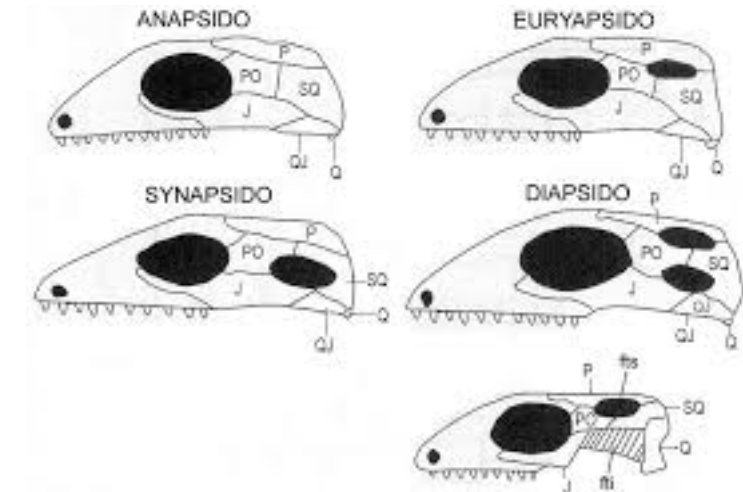
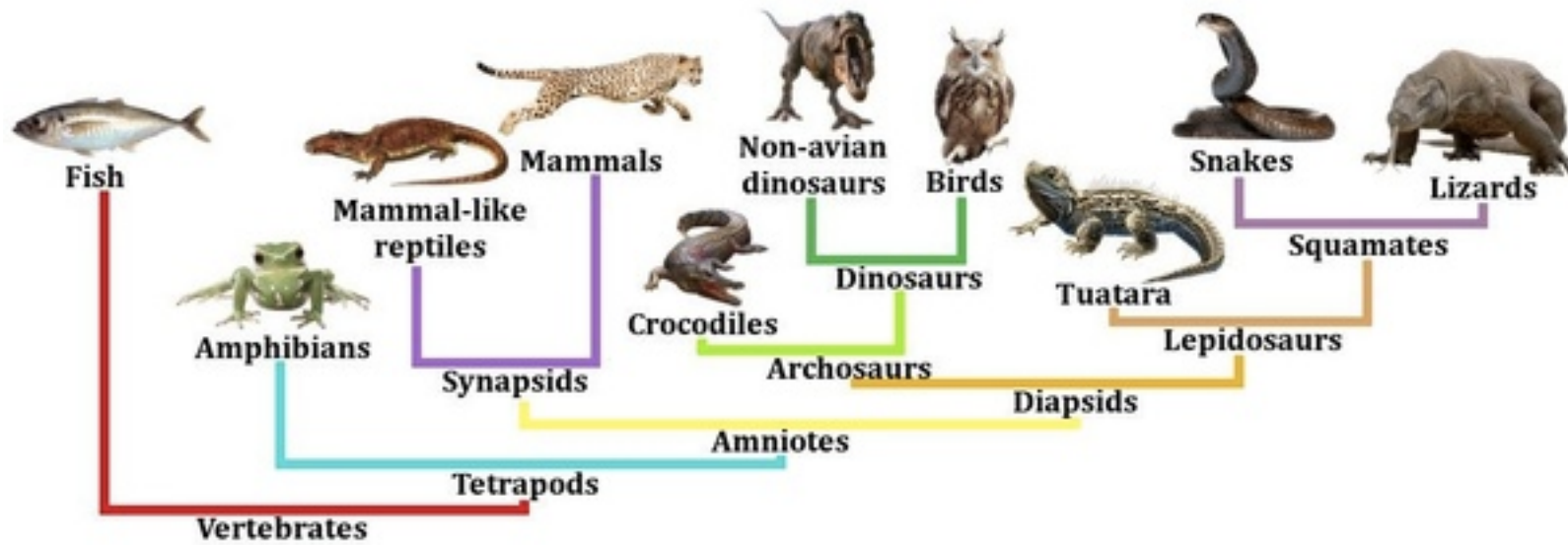


LEPIDOSAURIA

Lepidosaurios “Lagartos con escamas”, reptiles diápsidos.

2 órdenes: *Squamata* (lagartos, serpientes y anfisbénidos) y *Sphenodontia* (tuatara de NZ).



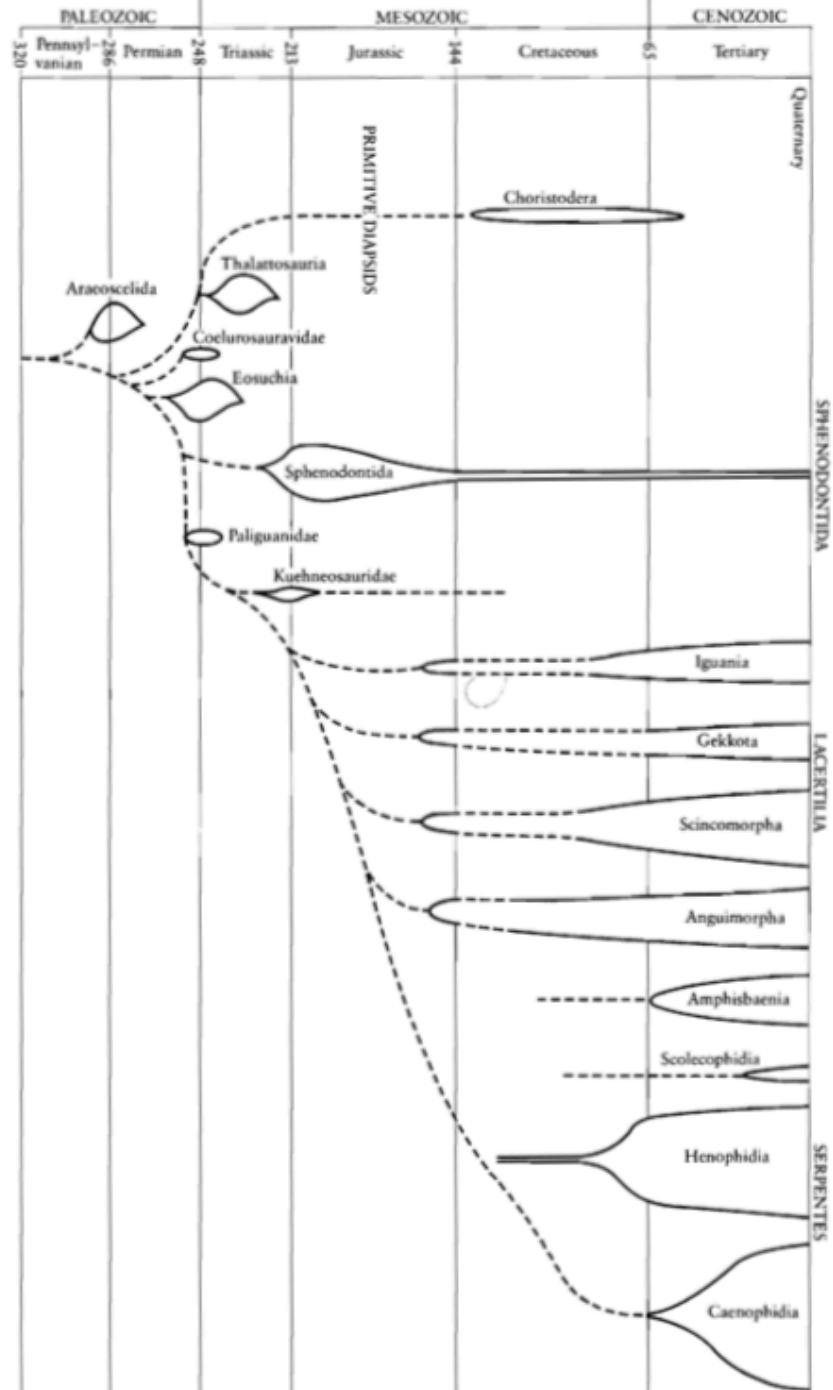
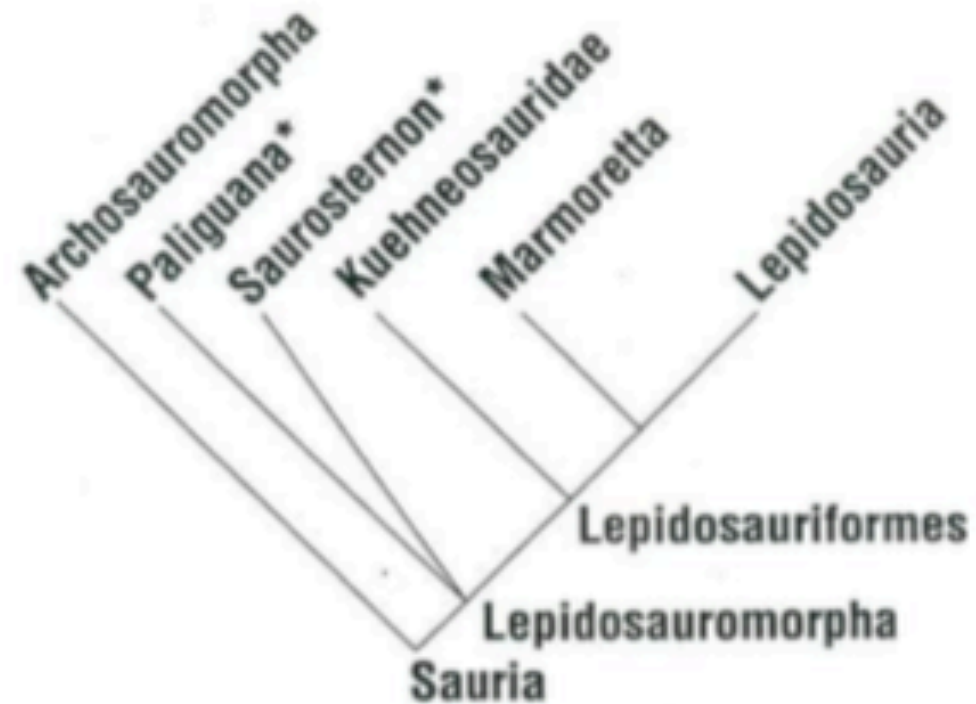


Figure 11-1. PHYLOGENY OF PRIMITIVE DIAPIIDS AND LEPIDOSAURS. Data on liards primarily from Estes, 1983a; data on snakes from Rugg, 1984.

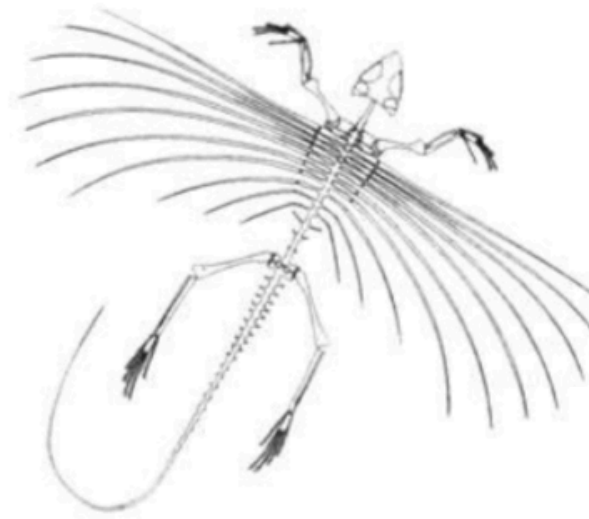
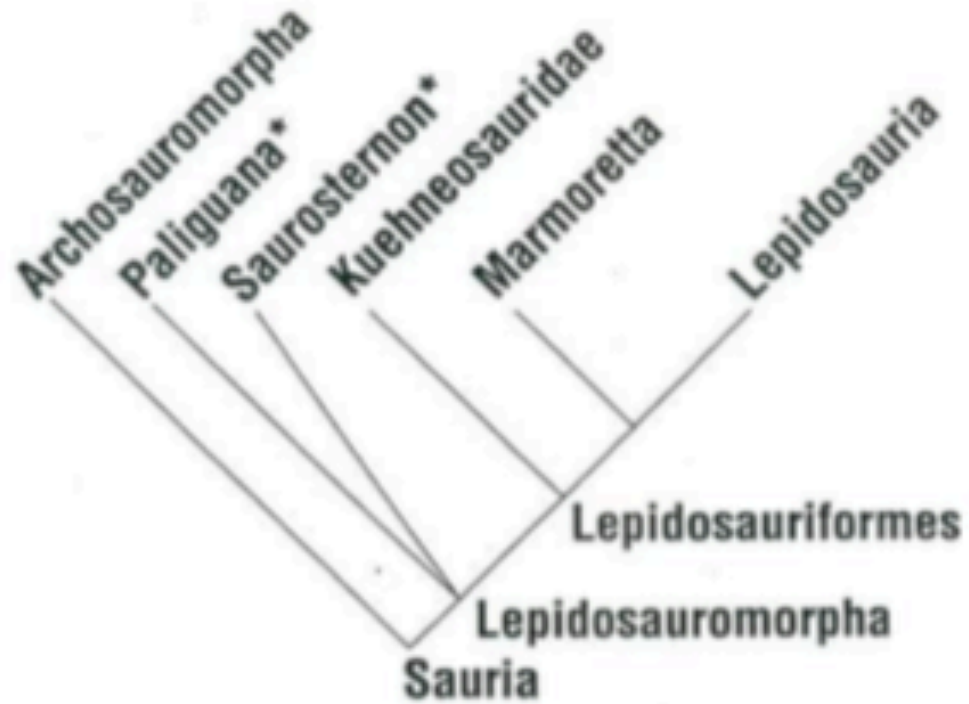


Lepidosauromorpha

Características: bordes del postfrontal sobre la fenestra; supratemporal ausente; cuadrado amplio desde vista posterior formando un caracol; cuadrado inclinado en vista lateral; foramen del cuadrado ausente; proceso retroarticular largo; dientes ausentes en flancos pterigoideos laterales; dientes paraesfenoideos ausentes; intercentra ausente de vertebras del tronco; articulaciones vertebrales accesorias; costillas dorsales; especializaciones no bipedas; cintura pectoral rígida; esternón largo; escamas superpuestas.

Lepidosauromorpha

Paliguana



Icarosaurus

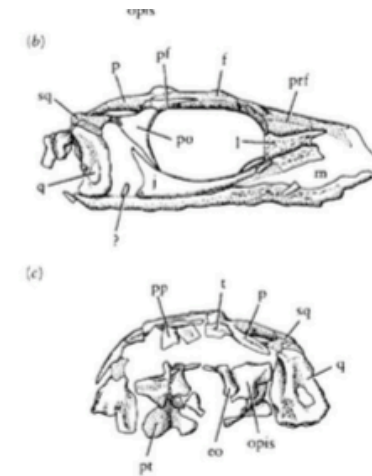
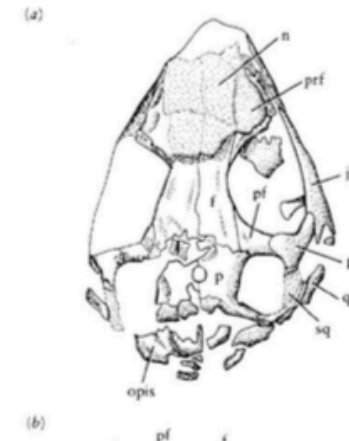


Figure 11-22. SKULL OF THE EARLIEST KNOWN LIZARD, PALIGUANA. From the Upper Permian of southern Africa. (a) Dorsal, (b) lateral, and (c) occipital views, $\times 2$. Abbreviations as in Figure 8-3. From Carroll, 1977.

- Triásico, ~250 MYA.
- Primer linaje con fenestra temporal. Barra temporal inferior ausente, sutura frontal-parietal “floja”, articulación cuadrado con pterigoide flexible o ausente..

Lepidosauromorpha

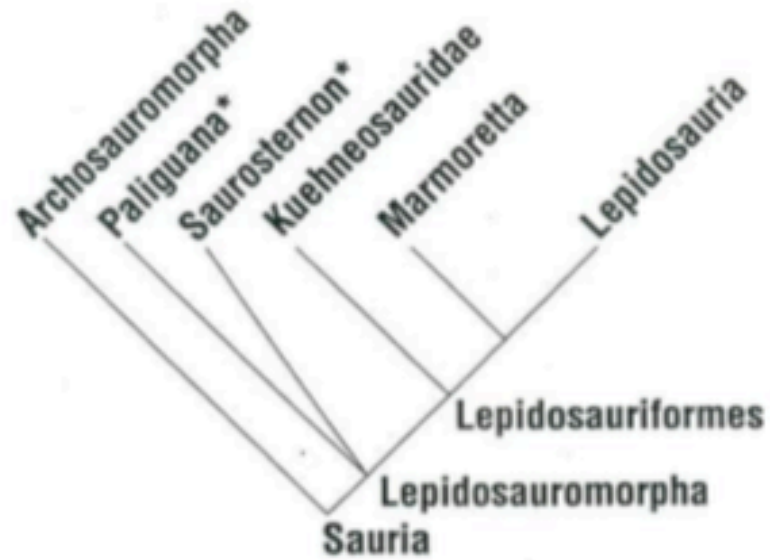


Figure 11-23. RESTORATION OF THE SKELETON OF A PRIMITIVE LIZARD. Based on the skeletons of *Saurosternon* and *Palaeagama* and the skull of *Paliguana* from the Upper Permian and Lower Triassic of southern Africa. From Carroll, 1977.

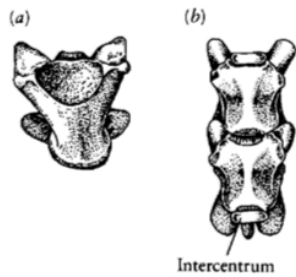


Figure 11-25. LIZARD VERTEBRAE. (a) The procoelus pattern of most groups of advanced lizards. (b) The trunk vertebrae of a gecko. They are amphicoelus, as in eosuchians, but this condition may be secondarily evolved within the geckos rather than being retained from their more primitive ancestors. Drawn from specimens in Redpath Museum.

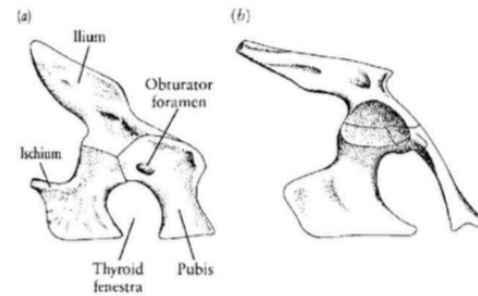


Figure 11-15. PELVES OF LEPIDOSAUURS. (a) Pelvis of the Upper Triassic sphenodontid *Planocephalosaurus*. From Fraser and Walkden, 1984. (b) Pelvis of *Iguana*. In both sphenodontids and modern lizards, there is a large opening ventrally between the pubes and ischia, the thyroid fenestra. This opening may have evolved in the common ancestor of these two groups or independently after their divergence. A thyroid fenestra evolves separately in several other groups of diapsid reptiles.

Fenestra temporal

Foramen de la pelvis (fenestra tiroidea) poco desarrollada.

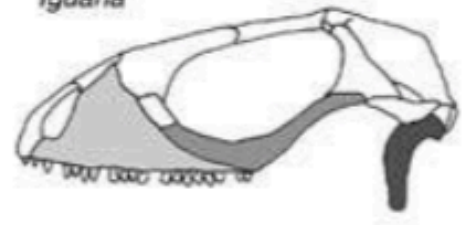
Dientes unidos a una ranura poco profunda en el borde de la mandíbula

Vértebras anficélicas (→ procélicas)

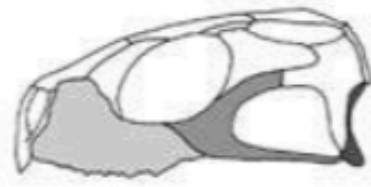
Barra temporal inferior ausente

Articulación cuadrado con pterigoide flexible

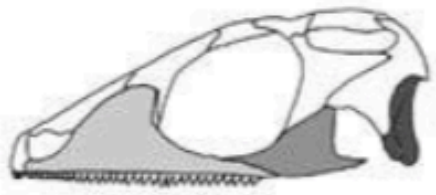
Iguana



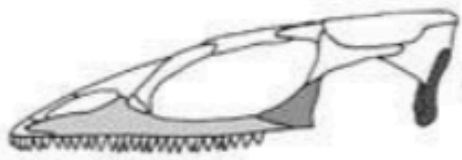
Sphenodontia



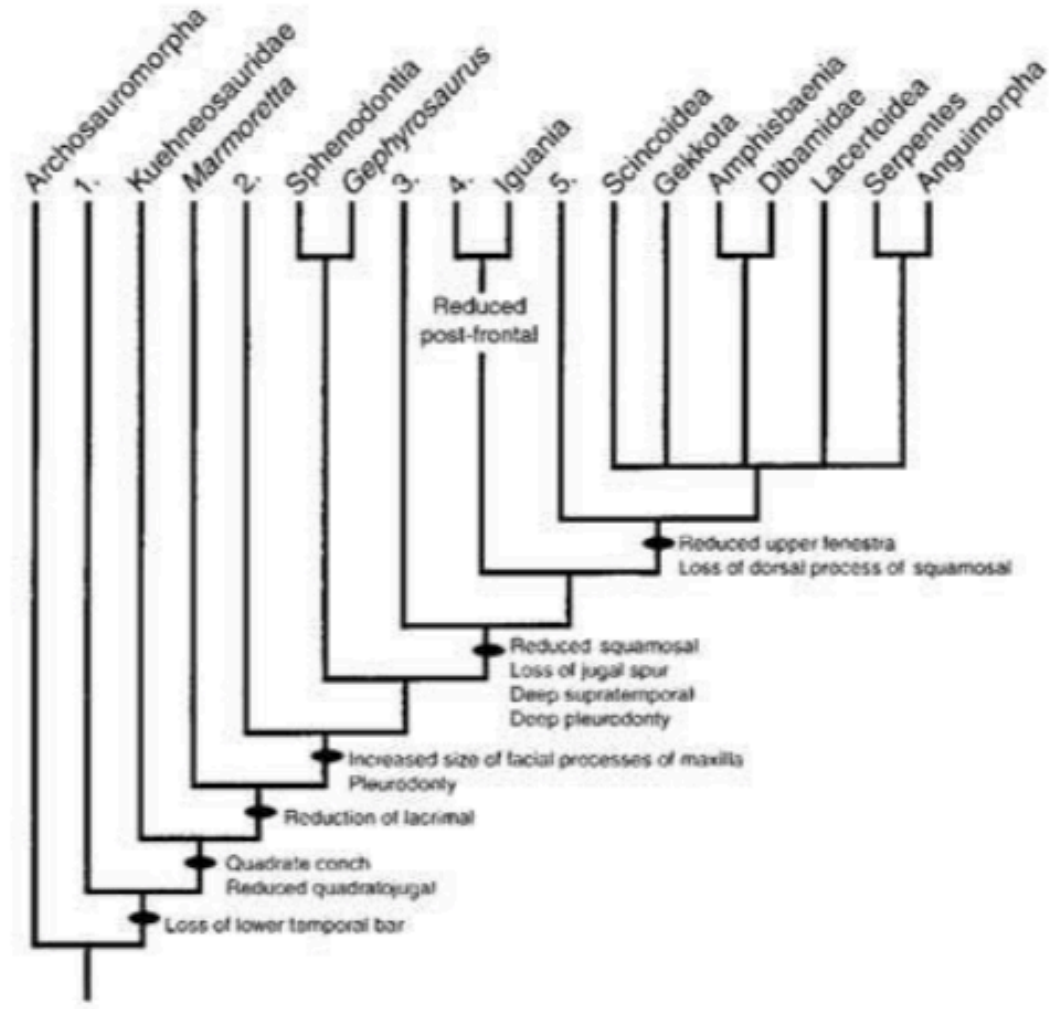
Gephyrosaurus



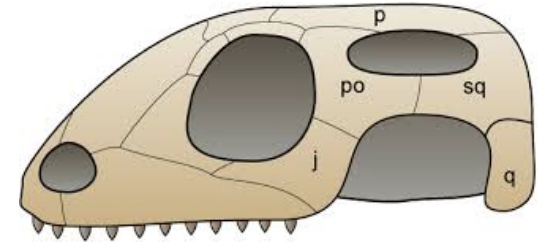
Marmoretta



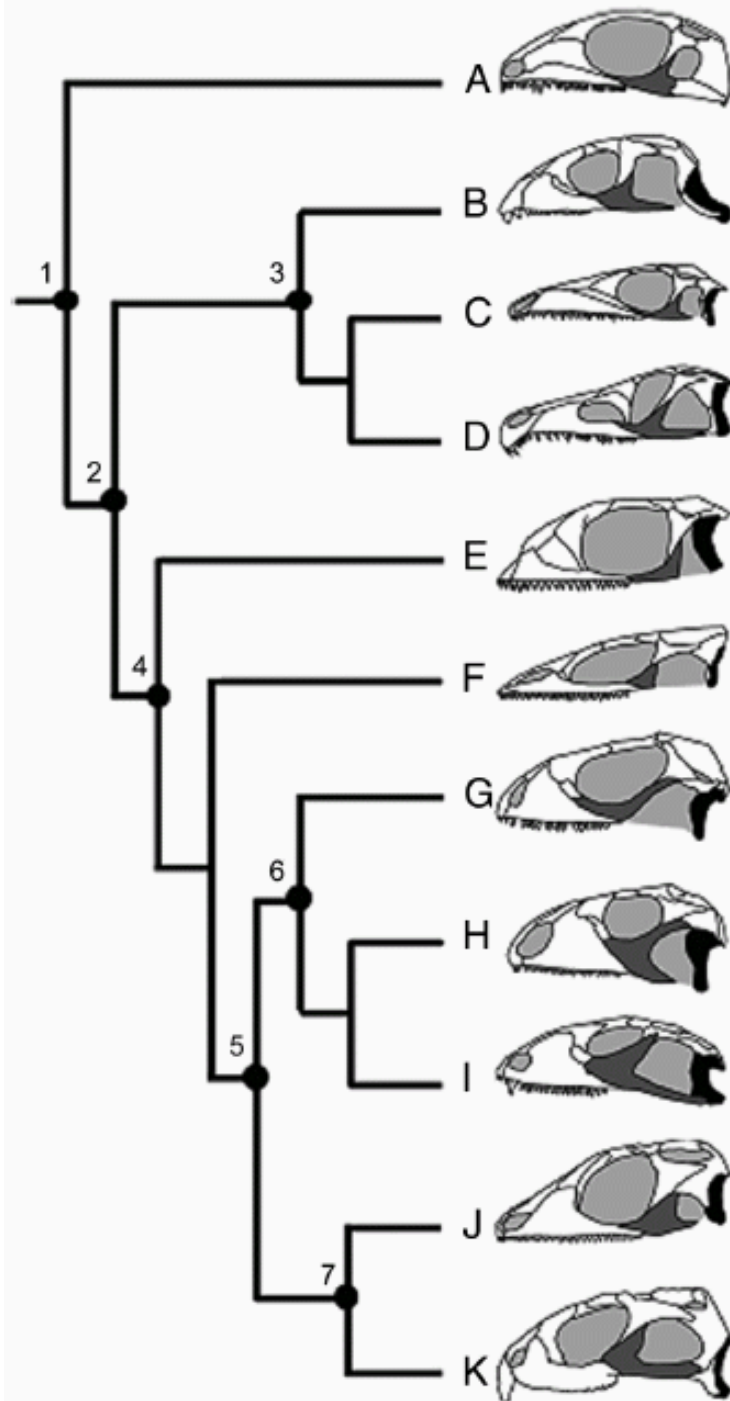
Kuehneosauridae



Negro: cuadrado
Gris oscuro: yugal



Rango de variación y modificaciones de la barra temporal entre diápsidos, particularmente entre lepidosauriformes.



A simplified phylogeny of diapsid reptiles showing variation in the development of the lower temporal bar. Black indicates quadrate; dark gray, jugal. (A) the basal diapsid *Petrolacosaurus*; (B) the early rhynchosaur *Mesosuchus*; (C) the archosauromorph *Prolacerta*; (D) the archosauriform *Proterosuchus*; (E) the lepidosauriform *Kuehneosaurus*; (F) the stem lepidosaur *Marmoretta*; (G) the extant squamate *Iguana*, representing a more or less unspecialised type; (H) the large herbivorous Cretaceous *scincomorph* *Polyglyphanodon*, (I) the related late Cretaceous lizard *Tianyusaurus*, unique among squamates in having a rhynchocephalian-like akinetic quadrate; (J) the basal rhynchocephalian *Gephyrosaurus*; and (K) the advanced extant rhynchocephalian *Sphenodon*. Nodes: 1, *Diapsida*, primitively lower temporal bar, fixed quadrate, robust epipterygoid; 2, *Sauria*, no lower temporal bar, fixed quadrate and epipterygoid; 3, *Archosauromorpha*, no lower temporal bar in basal taxa, but developed in Rhynchosaur and Archosaurs; 4, *Lepidosauriformes* and 5, *Lepidosauria*, no lower temporal bar in basal taxa quadrate, epipterygoid sutured to pterygoid, large squamosal; 6, *Squamata*, quadrate/pterygoid overlap reduced, ligamentous, squamosal reduced, epipterygoid with synovial pterygoid joint, development of lower temporal bar in *Tianyusaurus* only; and 7, *Rhynchocephalia*, no lower temporal bar in basal taxa, developed in some descendants, quadrate, pterygoid, and epipterygoid firmly sutured. Text (slightly modified) and diagram from [Moazen et al 2009](#) p.8274

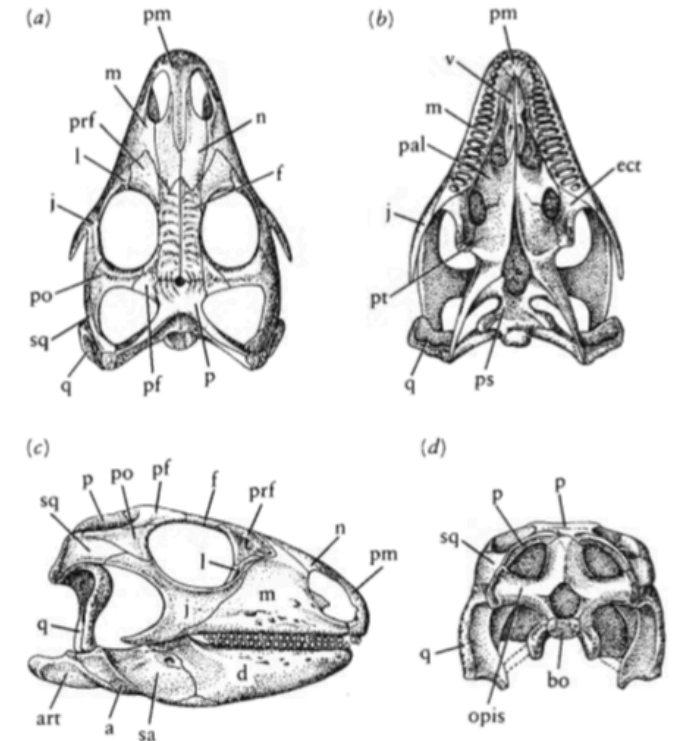
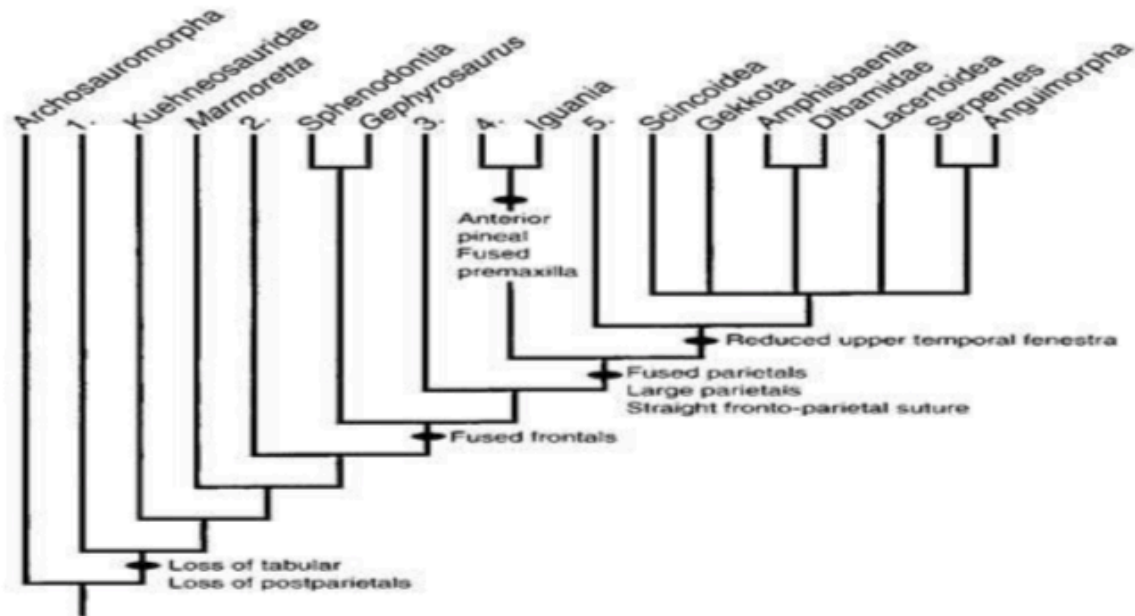
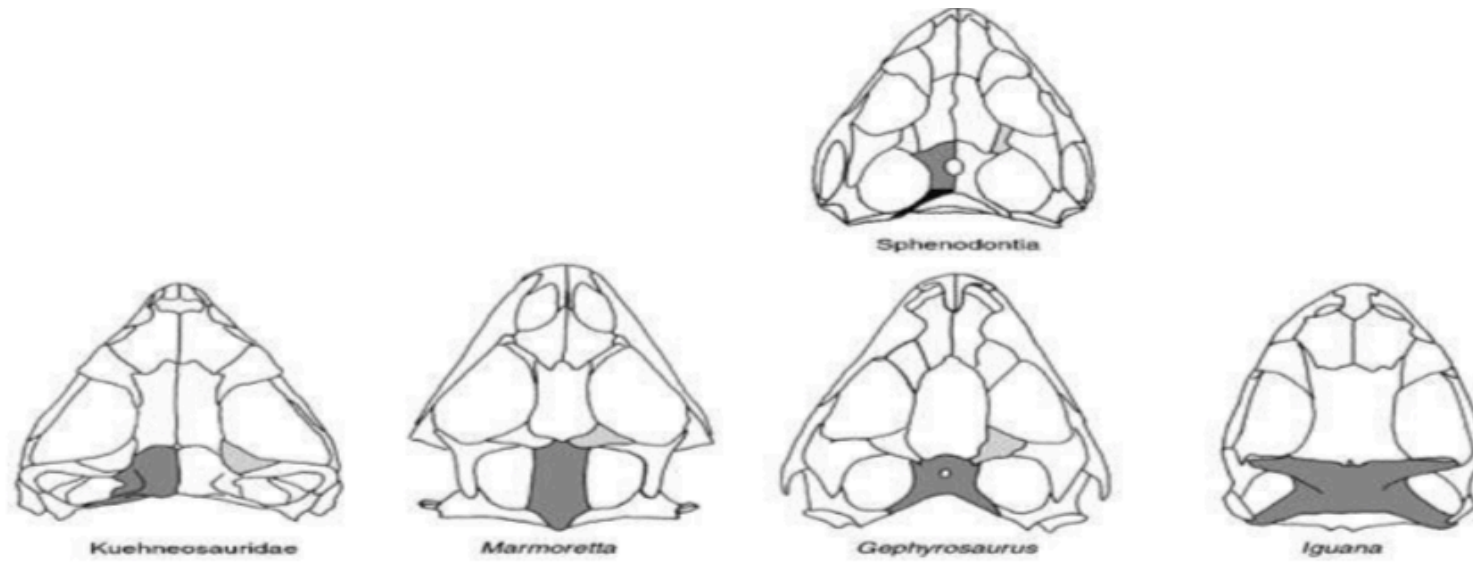


Figure 11-27. THE UPPER CRETACEOUS TEIID LIZARD *POLYGLYPHANODON*. (a) Dorsal, (b) palatal, (c) lateral, and (d) occipital views, $\times \frac{1}{2}$. The pattern of the skull root is typical of modern lizards. A transverse suture separates the frontals and parietals, which permits raising the snout in some genera. The pineal opening lies along this suture rather than further posteriorly as in more primitive lepidosaurs. The pineal and premaxilla are both fused at the midline. Abbreviations as in Figure 8-3. From Gilmore, 1942. By permission of Smithsonian Institution Press.

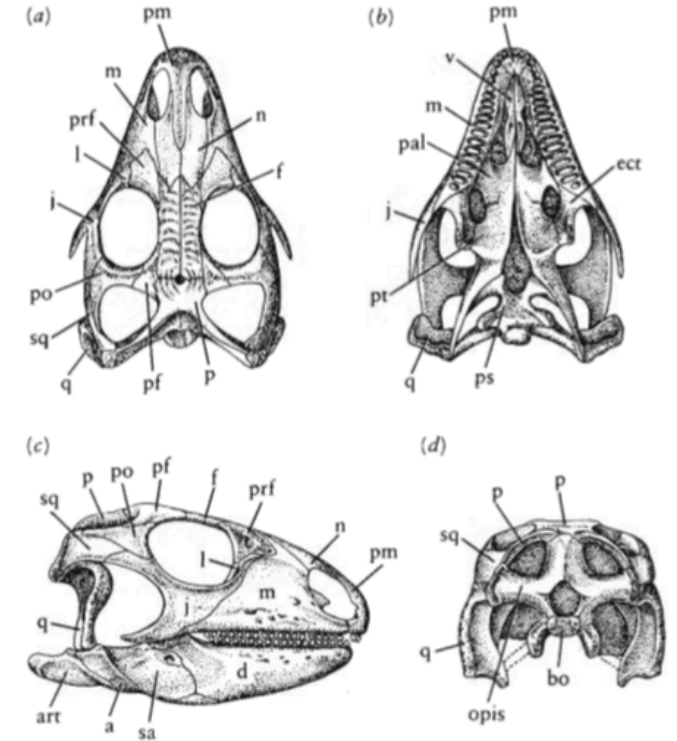
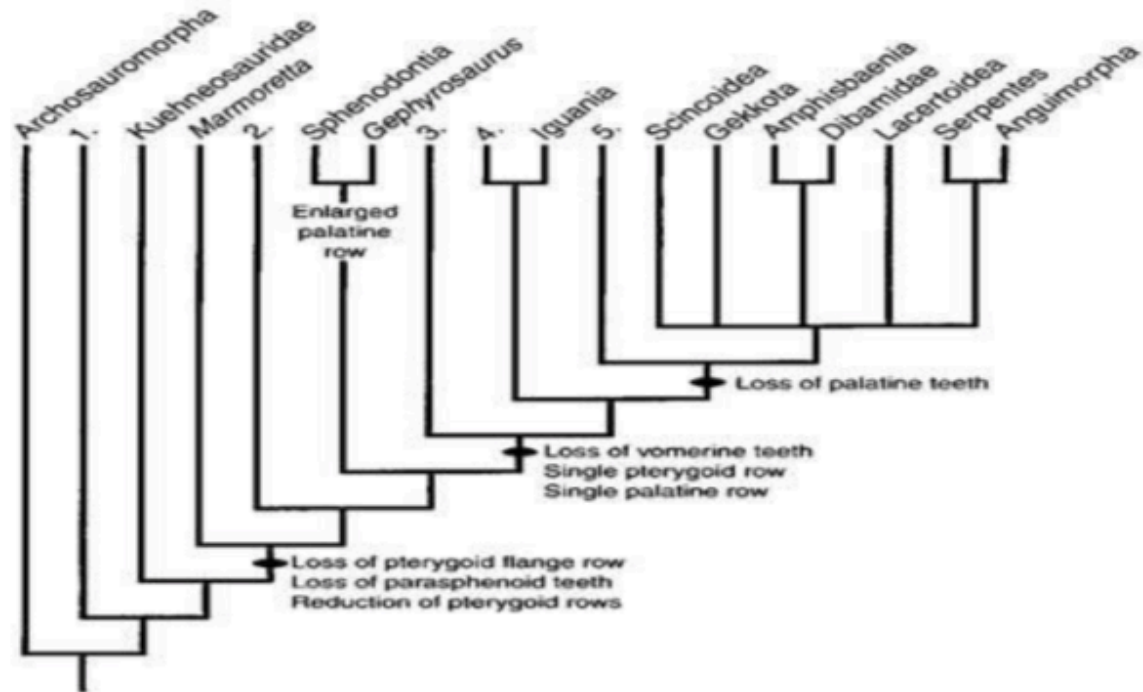
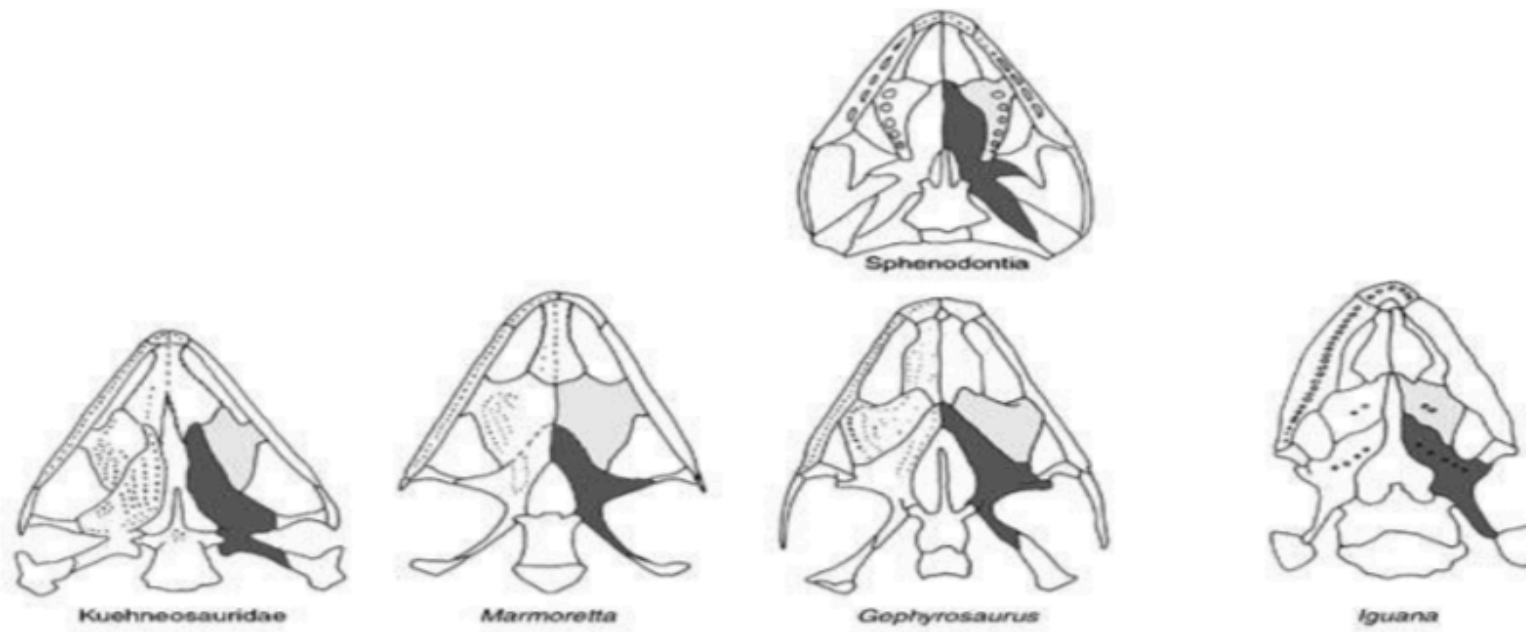


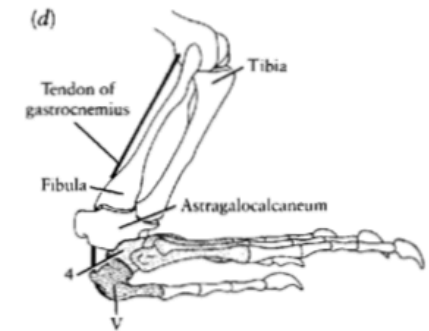
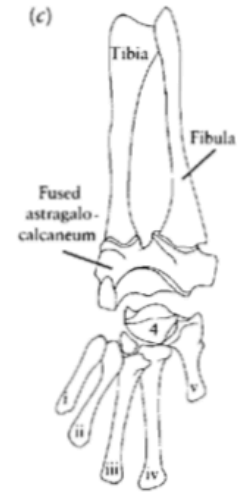
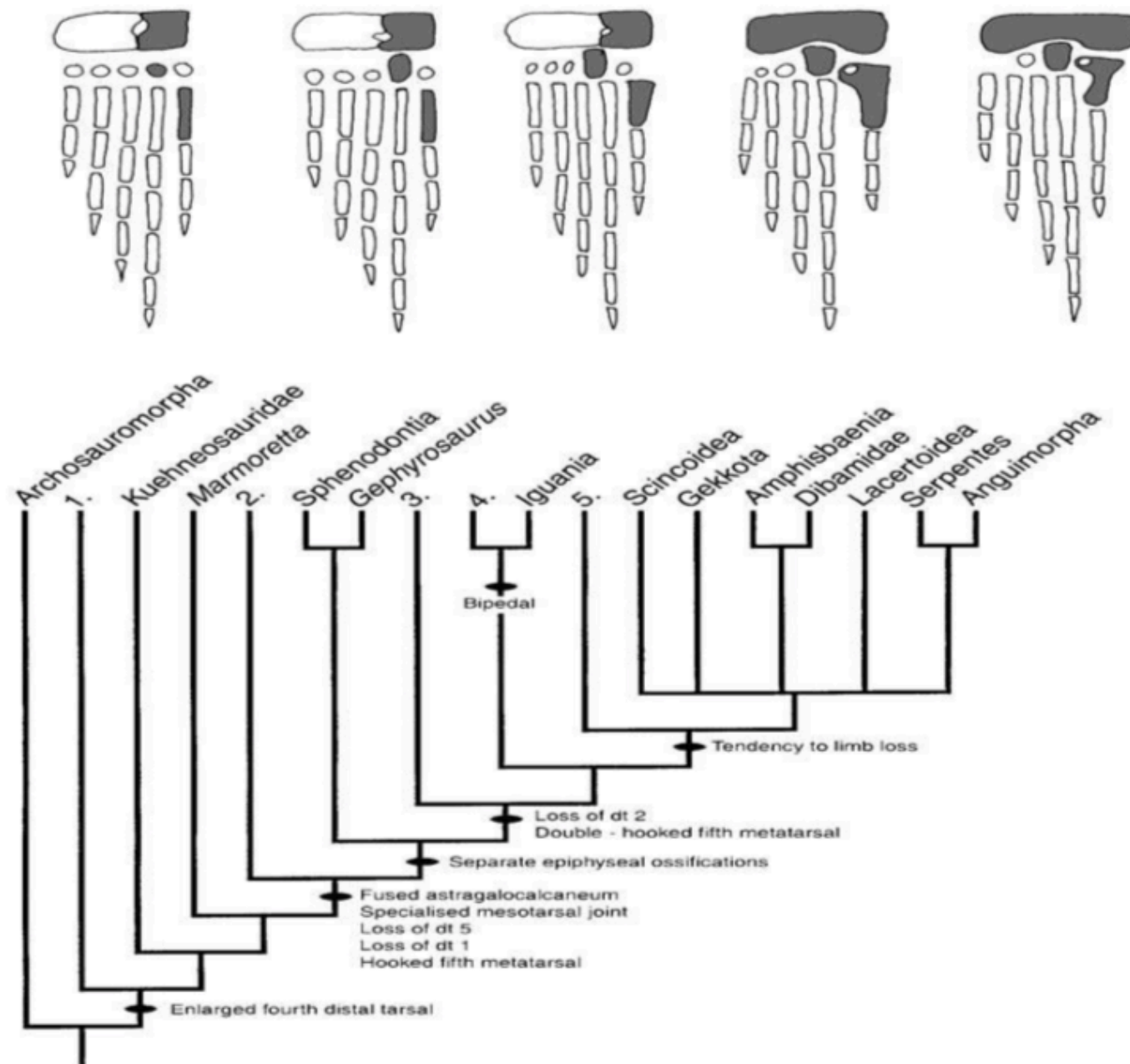
Figure 11-27. THE UPPER CRETACEOUS TEIID LIZARD *POLYGLYPHANODON*. (a) Dorsal, (b) palatal, (c) lateral, and (d) occipital views, $\times \frac{1}{2}$. The pattern of the skull root is typical of modern lizards. A transverse suture separates the frontals and parietals, which permits raising the snout in some genera. The pineal opening lies along this suture rather than further posteriorly as in more primitive lepidosaurs. The parietal and premaxilla are both fused at the midline. Abbreviations as in Figure 8-3. From Gilmore, 1942. By permission of Smithsonian Institution Press.

Lepidosauria

- Descendientes de ACMR entre *Sphenodon* y *Varanus*.
- Estructura de la piel derivada, con alternancia de keratogenesis entre alpha y beta keratina y mudas cíclicas completas.
- Hemipenes pareados
- Centros de oscificación epifiseal (centro de oscificación separados)
- Planos de fractura especializados en las vértebras de la cola
- Articulación de la rodilla en que la fíbula se encuentra con un receso lateral del fémur
- Quinto metatarso con forma de gancho, articulación mesotarsal con astragalocalcáneo fusionado.



Quinto metatarso con forma de gancho, articulación mesotarsal con **astragalocalcáneo fusionado**.



Rhynchocephalians o Sphenodontida

Hoy están representados por dos subespecies: *S. punctatus* y *S. guentheri*.

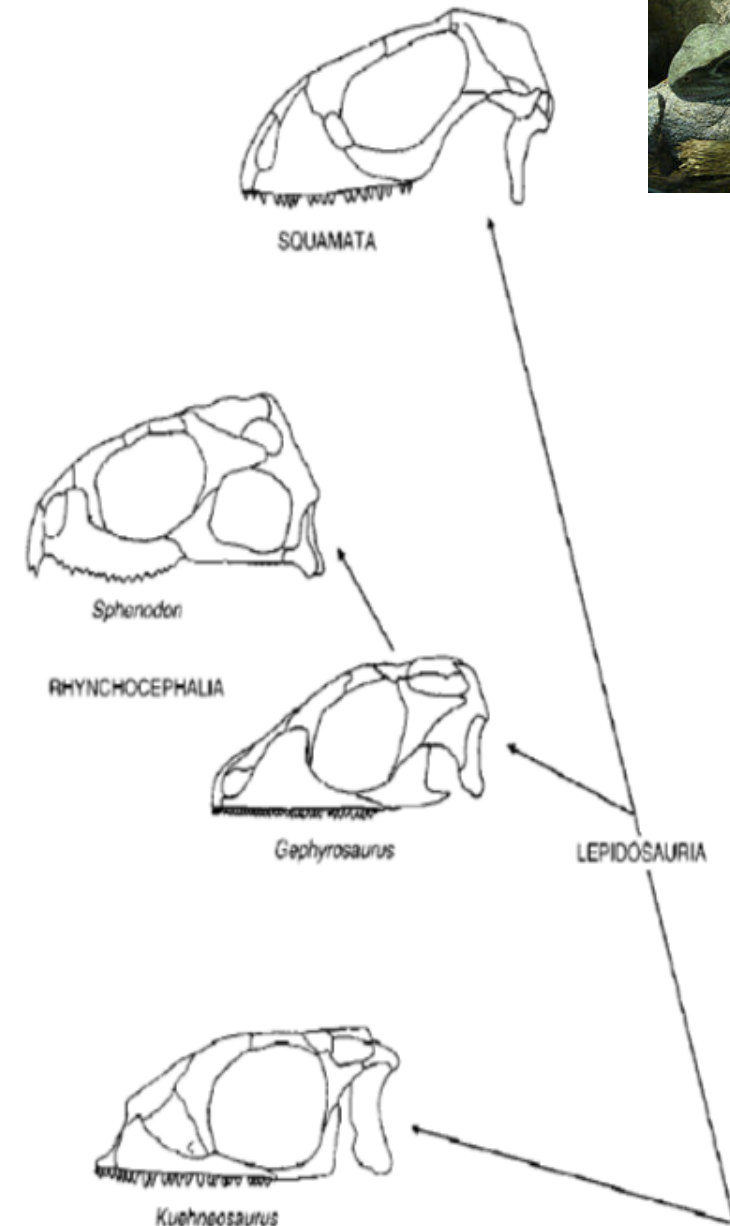
Registro fósil cosmopolita que se extiende hasta el Triásico.

Dientes:

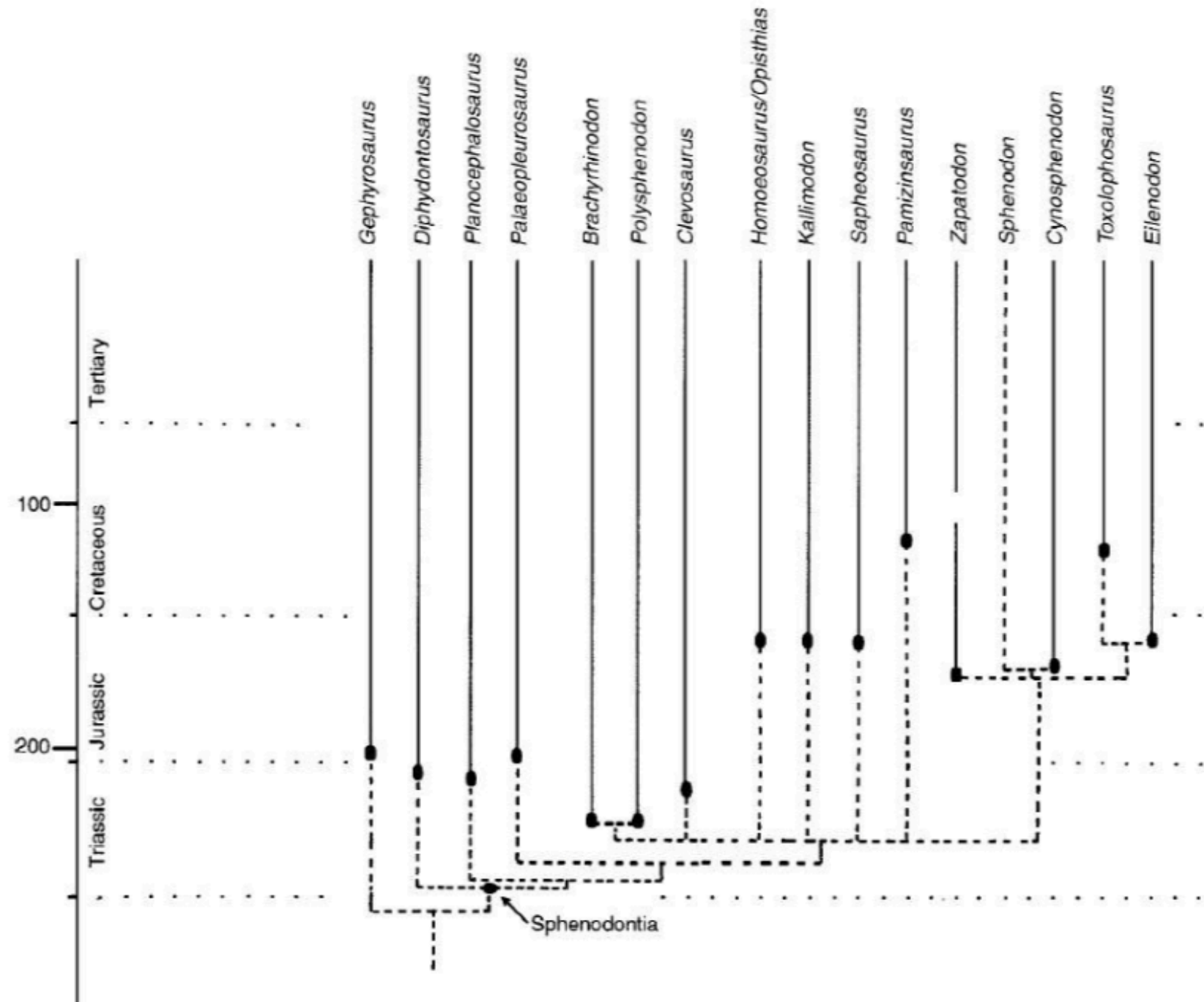
- Dentición acrodonta.
- Fila palatina de dientes en paralelo (o subparalelo) a la corrida maxilar.
- Extensión posterior del dentario.
- Pérdida o fusión del supratemporal.



Figure 1. Five major types of tooth implantation, and several variations of them, are recognized in amniotes. After Romer (1956) and Edmund (1960).



RHYNCHOCEPHALIA



Ej. sphinodontides marinos: *Pleuroosauridae* o *Ankylosphenodon*

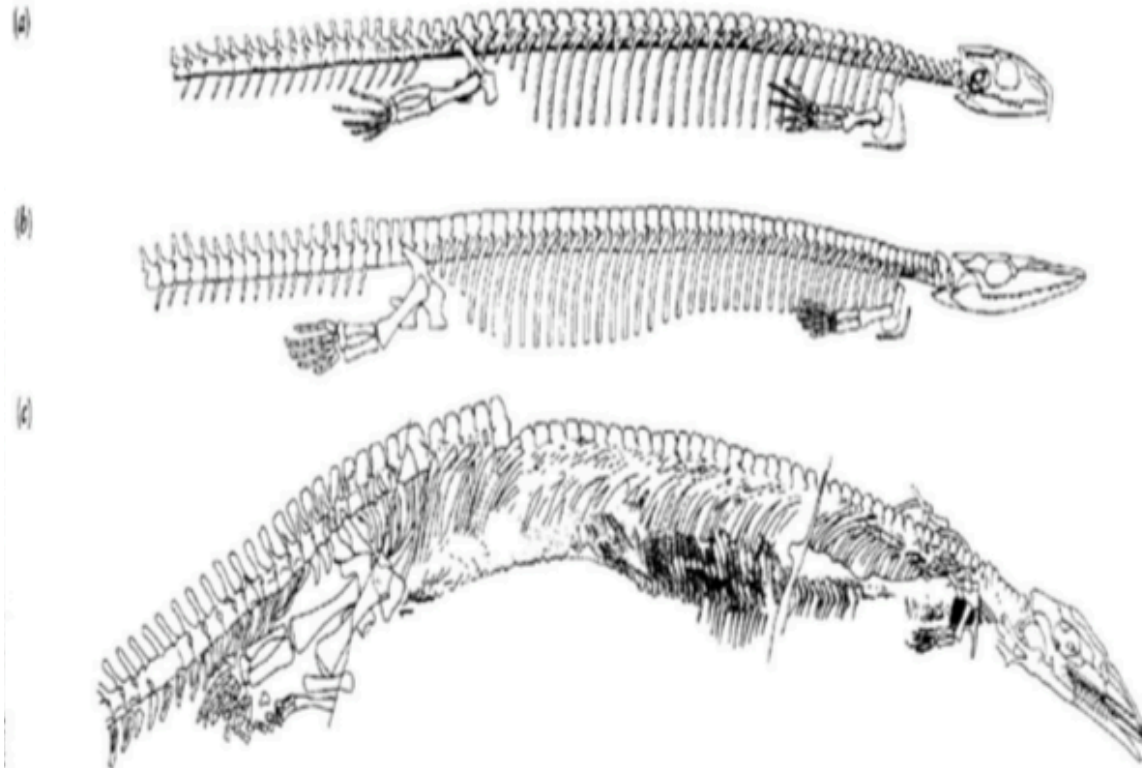


Figure 11-19. PROGRESSIVE CHANGES IN BODY PROPORTIONS WITHIN THE FAMILY PLEUROSAURIDAE. (a) *Paleopleurosaurus* from the Lower Jurassic. (b) *Pleurosaurus goldfussi* from the Upper Jurassic. (c) *Pleurosaurus ginsburgi* of the Lower Cretaceous. From Carroll, 1985.

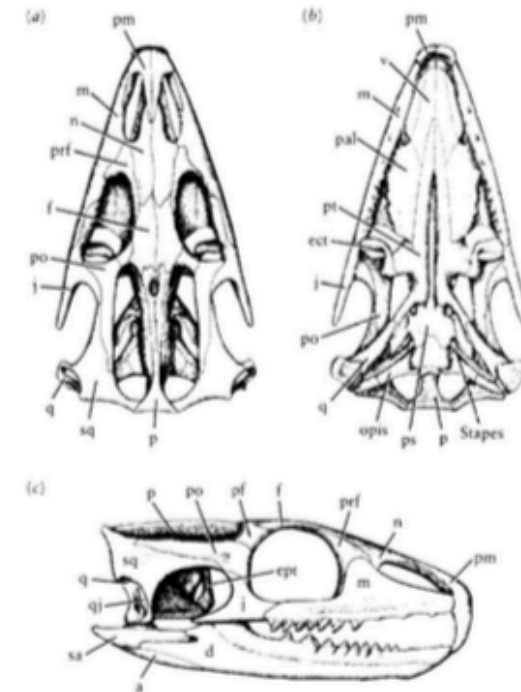


Figure 11-20. SKULL OF THE PRIMITIVE PLEUROSAUR PALEO-
PLEUROSAURUS. (a) Dorsal, (b) palatal, and (c) lateral views. Note
similarity to *Sphenodon* (see Figure 11-17). Abbreviations as in Figure
8-3. From Carroll, 1985.

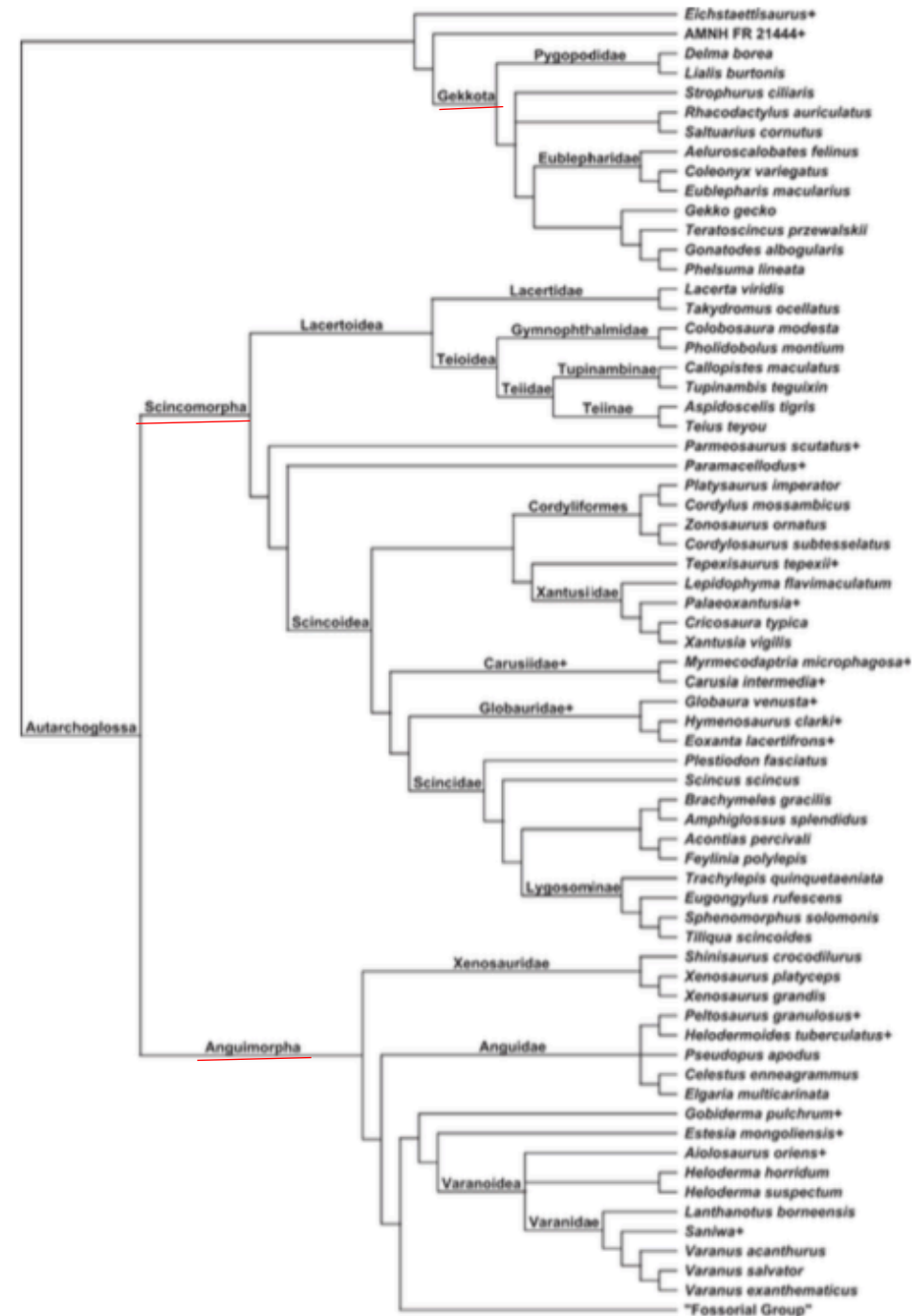
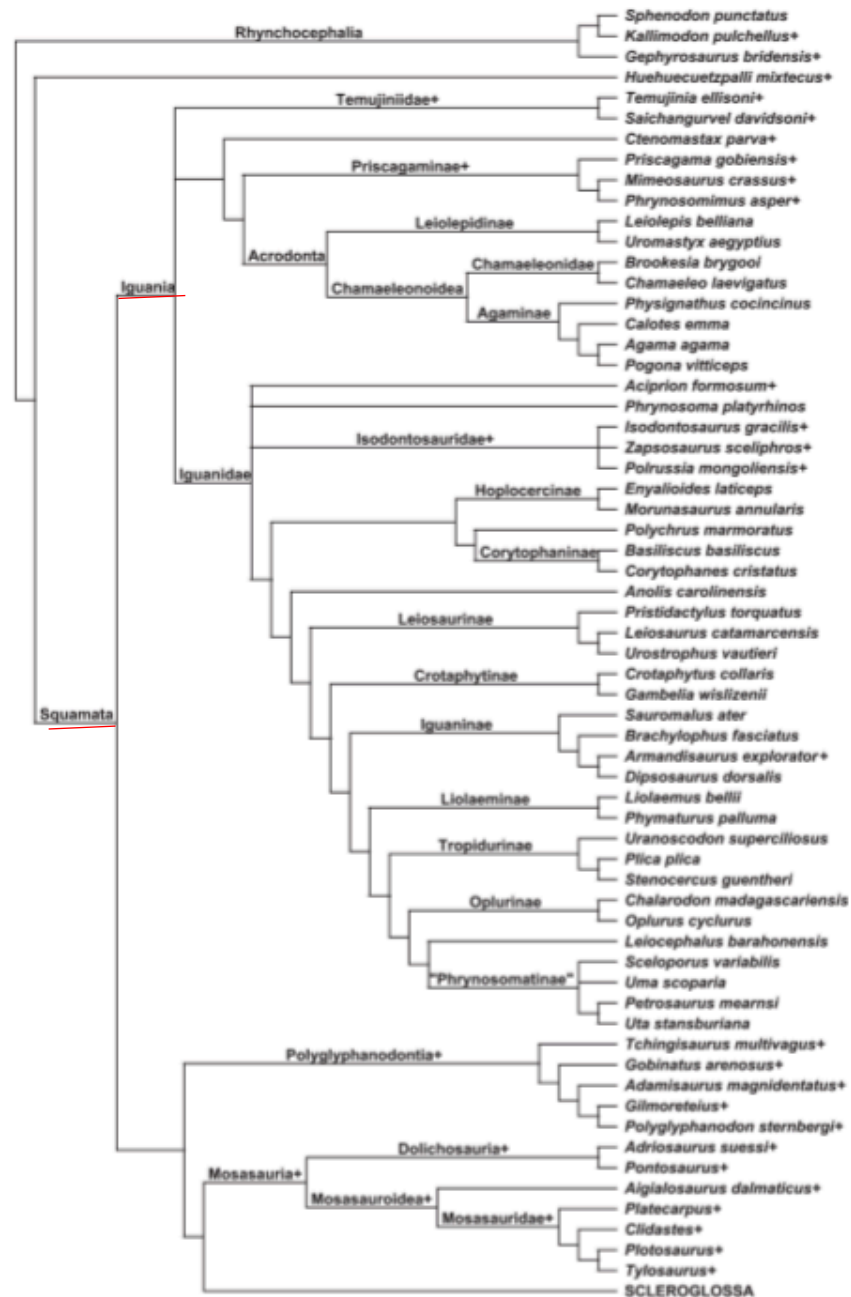
Cráneo elongado
anteroposterior.

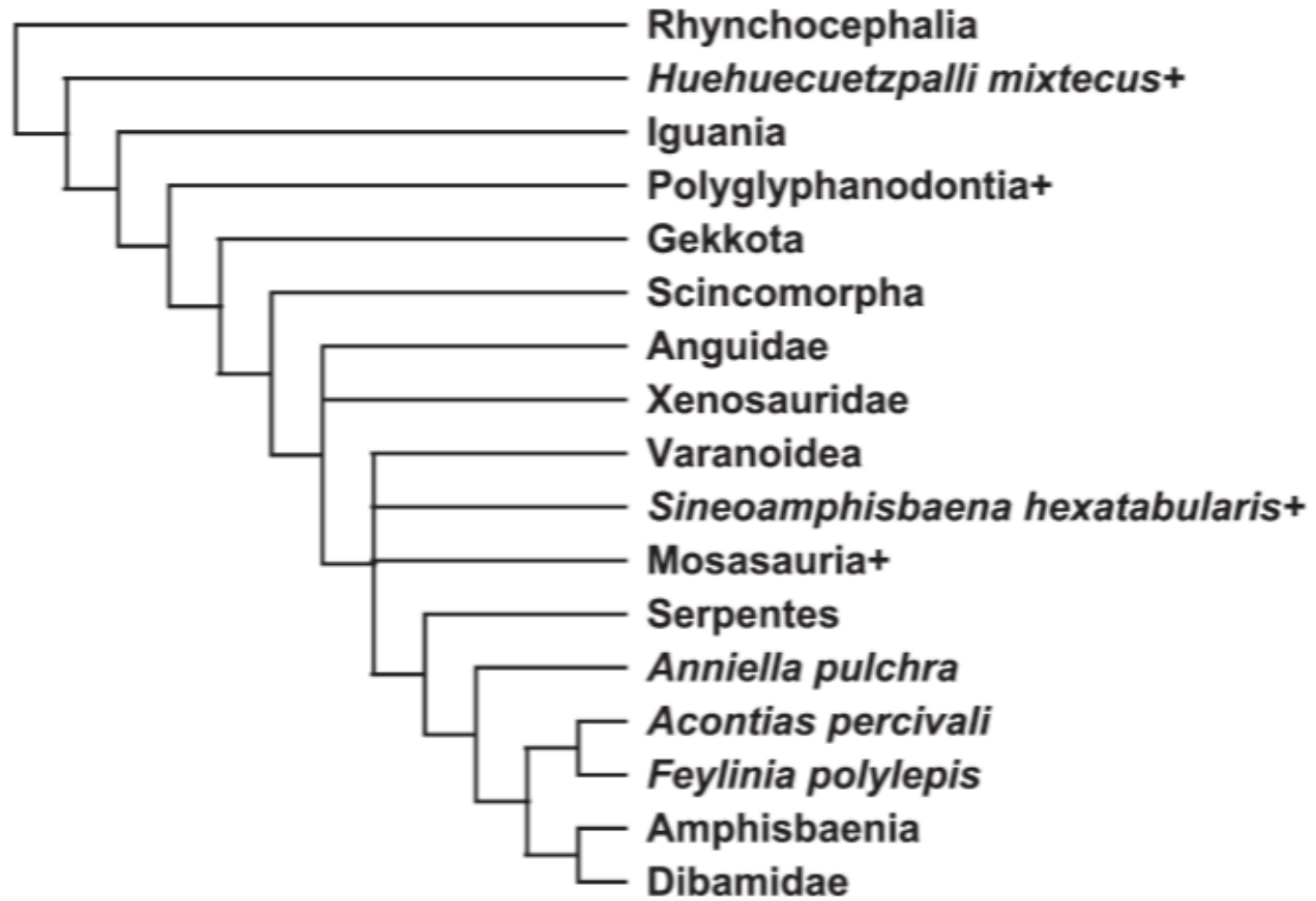
Extremidades reducidas.

Squamata



Fig. 1. Representative squamates: top row (left to right), *Sphaerodactylus cinereus* (Sphaerodactylidae); *Cricosaura typica* (Xantusiidae); *Ameiva lineolata* (Teiidae); middle row, *Typhlops anousius* (Typhlopidae); *Anolis noblei* (Iguanidae); *Tropidophis maculatus* (Tropidophiidae); bottom row, *Epicrates angulifer* (Boidae); *Cadea blanoides* (Cadeidae); and *Uromacer oxyrhynchus* (Dipsadidae). Photos by S.B. Hedges.





Iguania



Iguanas, camaleones y agámidos

Gekkota



Geckos...

Scincomorpha



Teideos y eslizones

Anguimorpha



Ánguidos (largartos caimanes, lagartos de cristal, celestus, lagartos sin patas)

Grupo fosorial (Gauthier, 2013)



Características generales de Squamata

Lizards and snakes are the most successful of modern reptiles in terms of the number of species and their wide geographical distribution. All can be traced to fossils from the late Permian and early Triassic. These early genera differ most significantly from sphenodontids and eosuchians in the loss of the lower temporal bar and the development of a joint between the dorsal extremity of the quadrate and the squamosal. Mobility of the quadrate at this joint is referred to as streptostyly; it appears to be a major factor in the success of lizards.

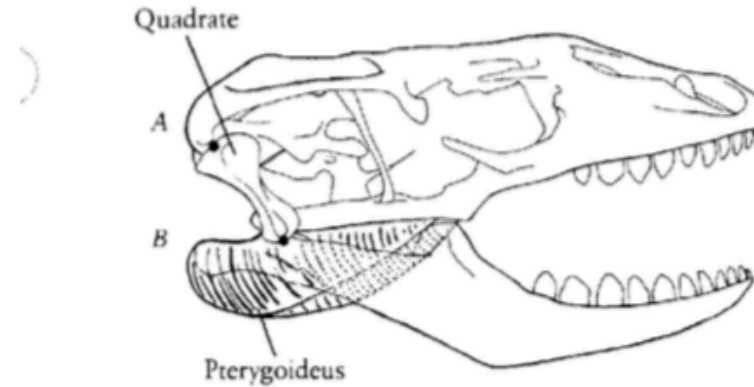


Figure 11-21. SKULL OF A MODERN LIZARD SHOWING THE ADVANTAGE OF STREPTOSTYLY. The pterygoideus muscle lies nearly parallel with the long axis of the skull. In most reptiles, the maximum force of this muscle is achieved when the jaw is widely open, at which time the muscle acts at nearly right angles to the axis of the jaw. When the jaw is nearly closed, the force of the pterygoideus is nearly parallel to the long axis of the jaw and has little effect in rotating the jaw about the quadrate-mandibular articulation (*B*). Since the force of the pterygoideus acts at nearly right angles to the quadrate, a joint between this bone and the skull (at *A*) enables this muscle to deliver much more effective force when the jaw is nearly closed. *From Smith, 1980. Redrawn by permission from Nature. Copyright © 1980, Macmillan Journal, Ltd.*

- Pérdida de la barra temporal inferior
- Unión entre el extremo dorsal del cuadrado y el escamoso.

Características generales de Squamata

Nearly all modern lizards have a transverse joint between the frontals and parietals that enables the snout to be raised and lowered through a small arc. Especially in the larger carnivorous lizards, this joint may function to improve the orientation of the long curving teeth that penetrate prey. In association with this mobility, the frontals and/or parietals are fused at the midline in most advanced lizards. The paroccipital process and the supra temporal contribute to support the quadrate and the streptostylic joint is further perfected.

Advanced lizards also specialize the nature of tooth implantation. In most groups, the jaw margin has extended to cover a large portion of the base of the teeth. The teeth are attached largely by their lateral surface, a pattern termed **pleurodont**. In two families, the Agamidae and Chamaeleontidae, the teeth are fused to the edge of the jaw as in sphenodontids. In one extinct group of large lizards, the mosasaurs, the teeth are set in deep sockets.

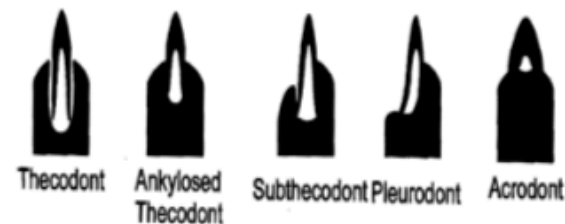
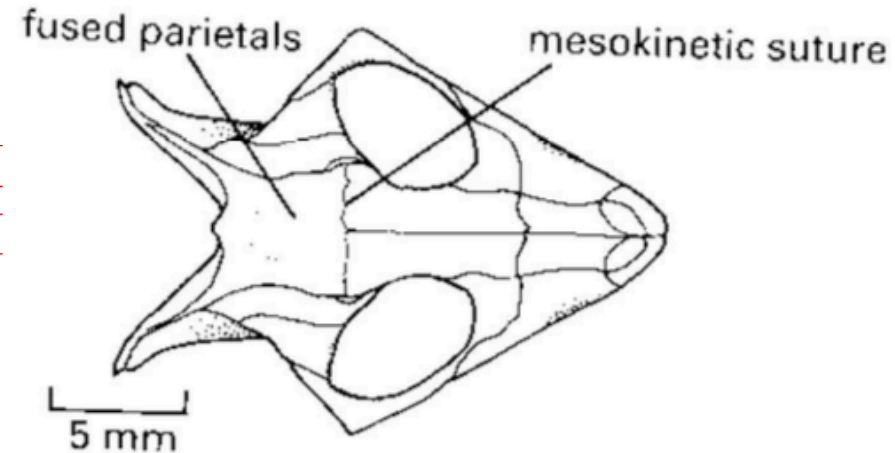
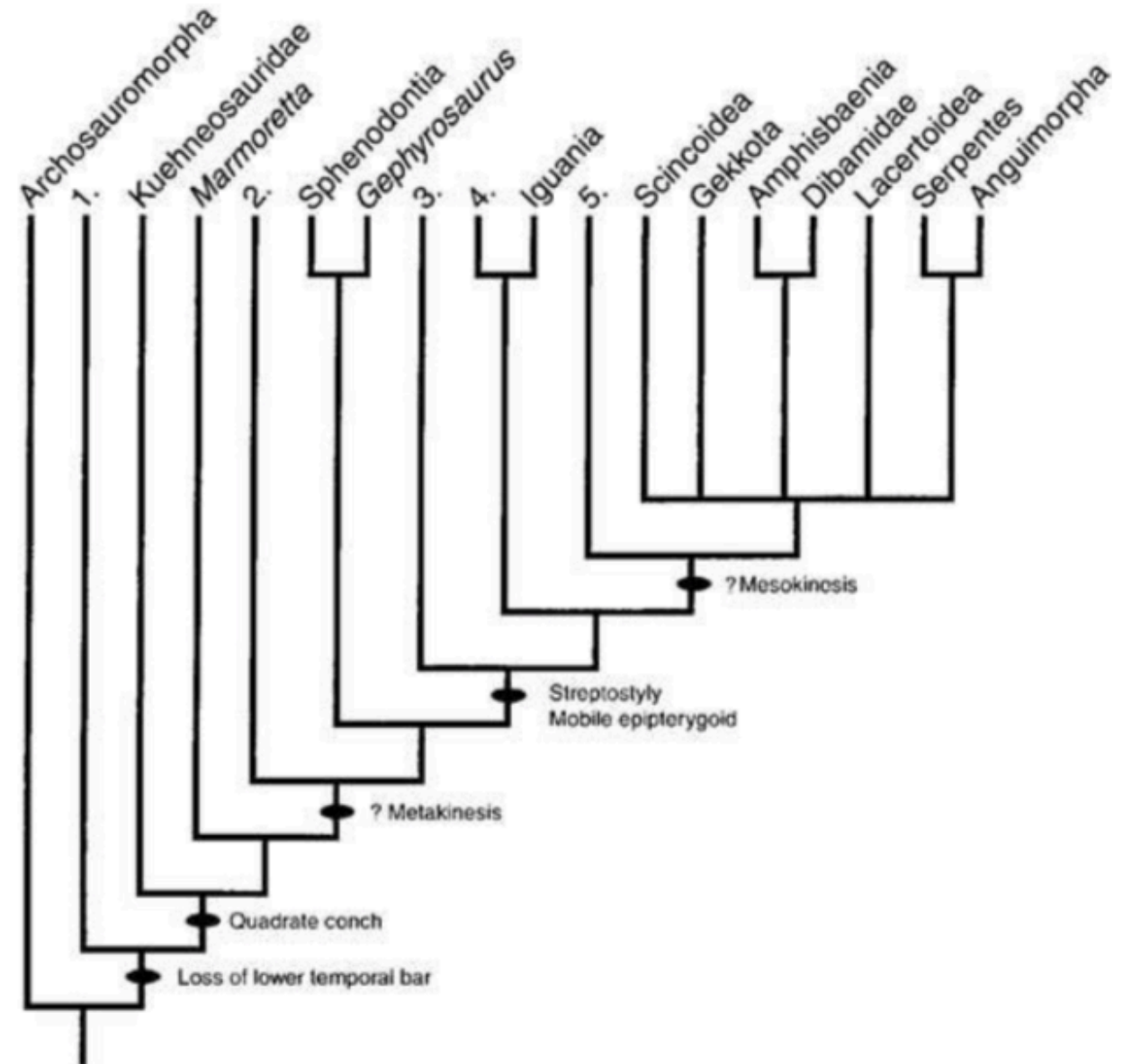
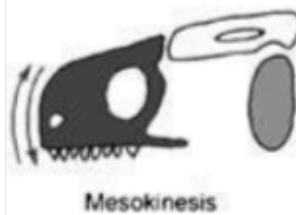
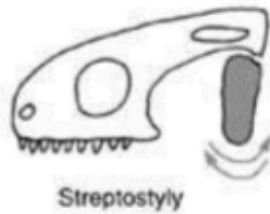
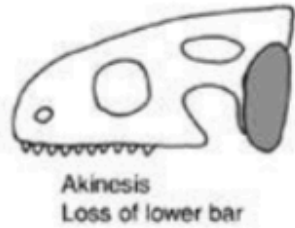
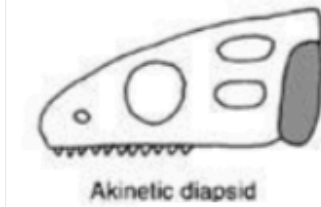
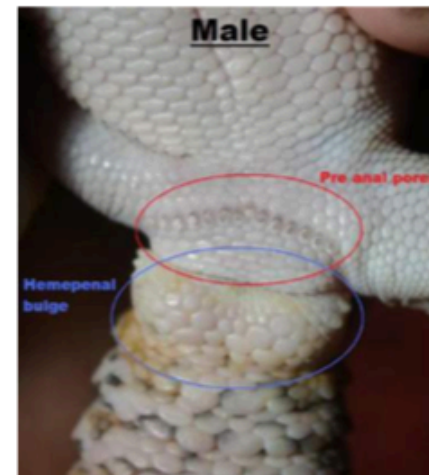
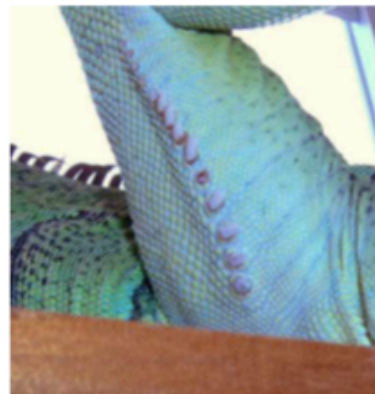


Figure 1. Five major types of tooth implantation, and several variations of them, are recognized in amniotes. After Romer (1956) and Edmund (1960).

Características generales de Squamata



Características generales de Squamata



Características generales de Squamata

The presence of specialized joints between the vertebral centra is an important characteristic of most advanced lizard groups. A socket develops in the anterior surface into which fits a condylar process that extends from the posterior surface of the next anterior centrum. This condition is termed procoely and is common to all modern lizard groups with the exception of many genera within the Gekkota (Figure 11-25).

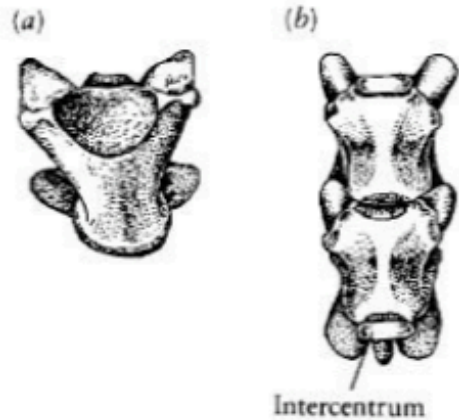


Figure 11-25. LIZARD VERTEBRAE. (a) The procoelus pattern of most groups of advanced lizards. (b) The trunk vertebrae of a gecko. They are amphicoelous, as in eosuchians, but this condition may be secondarily evolved within the geckos rather than being retained from their more primitive ancestors. *Drawn from specimens in Redpath Museum.*

Members of the Gekkota are among the earliest known and most divergent of the modern lizard groups (Figure 11-26). Unlike all other advanced lizards, most Gekkota have amphicoelous vertebrae. This condition is known as early as the Upper Jurassic but may be a reversion to a primitive condition resulting from the suppression of structures that are expressed late in embryological development in other lizard groups (Kluge, 1967). We also know procoelous gekkonids in the late Jurassic, and the condition is present in some living genera that are otherwise relatively primitive in their anatomy.



Características generales de Squamata

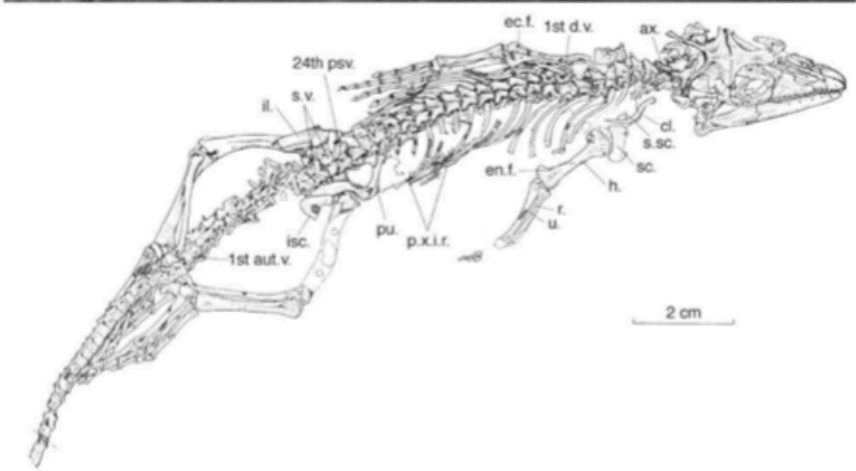
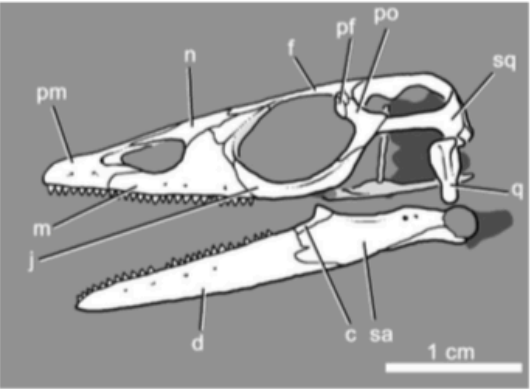
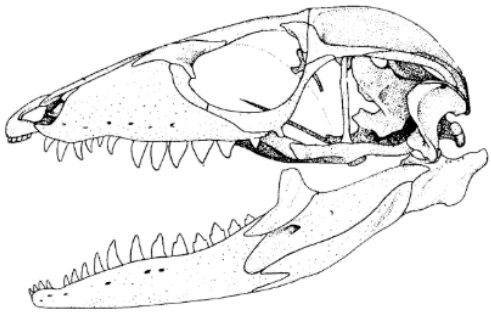
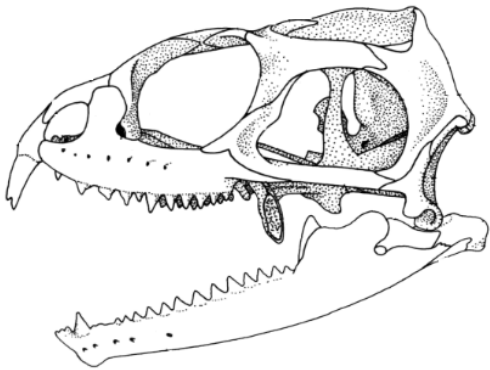


Figure 1. Skeleton of the holotype of *Huchanetzpalli mixtensis* gen. et sp. nov. (IGM 7389) as preserved on the block. Abbreviations are listed in Appendix 2.



Gran premaxila
Distal tarsal 2

Plesiomorfías...
Squamata basal



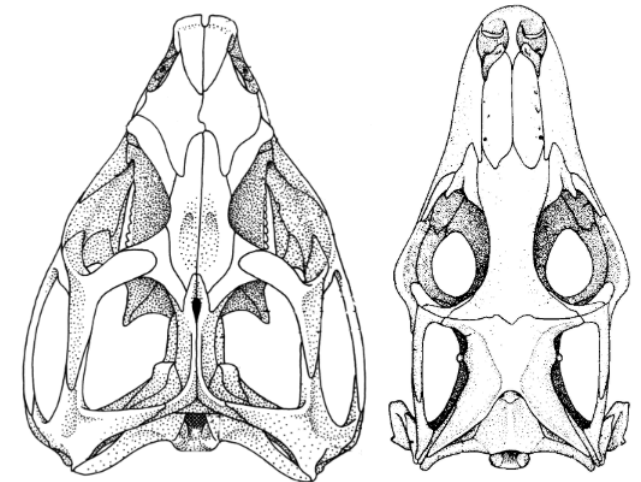
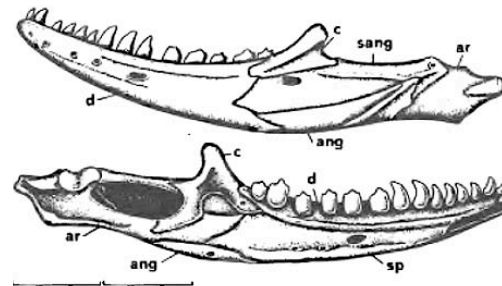
Sphenodon punctatus a rhynchocephalian compared to *Tupinambis teguixin*, a squamate.

Resumen: Características generales de Squamata

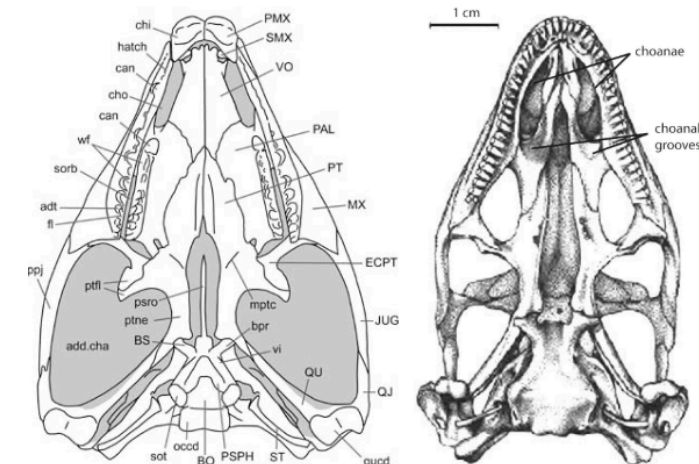
- Jugal extends anteriorly in orbit margin
- Epipterygoid is reduced to a narrow column
- Angular is short (not reaching the jaw articulation posteriorly)
- Coronoid is complex and forms a tall coronoid process.
- Frontals and parietals meet in a straight line that forms a hinge. This is functionally similar to the **intracranial hinge of basal sarcopterygians**. Together with the mobile quadrate, squamate skulls enjoyed a degree of **cranial kinesis** that enabled them to optimize the leverage of the *temporalis* and *petrygoideus* muscles of the jaw.
- Pineal foramen moves to the fronto-parietal contact (but is often absent)
- Nasals reduced
- Premaxilla fused
- Frontals fused
- Parietals fused
- Parietals anteroposteriorly short, such that the occipital region is exposed in dorsal view.
- Opisthotics and exoccipitals fused
- Palatal teeth reduced
- Choanae recessed in choanal grooves
- Suborbital fenestrae expanded such that pterygoids form part of their medial border
- Enlarged interpterygoid vacuity, such that pterygoids barely touch, if at all
- Vertebral articulations procoelous (concave anteriorly)
- **Accessory articulations** of neural arches present
- Dorsal intercentra absent
- Coracoid emargination present
- **Sternum present**, facilitating rotation of coracoids.
- **Thyroid fenestra** in pelvis
- Astragalus and calcaneum fused to form **astragalocalcaneum**.
- Distal tarsals 1 and 2 are lost.

This is a bewildering list, however some major adaptations shine through:

- In contrast to rhynchocephalians, whose strong jaws enable them to bite pieces off of their prey, the anatomy of the kinetic squamate skull is adapted to seizing and holding prey, then swallowing it whole. In some, this is developed into an astonishing ability to **wrap their heads** around their prey.
- Squamate locomotion is improved, with increased rotation of forelimbs and robust consolidation of ankle bones. [Link to video](#).



Sphenodon punctatus a rhynchocephalian compared to *Tupinambis teguixin*, a squamate.



Iguania

- Fusión de las premaxilas
- Forámen parietal sobre la sutura fronto-parietal (ojo parietal)
- Presencia de un proceso ventromedial de los pterigoides
- Quillas hipapofisiales en las vértebras cervicales
- Planos caudales de autonomía posteriores a procesos transversales



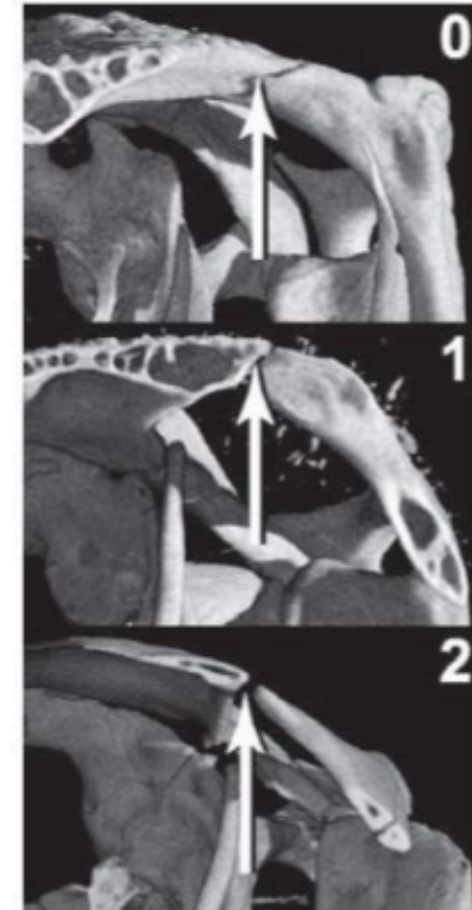
Phrynosomatidae:
Iguania basales?

- Aunque Iguanidae es exclusivamente “New World”, el origen de Iguania es asiático. Grupos hermanos como Isodontosauridae, Temujiniidae o Panacrodonta son de Asia.

Iguanidae

Articulación móvil entre el postorbital y el techo del cráneo

Foramen palatino



80. Postorbital firmly sutured to skull roofing bones (post-frontal or parietal): (0) present (*Polychrus marmoratus*, anterior close-up cutaway view of skull); (1) postorbital barely underlaps parietal at frontoparietal suture (equals mobile joint of Arnold 1998) (*Enyalioides laticeps*, anterior close-up cutaway view of skull); (2)^N postorbital tapers to blunt tip separated from parietal (*Liolaemus bellii*, anterior close-up cutaway view of skull). (Smith 2009a, 2009b) (ordered).

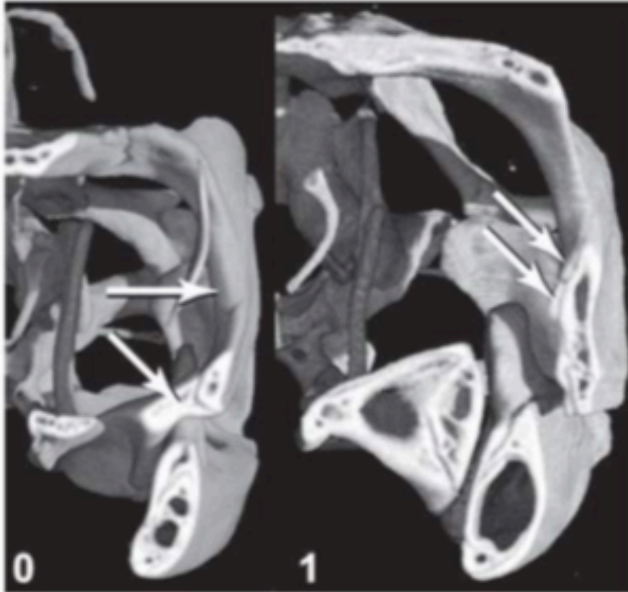
Chamaeleonoidea (Chamaelonidae + Agamidae)

Contacto postorbital-ectopterigoides
Foramen lacrimal agrandado
Dientes premaxilares distintivamente más pequeños que los maxilares
Pérdida de epibranchiales libres en el
Hioides
Escápula alta y angosta
Proyección de la lengua



Agaminae

Foramen epiótico único en amniotas
Parietal se extendiendo sobre el postorbital y forma parte del margen anteromedial de la fenestra temporal sup.
Coronoide restringido al aspecto medial de la mandíbula

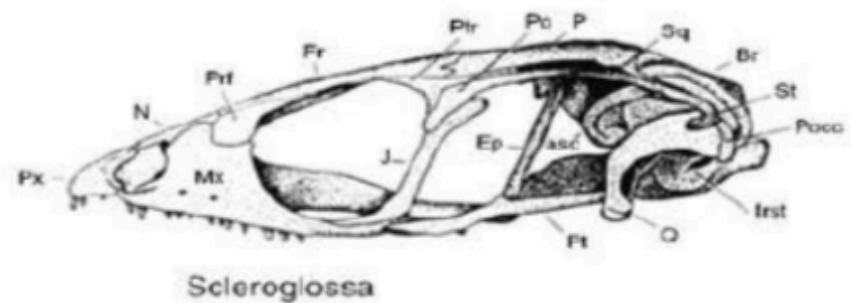
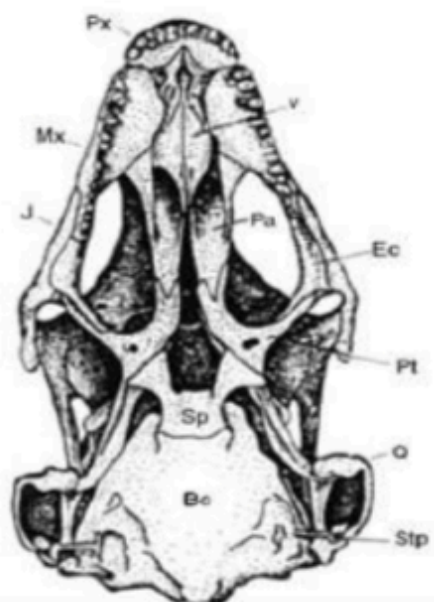
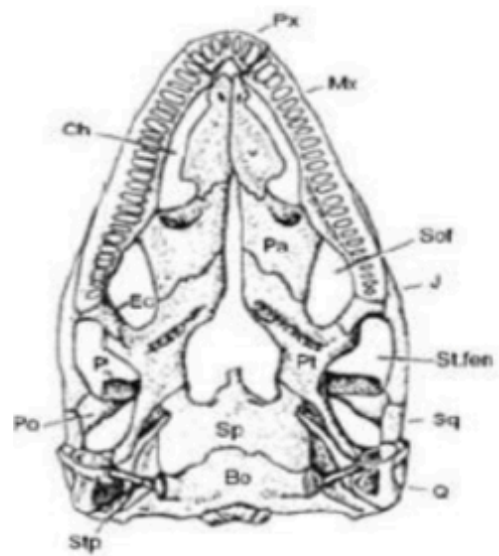
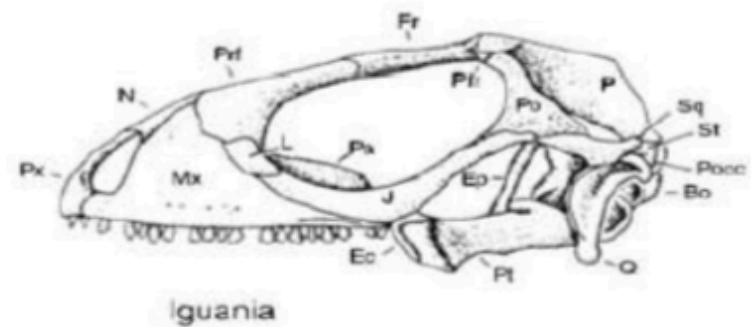
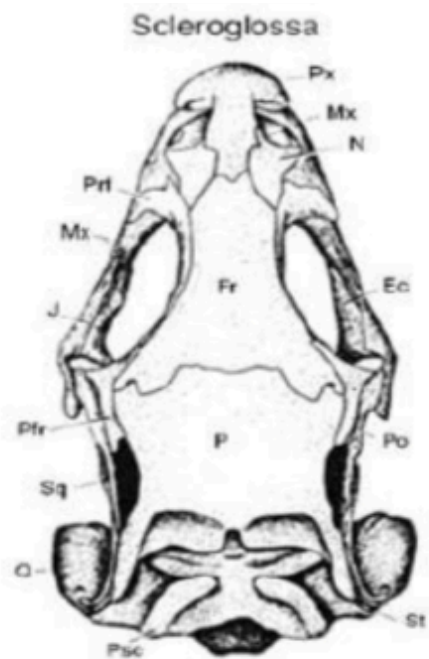
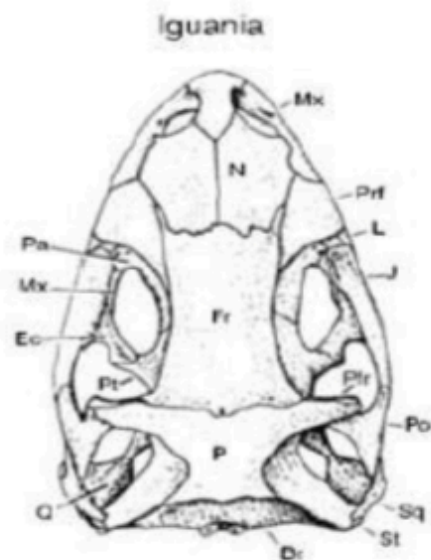


81. Postorbital-ectopterygoid contact: (0) absent (*Basiliscus basiliscus*, anterior close-up cutaway view of skull); (1) present (*Calotes emma*, anterior close-up cutaway view of skull). Moody (1980).

Scleroglossae

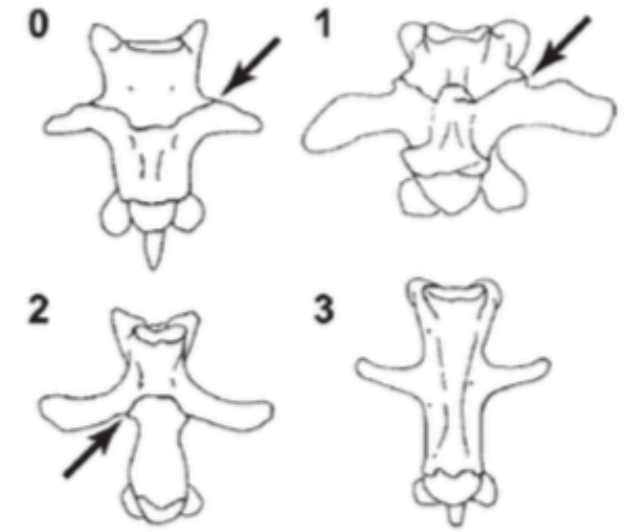
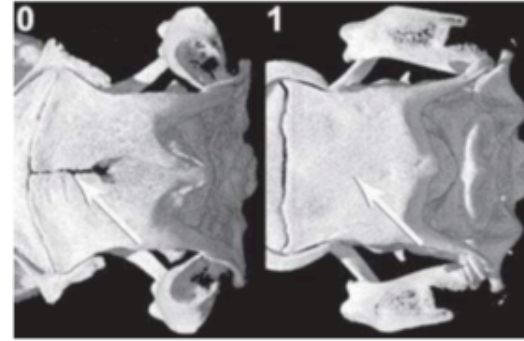
- Lengua plana y queratinizada
- Vomeronasal grande
- Unión yugal-postorbital es una articulación móvil
- Los músculos temporales se insertan en “tabla” del parietal
- Vomer grande
- Proceso alar de prootico
- Pérdida de proceso ascendiente del escamoso
- Proceso facial amplio del maxilar, 26 en vez de 24 vértebras pre-sacrales
- Interclavícula en forma de cruz (no te “T”).



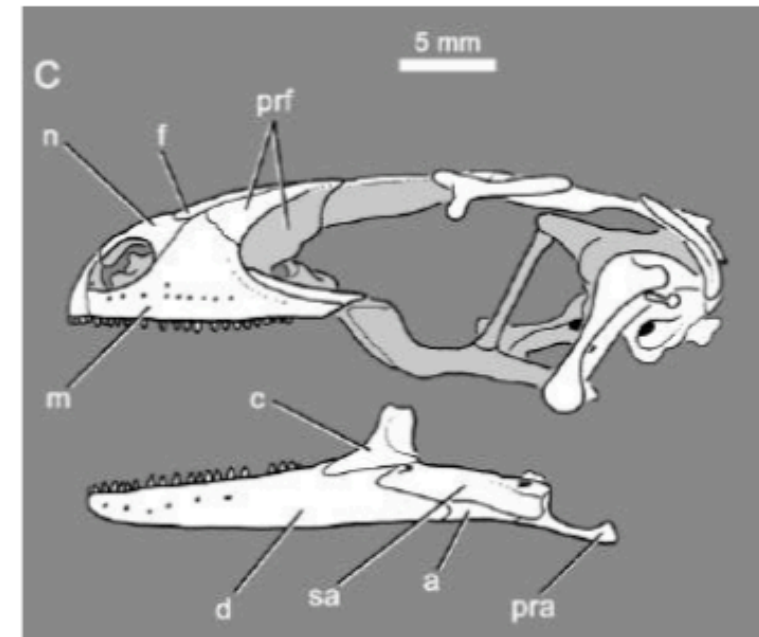
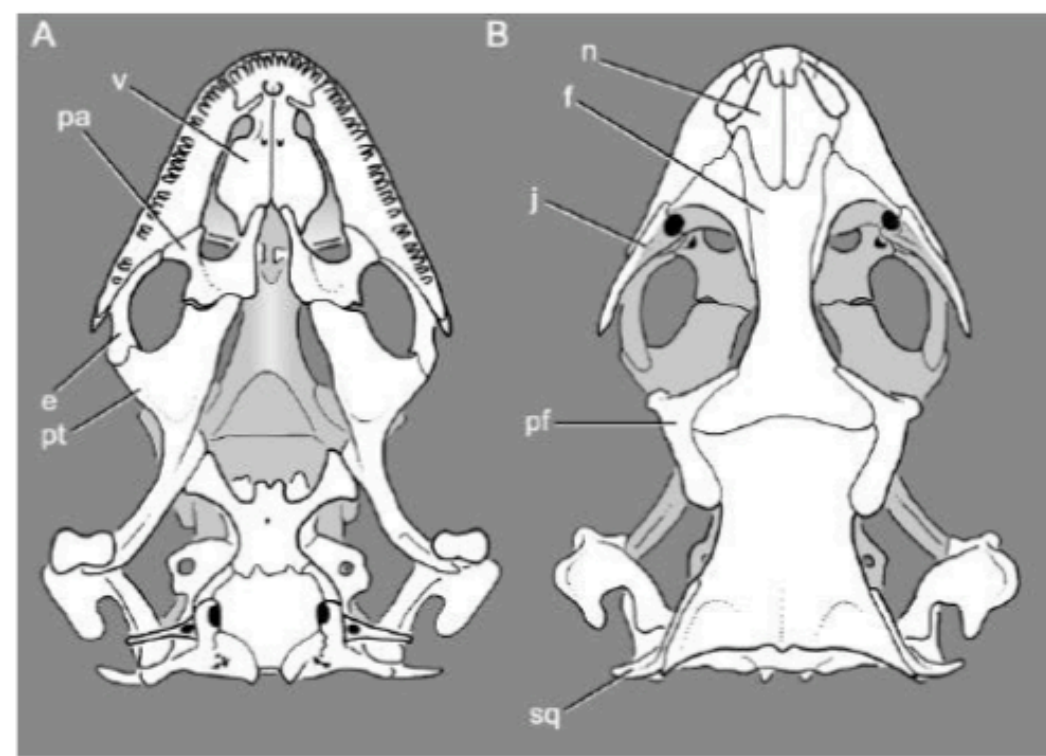


Gekkota

- Procesos frontal subolfatorios arqueados bajo el cerebro
- Parietales pareados (1)
- Rama temporal del escamoso contacta el proceso supratemporal del parietal
- 10 o más dientes maxilares y 31 o más dientes maxilares
- Septum autotómico caudal posterior a la costilla caudal (2)



Gekkotans are specialized in the loss of the dorsal process of the squamosal, the down growth of the frontal bones below the brain, and the presence of the facial artery anterior to the stapes. The karyotype is very different from that of other lizards. The eyes of modern geckos are adapted to feeding under conditions of limited light. The diverse family Gekkonidae is known from the Upper Eocene. The Pygopodidae are rare burrowing lizards, without a fossil record, which are apparently related to the geckos.



Autarchoglossa: Scincomorpha + Anguimorpha

- Esculpimiento dermal del frontal y parietal
- Premaxila fusionadas
- Jugal angulado
- Proceso posteroventral del jugal
- Articular-prearticular fusionados al surangular
- Vómer encapsula el órgano vomeronasal anterior y medialmente
- Músculo rectus abdominus unido a la piel en intersticios entre grandes filas transversales de escamas ventrales
- Escamas cefálicas grandes, regulares, como placas firmemente unidas al cráneo.



Scincomorpha: Scincoidea + Lacertoidea

- Lengua escamosa
- Osteodermos compuestos (varios forman uno)



- Polyglyphanodon aparece como grupo hermano de Scleroglossa en algunos análisis

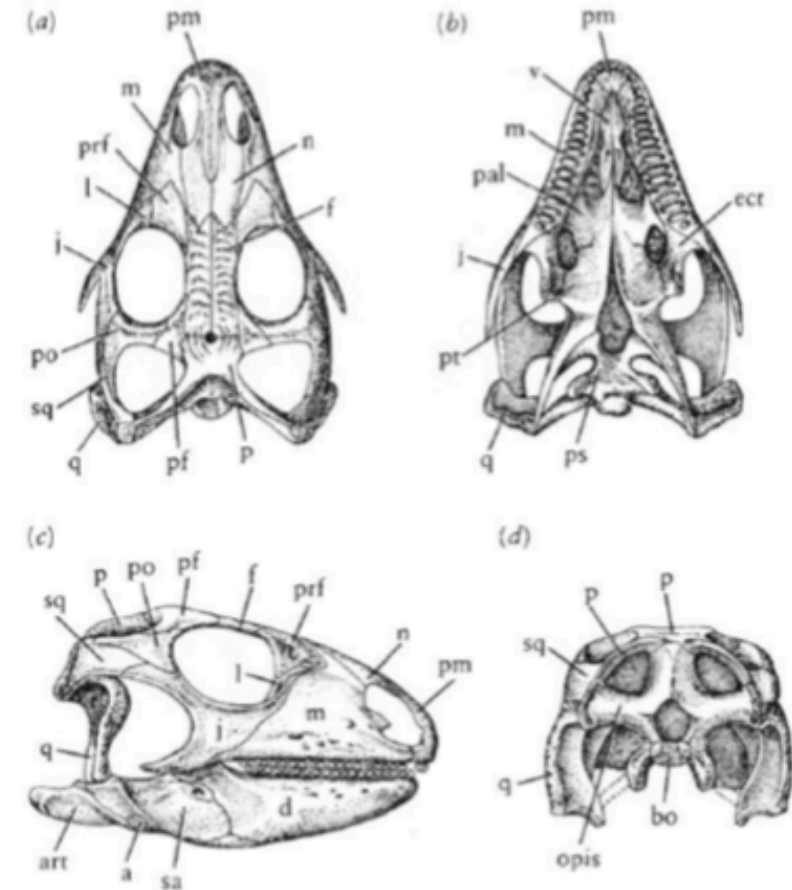


Figure 11-27. THE UPPER CRETACEOUS TEIID LIZARD *POLYGLYPHANODON*. (a) Dorsal, (b) palatal, (c) lateral, and (d) occipital views, $\times 1$. The pattern of the skull root is typical of modern lizards. A transverse suture separates the frontals and parietals, which permits raising the snout in some genera. The pineal opening lies along this suture rather than further posteriorly as in more primitive lepidosaurs. The parietal and premaxilla are both fused at the midline. Abbreviations as in Figure 8-3. From Gilmore, 1942. By permission of Smithsonian Institution Press.

Anguimorpha

- Lengua bífida, cuerpos largos con al menos 28 vértebras presacrales.
- Bases de los dientes presentan repliegues (laberintodontes)
- Articulación intra-mandibular
- Anduidae: muchas formas semejantes a serpientes
- Varanoidea: macrocarnívoros como el dragón de Komodo (varanidae), formas venenosas como Helodermatidae (monstruo de gila)

The family Necrosauridae, which is known from the Upper Cretaceous into the Oligocene, is structurally intermediate between primitive members of the Anguioidea and the Varanoidea. Necrosaurs retain osteoscutes and the jaw hinge is only partially developed.



is a highly specialized structure with a bifid sensory tip that can be retracted into an elastic posterior portion. Replacement teeth are located between, rather than medial to, mature teeth. The mandible is hinged in the mid-





Figure 11-28. *HELODERMOIDES*, AN ARMORED ANGUID LIZARD FROM THE OLIGOCENE. Photograph courtesy of Robert Sullivan.



© Gary Nafis

We can place most remaining lizards in a single group, the Anguimorpha, which includes a considerable variety of body forms. The group is represented in the Upper Jurassic by incomplete remains that are placed in the family Dorsetisauridae. They show some features of the living families Xenosauridae and Anguidae. The Anguidae, which appears in the late Cretaceous, encompasses a few genera with normally developed limbs, and others have snakelike proportions, including the “glass snake” *Ophisaurus*, and the European “slow worm” *Anguis*. Osteoderms are highly developed in the anguids, and they are especially prominent in a number of early Tertiary genera including *Glyptosaurus*, in which they form a massive armor (Figure 11-28). The “Gila monster,” *Heloderma*, with antecedents from the Upper Cretaceous, belongs to an allied family, *Helodermatidae*, that is associated with more advanced anguimorphs. It is the only venomous lizard.

Varanus y Lanthanotus



- Varanoidea: macrocarnívoros como el dragón de Komodo (varanidae), formas venenosas como Helodermatidae (monstruo de gila)

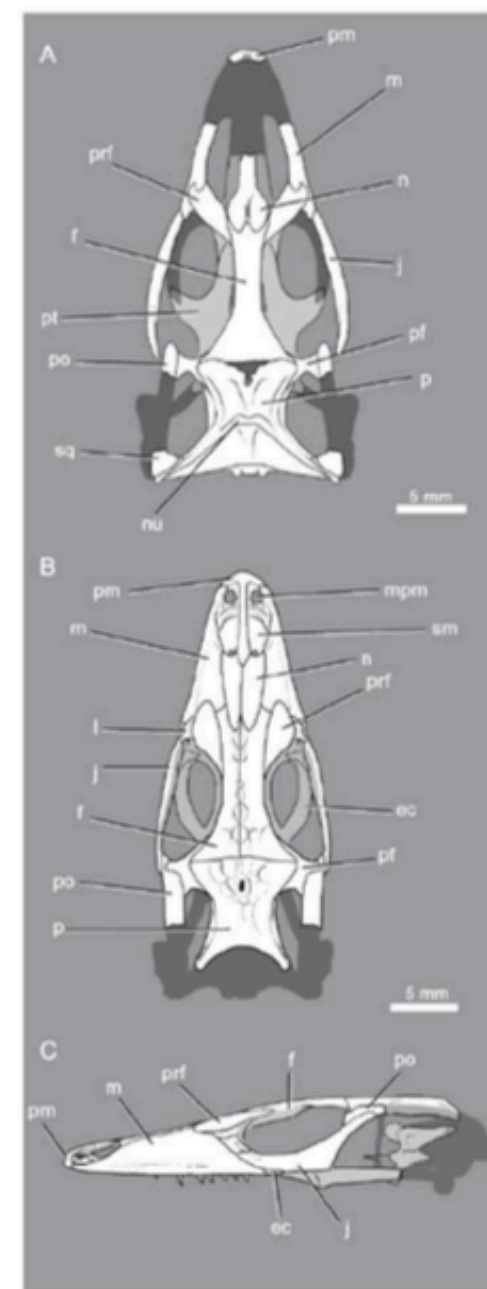


Fig. 22. Skulls of (A) *Paravaranus angustifrons* in dorsal view and *Proplatynotis longirostris* in (B) dorsal and (C) left lateral views. Modified after

Mosasauros

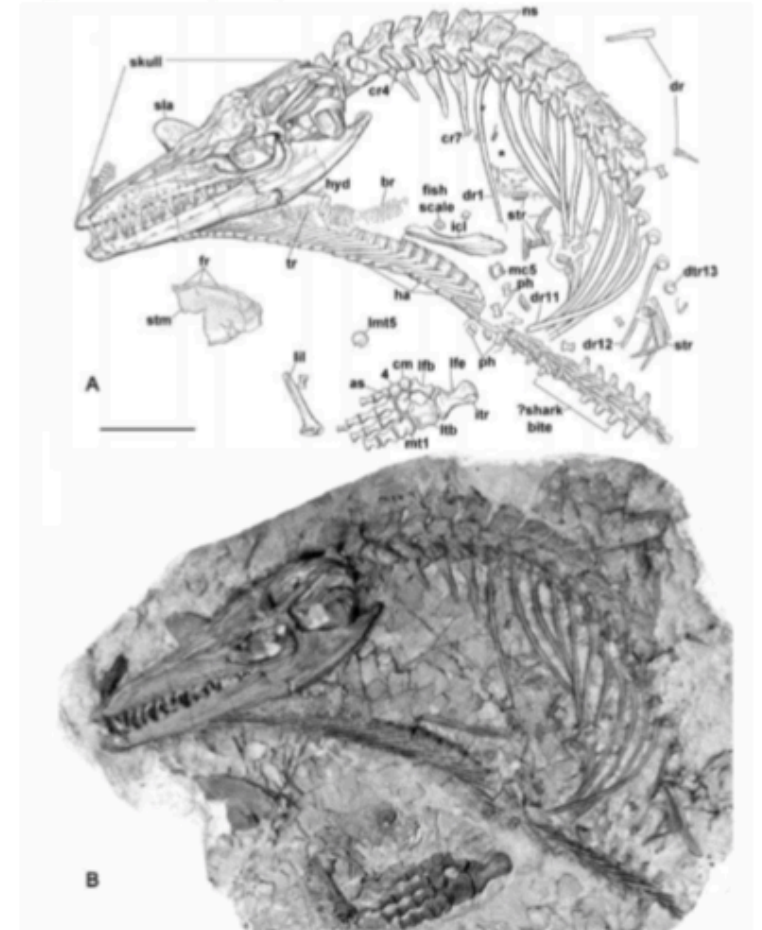


Figure 11-29. SKELETON OF THE AIGIALOSAUR *OPETIOSAURUS*. From the mid-Cretaceous of Yugoslavia. Approximately 1 meter long. Restoration based on a specimen described by Kornhuber (1901).

- Formas que exceden los 10 metros.
- Formas de cola sugiere nado anguiliforme y extremidades y escamas están modificadas para el nado.
- Cráneo similar a varanoides actuales

skeletons from the middle Cretaceous (Cenomanian-Turonian) of Yugoslavia. The neck, with eight cervical vertebrae, resembles that of terrestrial varanids; the limbs are reduced but not structurally altered. In *Opetiosaurus*

(Figure 11-29), the tail is laterally compressed and the tip is bent ventrally, as in marine crocodiles and advanced ichthyosaurs. The body, including the tail, is a little more than 1 meter long. By themselves, the aigialosaurs show only a modest radiation and limited specialization toward an aquatic way of life. Their importance lies in their close affinities with the most specialized of marine lizards, the mosasaurs, judged by the near identity of the skull structure (Figure 11-30).



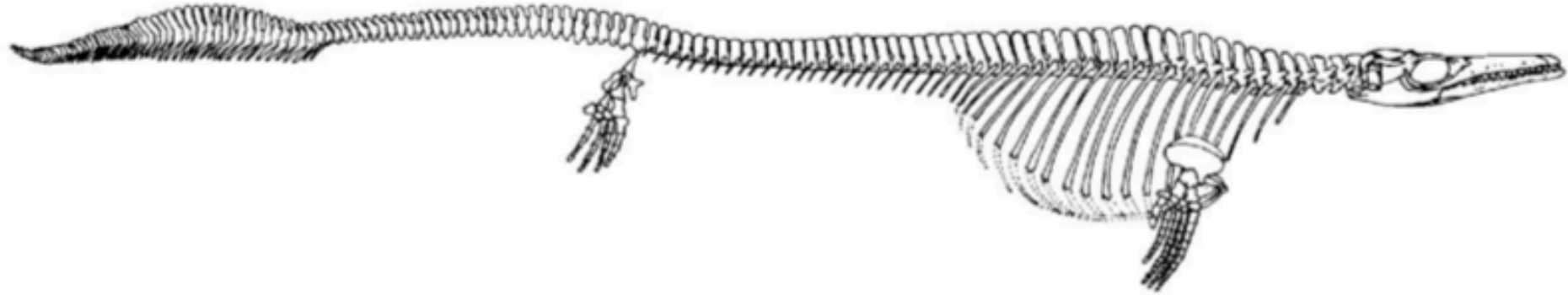
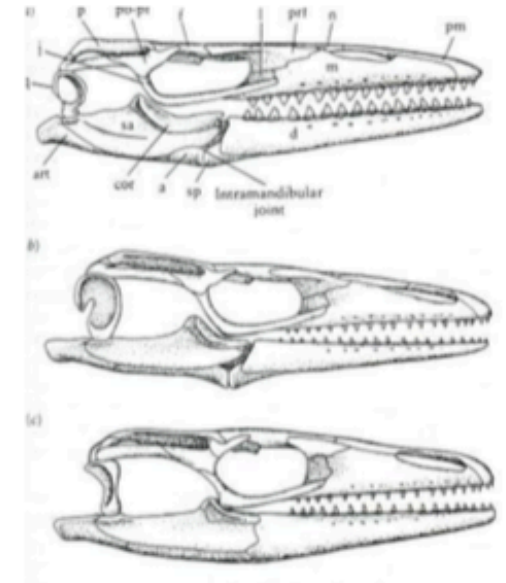
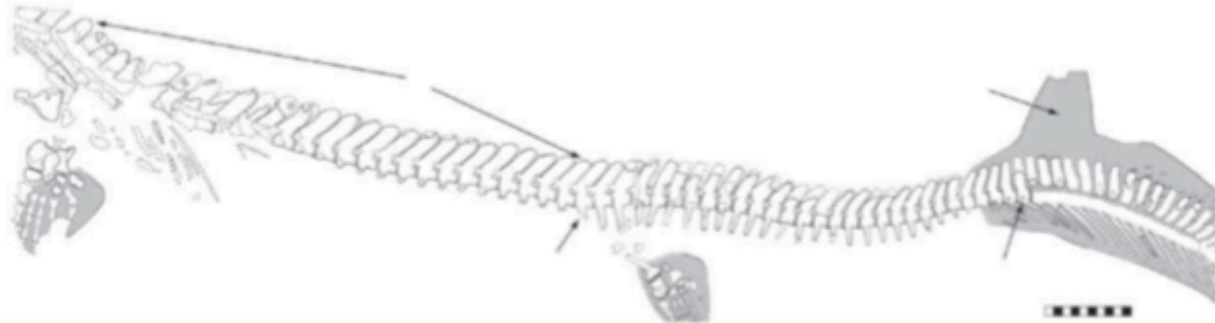
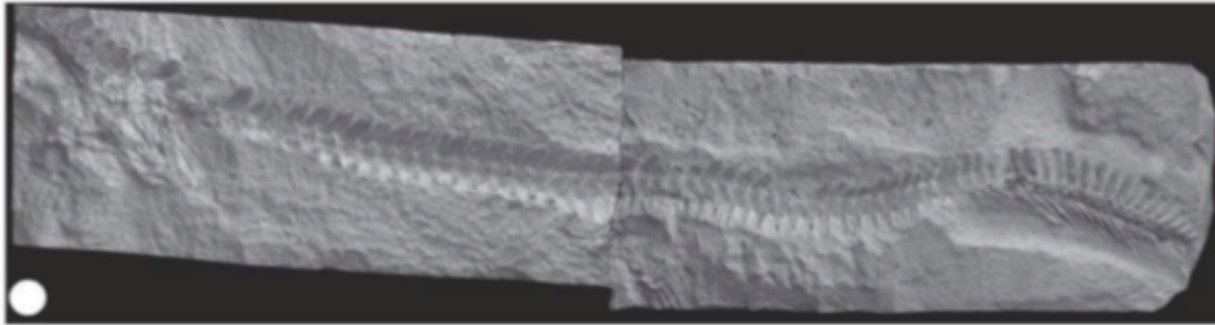
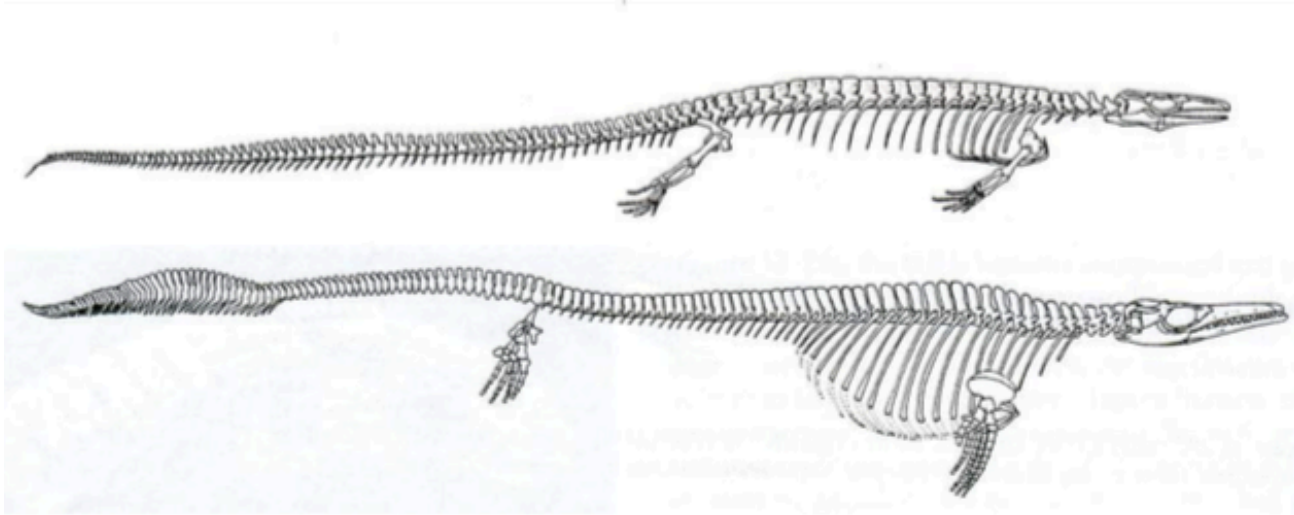


Figure 11-31. SKELETON OF THE MOSASAUR *PLOTOSAURUS*. Genus is a giant marine lizard from the Upper Cretaceous, approximately 10 meters long. *From Russell, 1967.*

fast-swimming fish. There is no connection between the vertebral column and the ilium. The rib cage is expanded anteriorly, with the first five thoracic ribs being attached to the sternum as in primitive terrestrial lizards. The posterior trunk ribs are much reduced. The manus and pes are extended by **hyperphalangy** (multiplication of the units in each digit) but do not exhibit **hyperdactyly** (multiplication of digits). The phalangeal count of the manus ranges from approximately 4, 5, 5, 5, 3 to 10, 10, 10, 7, 2.

Dentro de los Squamata, los mayores tamaños ocurrieron en los varanoidea, quienes evolucionaron gigantescas formas acuáticas, los Mosasauridae



The skull is basically similar to that of modern varanids, but the closest resemblance is to the aigialosaurs. Mosasaurs and aigialosaurs differ from varanids in the fusion of the frontals, the extension of the premaxillae to the frontals, and the reduction of the nasals. There is a well-developed transverse joint between the angular and splenial, midway in the length of the lower jaw. There is some mobility between these bones in varanids, but the joint is already fully developed in aigialosaurs. As in aigialosaurs, the quadrate of mosasaurs is oval in lateral view and extremely massive. The tympanum is calcified in several genera.

The mosasaurs were the most spectacular of all lizards. We know these large, predaceous, fishlike forms only from the Upper Cretaceous. Nearly 20 genera are recognized, including *Clidastes*, *Tylosaurus*, and *Plotosaurus*, the largest specimens of which exceed 10 meters (Figure 11-31).

In most genera, the teeth are large, sharp cones, set in sockets rather than fused to the side of the jaw. In the

The neck is relatively short, with seven cervical vertebrae, but would have allowed considerable flexibility of

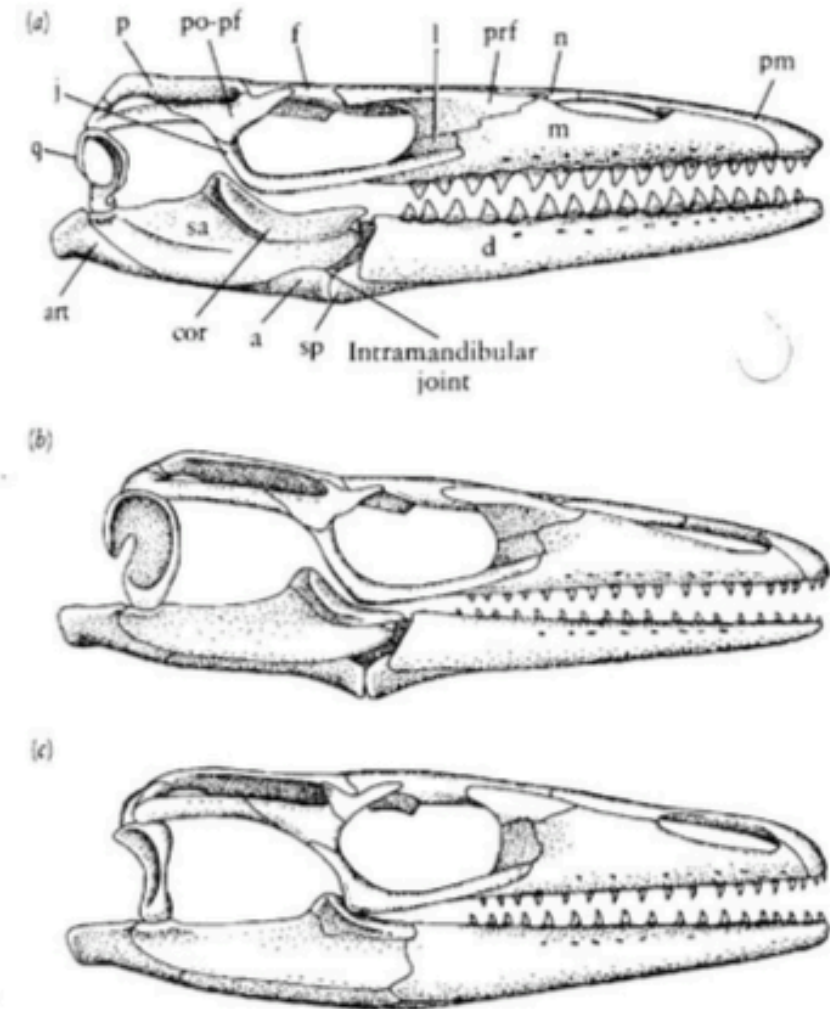


Figure 11-30. VARANOID LIZARD SKULLS. (a) The mosasaur *Clidastes*. (b) The aigialosaur *Opetiosaurus*. (c) Hypothetical primitive platinotan. From Russell, 1967. Abbreviations as in Figure 8-3.

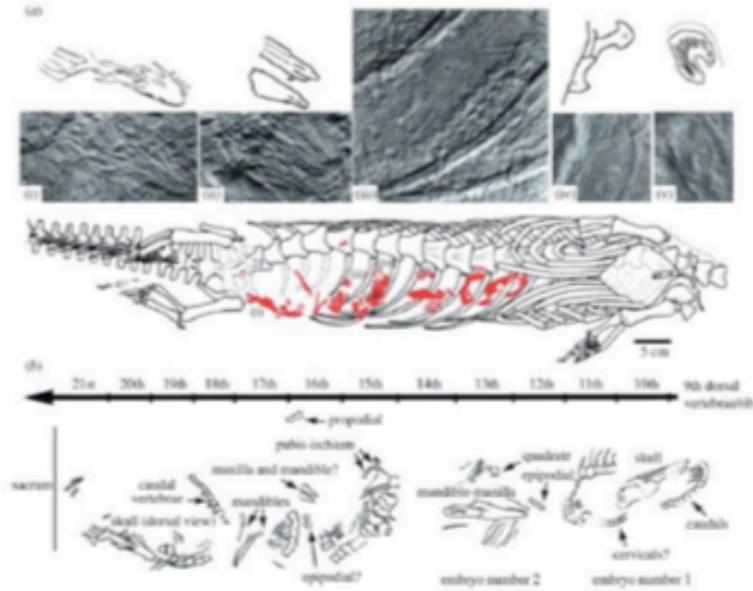


Figure 1. (a) Photographs and line drawings of embryonic skeletal elements: (i) skull in dorsal view; (ii) maxilla and mandible in lateral view; (iii) articulated vertebral column and ribs; (iv) pelvic elements; and (v) probable quadrate. (b) Adult skeleton of *Carosaurus narchetti*, showing the locations of the embryonic skeletal components (highlighted in red), with roman numerals i-v indicating the positions of the photographed elements. (c) Detailed drawings of all the embryonic material in shown in (b). (d) Reconstruction of the adult and three embryos of the right oviduct.

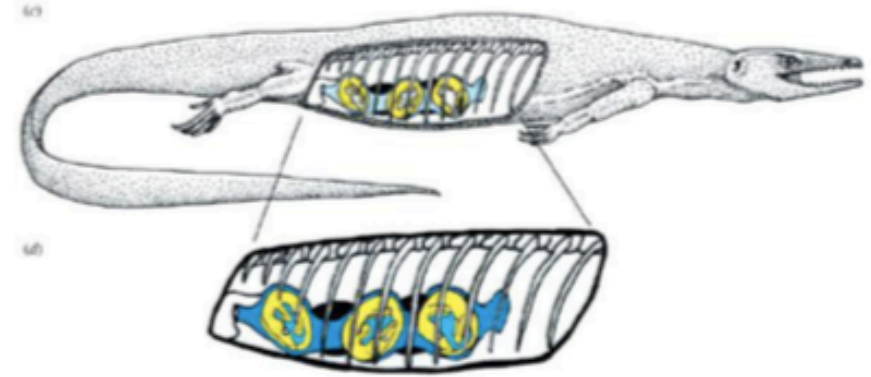
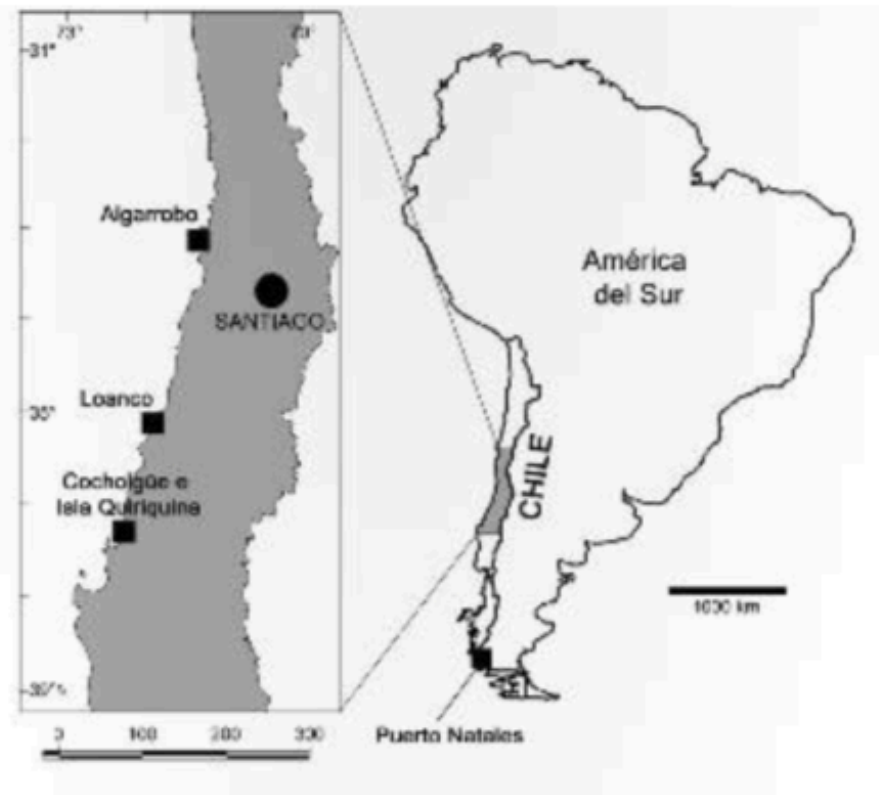


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Repetidamente se ha señalado la cercanía de Varanoidea a Mosasauridae. El descubrimiento de los mosasauridae por Georges Cuvier hacia comienzos del siglo XIX permitió reconocer el hecho de la extinción y da inicio formal a la ciencia paleontológica

The skull is basically similar to that of modern varanids, but the closest resemblance is to the aigialosaurs. Mosasaurs and aigialosaurs differ from varanids in the fusion of the frontals, the extension of the premaxillae to the frontals, and the reduction of the nasals. There is a well-developed transverse joint between the angular and splenial, midway in the length of the lower jaw. There is some mobility between these bones in varanids, but the joint is already fully developed in aigialosaurs. As in aigialosaurs, the quadrate of mosasaurs is oval in lateral view and extremely massive. The tympanum is calcified in several genera.





Dientes y vértebras de Algarrobo

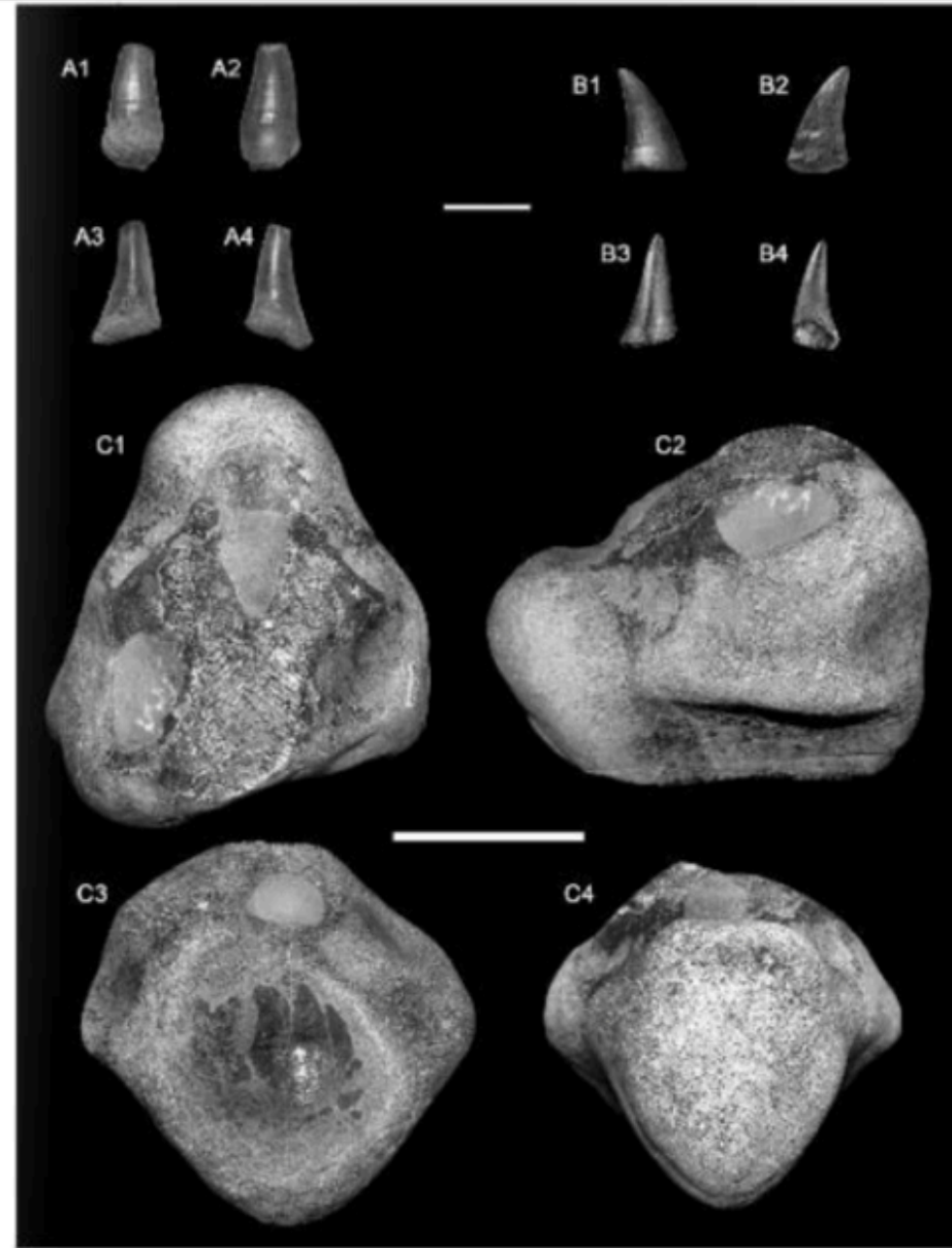


FIGURA 2. Mosasauridae indet. SGO.PV.6570 diente completo. A1) Vista labial. A2) Vista lingual. A3) Vista anterior. A4) Vista posterior. SGO.PV.6571 Corona aislada. B1) Vista labial. B2) Vista lingual. B3) Vista anterior. B4) Vista posterior. Algarrobo, Región de Valparaíso. Estratos de la Quebrada Municipalidad, Maastrichtiano temprano. CPMC.18. Vértebra dorsal. C1) Vista dorsal. C2) Vista lateral derecha. C3) Vista articular anterior. C4) Vista articular posterior. Barra de escala (A, B) = 1 cm; (C) = 50 mm.



FIGURA 3. Mosasauridae indet. SGO.PV.6568. Restos de cuatro vértebras caudales articuladas. Cerro Dorotea, Puerto Natales, Región de Magallanes. Formación Dorotea, Maastrichtiano tardío. Barra de escala = 50 mm.

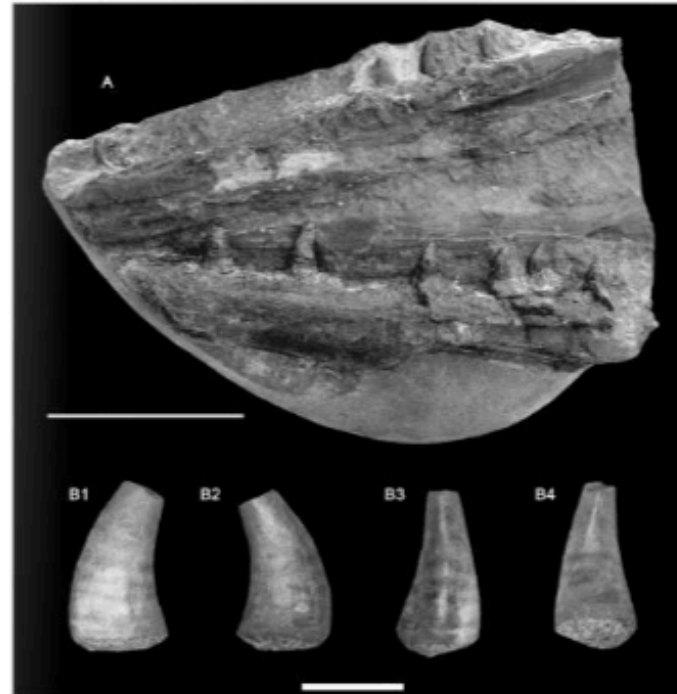


FIGURA 5. cf. *Halisaurus* indet. Q.315: Ramas mandibulares asociadas de un mismo individuo. Cocholgüe, Región del Biobío, Formación Quiriquina, Maastrichtiano tardío. A) vista occlusal de ambos dentarios cortados hacia la derecha. SGO.PV.6629: Diente lateral. Leusue, Región del Maule, Formación Quiriquina, Maastrichtiano tardío. B1) Vista anterior. B2) Vista posterior. B3) Vista labial. B4) Vista lingual. Barras de escala (A) = 50 mm; (B) = 10 mm.

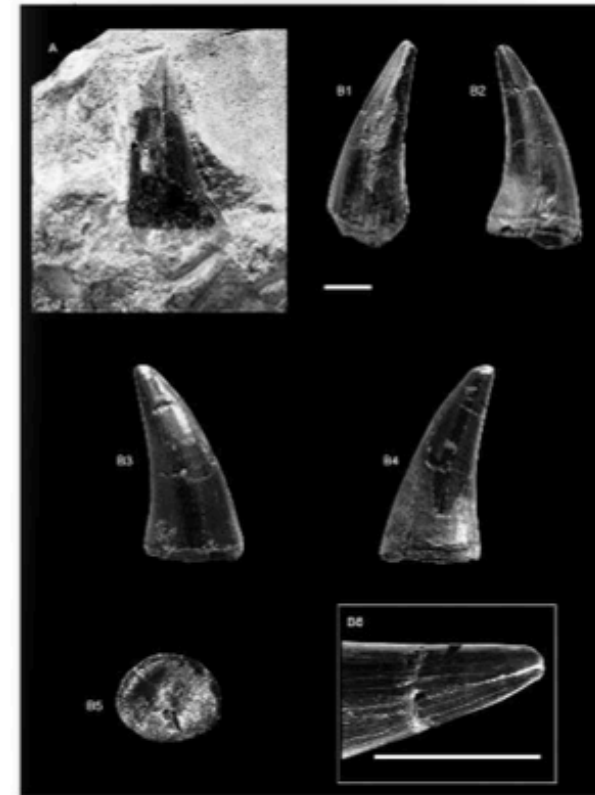


FIGURA 4. *Tylosaurinus* indet. MPC.11000. Diente antero-lateral. A) Vista anterior. Cocholgüe, Región del Biobío, Formación Quiriquina, Maastrichtiano tardío. MPC.11001: Diente antero-lateral. B1) Vista anterior. B2) Vista posterior. B3) Vista labial. B4) Vista lingual. B5) Vista basal. B6) Detalle de la carena posterior. Leusue, Región del Maule, Formación Quiriquina, Maastrichtiano tardío. Barras de escala (A, B) = 10 mm; (C) = 50 mm.

OPHIDIA (serpentes). Afinidades debatidas

No hay parpados ni tímpanos.
Cuerpo y órganos alargados.
Vomer nasal gigante



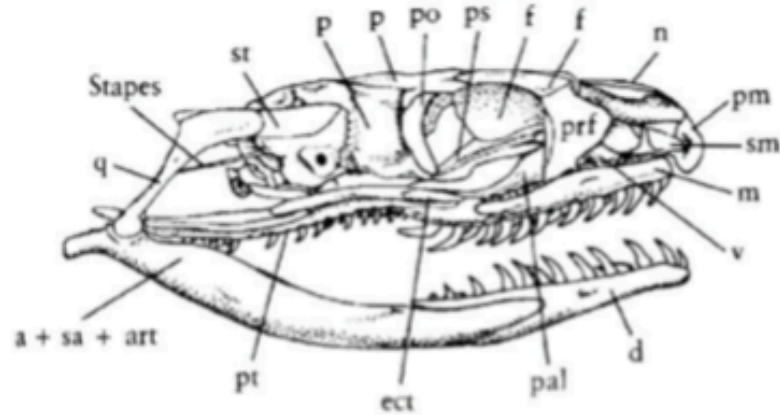


Figure 11-34. SKULL OF A MODERN COLUBRID SNAKE, *PTYAS*. The loose connection of the upper and lower jaw is clearly evident. Abbreviations as in Figure 8-3. From Parker and Grandison, 1977. © Trustees of The British Museum (Natural History) 1977. Used by permission of the publisher, Cornell University Press.



Arco temporal superior desaparece

Área temporal elongada

Cuadrado aún más móvil que en otros squamata

Mandíbulas sueltas a nivel de la sínfisis

Dientes alargados y comprimidos lateralmente. A veces ausentes de la premaxila

Frontales y parietales crecen ventralmente, rodeando completamente el cerebro anterior

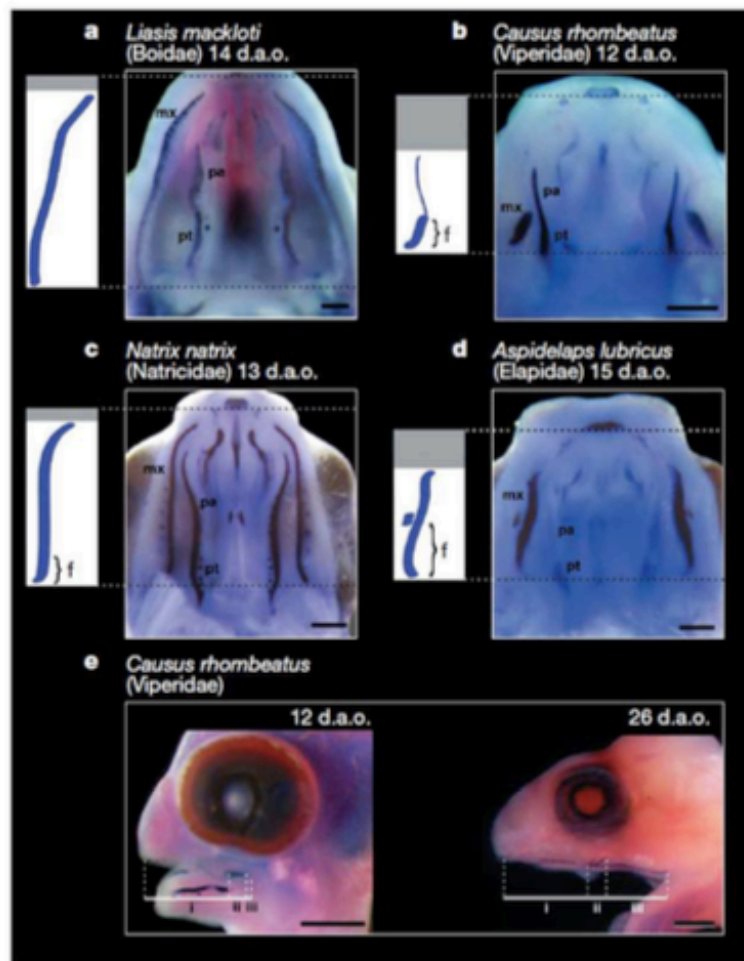
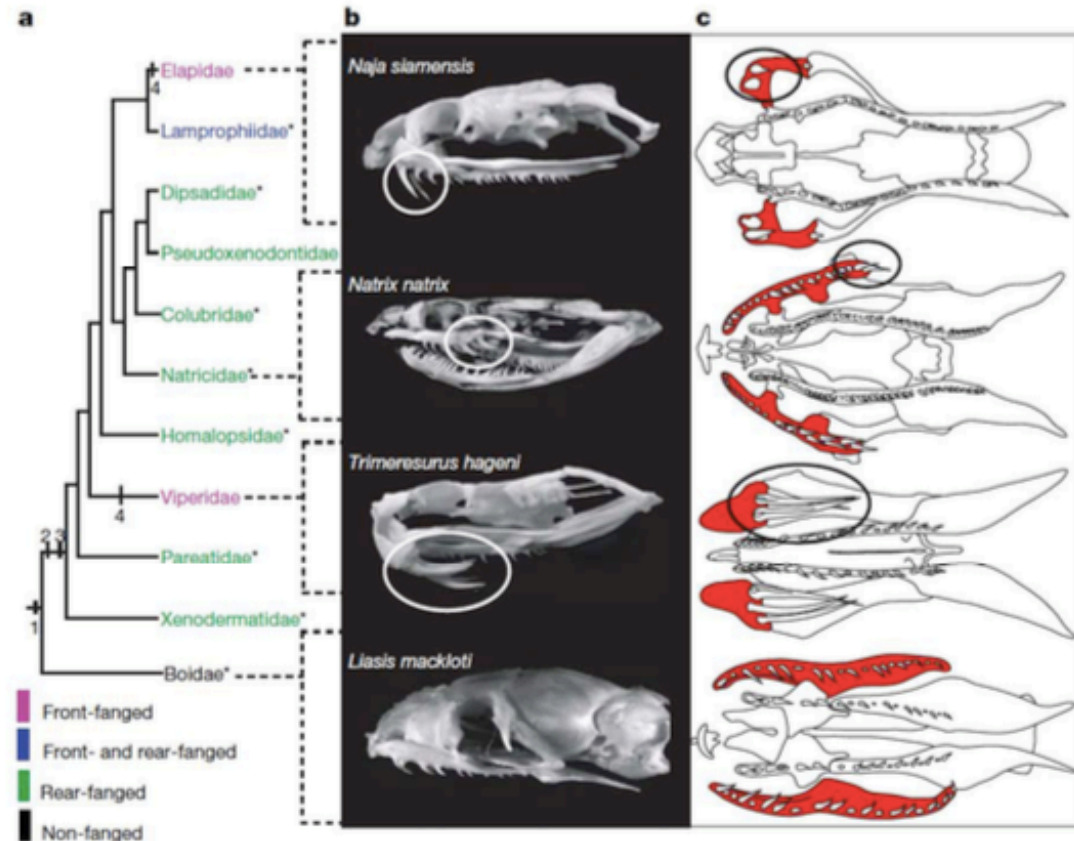


Figure 2 | *Shh* expression in the embryonic snake palate, showing the posterior developmental origins of front fangs. a–d, Palate, ventral view: top, anterior; scale bar, 0.5 mm; dotted lines, upper jaw (posterior margin of premaxilla to attachment of the mandible); boxes, schemes of maxillary odontogenic band (purple, *shh* expression; grey, no *shh* expression). Positions of fangs in **b–d** were identified histologically (Fig. 3, Supplementary Fig. 3). The odontogenic band in the front-fanged species is located posterior in the upper jaw (**b, d**). In the non-fanged outgroup (**a**) and the rear-fanged *Natrix* (**c**), the odontogenic band extends along the entire upper jaw. f, fang; mx, maxillary odontogenic band; pa, palatine odontogenic band; pt, pterygoid odontogenic band. **e**, Ontogenetic allometry in the fang in the front-fanged *Causus* displaces the fang along the upper jaw (Supplementary Figs 5–9, Supplementary Tables 5–9). Scale bars, 1 mm. We note the change in relative size of the upper jaw subregions: i, anterior; ii, fang; iii, posterior. d.a.o., days after oviposition.

El desarrollo demuestra que los colmillos especializados venenosos son homólogos (y no, por ej. aparecido independientemente de colmillos anteriores en viperidae)



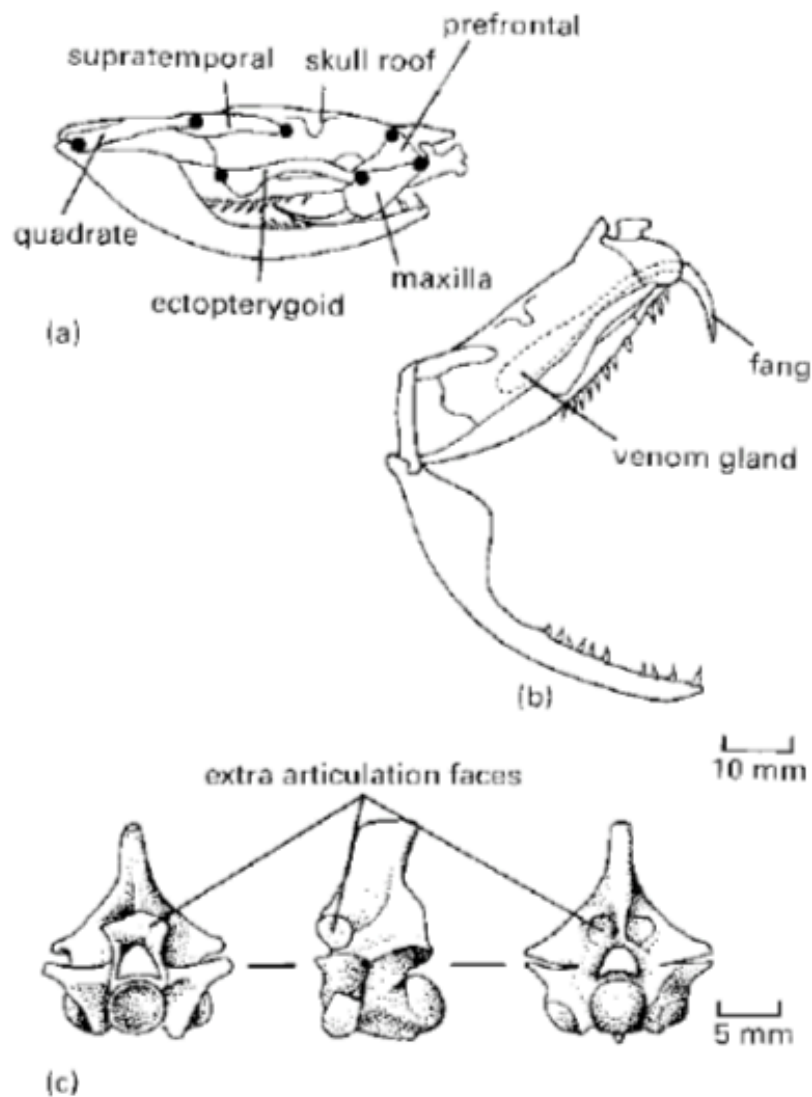


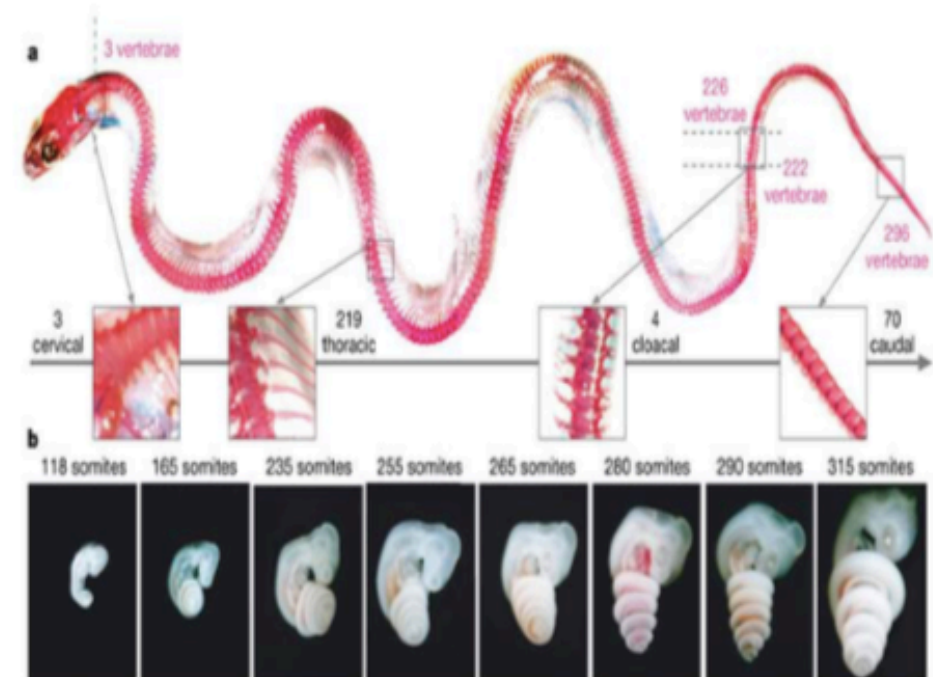
Fig. 8.34 Snake anatomy: (a, b) skull of a viperid snake in lateral view, showing the jaws closed and open; (c) mid-trunk vertebra of the living *Python* in posterior, lateral and anterior views. [Figures (a, b) after Alexander, 1975, courtesy of the Cambridge University Press; (c) after Rage, 1984.]

No hay rastros de extremidades anteriores ni de cintura pectoral, aunque sí vestigios de patas traseras y cint. Pélvica

Gran número de vértebras (120-454)

Facetas articulares accesorias

Regionalización de las vértebras aún se conserva





Pérdida del timpano y la cavidad del oído medio

Párpados modificados a un lente fijo

Células retinianas simplificadas

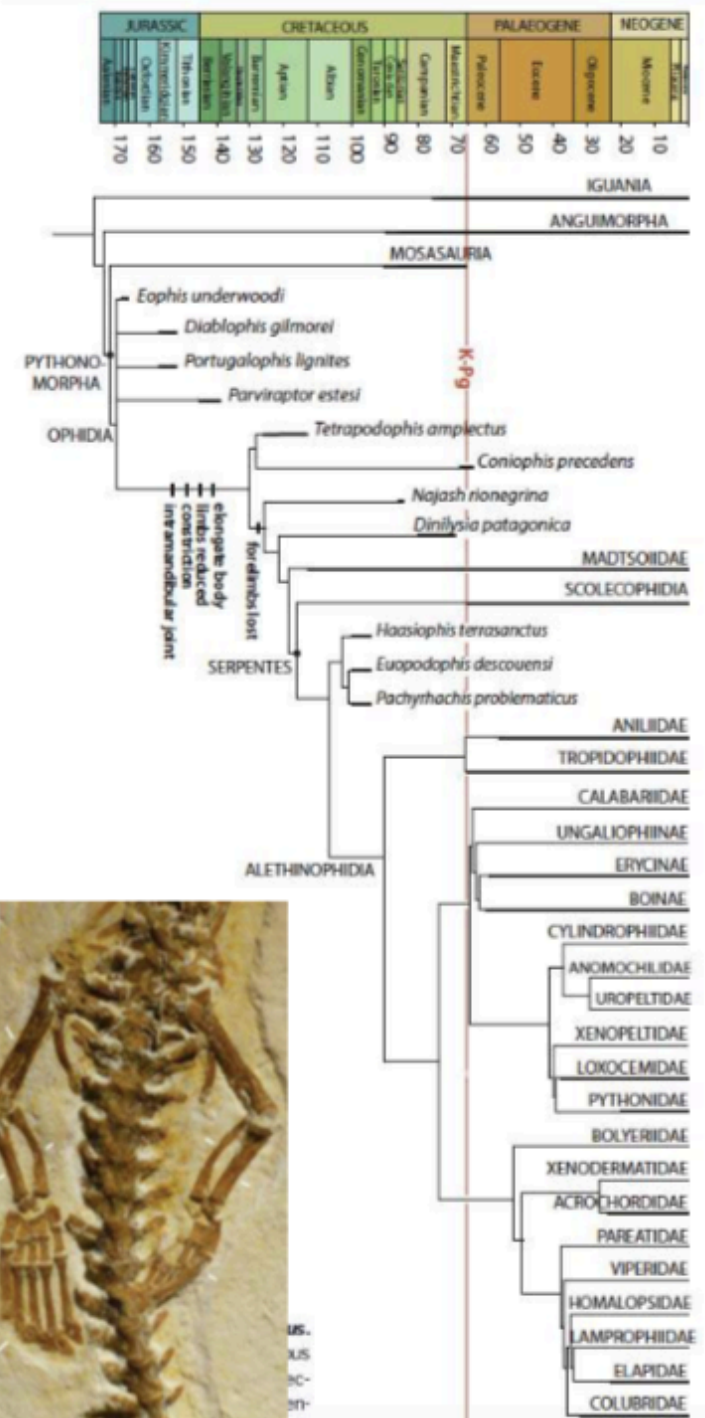
Degeneración de músculos intrínsecos y extrínsecos del ojo

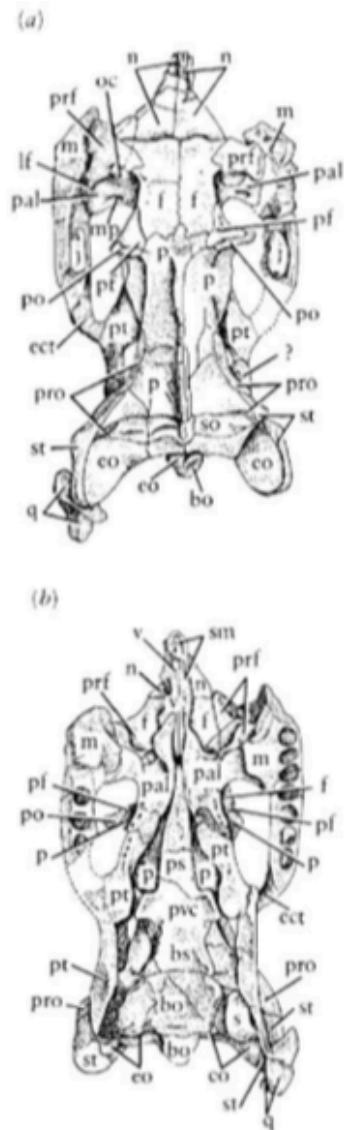
Sin fovea



Ausencia de huesos esclerales

Tetrapodophis





The oldest snake in which the skull is adequately known, *Dinilysia* from the Upper Cretaceous of South America, shows a fairly advanced stage of evolution of these features (Figure 11-35).



Figure 11-35. SKULL OF THE EARLIEST ADEQUATELY KNOWN SNAKE *DINILYSIA*. From the Upper Cretaceous of South America, in dorsal and palatal views, $\times 1$. Abbreviations as in Figure 8-3 plus: lf, lacrimal foramen; mp, maxillopalatine foramen; oc, orbitonasal canal; pvc, posterior opening of vidian canal; s, stapes. From Estes, Frazetta, and Williams, 1970.

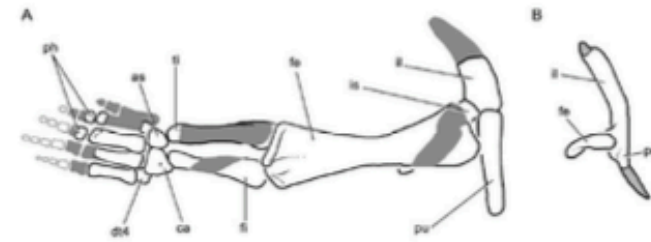
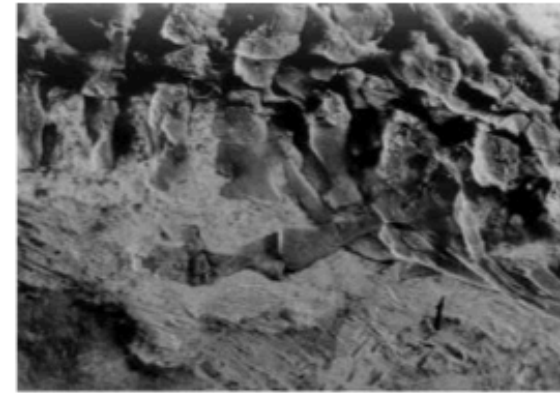
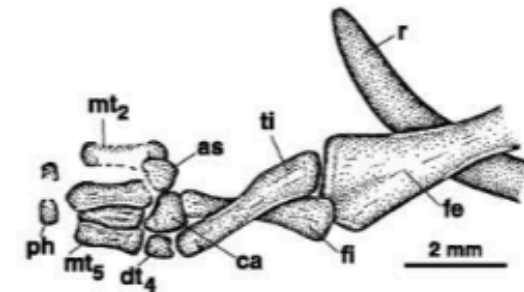


Fig. 47. Hind limbs (A) *Haasiophis terrasanthi* and (B) *Blanus cinereus*. The hind limb of *Haasiophis terrasanthi*, a snake is well developed with tarsals, metatarsals, and phalanges [character state 290(0)]. The hind limb of *Blanus* is composed only of a femur without distal elements such as a pes [an exemplar of character state 290(1)]. Note that the dark gray represents unknown or heavily reconstructed portions and the light gray (in B) represents cartilaginous elements. The gray outlines represent portions that are hypothesized to have originally been present, but for which there is not direct evidence. Modified after (A) Tchernov et al. (2000) and Rieppel et al. (2003), and (B) Kearney (2002).



Las primera serpientes como *Haasiophis* y *Pachyrhachis* del cretácico temprano presentan pequeñas piernas incluso con elementos del arco digital, y han sido recuperadas de hábitats marinos. Por lo tanto, es posible que las serpientes perdieran las extremidades en el medio marino, y después hayan “recolonizado” el medio terrestre. Se ha argumentado que las serpientes descendieron de autarchoglossos marinos cercanos a los Varanidae, los Mosasauridae



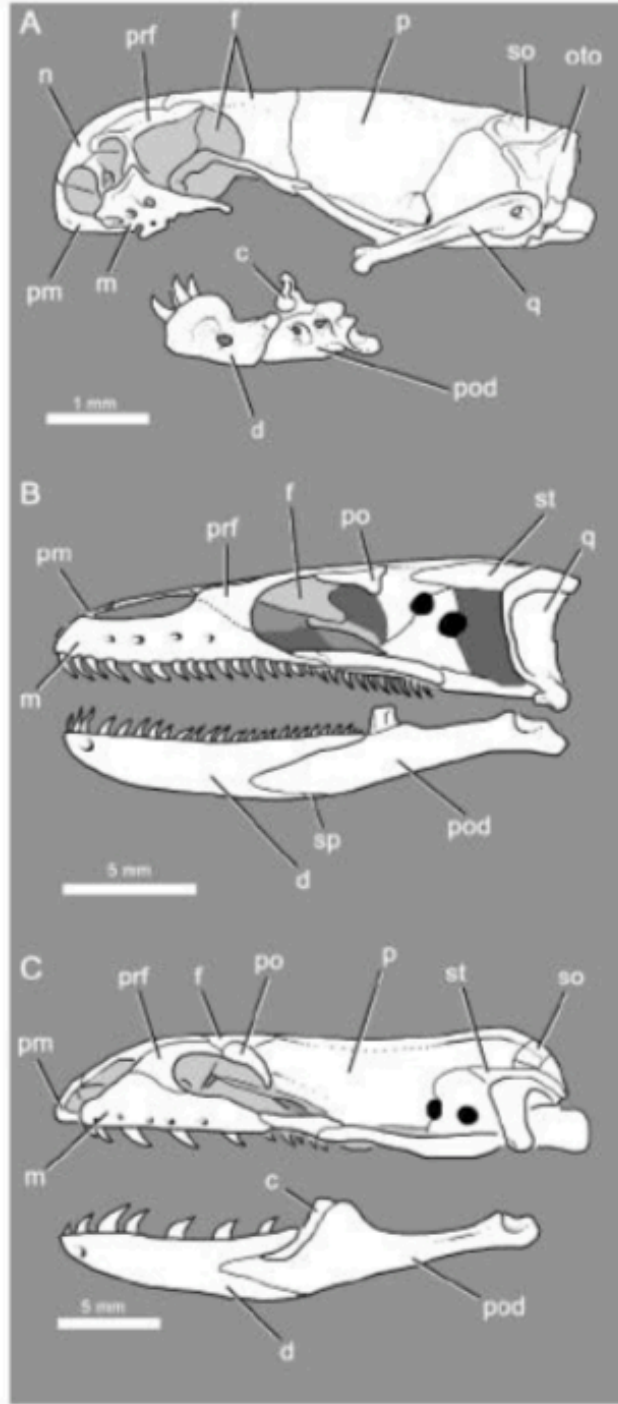


Fig. 58. The skulls of three snakes that have, at some point, been considered close to the ancestral morphology for Serpentes. (A) *Leptotyphlops goudotii dulcis*, (B) *Haasiophis terrasancus*, and (C) *Cylindrophis ruffus*. *Leptotyphlops dulcis* is an extant burrowing form with greatly reduced eyes, *H. terrasancus* is an aquatic Cretaceous fossil snake with legs, and *C. ruffus* is an extant burrower that is less specialized for fossoriality than *L. dulcis*. Modified after (A) Kley (2004; 2006), (B) Tchernov et al. (2000) and Rieppel et al. (2003), and (C) Rieppel (1983).

