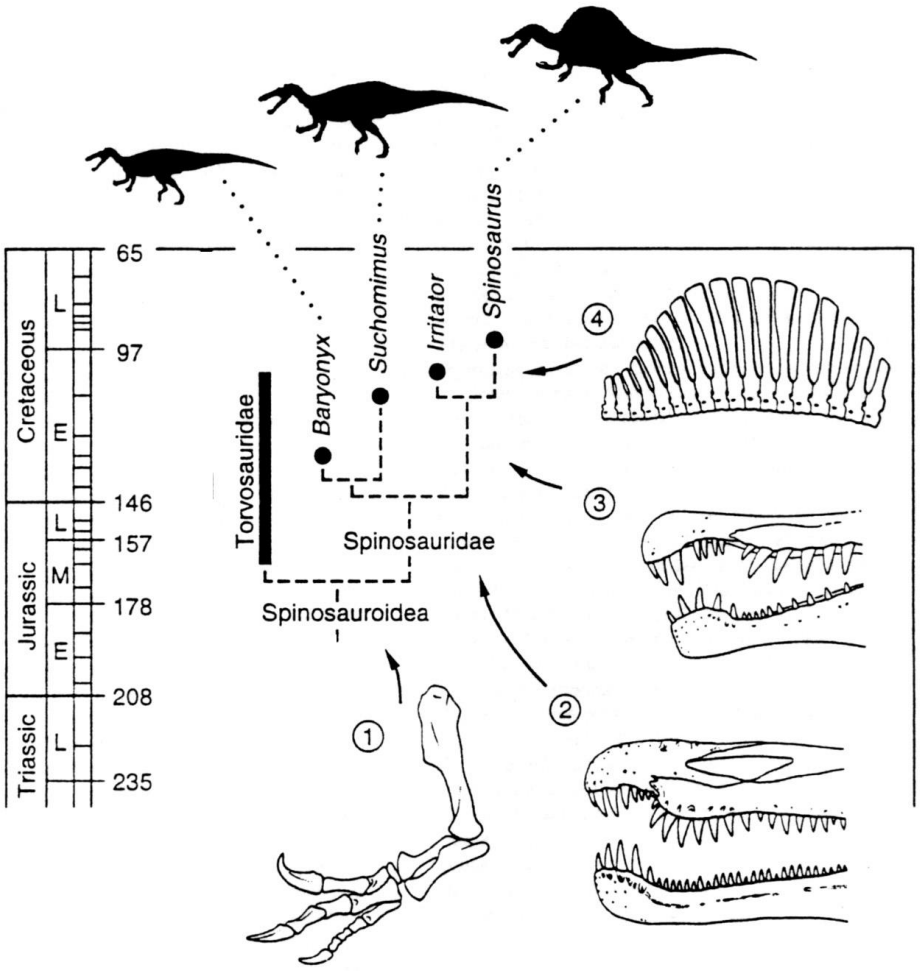
Torvosaurus Jurássico sup., EUA

Tetanurae (Jurássico inf. - Recente)

Sciurumimus (Jurássico sup., Alemanha): juvenil com penas filiformes

Tetanurae (Jurássico inf. - Recente)

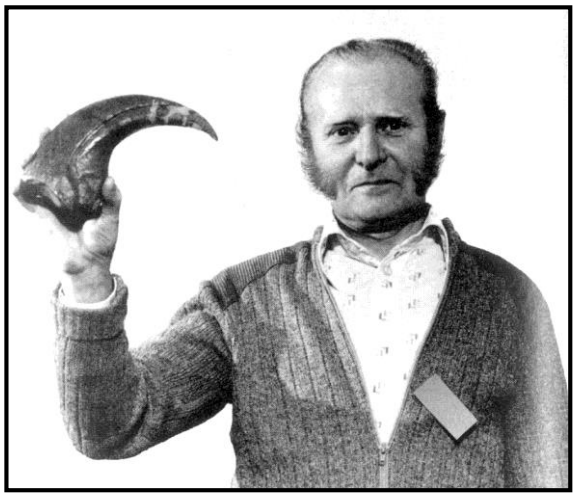
Spinosauridae (Cretáceo inf. – sup.): formas longirostrinas, algumas com "vela"



Possivelmente piscívoros

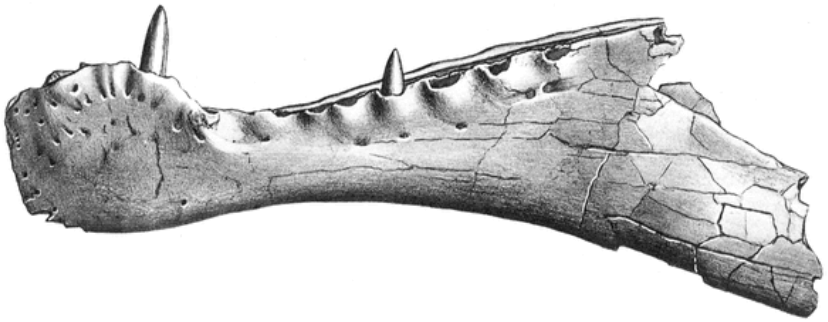
Spinosauridae (Cretáceo inf. – sup.): *Baryonyx*/*Suchomimus*

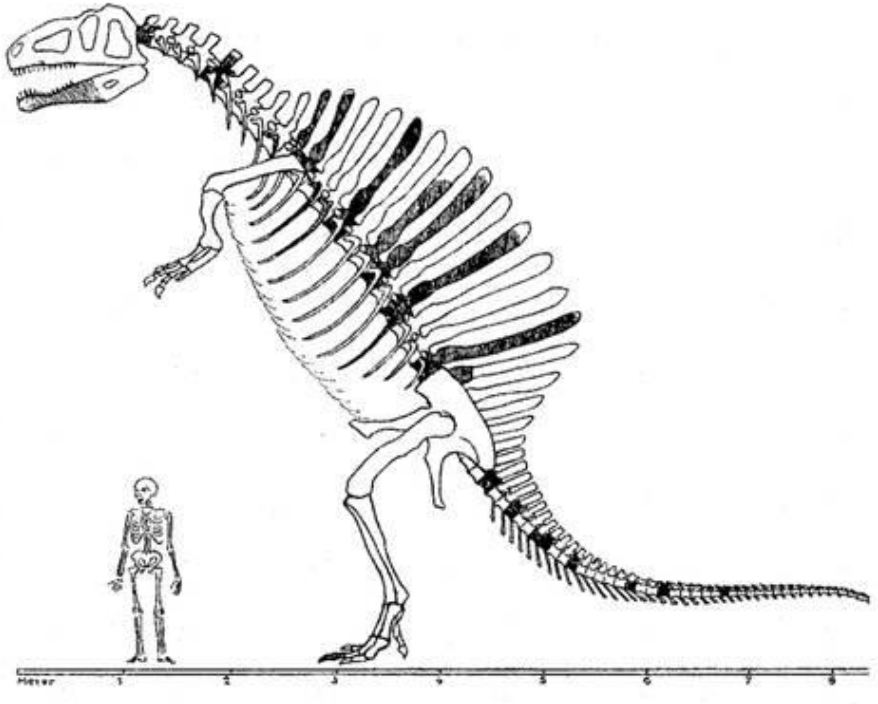
Cretáceo "médio" da Inglaterra (Surrey) e Niger (Teneré)



Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

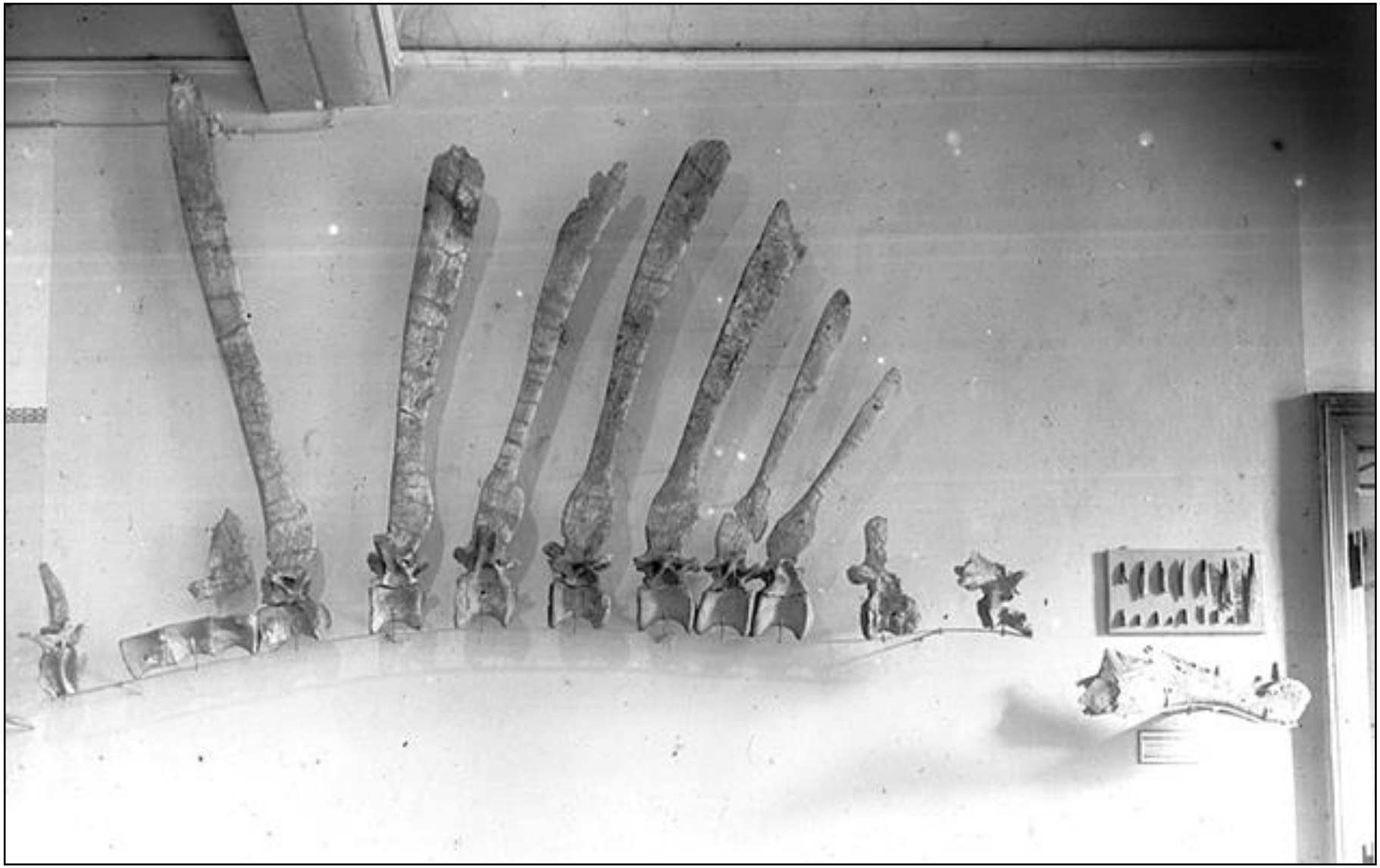
Cretáceo sup. do Egito : Baharyia oásis





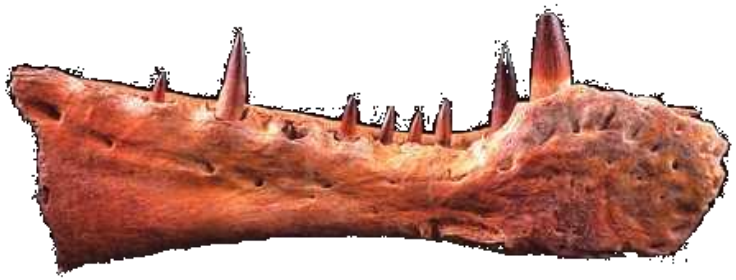
Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

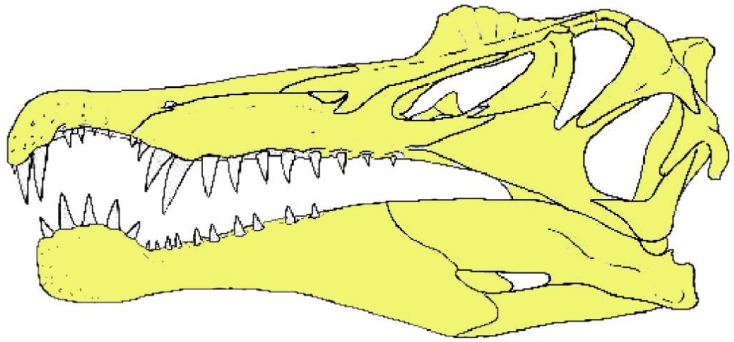
Cretáceo sup. do Egito e Marrocos: 14-18 m de comprimento e "vela"

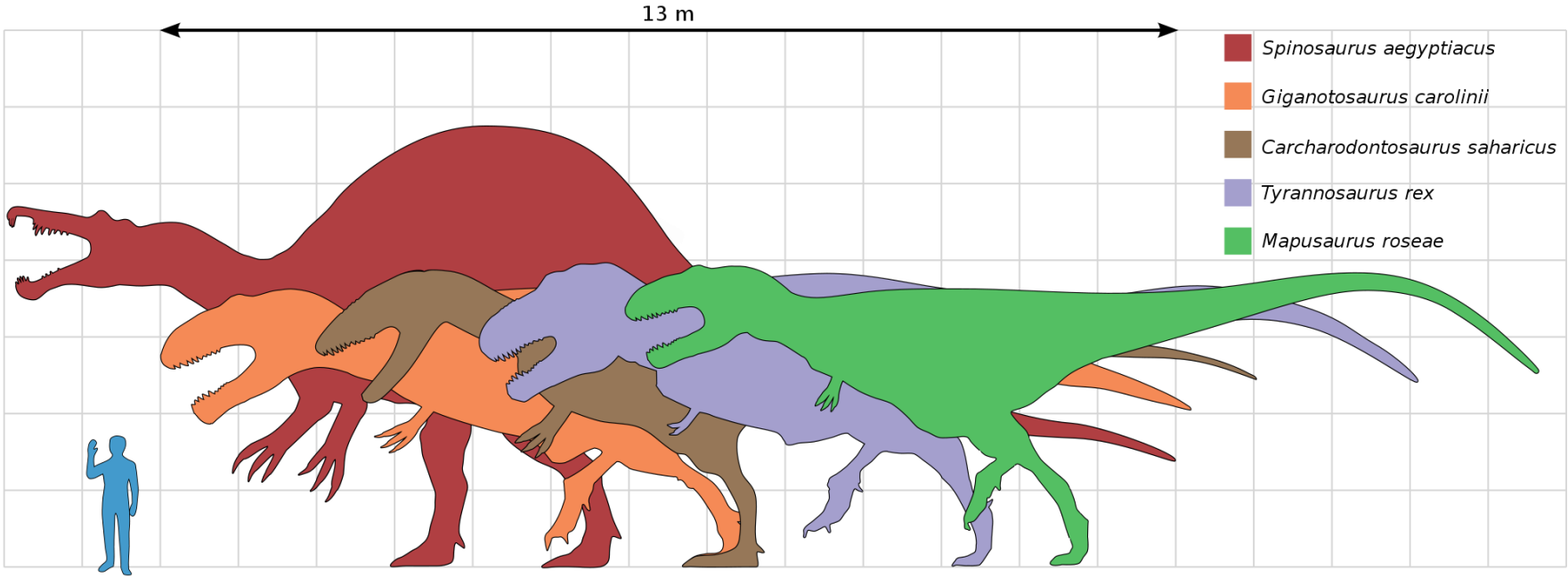


Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

Cretáceo sup. do Egito e Marrocos: 14-18 m de comprimento e "vela"

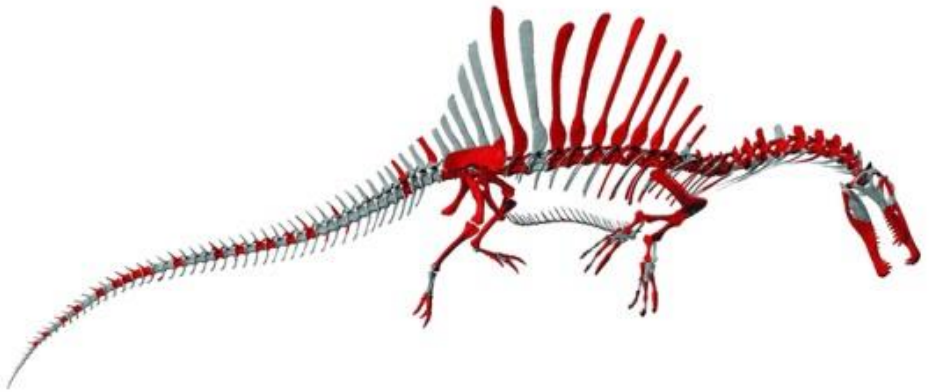






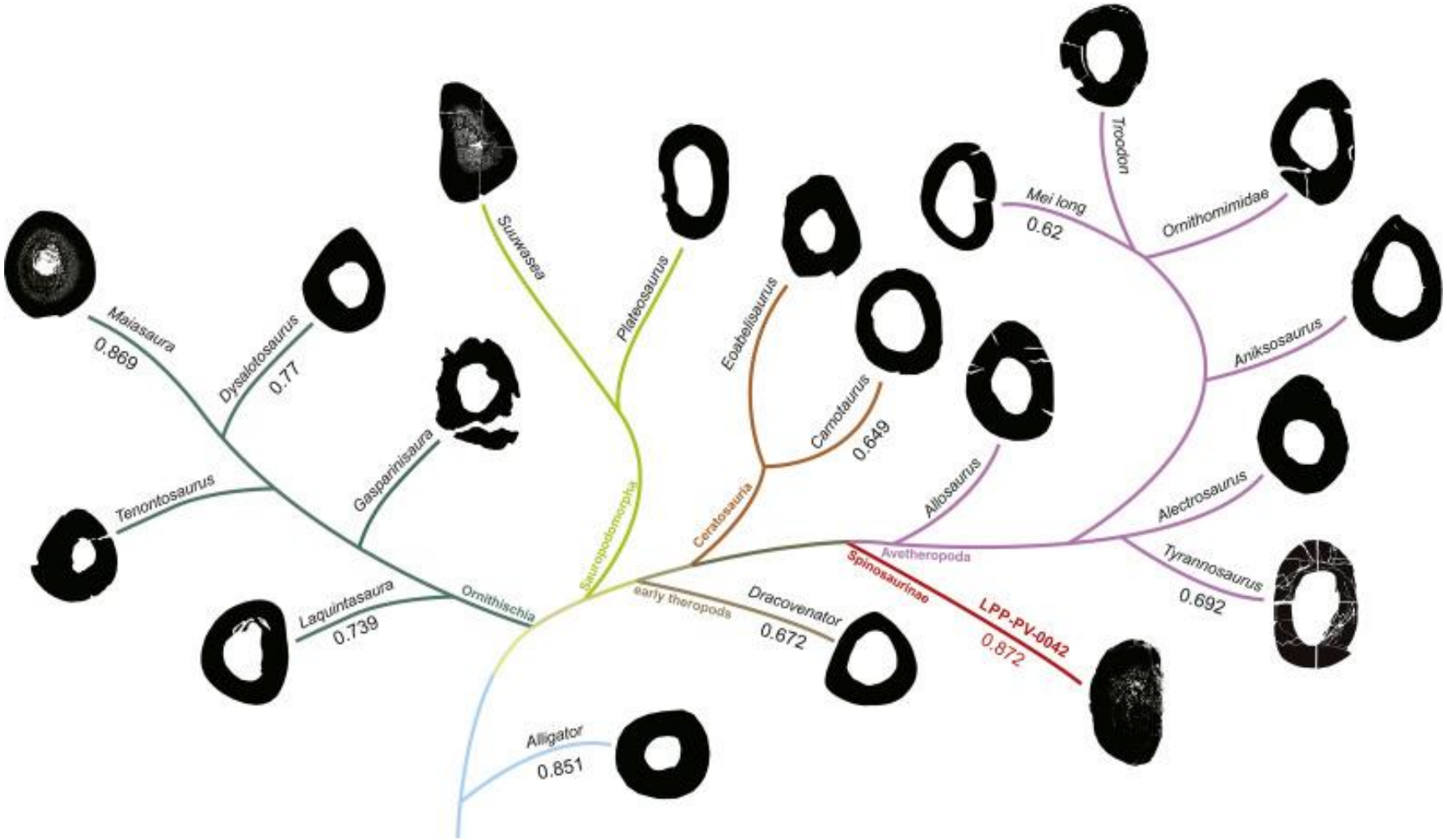
Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

Novo "esqueleto" das Kem-Kem beds



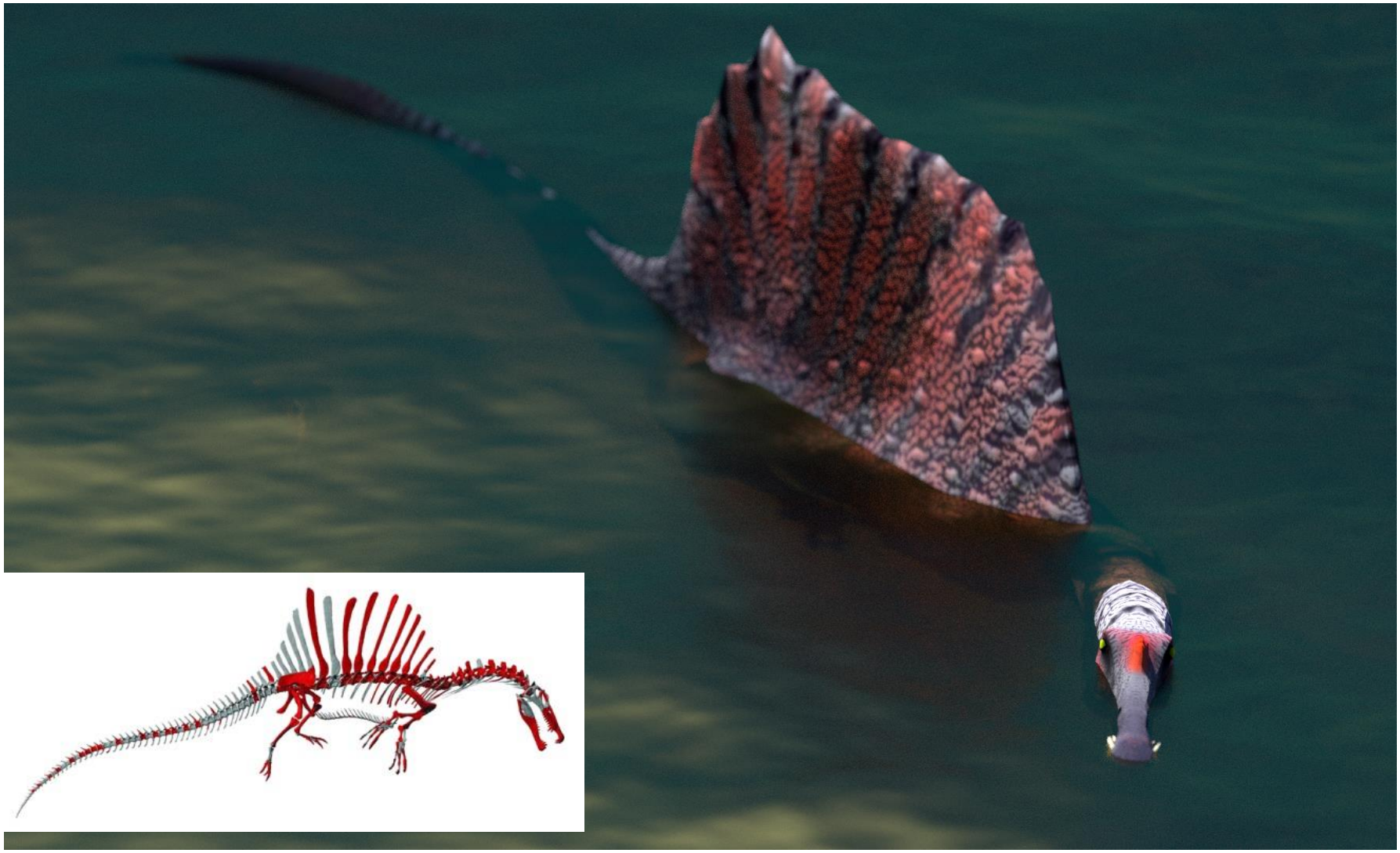
Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

Novo "esqueleto" das Kem-Kem beds



Spinosauridae (Cretáceo inf. - sup.): *Spinosaurus aegyptiacus*

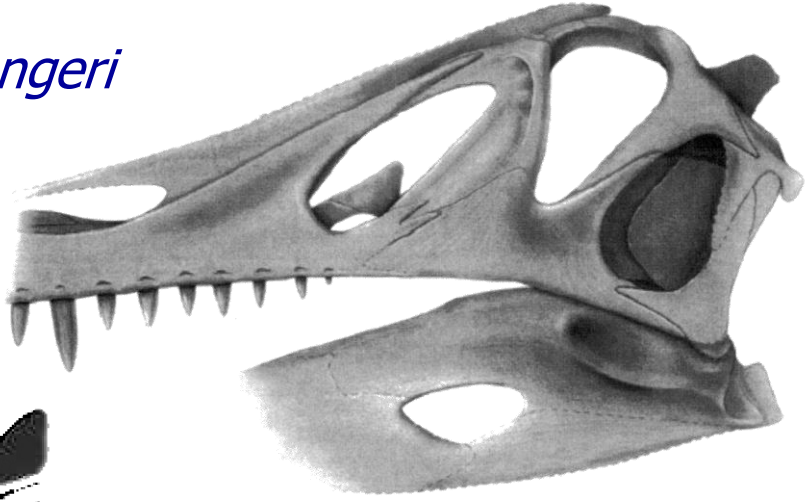
Novo "esqueleto" das Kem-Kem beds

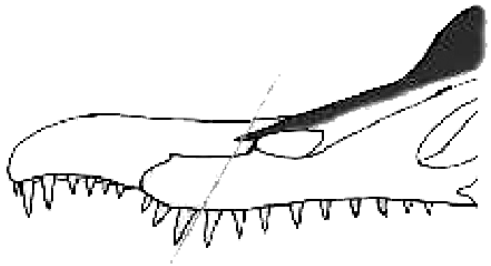


Spinosauridae (Cretáceo inf. – sup.): no Brasil

Fm. Santana, Cretáceo inf., Chapada do Araripe, CE

Irritator challengeri



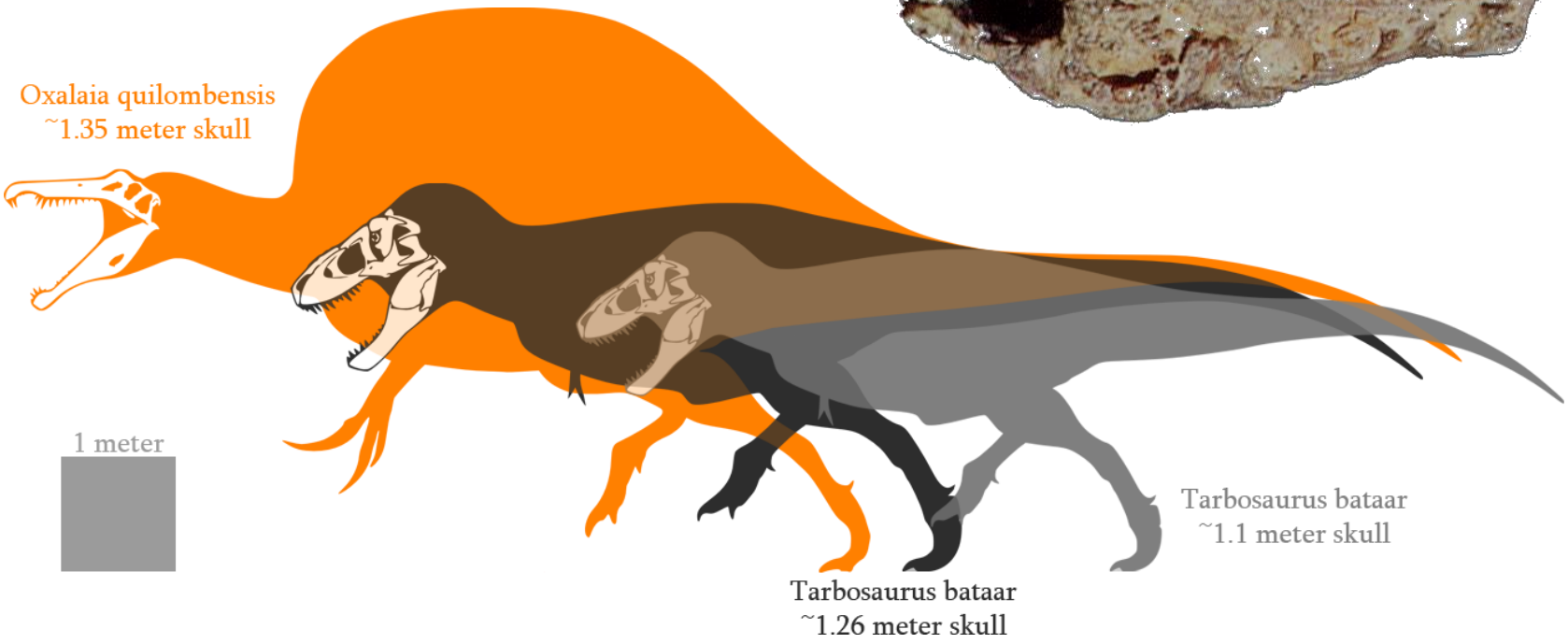


"Angaturama limai"

Spinosauridae (Cretáceo inf. – sup.): no Brasil

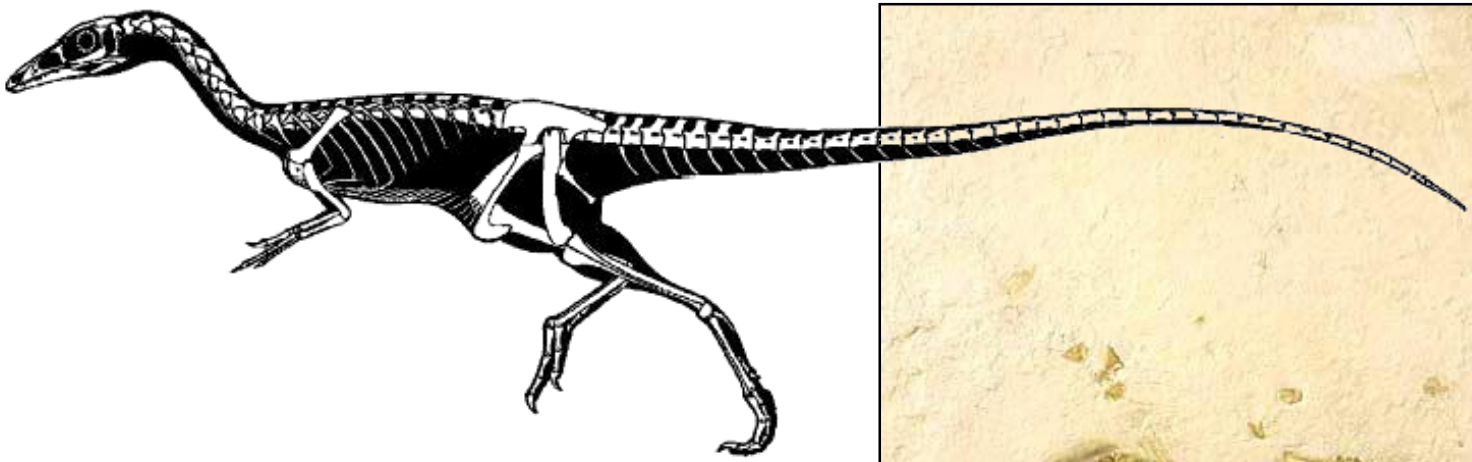
Fm. Itapecuru, Cretáceo sup., Bacia de São Luis-Grajaú, MA

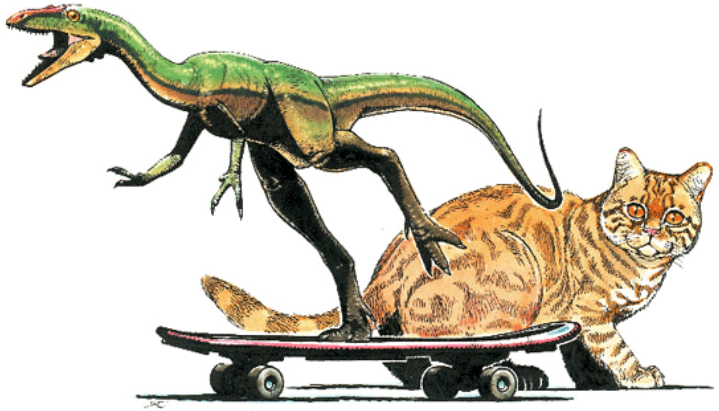
No limite inferior de tamanhos estimados para *Spinosaurus*

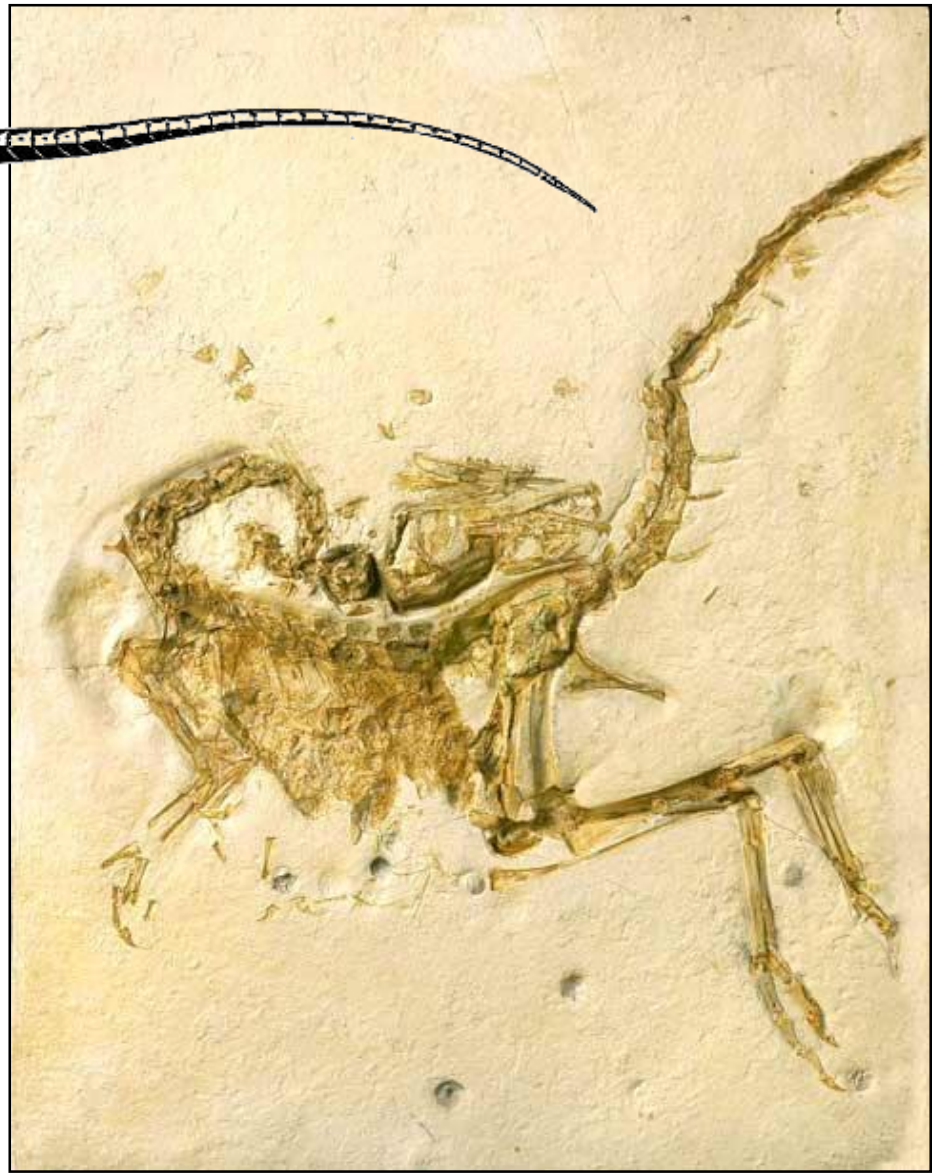


Coelurosauria (Jurássico médio - Recente)

Compsognathidae (Jurássico sup. - Cretáceo inf.)



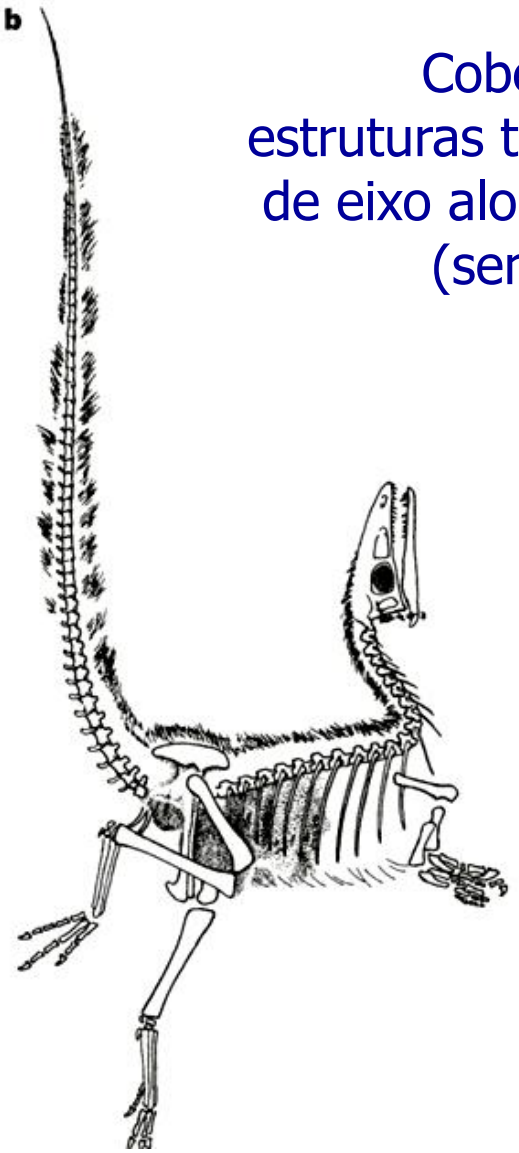




Compsognathus
Jurássico sup., Solnhofen

Compsognathidae (Jurássico sup. - Cretáceo inf.)

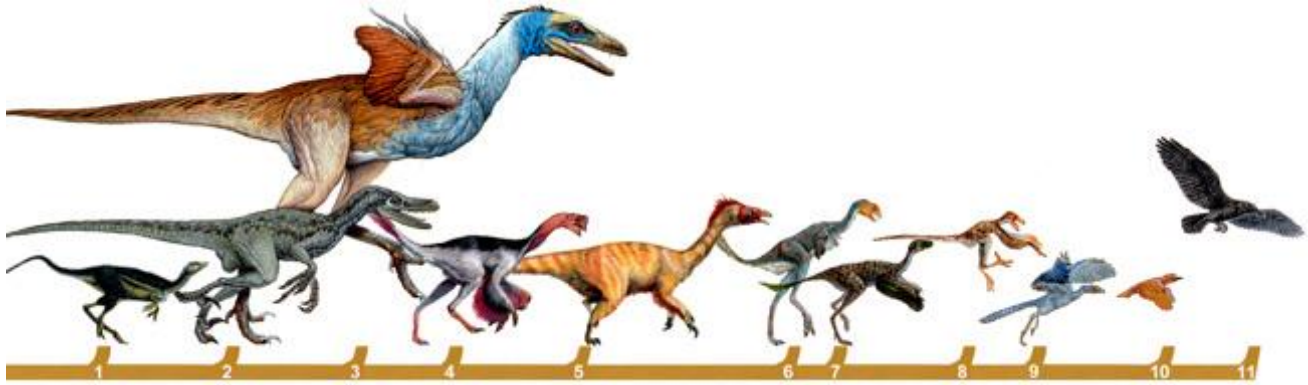
Sinosauropteryx, Cretáceo inf. Liaoning



Cobertura dorsal de estruturas tegumentares formadas de eixo alongado (barba) simples (sem ramificações)

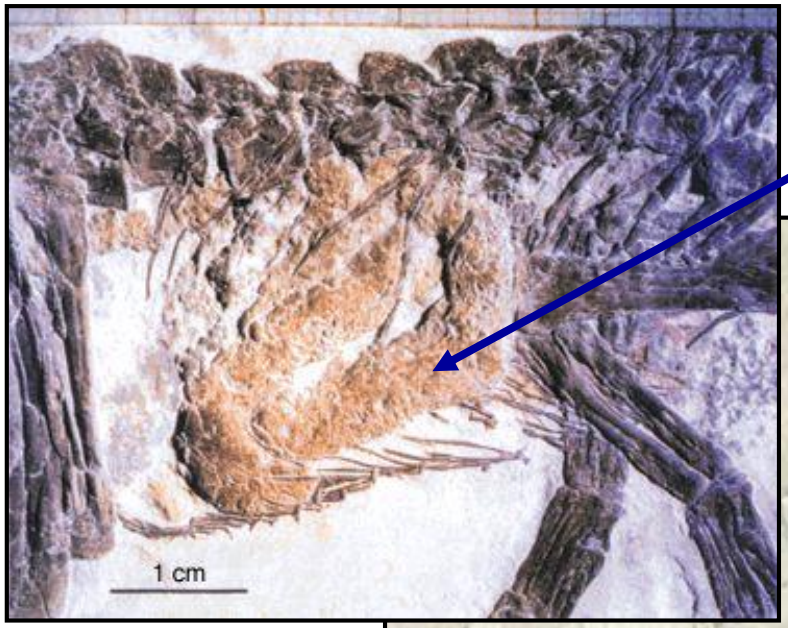
Compsognathidae (Jurássico sup. - Cretáceo inf.)

Sinosauropteryx, Cretáceo inf. Liaoning

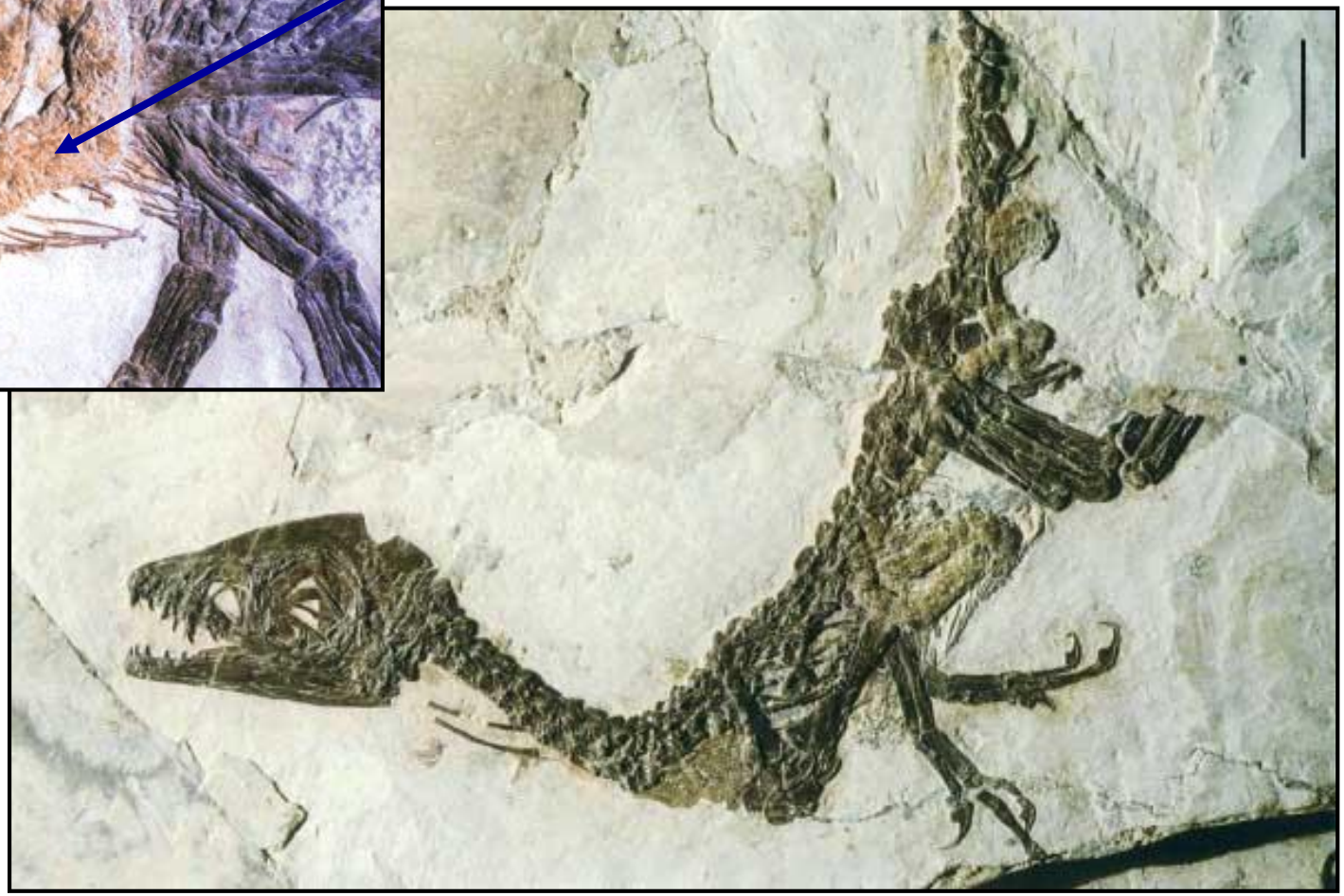


Coelurosauria (Jurássico médio - Recente)

Scipionyx, Cretáceo inf., Pietraroia



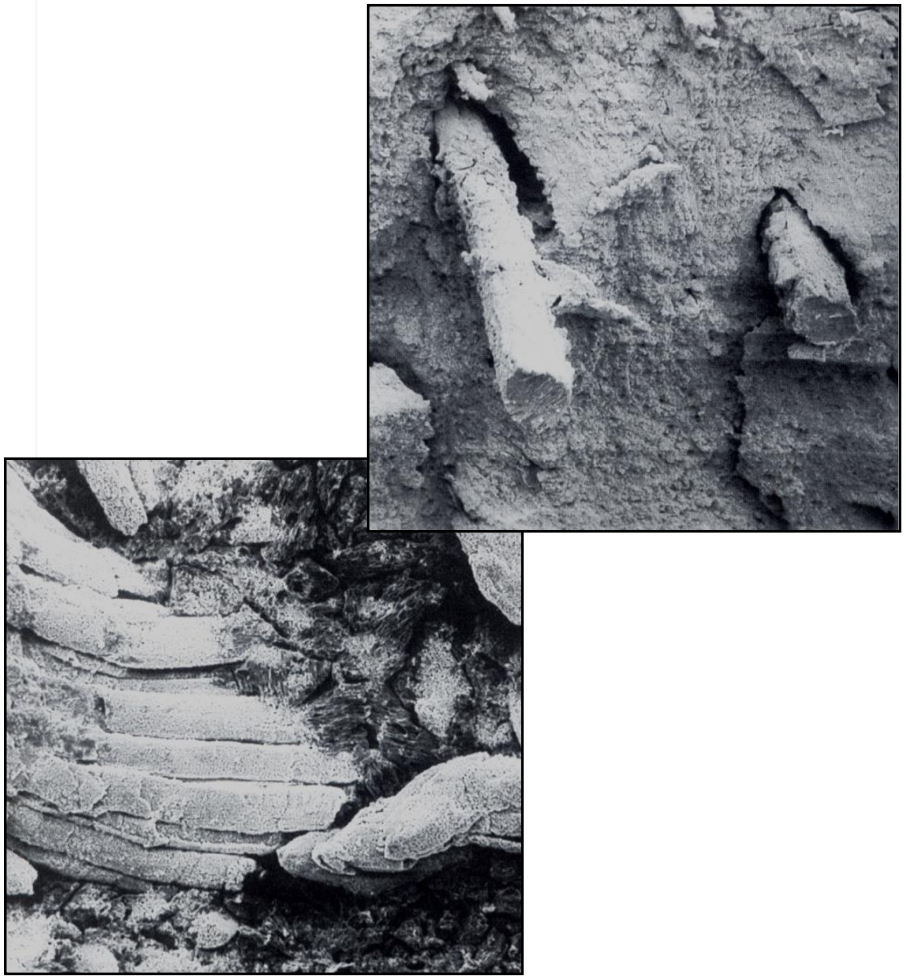
Intestino



Santanaraptor placidus: Cretáceo inf. (Fm. Santana)

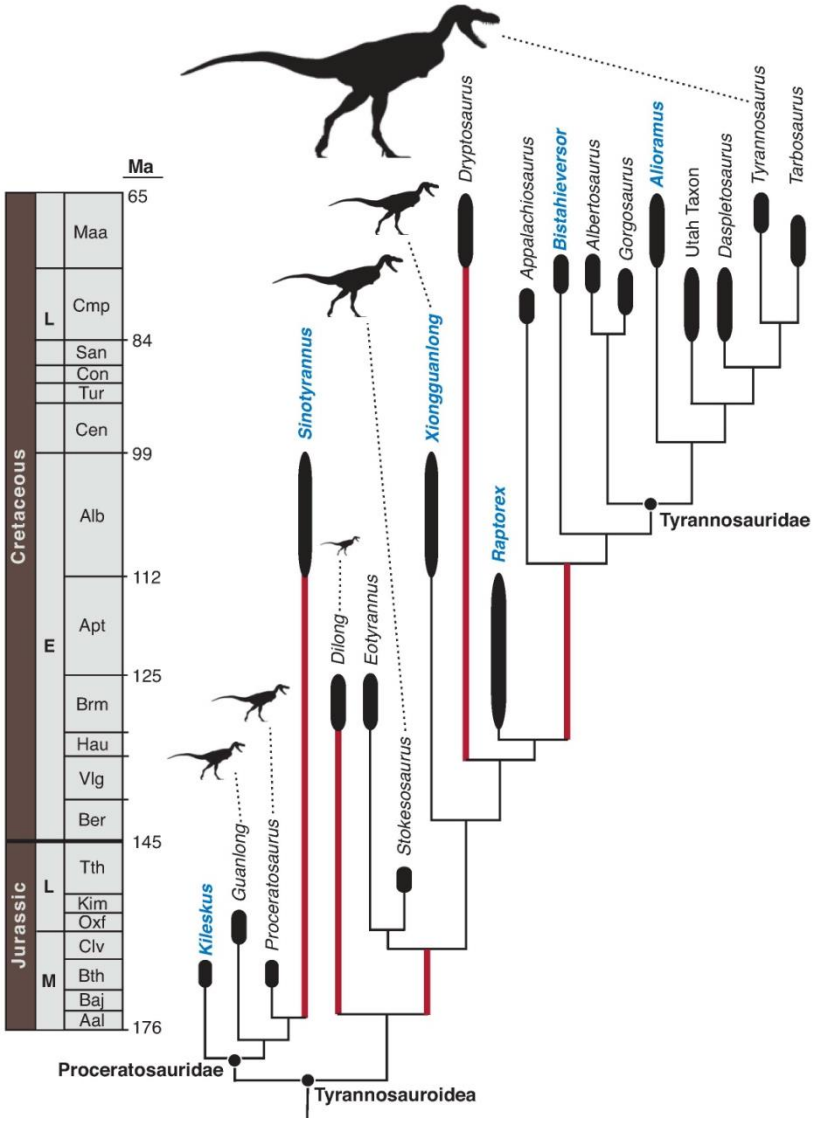
Preservação de partes moles: vasos sanguíneos e tecido muscular

Possível Tyrannoraptora (Tyrannosauria + Maniraptora)



Tyrannosauroidea (Jurássico sup. - Cretáceo sup.)

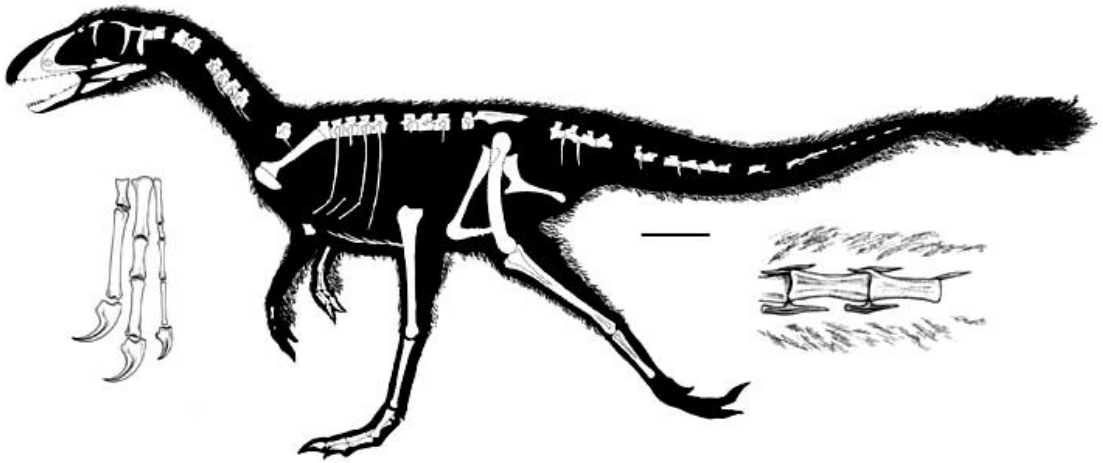
Classicamente considerados afins aos "carnossauros"

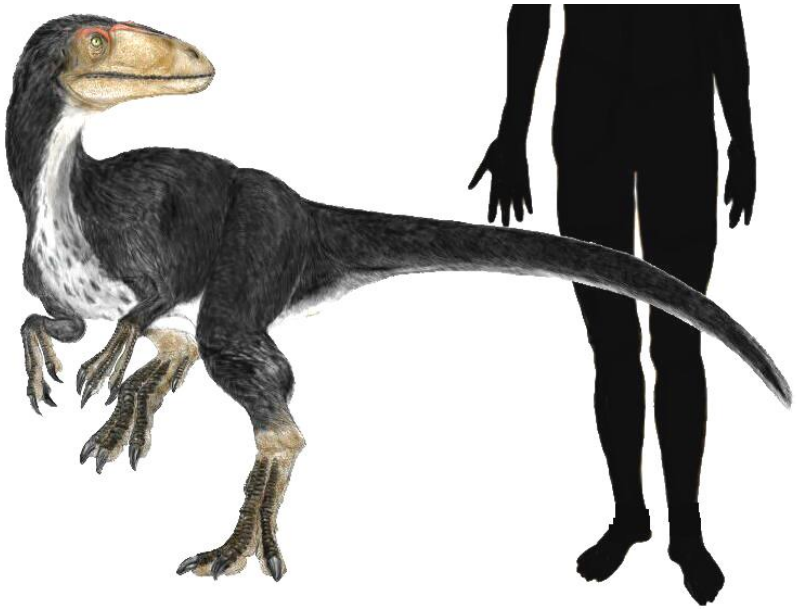


Formas basais de menor tamanho

Tyrannosauroidea (Jurássico sup. - Cretáceo sup.)

Dilong paradoxus, Cretáceo inf. (Liaoning)





Forma basal com "penas-filiformes"

Tyrannosauroidea (Jurássico sup. - Cretáceo sup.)

Tyrannosaurus rex (EUA e Canadá)

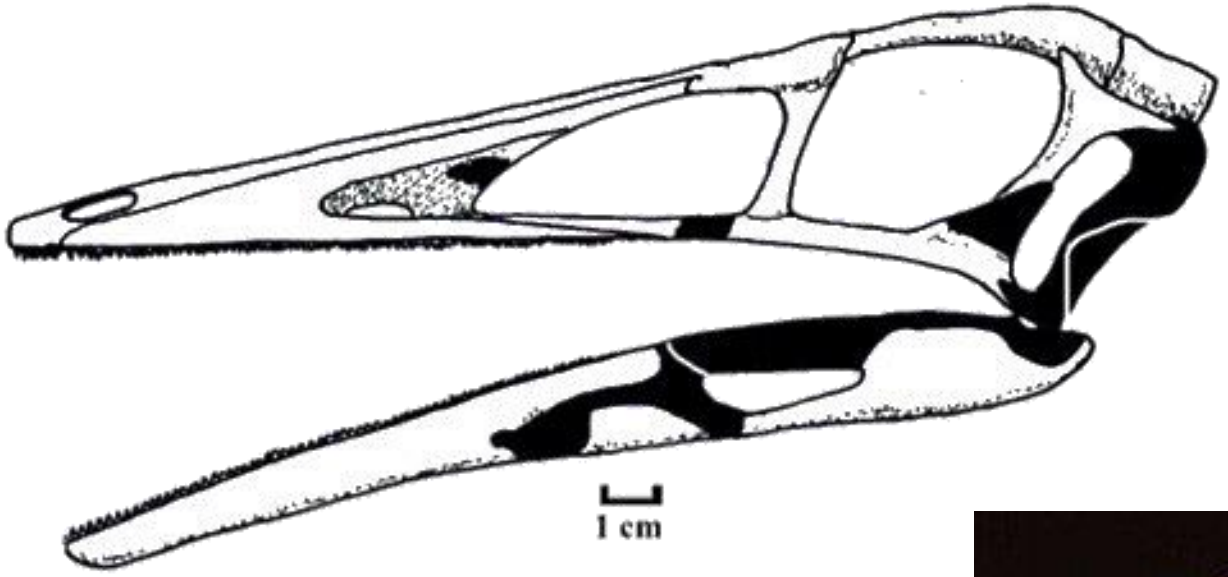
13 m de comprimento

Ornithomimosauria (Cretáceo inf. - sup.)

"Dinossauros-avestruz": hábito possivelmente onívoro

Distribuição laurasiana (Europa, Ásia e América do Norte)

Formas basais do Cretáceo inf. com dentes



Pelecanimimus

Calizas de la Huergina, Cauca

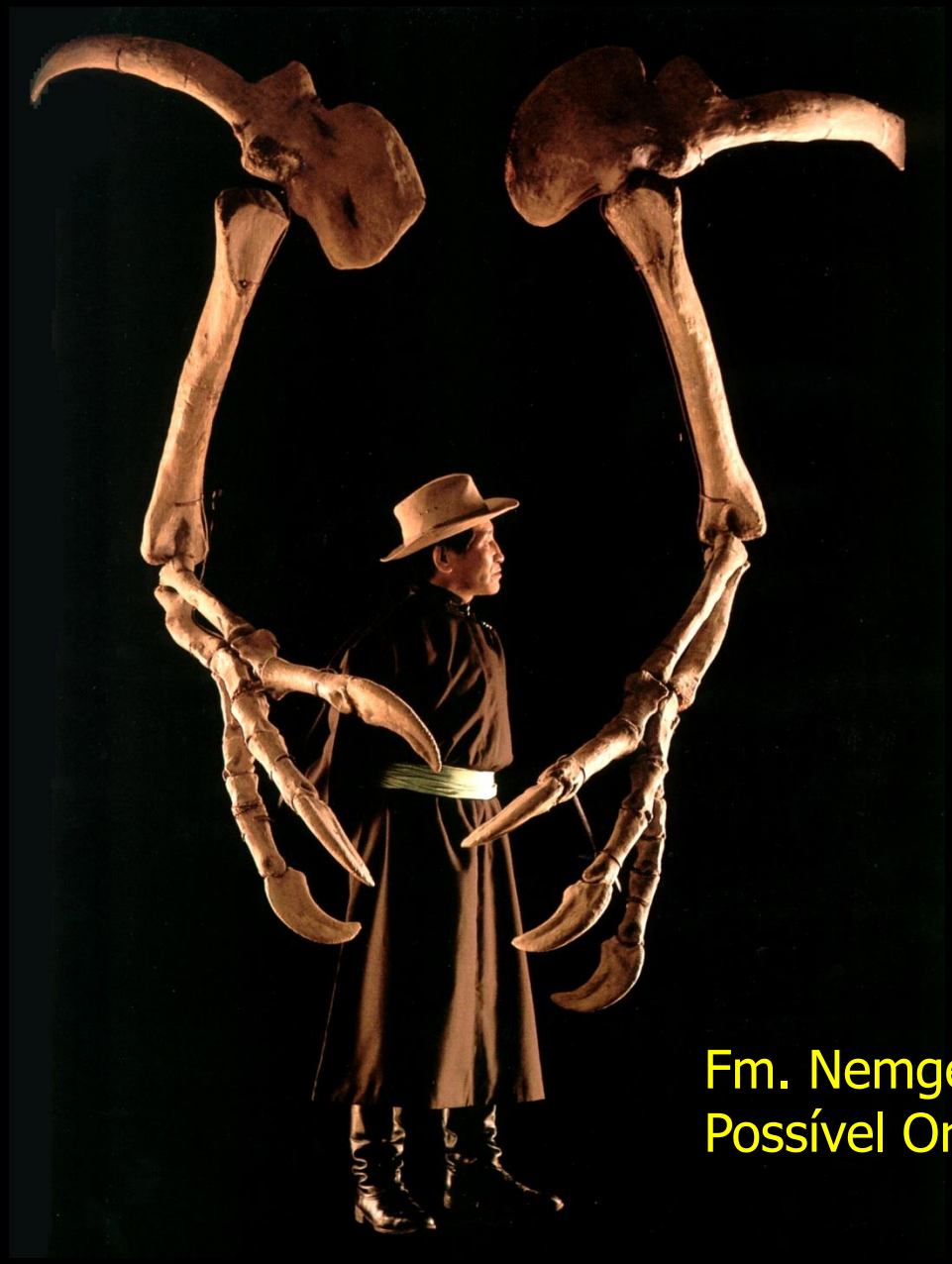
Ornithomimosauria (Cretáceo inf. - sup.)

Gallimimus, Fm. Nemget, Mongólia

Ornithomimosauria (Cretáceo inf. - sup.)

Gallimimus, Fm. Nemget, Mongólia: ranforeca

Deinocheirus mirificus

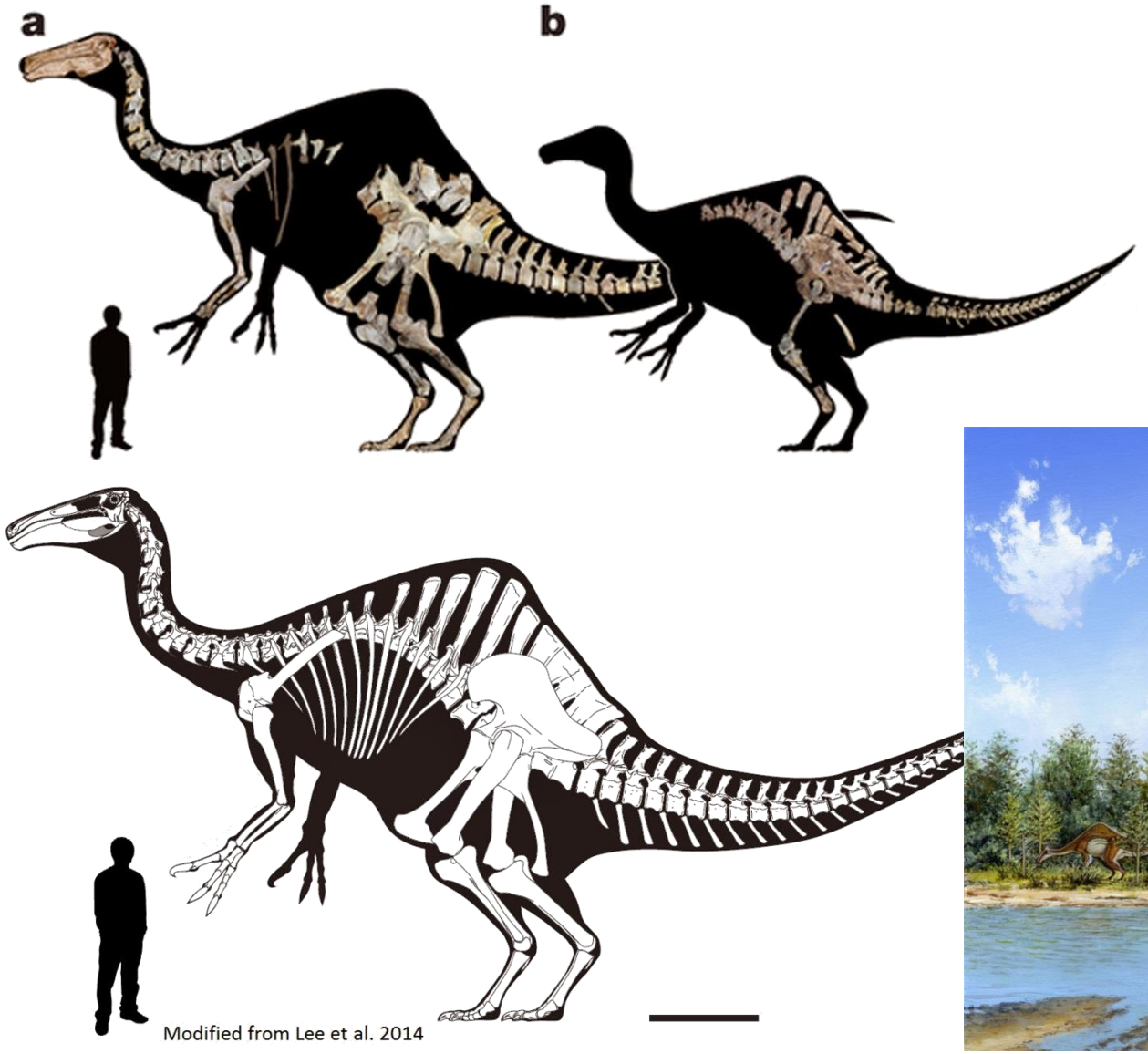


Gallimimus

Fm. Nemget (Cretáceo sup., Mongólia)
Possível Ornithomimosauria

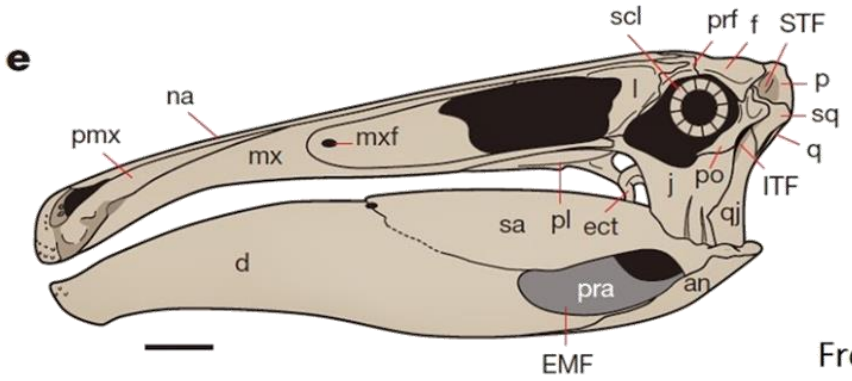
Ornithomimosauria (Cretáceo inf. - sup.)

Deinocheirus mirificus



Ornithomimosauria (Cretáceo inf. - sup.)

Deinocheirus mirificus



From Lee et al. 2014

Segnosauria (Cretáceo inf. - sup.)

Por muito tempo classificados como Dinosauria *insertae sedis*

Púbis retrovertido (Ornithischia) e dentes lanceolados (Prosauropoda)

Distribuição laurasiana (Ásia e América do Norte)

Falcarius
Cretáceo inf. Utah

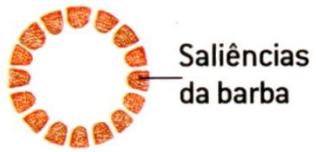
Segnosauria (Cretáceo inf. - sup.)

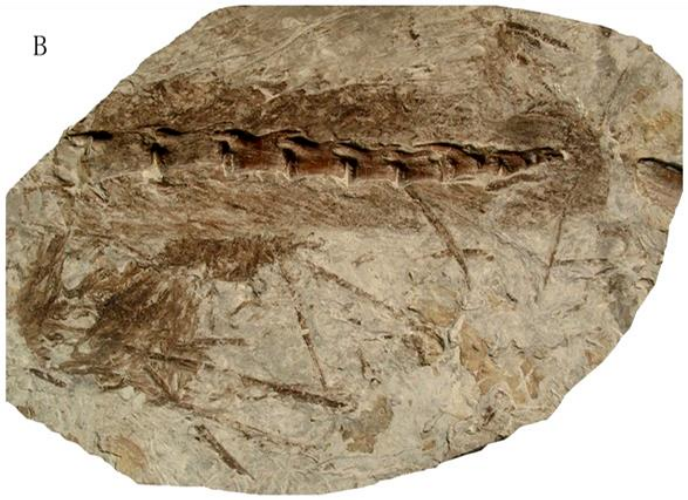
Beipiaosaurus (Cretáceo inf., Liaoning) - tegumento formado por elementos "plumáceos" (tufo de "barbas" sem ramificação presas ao cálamo)

Diferenciação do colarinho do folículo

Segnosauria (Cretáceo inf. - sup.)

Beipiaosaurus (Cretáceo inf., Liaoning) - tegumento formado por elementos "plumáceos" (tufo de "barbas" sem ramificação presas ao cálamo)

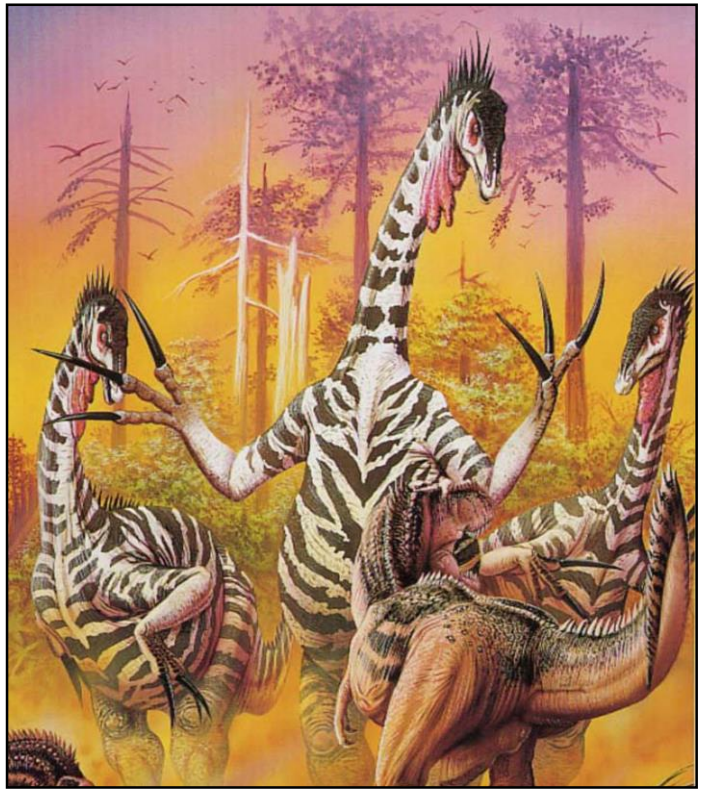


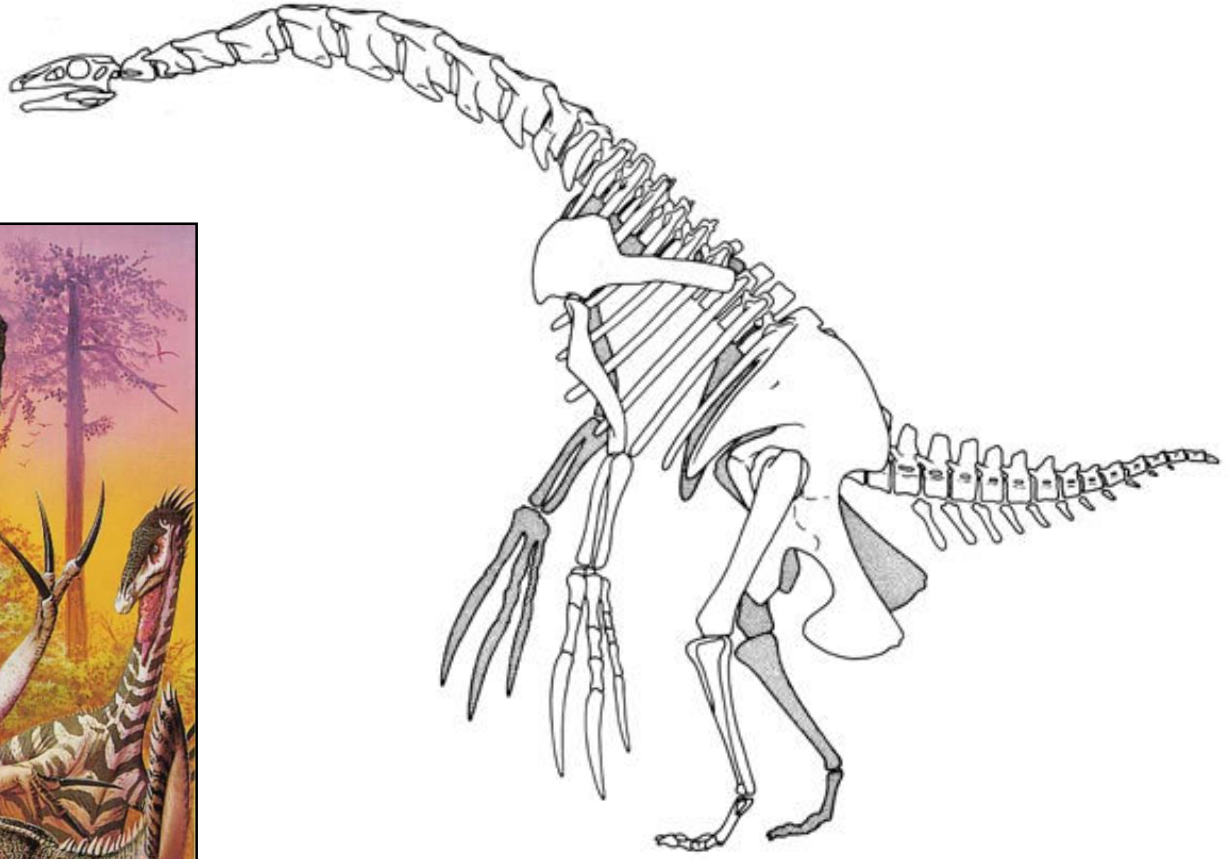


Diferenciação do colarinho do folículo

Segnosauria (Cretáceo inf. - sup.)

Formas mais derivadas com sustentação tripodial como alguns edentados e garras manuais alongadas

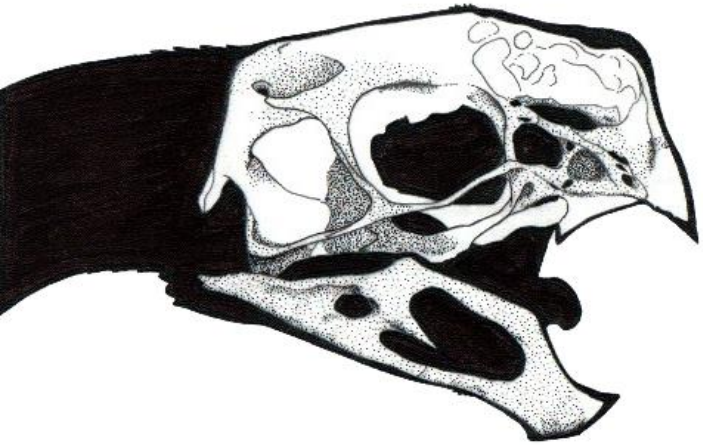




Therizinosaurus
Cretáceo sup., Mongólia

Oviraptorosauria (Cretáceo inf. - sup.)

Distribuição laurasiana (Ásia e América do Norte)



"Ladrão de ovos"

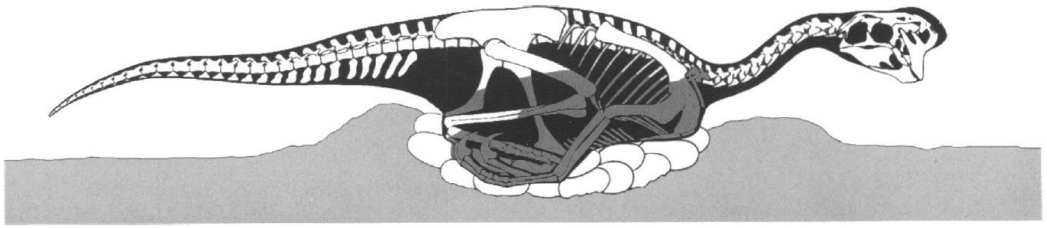
Oviraptorosauria (Cretáceo inf. - sup.)

"Ovos de *Protoceratops*" com embriões de *Oviraptor*

Fm. Djadokhta
Deserto de Gobi

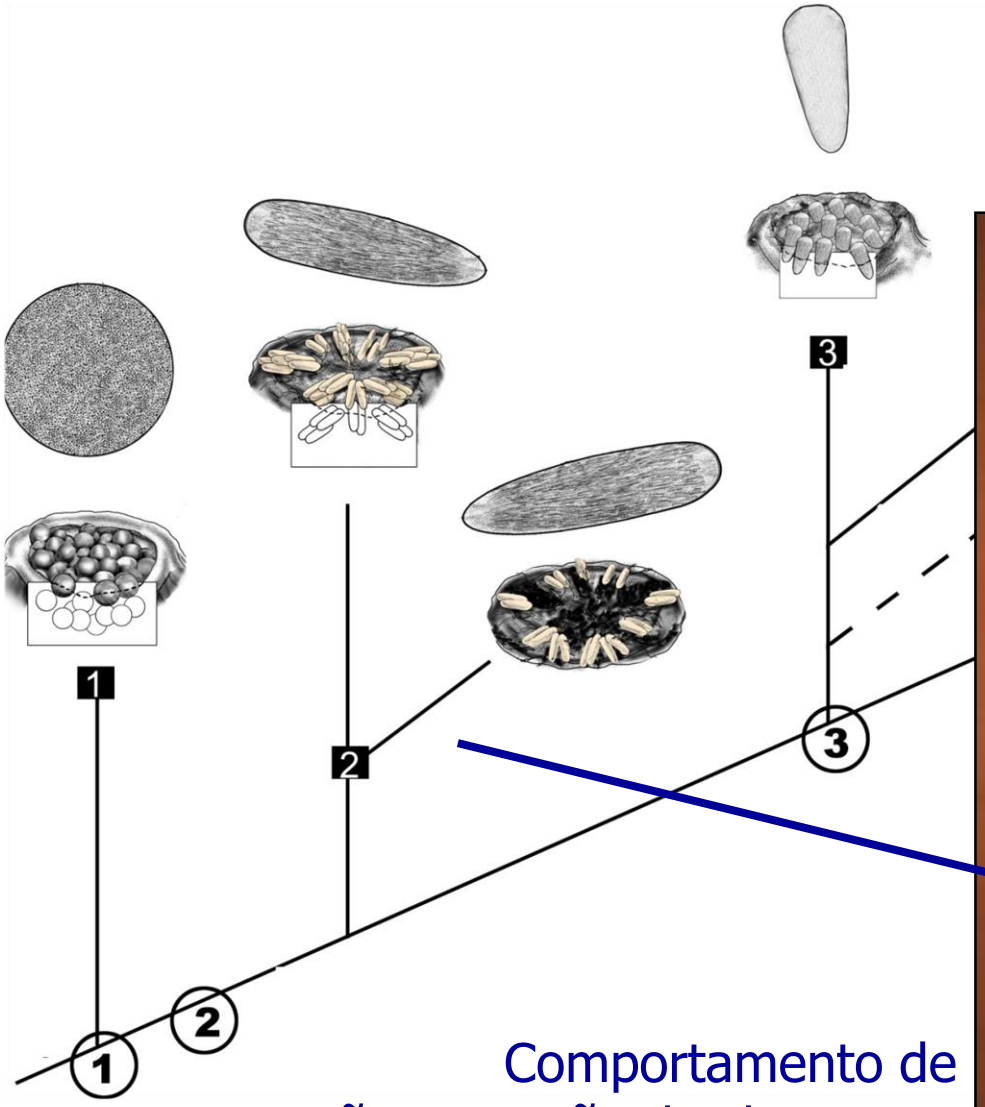
Oviraptorosauria (Cretáceo inf. - sup.)

Oviraptor: adulto no ninho



Oviraptorosauria (Cretáceo inf. - sup.)

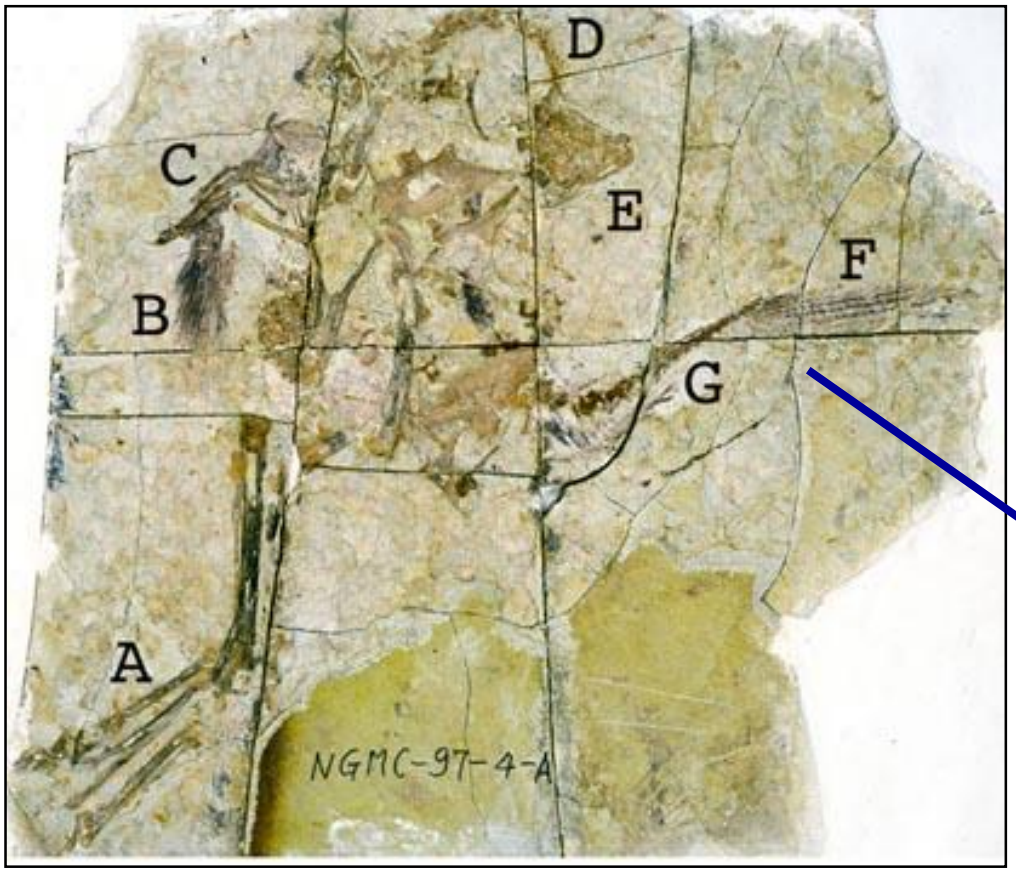
Oviraptor: ovos empilhados e fora da região central

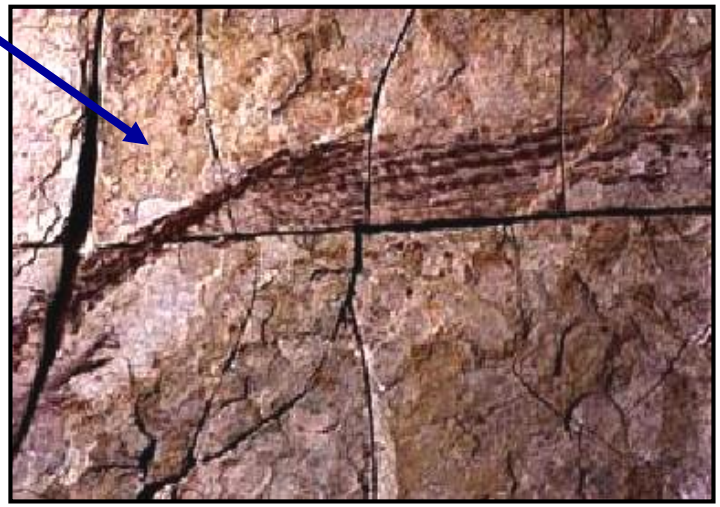


Comportamento de proteção, mas não de chocagem

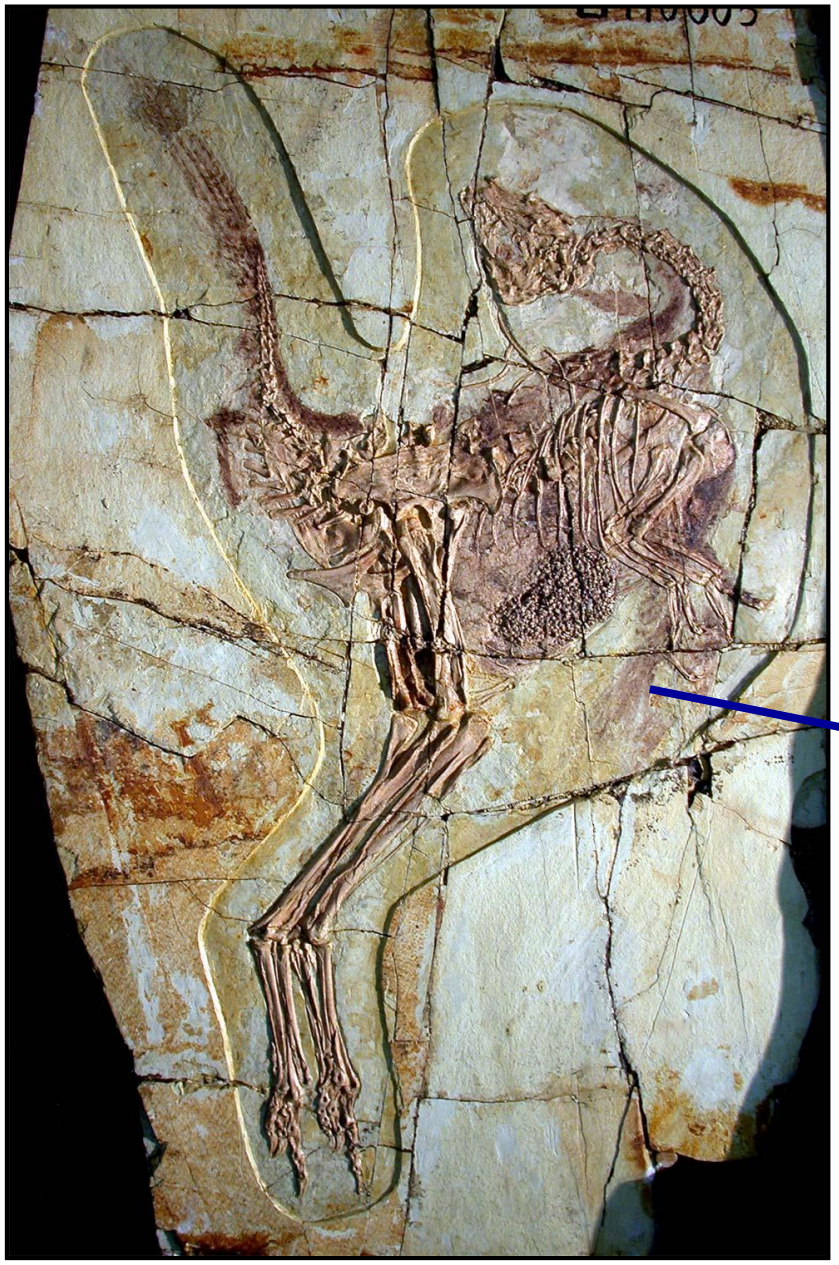
Oviraptorosauria (Cretáceo inf. - sup.)

Caudipteryx (Cretáceo inf. Liaoning): tegumento com estrutura "penácea" (planar com barbas ligadas à raque central) nos braços e cauda



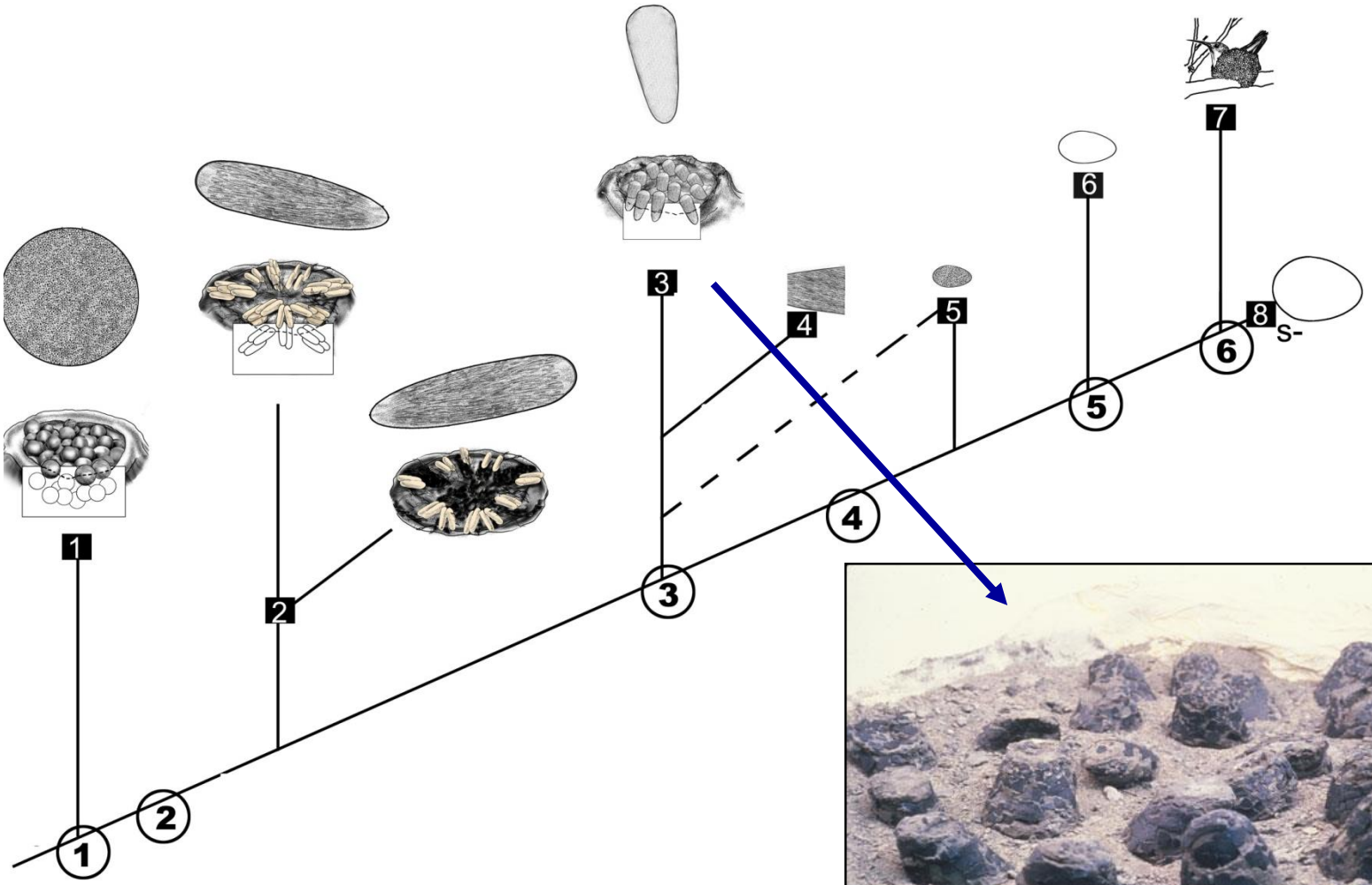


Oviraptorosauria (Cretáceo inf. - sup.)



Troodontidae (Jurássico sup. - Cretáceo sup.)

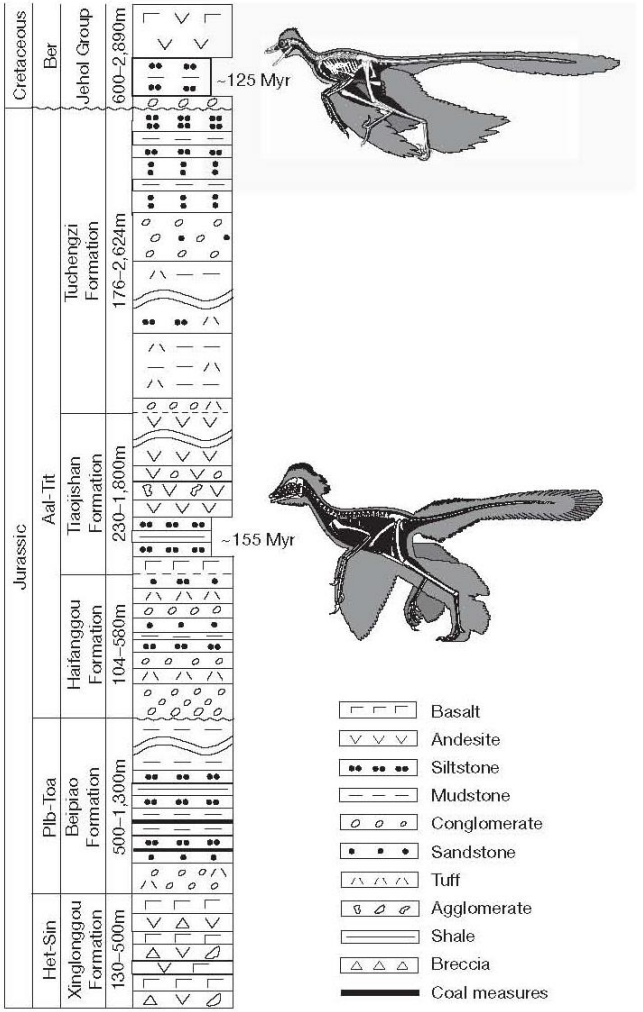
Troodon (Cretáceo sup. de Montana): postura de ovos para chocagem



Apenas uma camada e
sem espaço central

Troodontidae (Jurássico sup. - Cretáceo sup.)

Anchiornis (Jurássico sup., Grupo Jehol, Liaoning, China)

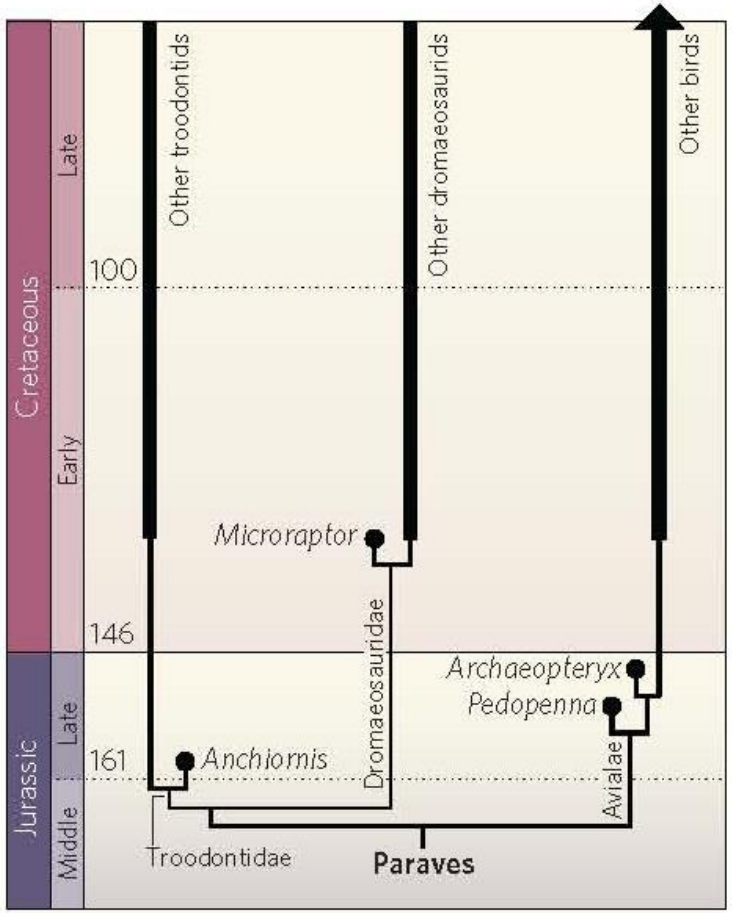


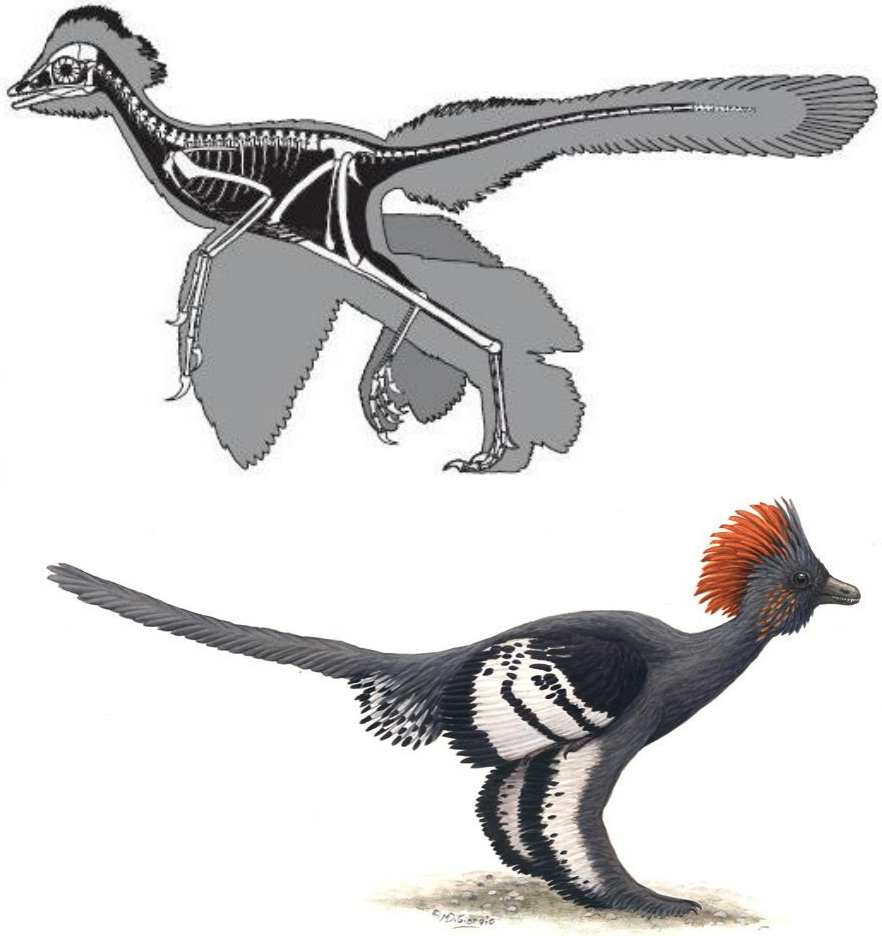
Troodontidae (Jurássico sup. - Cretáceo sup.)

Anchiornis (Jurássico sup., Grupo Jehol, Liaoning, China)

"Fim do paradoxo temporal aviano", em contexto Deinonychosauria

Penas penáceas nas pernas sugere padrão ancestral à aves





Dromaeosauria (Cretáceo inf. - sup.)

Velociraptorinae / Dromaeosaurinae

Formas maiores e terrestres: grande garra no pé e cauda "endurecida"

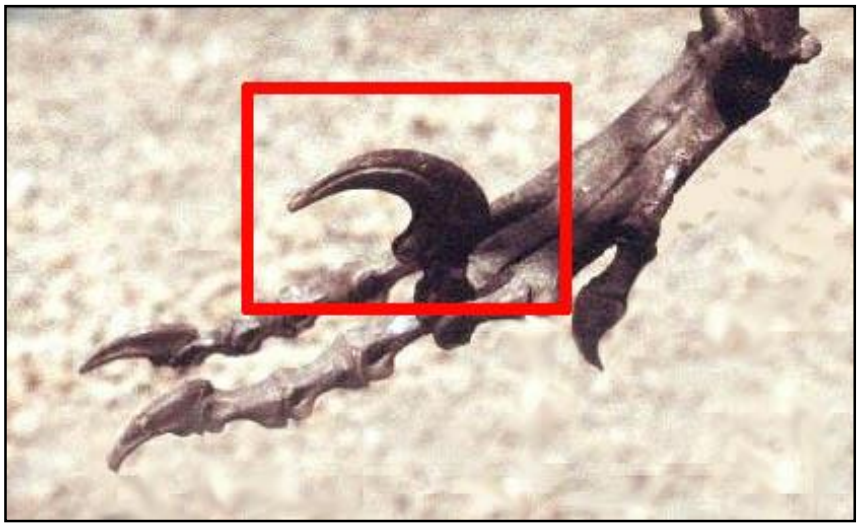
Velociraptor

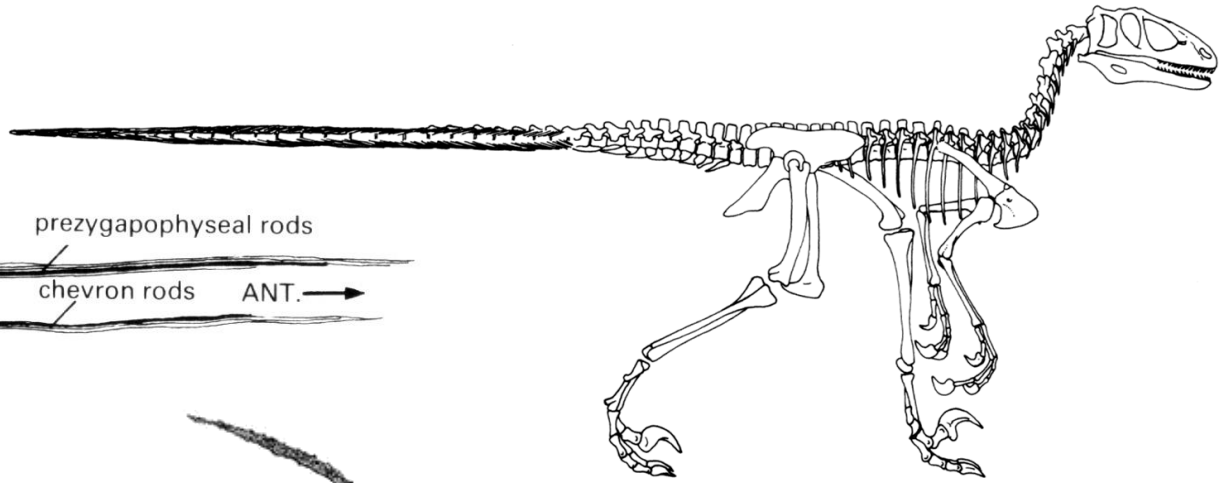
Cretáceo sup. da Mongólia e China

Dromaeosauria (Cretáceo inf. - sup.)

Velociraptorinae / Dromaeosaurinae

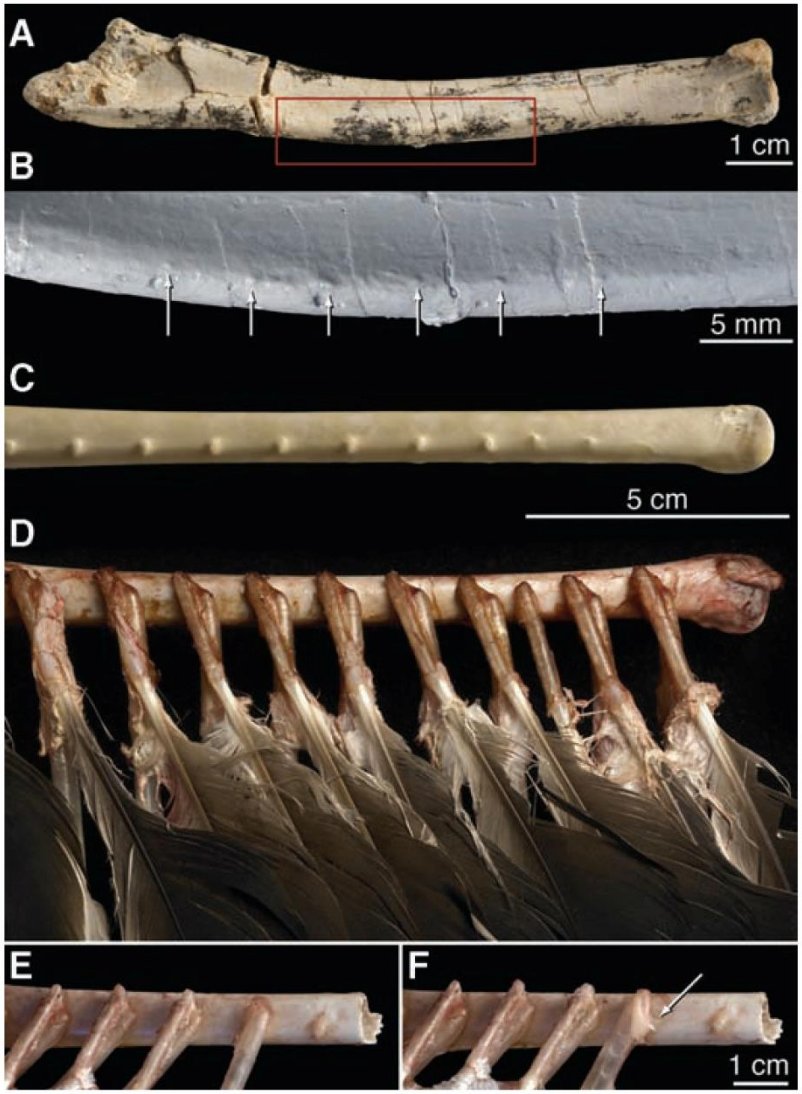
Deinonychus
Cretáceo inf., EUA





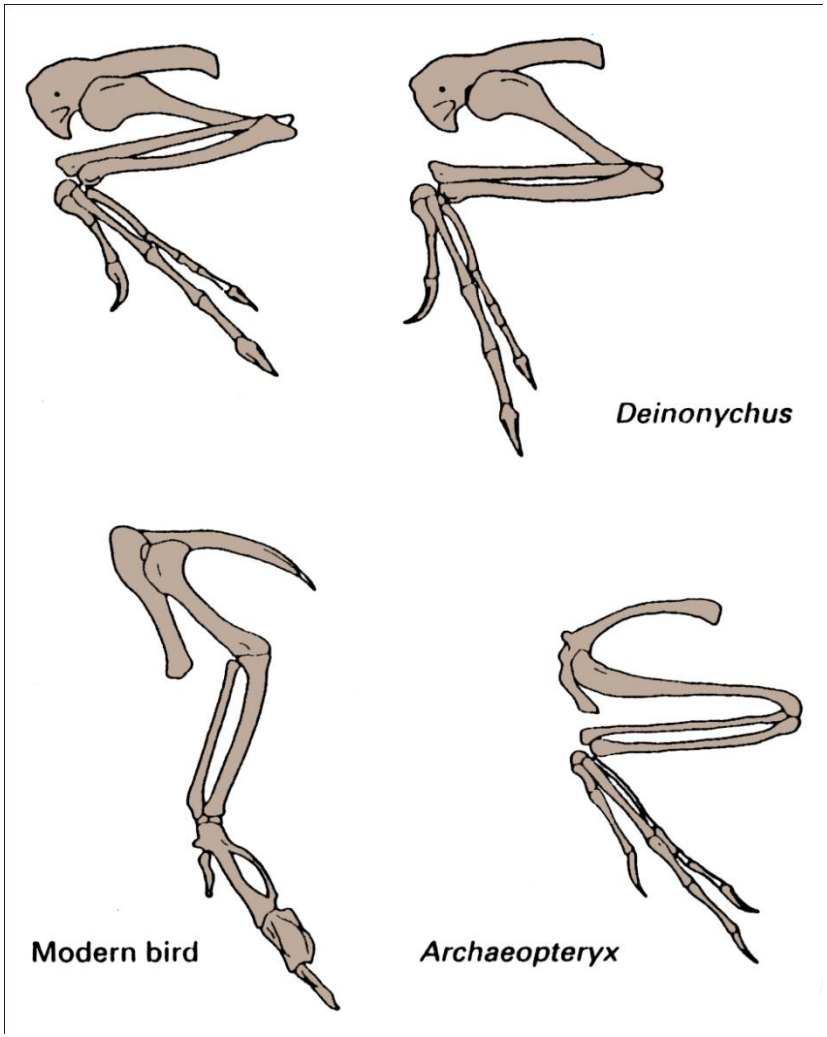
Dromaeosauria (Cretáceo inf. - sup.) paleobiologia

Inserção de penas na ulna de *Velociraptor*



Microraptorinae (Cretáceo inf. - sup.) paleobiologia

O movimento do "louva-à-deus" e o vôo das aves

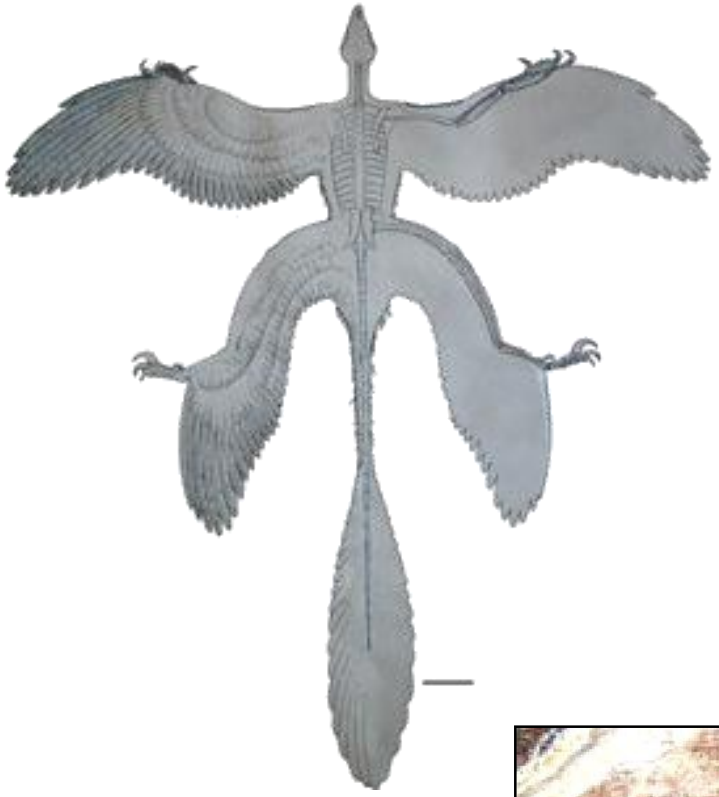


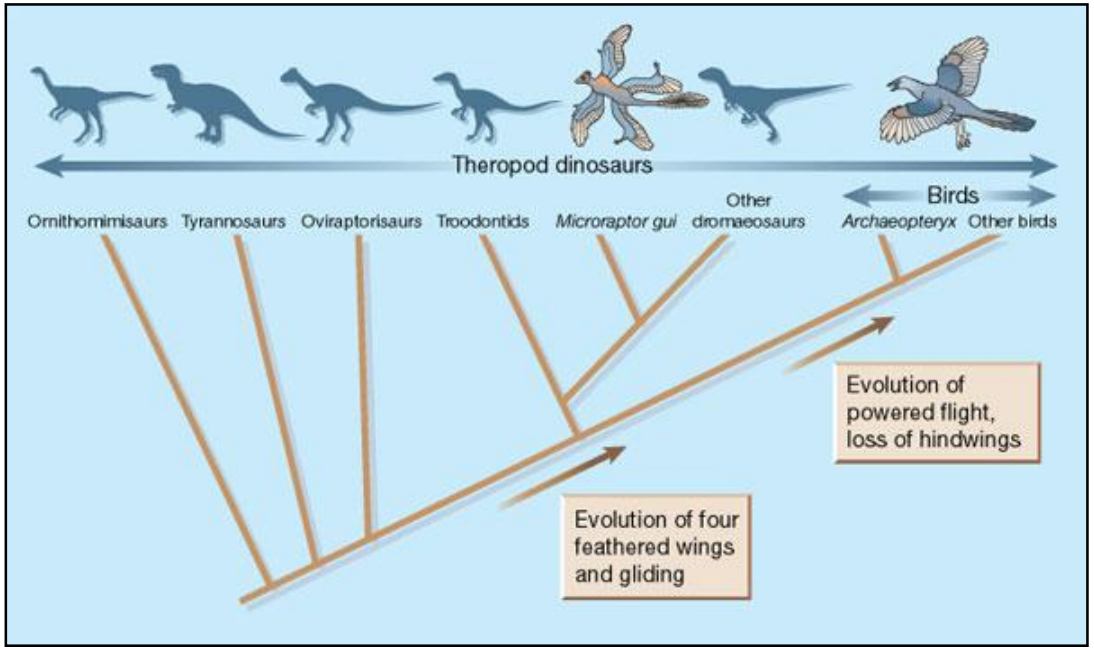
Microraptorinae (Cretáceo inf. - sup.)

Microraptor gui: penas assimétricas nas quatro patas

Microraptorinae (Cretáceo inf. - sup.)

Microraptor gui: penas assimétricas nas quatro patas





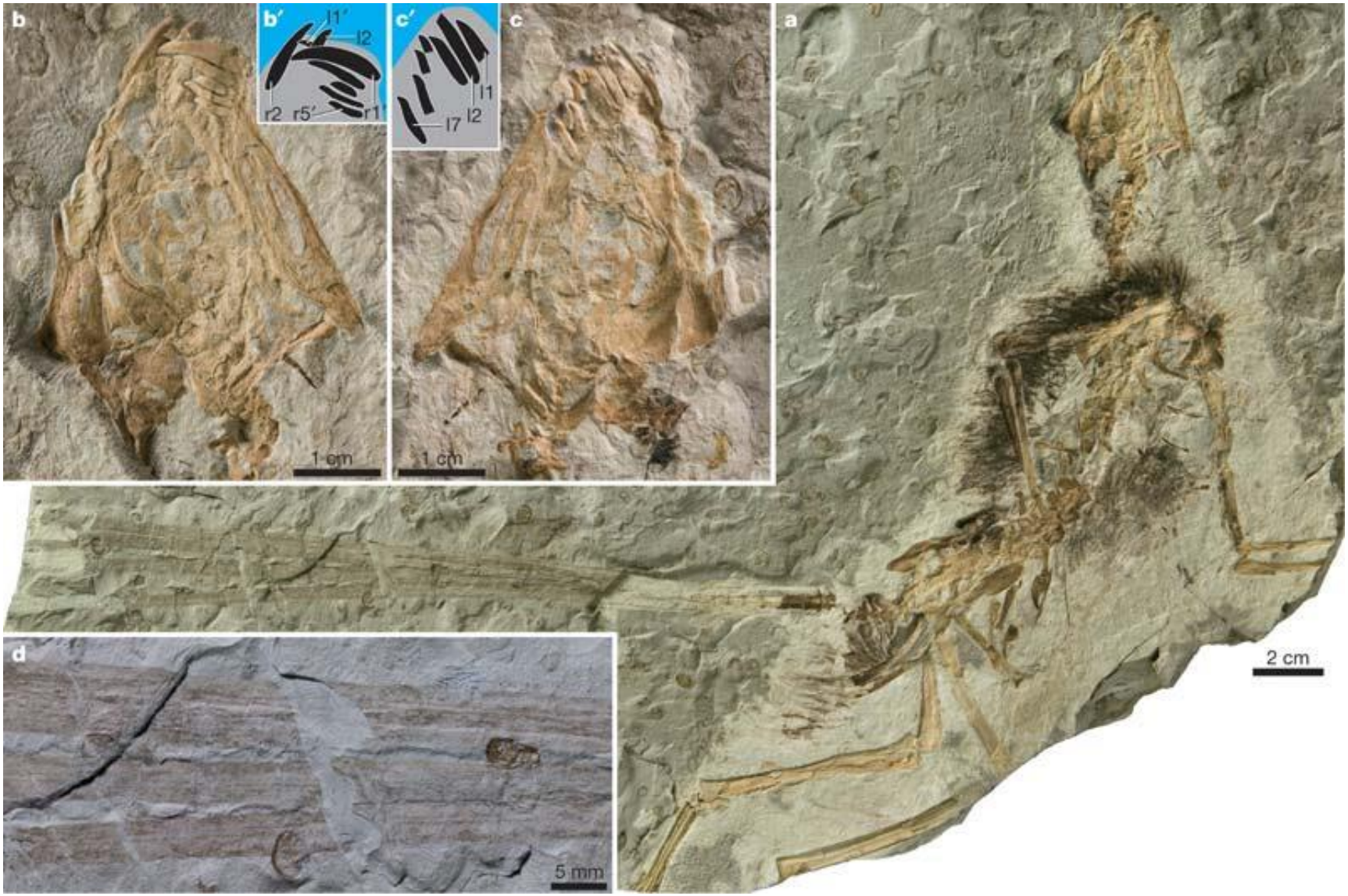
Microraptor gui

Epidexipteryx (Fm. Daohugou, Mongolia Interior)

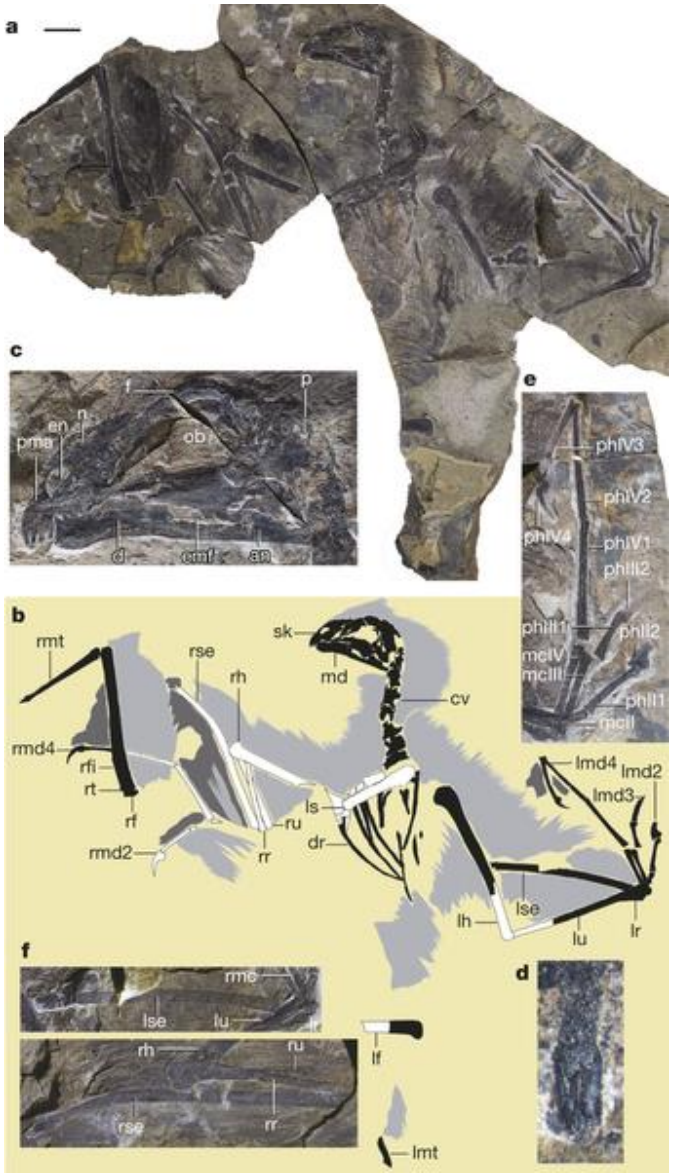
Jurásico-Cretáceo inf., Avialae basal à *Archaeopteryx*

Epidexipteryx (Fm. Daohugou, Mongolia Interior)

Jurásico-Cretáceo inf., Avialae basal à *Archaeopteryx*



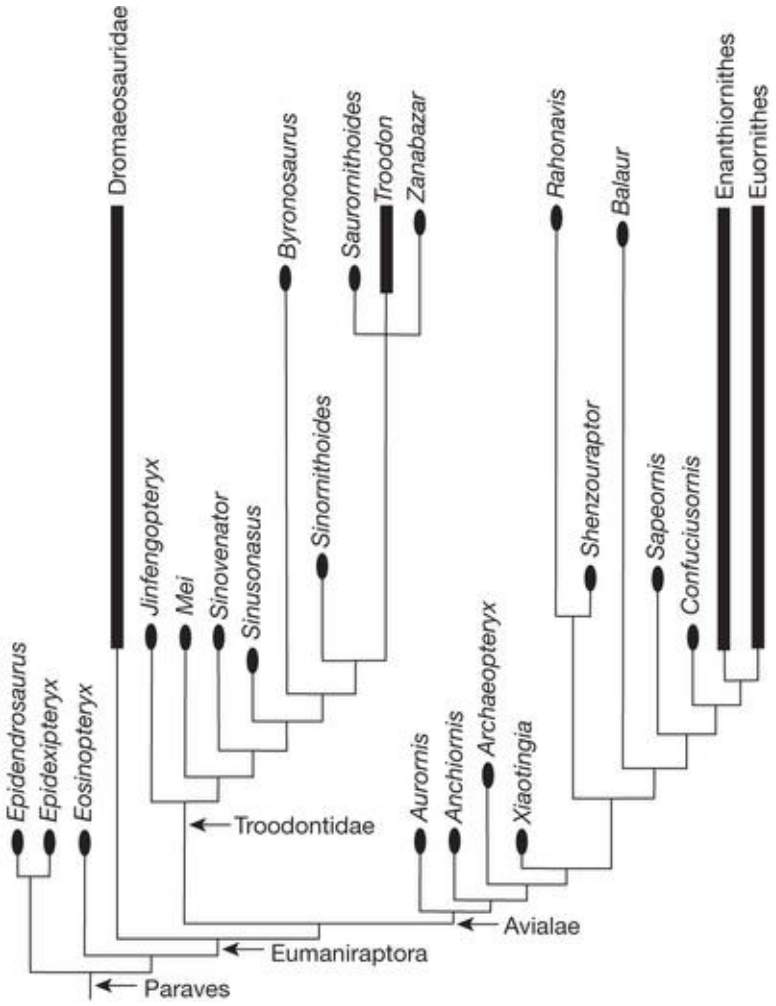
Yi qi (Jurássico do China): assa membranosa

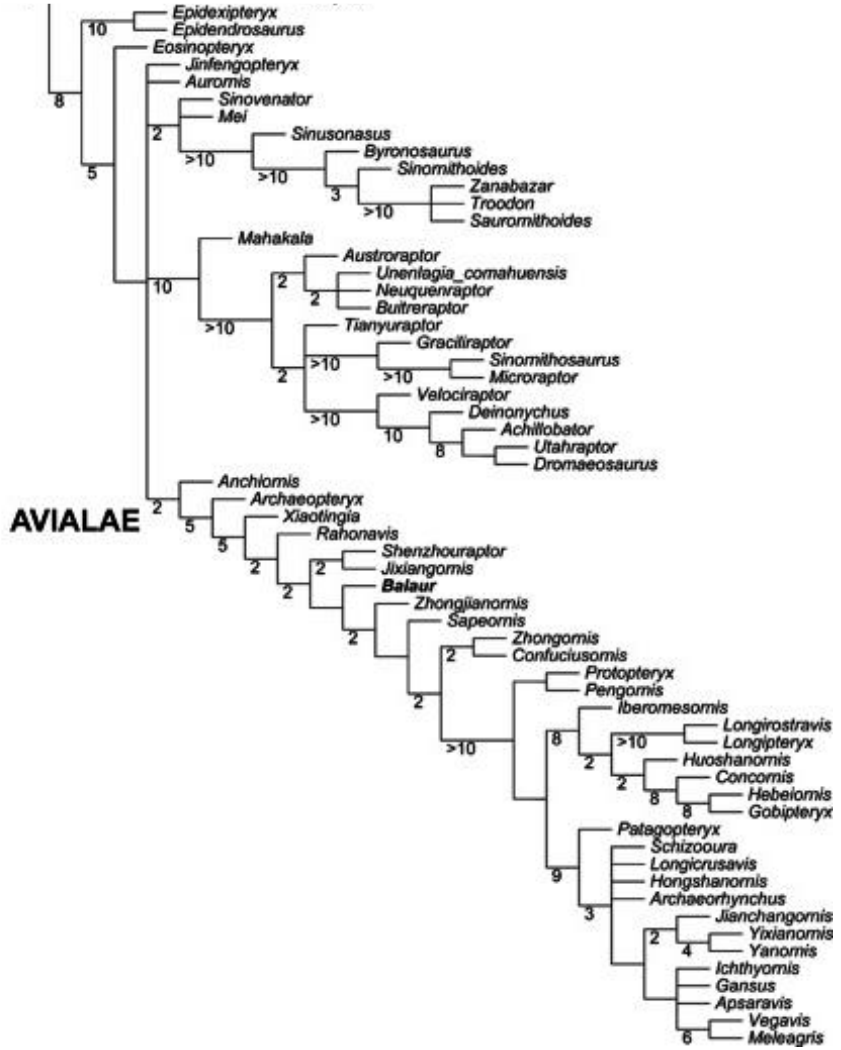


Aves (Jurássico sup. - Recente)

Avialae: todos terópodos mais próximos a Aves que a *Deinonychus*

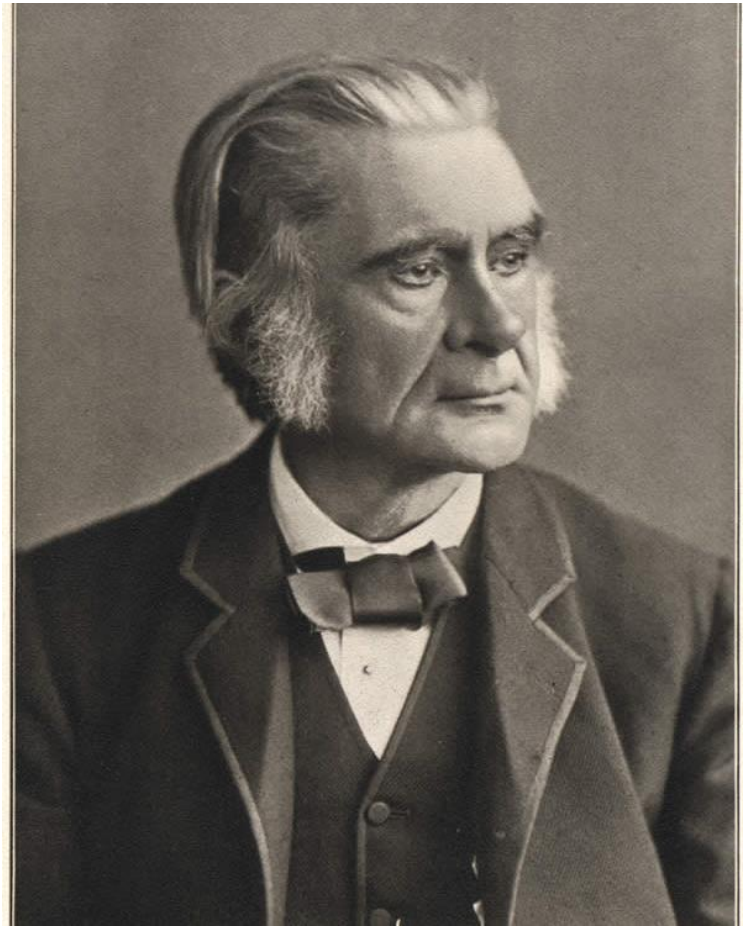
Paraves (Eumaniraptora): terópodos mais próximos a Aves que a oviraptores





A origem das aves

Dinosauria: hipótese primeiramente defendida por Thomas Huxley com base em estudos do *Archaeopteryx* e dinossauros do Cretáceo inglês



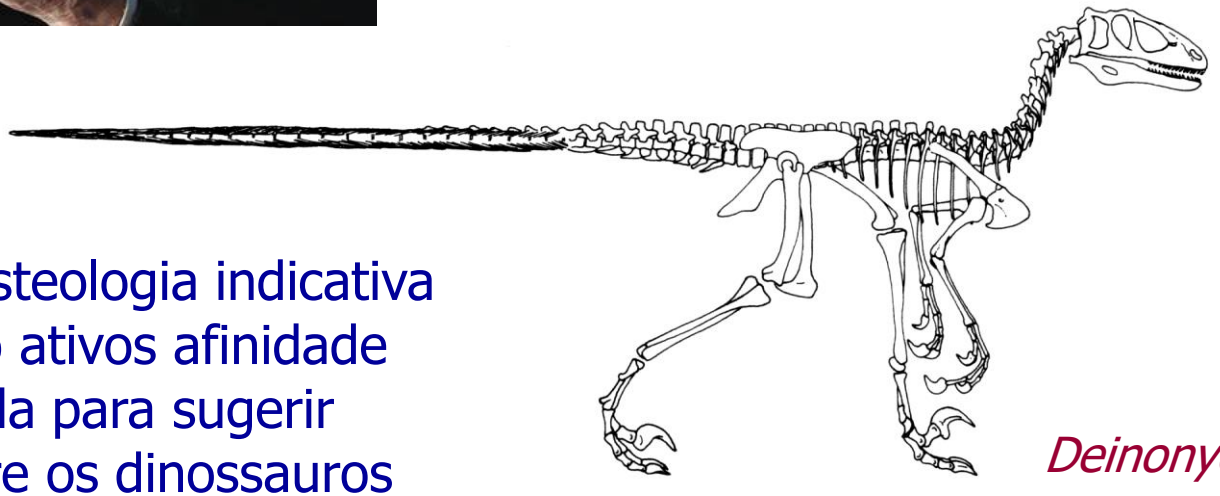
Thomas H. Huxley 1868

... If the whole hind quarters,
from the ilium to the toes,
of a half-hatched chicken
could be suddenly enlarged,
ossified, and fossilized as they are,
they would furnish us with
the last step of the transition
between birds and reptiles;
for there would be nothing in
their characters to prevent us
referring them to the Dinosauria

A origem das aves

Dromaeosauria: grupo irmão das aves: John Ostrom

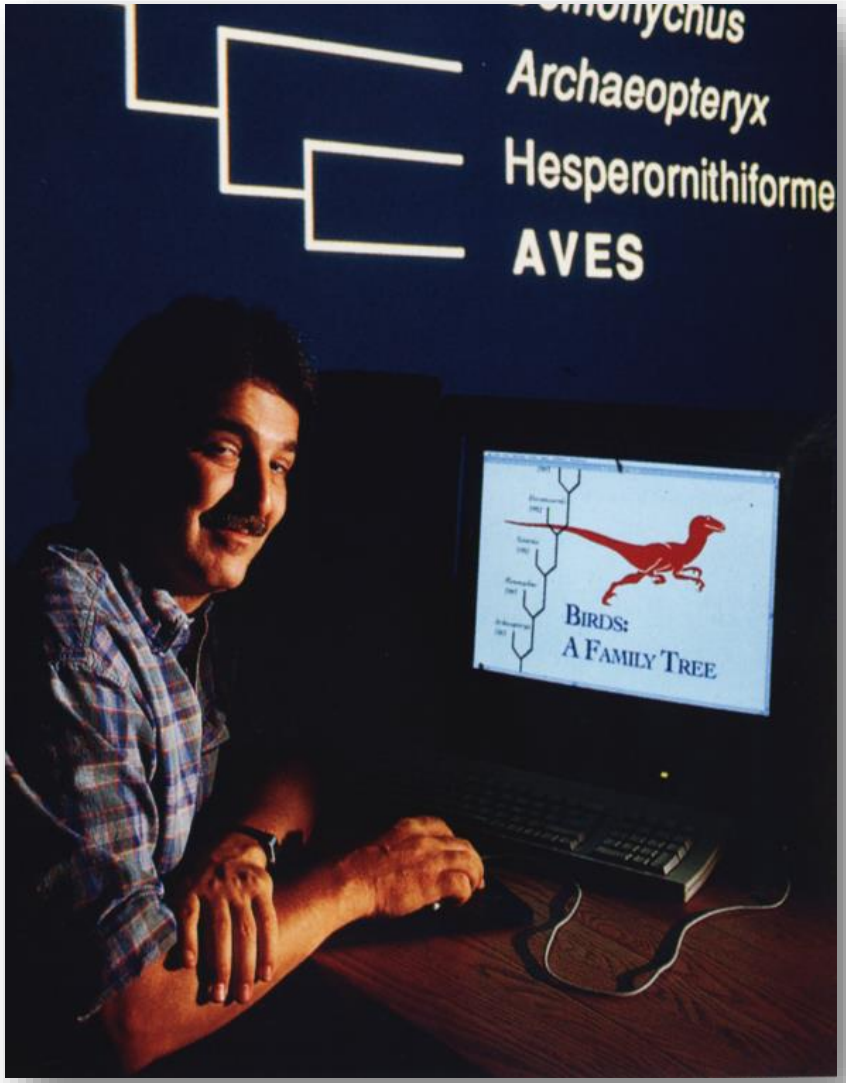
Archaeopteryx

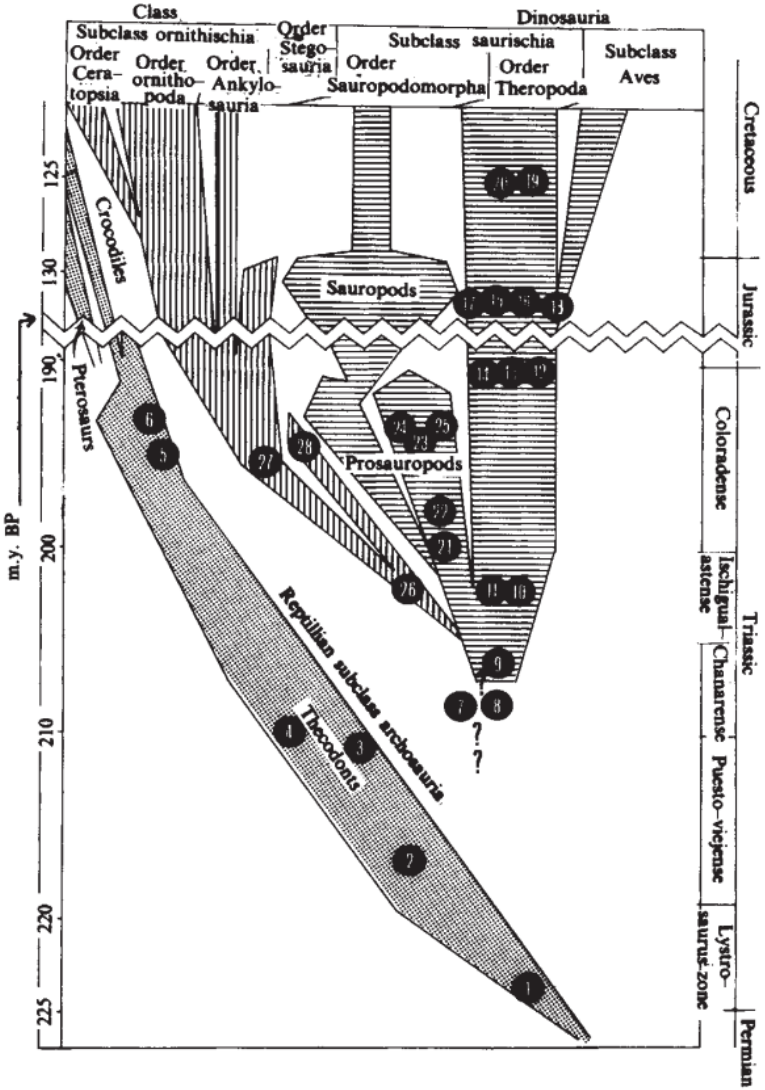


Deinonychus

Juntamente com osteologia indicativa de animais muito ativos afinidade aviana foi usada para sugerir endotermia dentre os dinossauros

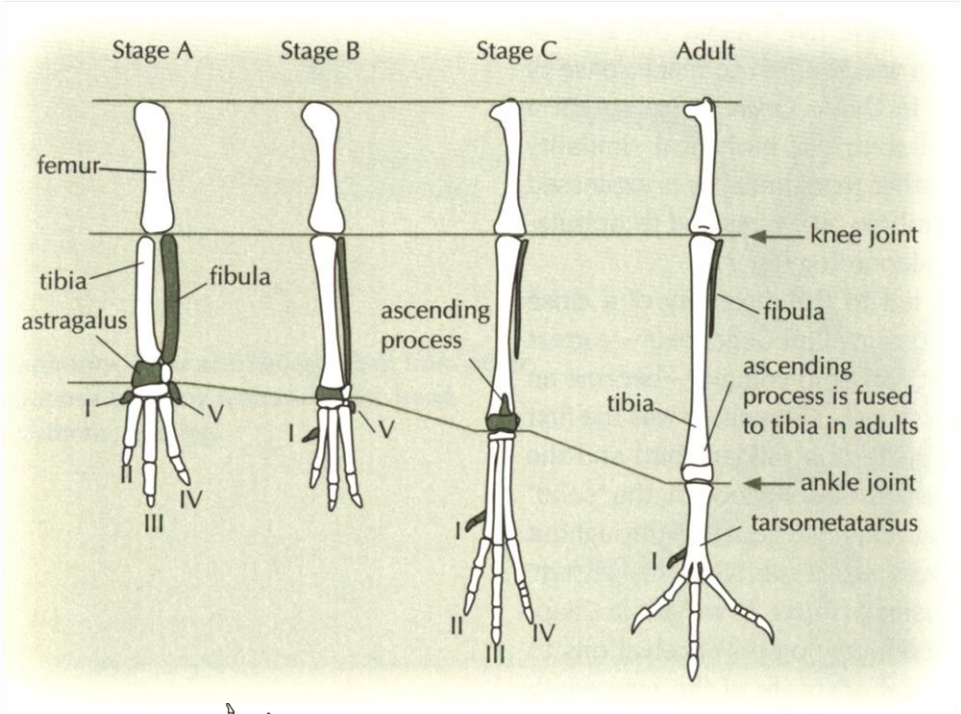
A origem das aves

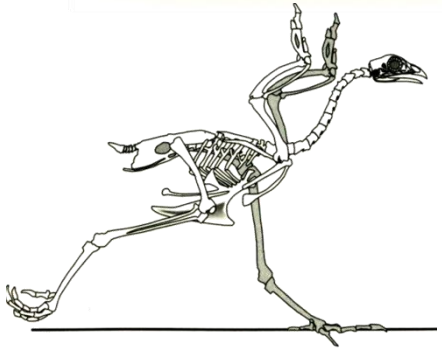


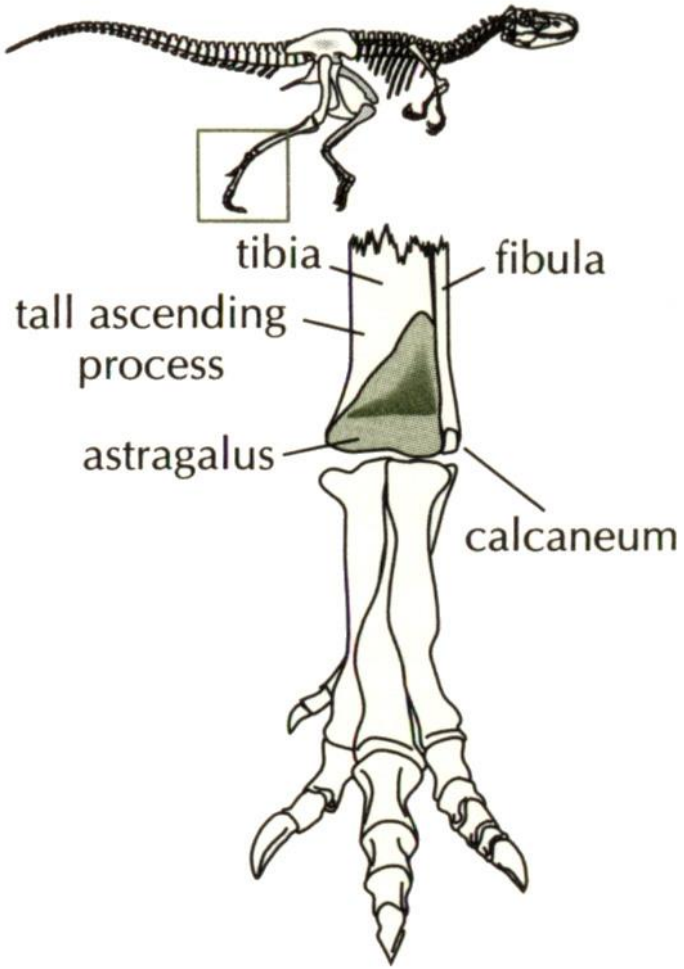


Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Archosauria: DINOSAURIA => bipedalismo: tridactilia, membros eretos e articulação mesotarsal

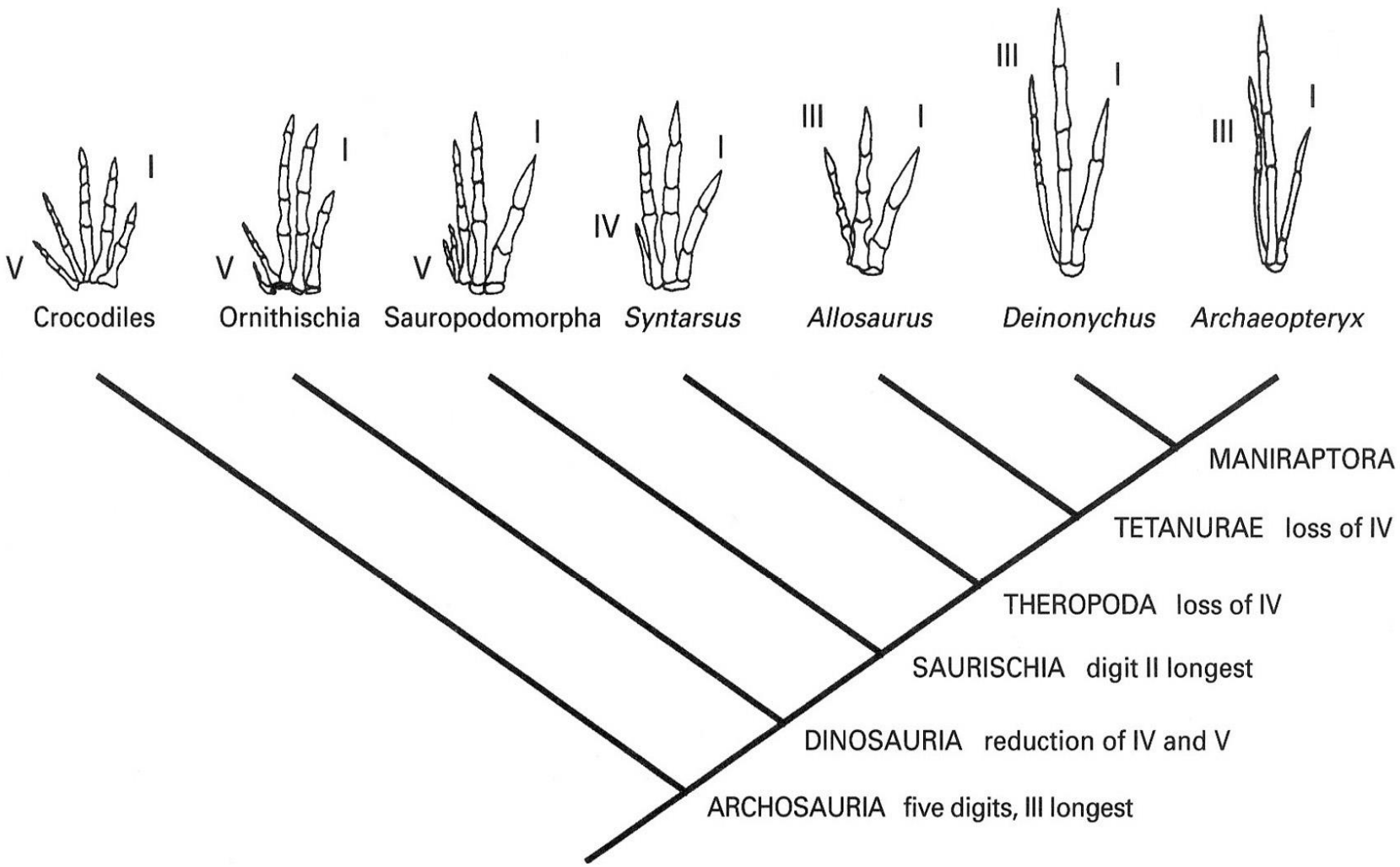






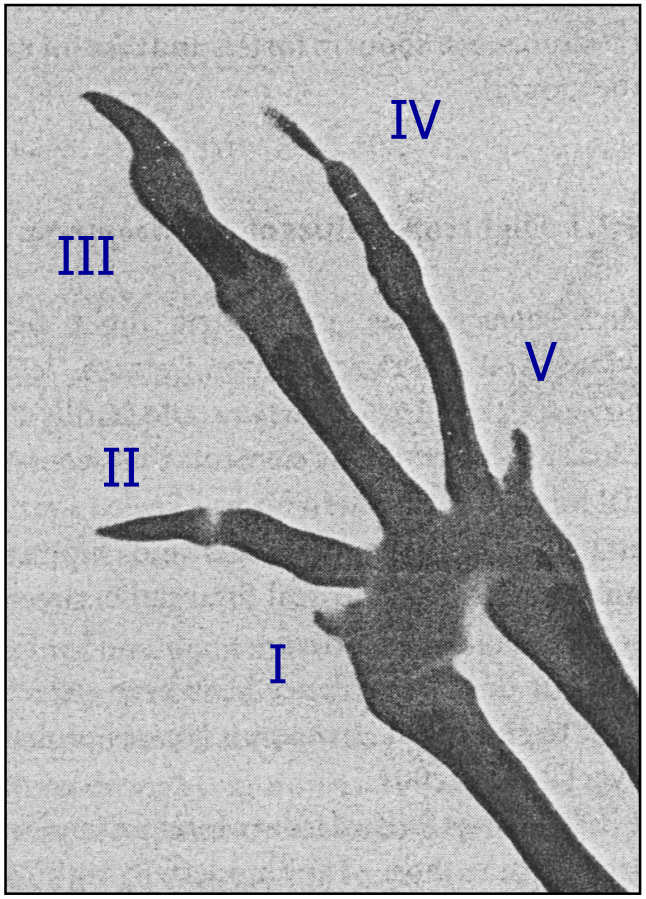
Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Archosauria: DINOSAURIA => redução dos dígitos 4 e 5 da mão

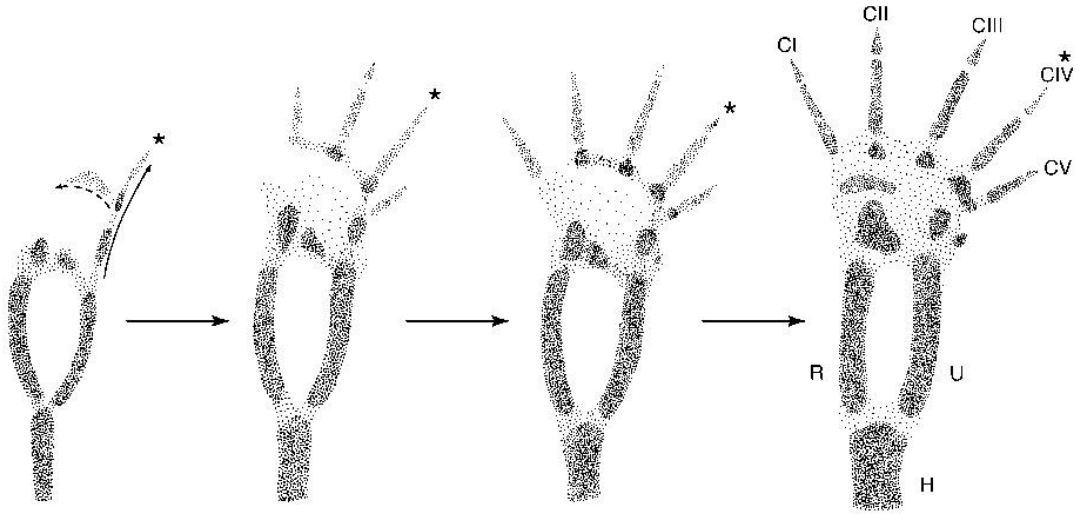


Aves (Jurássico sup. - Recente) - Origem das aves

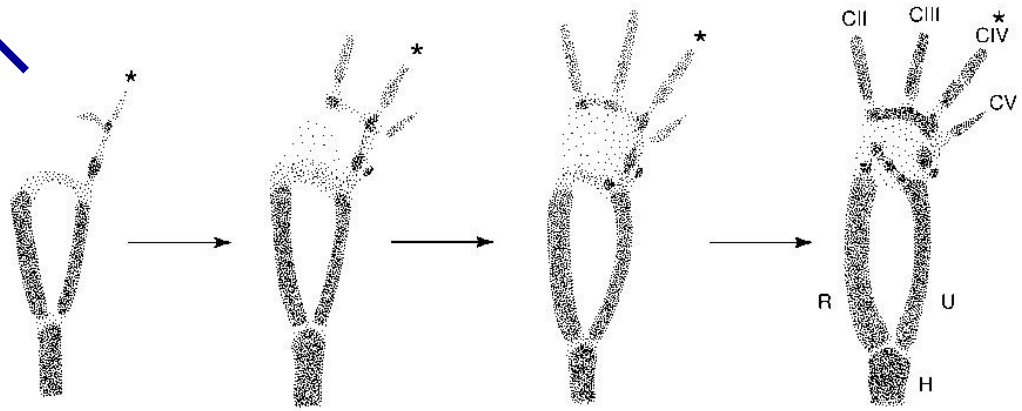
Dedos avianos parecem ser II-IV



Crocodilo

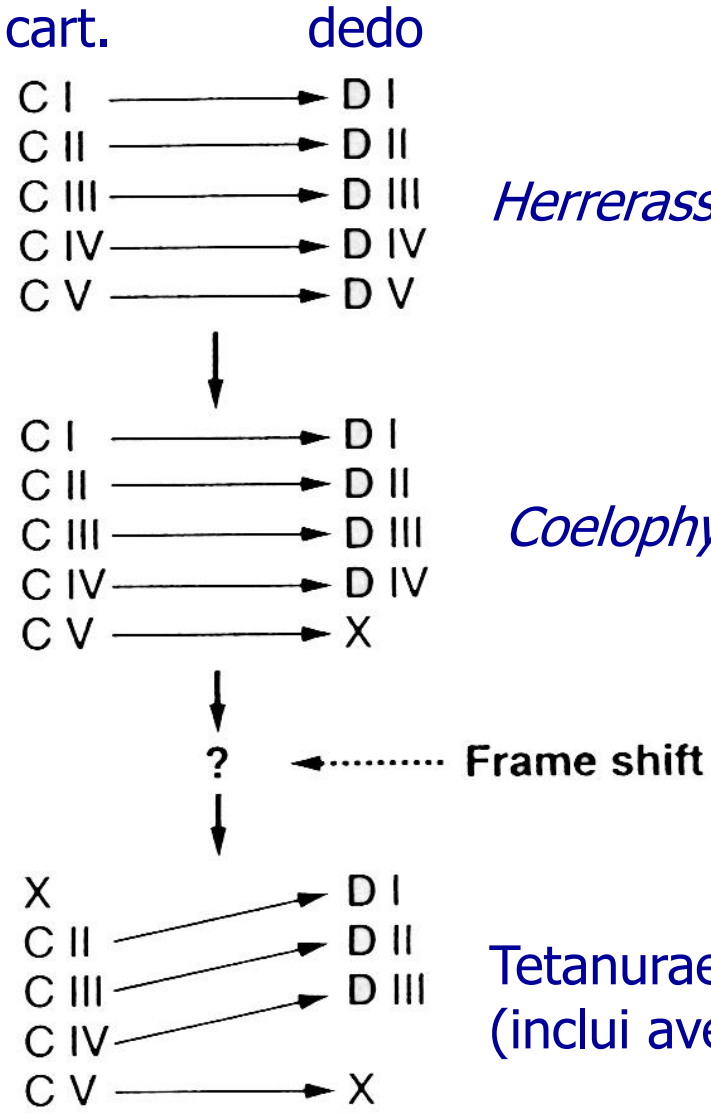


Ave



Aves (Jurássico sup. - Recente) - Origem das aves

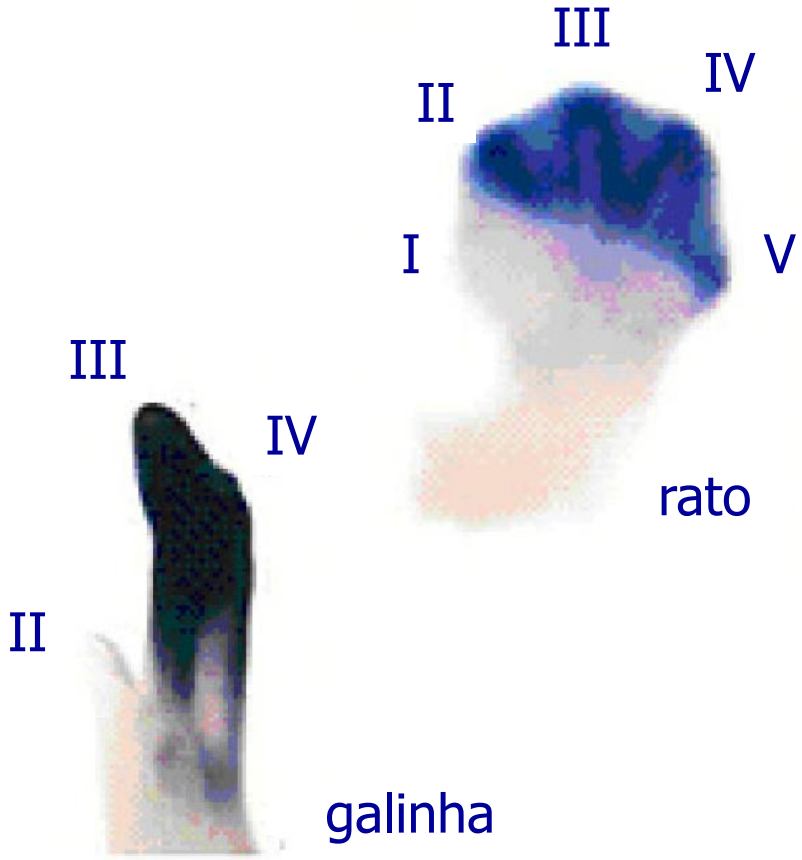
Frame-shift na ossificação (independente da condensação cartilaginosa)



Herrerassaurus

Coelophysis

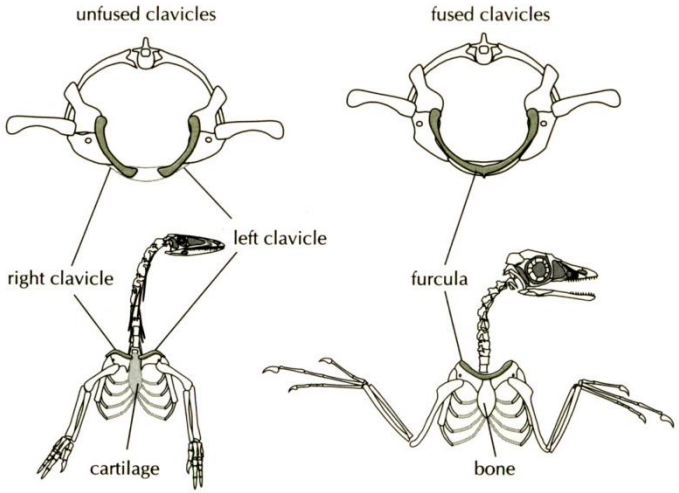
Tetanurae
(inclui aves)



Ossificação controlada por *Hoxd* 11
Expressão tardia em azul/negro

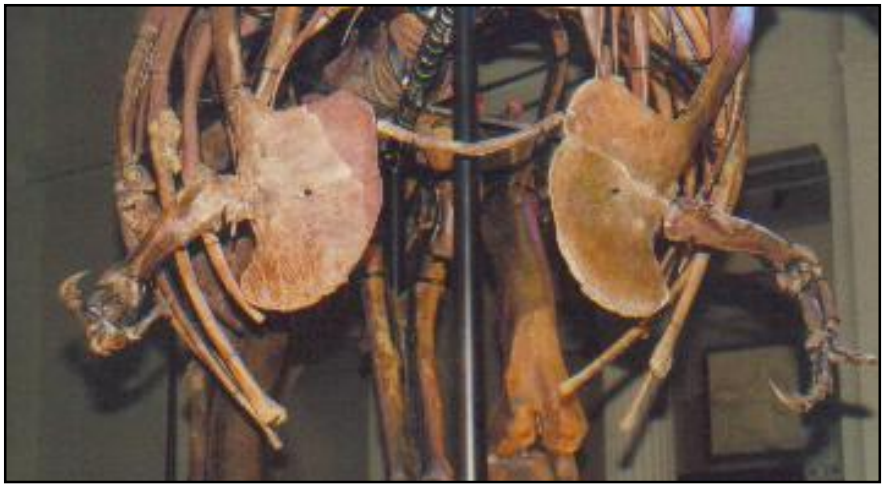
Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Theropoda: TETANURAE => fúrcula



Coelophysis *Archaeopteryx*

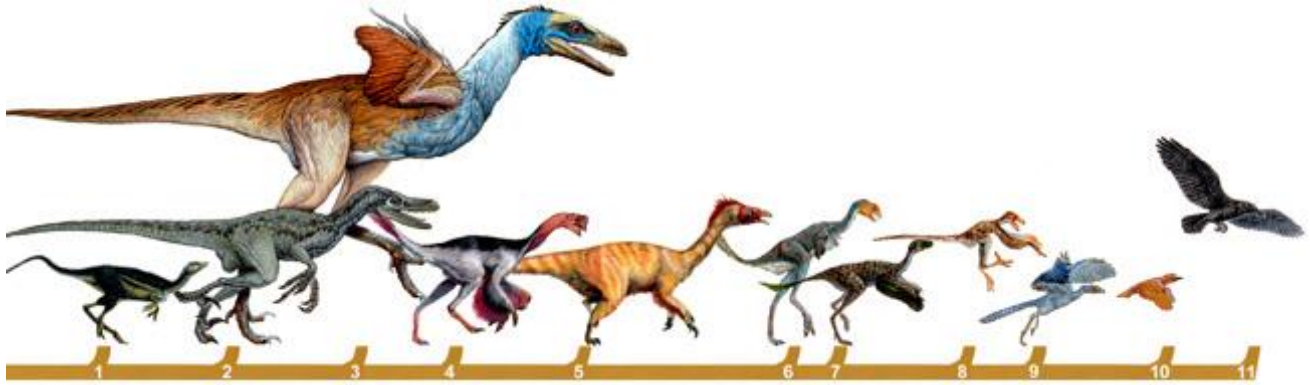
Ingenia



T. rex

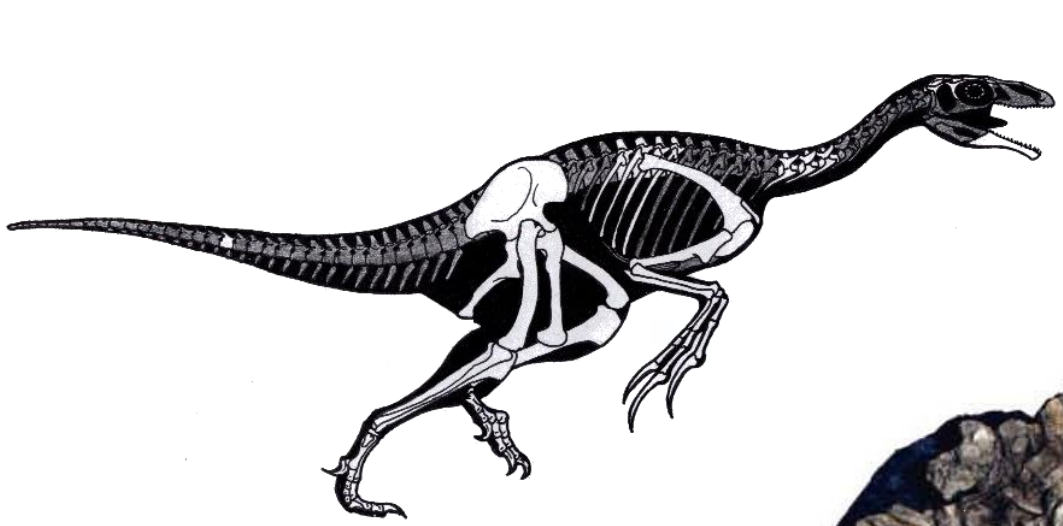
Aves (Jurássico sup. - Recente) - Origem das aves

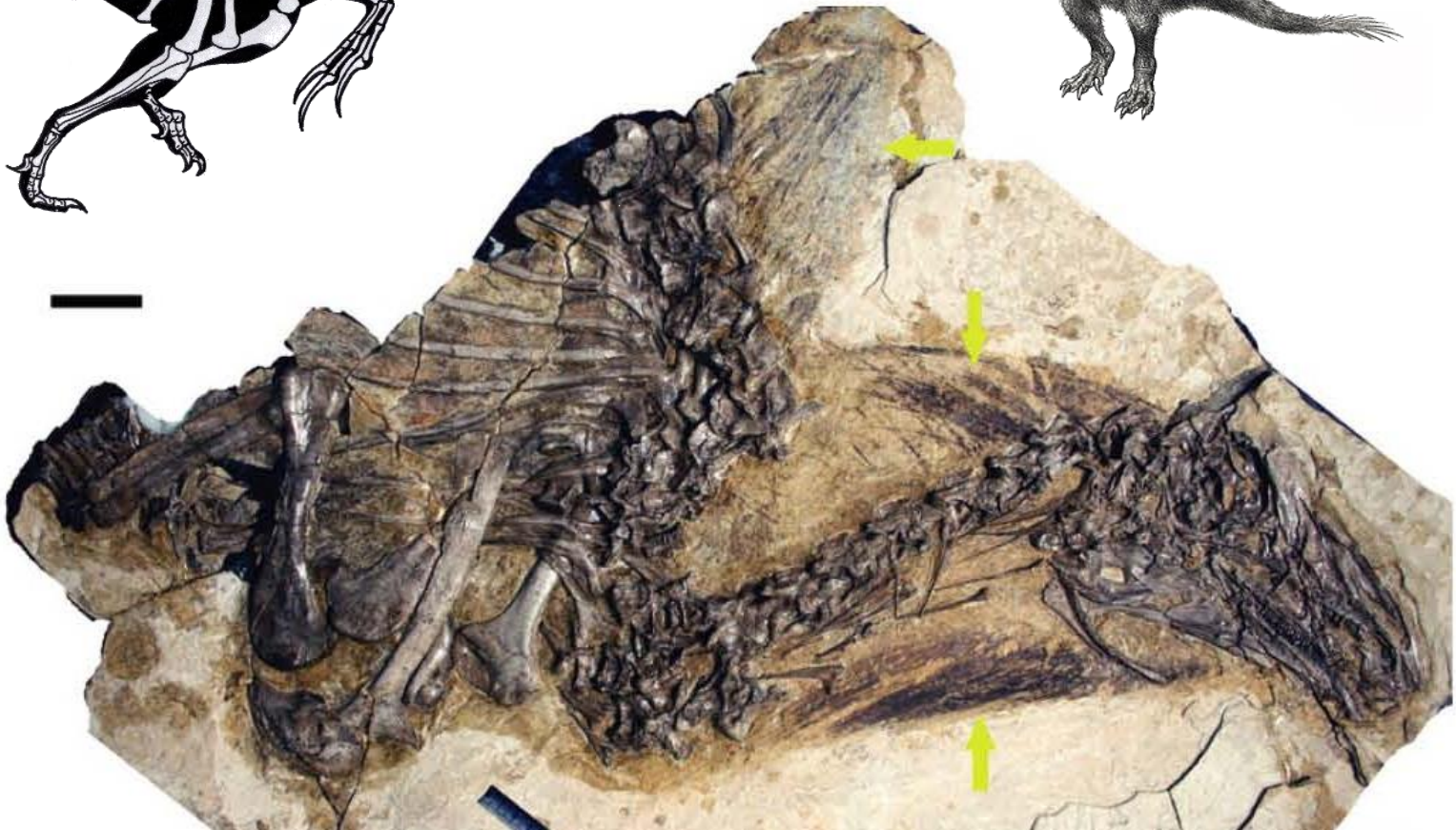
Dentre Theropoda: TETANURAE => "penas" filiformes



Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Tetanurae: MANIRAPTORA => penas plumáceas

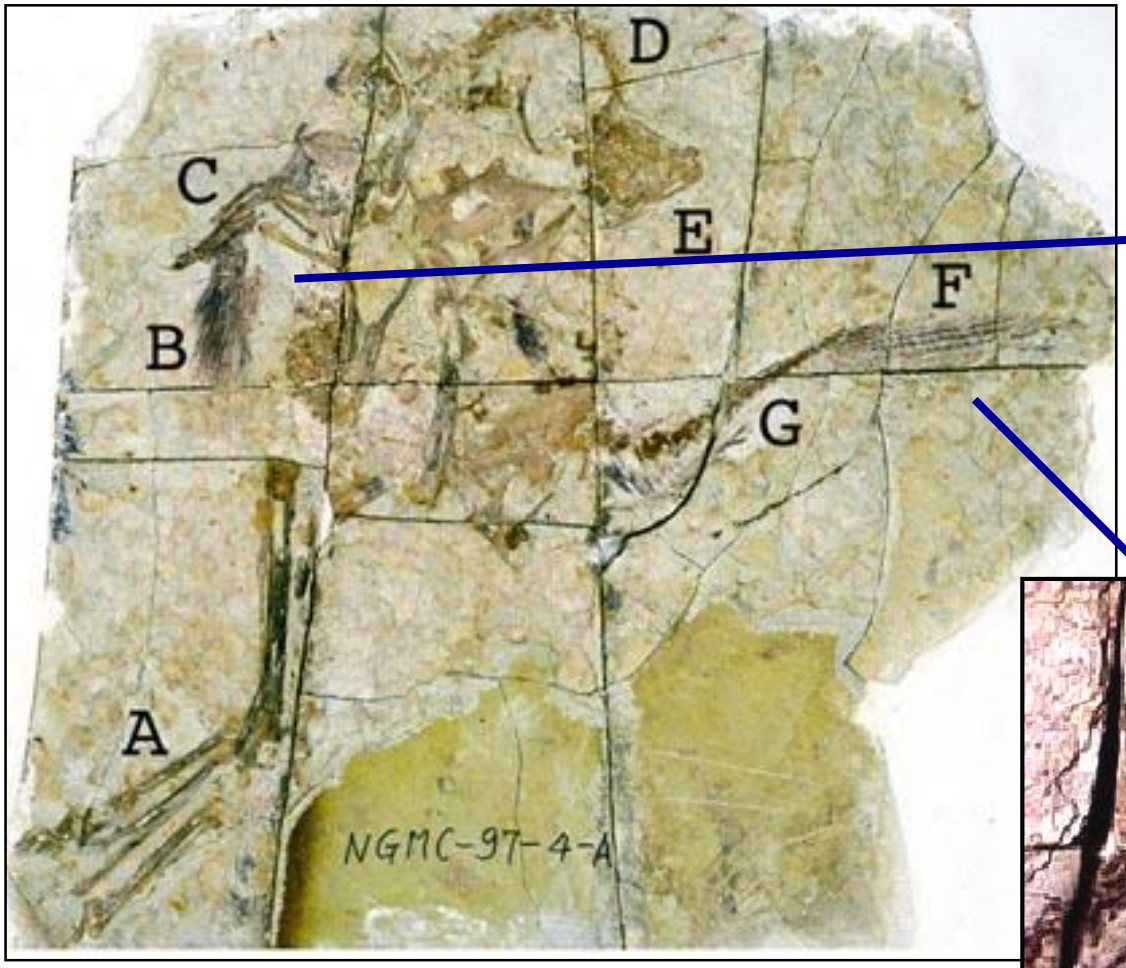


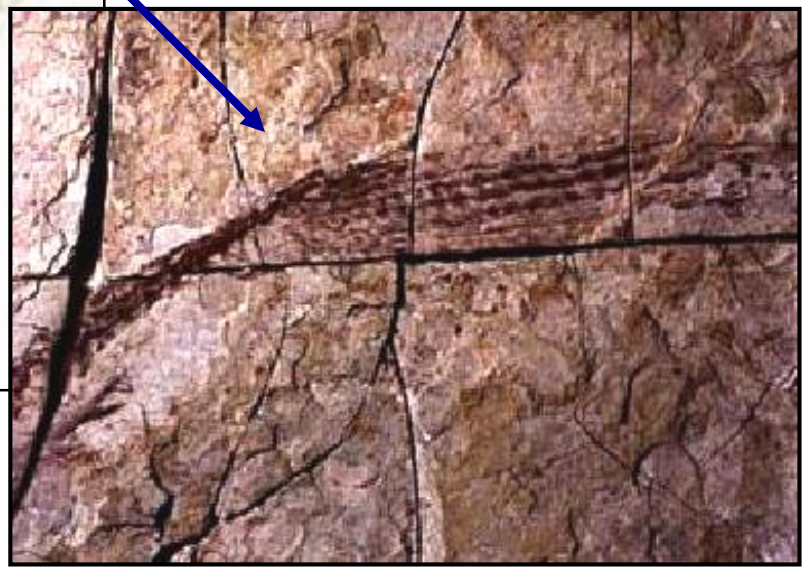


Diferenciação do colarinho do folículo

Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Maniraptora: formas com penas com lâmina penácea

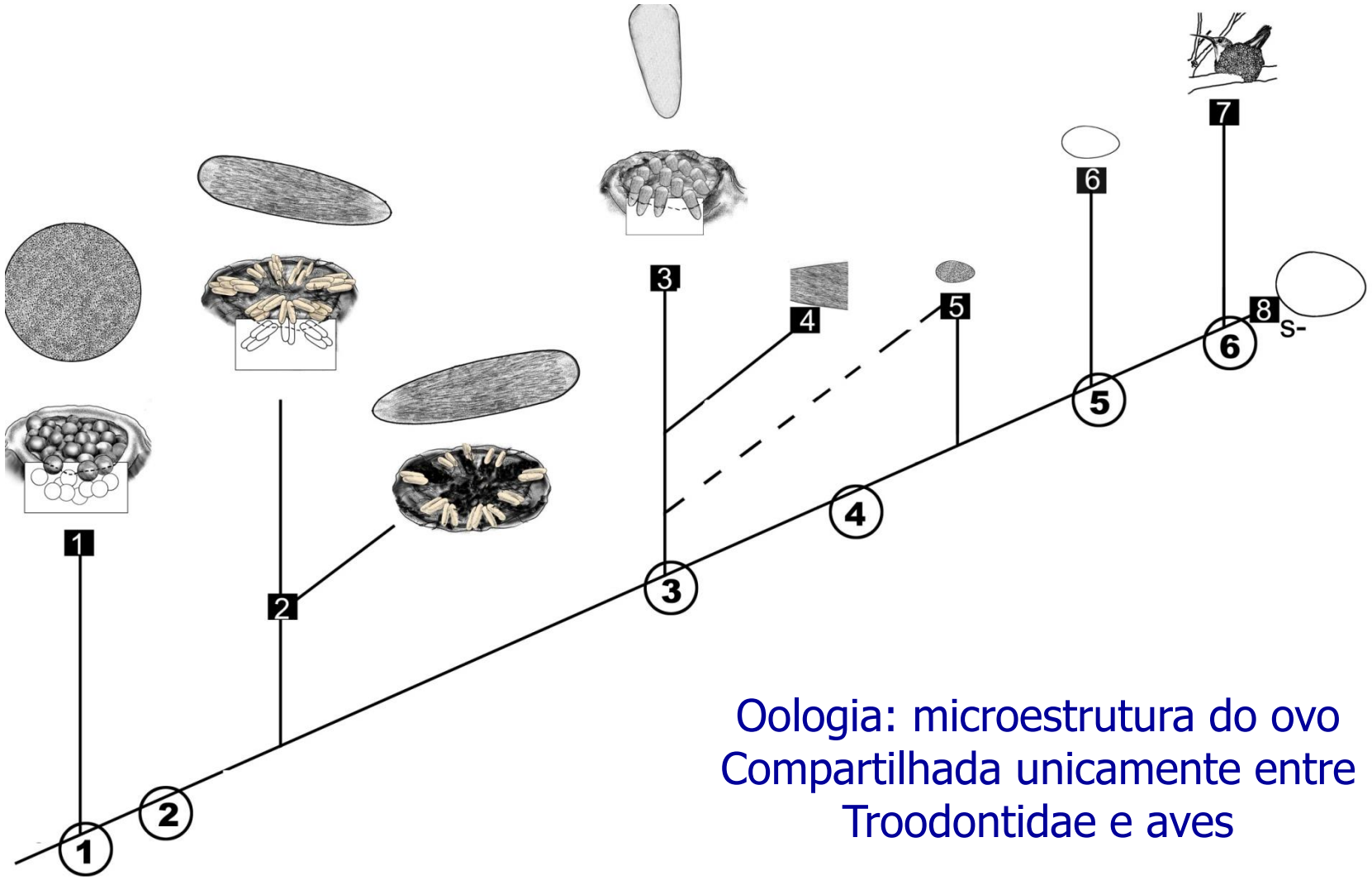




Oviraptorosauria:
e.g. *Caudipteryx*

Aves (Jurássico sup. - Recente) - Origem das aves

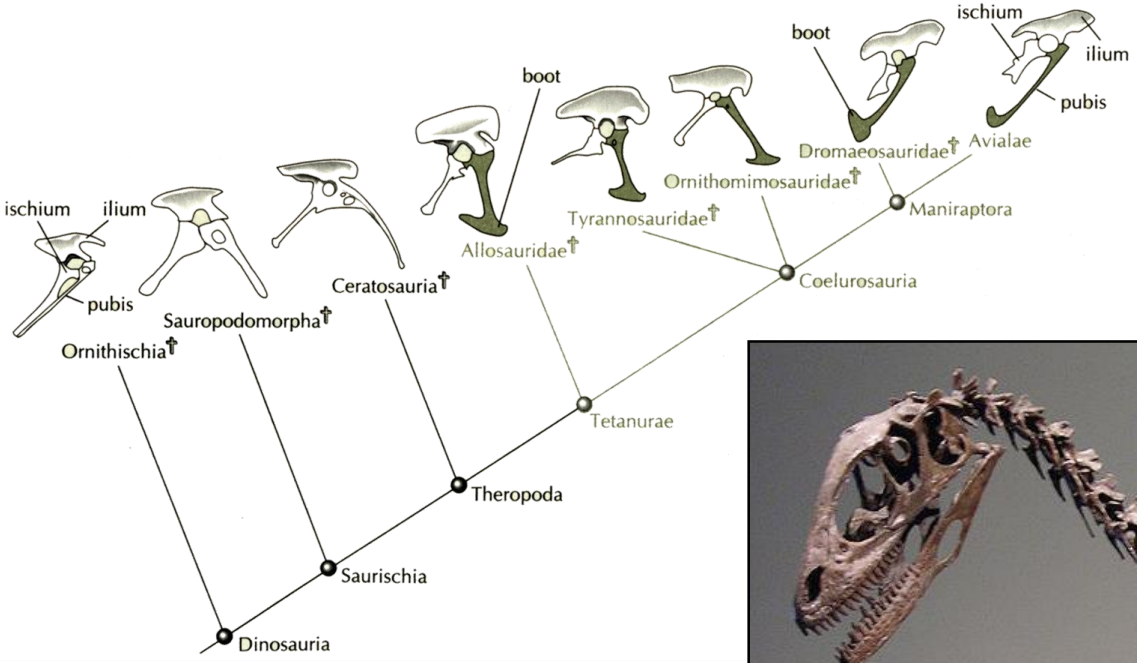
Dentre Maniraptora: EUMANIRAPTORA => chocagem de ovos

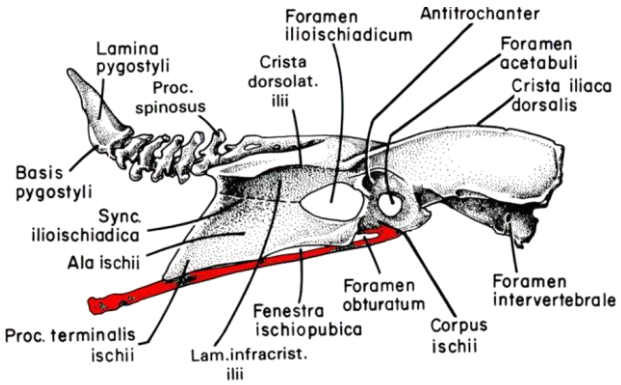


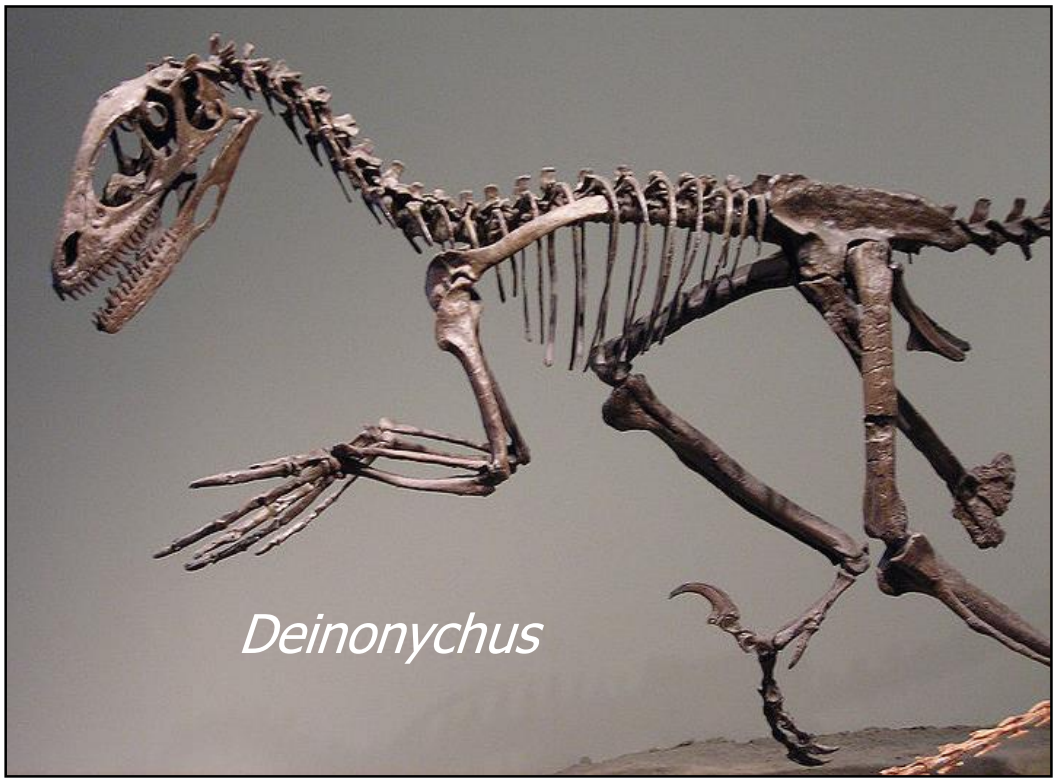
Oologia: microestrutura do ovo
Compartilhada unicamente entre
Troodontidae e aves

Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Maniraptora: EUMANIRAPTORA => púbis retrovertido

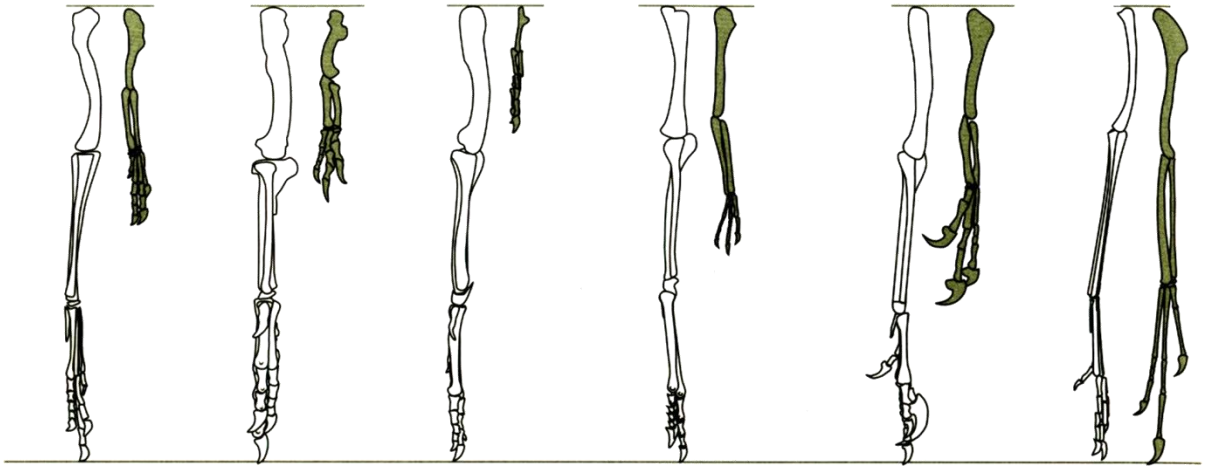


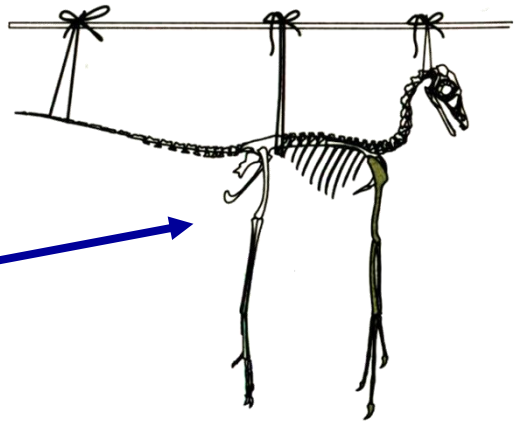




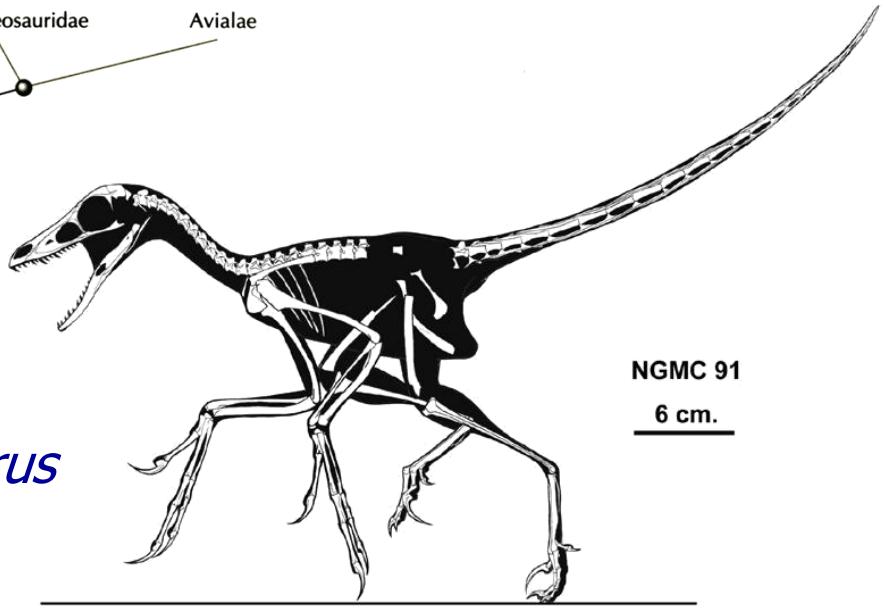
Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Maniraptora: EUMANIRAPTORA => braços longos



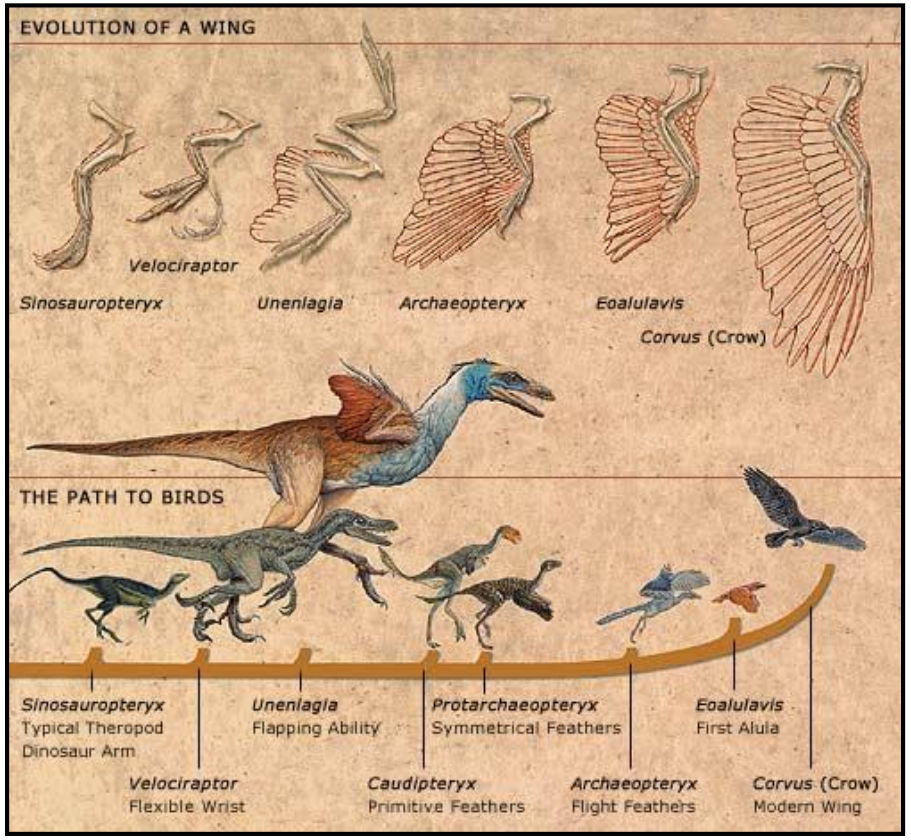


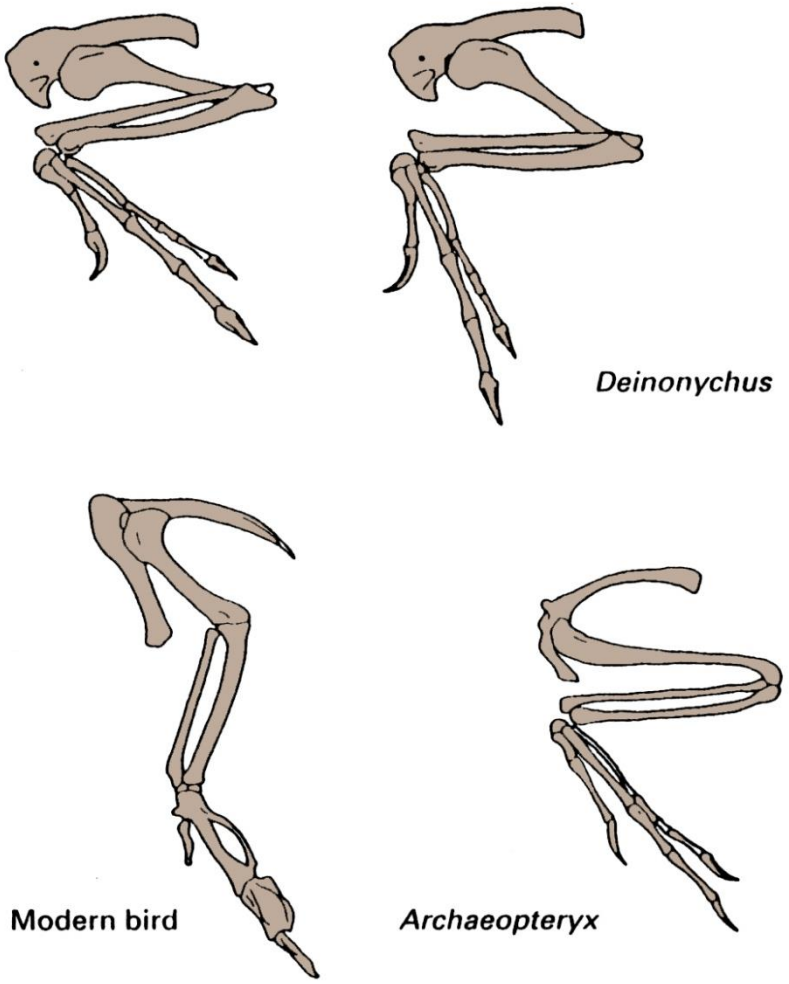
Sinornithosaurus



Aves (Jurássico sup. - Recente) - Origem das aves

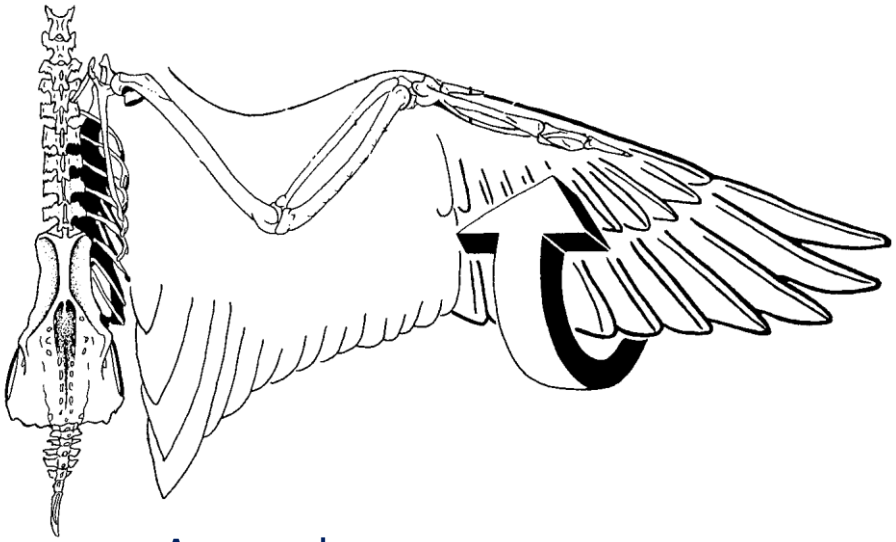
Dentre Eumaniraptora: DROMAEOSAURIDAE => braços raptoriais



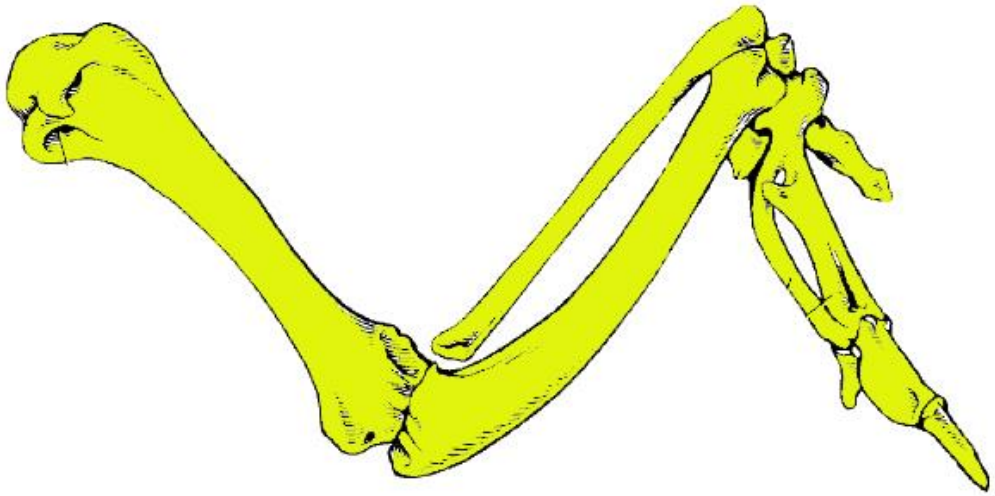


Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Eumaniraptora: DROMAEOSAURIDAE => braços raptoriais



Ave moderna



Sinornithosaurus

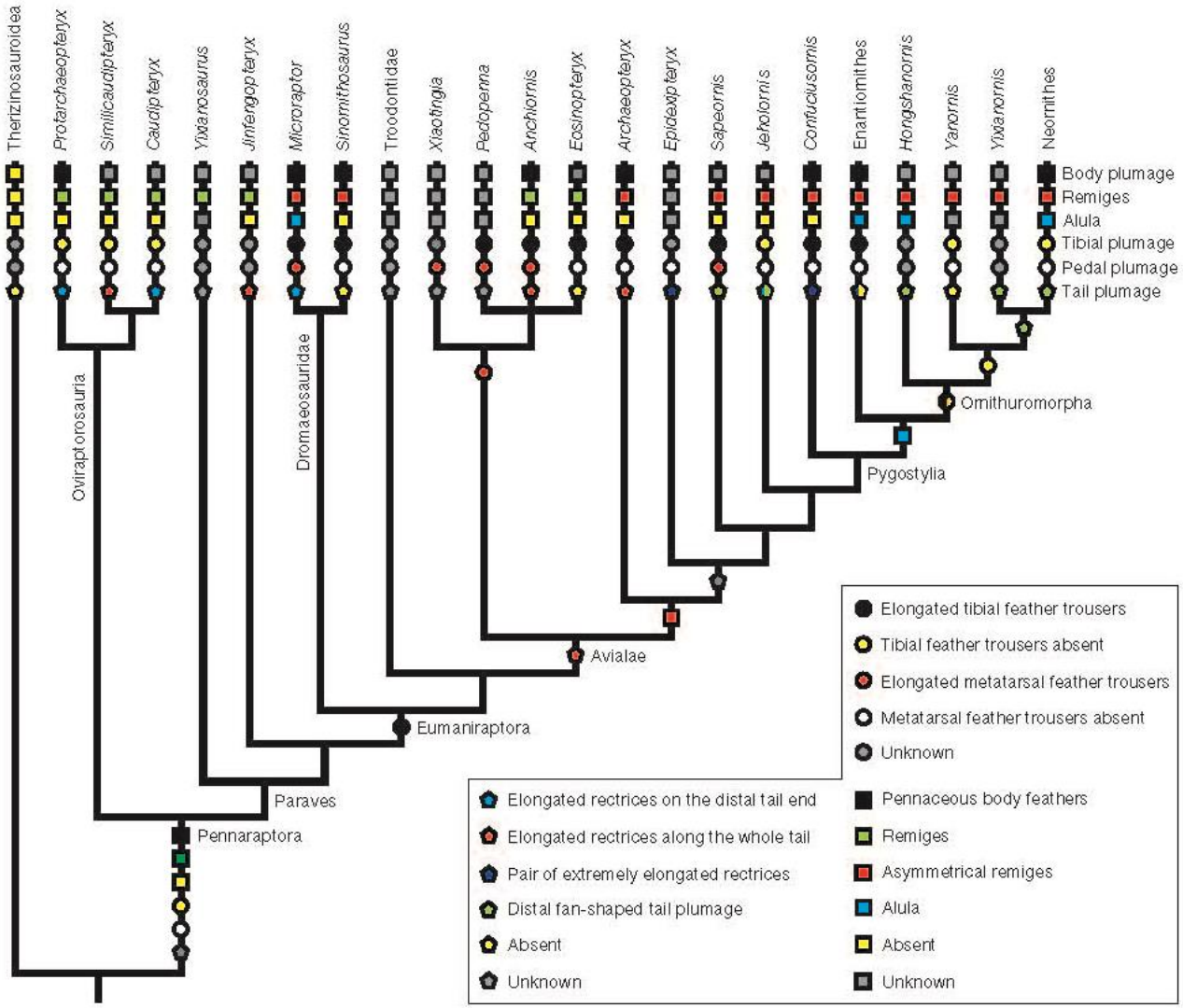
Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Dromaeosauridae: formas com penas com lâmina penácea assimétrica

Dromaeosauridae:
e.g. *Microraptor*

Aves (Jurássico sup. - Recente) - Origem das aves

Dentre Dromaeosauridae: formas com penas com lâmina penácea assimétrica



Origem do vôo – hipótese arbórea

Formas de "4 asas" arbóreos: gravidade trabalha à favor