

Reptiles

(animals in the class Reptilia)



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Chapter- 1

Reptile

Reptiles

Temporal range: Mississippian - Recent 320–0 Ma



Clockwise from above left: Spectacled Caiman (*Caiman crocodilus*), Green Sea Turtle (*Chelonia mydas*), Tuatara (*Sphenodon punctatus*) and Eastern Diamondback Rattlesnake (*Crotalus adamanteus*).

Scientific classification

Kingdom:	Animalia
Phylum:	Chordata
Superclass:	Tetrapoda
(unranked):	Reptiliomorpha
(unranked):	Amniota
Class:	Reptilia Laurenti, 1768

Subgroups

- Anapsida (=Parareptilia?)
 - Testudines (traditional)
- Eureptilia
 - Crocodylia
 - Sphenodontia
 - Squamata
 - Testudines (molecular)

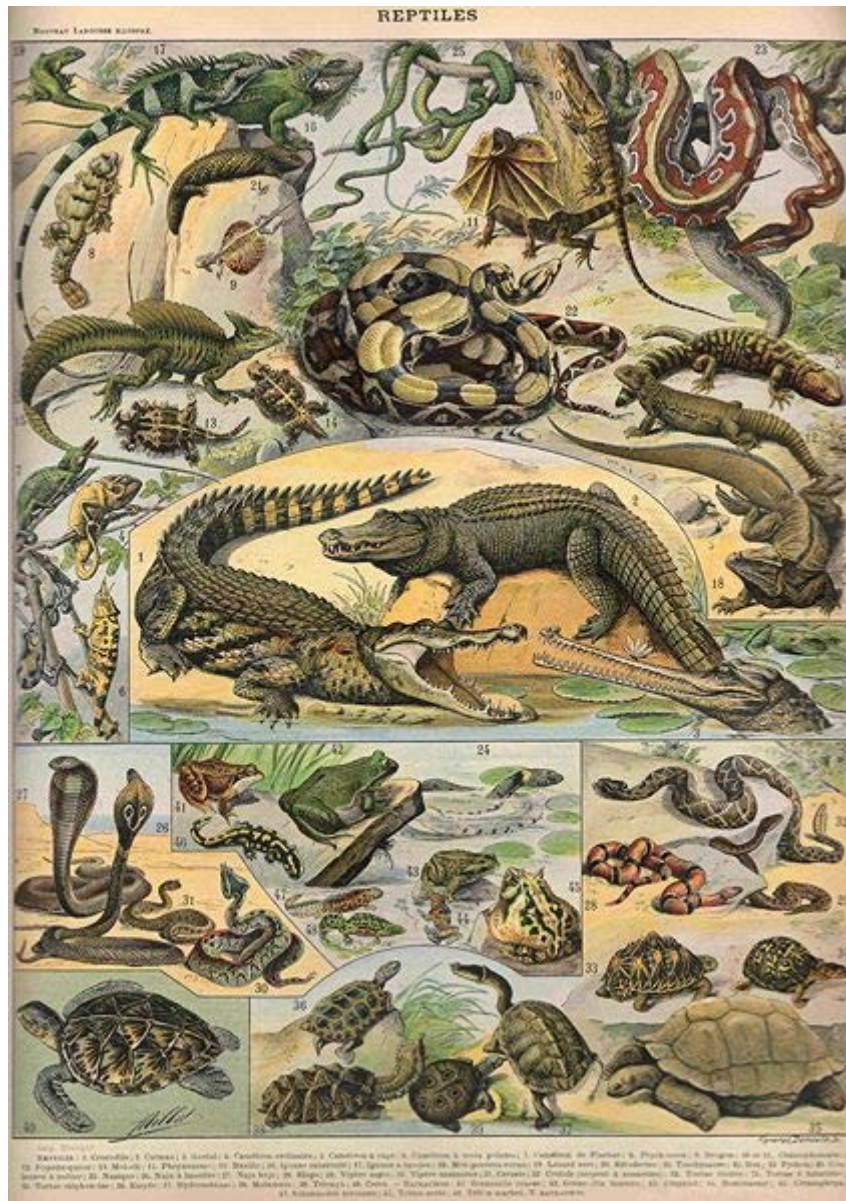
Reptiles are animals in the (Linnaean) class Reptilia. They are characterized by breathing air, laying shelled eggs, and having skin covered in scales and/or scutes. Reptiles are classically viewed as having a "cold-blooded" metabolism. They are tetrapods (either having four limbs or being descended from four-limbed ancestors). Modern reptiles inhabit every continent with the exception of Antarctica, and four living orders are currently recognized:

- Crocodylia (crocodiles, gavials, caimans, and alligators): 23 species
- Sphenodontia (tuataras from New Zealand): 2 species
- Squamata (lizards, snakes, and worm lizards): approximately 7,900 species
- Testudines (turtles and tortoises): approximately 300 species

Contrary to amphibians, reptiles do not have an aquatic larval stage. As a rule, reptiles are oviparous (egg-laying), although certain species of squamates are capable of giving live birth. This is achieved by either ovoviviparity (egg retention) or viviparity (birth of offspring without the development of calcified eggs). Many of the viviparous species feed their fetuses through various forms of placenta analogous to those of mammals, with some providing initial care for their hatchlings. Extant reptiles range in size from a tiny gecko, *Sphaerodactylus ariasae*, that grows to only 1.6 cm (0.6 in) to the saltwater crocodile, *Crocodylus porosus*, that may reach 6 m in length and weigh over 1,000 kg. The science dealing with reptiles is called herpetology.

Classification

History of classification



Reptiles, from *Nouveau Larousse Illustré*, 1897-1904

Linnaeus and the 18th century

The reptiles were from the outset of classification grouped with the amphibians. Linnaeus, working from species-poor Sweden, where the common adder and grass snake are often found hunting in water, included all reptile and amphibians in class "III – Amphibia" in his *Systema Naturæ*. The terms "reptile" and "amphibian" were largely interchangeable, "reptile" (from Latin *reperere*, "to creep") being preferred by the French. Josephus Nicolaus Laurenti was the first to formally use the term "Reptilia" for an

expanded selection of reptiles and amphibians basically similar to that of Linnaeus. It is today still common to treat the two groups under the same heading as herptiles.

The "Antediluvian monster"



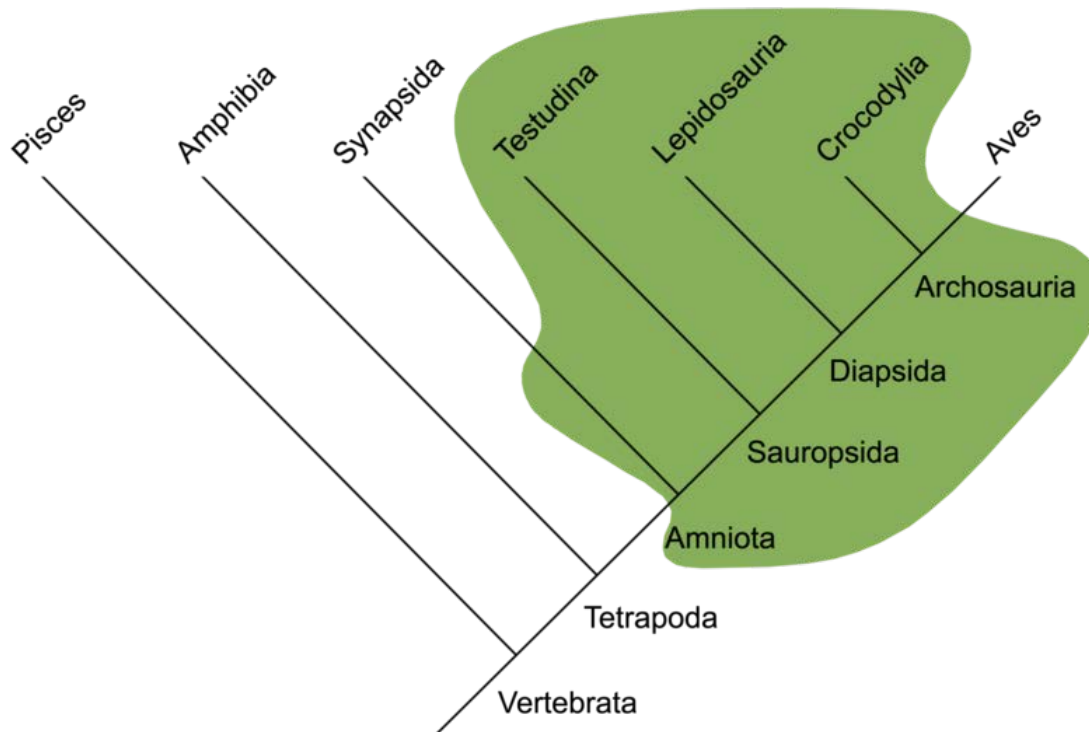
An "Antediluvian monster", a *Mosasaurus* discovered in a Maastricht limestone quarry, 1770 (contemporary engraving)

Not until the beginning of the 19th century did it become clear that reptiles and amphibians are in fact quite different animals, and Pierre André Latreille erected the class *Batrachia* (1825) for the latter, dividing the tetrapods into the four familiar classes of reptiles, amphibians, birds and mammals.

The British anatomist Thomas Henry Huxley made Latreille's definition popular, and together with Richard Owen expanded Reptilia to include the various fossil "Antediluvian monsters", including dinosaurs and the mammal-like (synapsid) *Dicynodon* he helped describe. This was not the only possible classification scheme: In the Hunterian lectures delivered at the Royal College of Surgeons in 1863, Huxley grouped the vertebrates into Mammals, Sauroids, and Ichthyoids (the latter containing the fishes and amphibians). He subsequently proposed the names of Sauropsida and Ichthyopsida for the two.

The terms "Sauropsida" ("lizard faces") and "Theropsida" ("beast faces") were used again in 1916 by E.S. Goodrich to distinguish between lizards, birds, and their relatives on the one hand (Sauropsida) and mammals and their extinct relatives (Theropsida) on the other. Goodrich supported this division by the nature of the hearts and blood vessels in each group, and other features such as the structure of the forebrain. According to Goodrich, both lineages evolved from an earlier stem group, the Protosauria ("first lizards") which included some Paleozoic amphibians as well as early reptiles.

In 1956 D.M.S. Watson observed that the first two groups diverged very early in reptilian history, and so he divided Goodrich's Protosauria between them. He also reinterpreted the Sauropsida and Theropsida to exclude birds and mammals, respectively. Thus his Sauropsida included Procolophonia, Eosuchia, Millerosauria, Chelonia (turtles), Squamata (lizards and snakes), Rhynchocephalia, Crocodilia, "thecodonts" (paraphyletic basal Archosauria), non-avian dinosaurs, pterosaurs, ichthyosaurs, and sauropterygians.



Reptiles (green field) are a paraphyletic group comprising all non-avian and non-mammalian amniotes.

In 1866, Haeckel demonstrated that vertebrates could be divided based on their reproductive strategies, and that reptiles, birds and mammals were united by the amniotic egg. By the end of the 19th century, the class Reptilia had come to include all the amniotes except birds and mammals. Thus reptiles were defined as the set of animals that includes the extant crocodiles, alligators, tuatara, lizards, snakes, amphisbaenians, and turtles, as well as fossil groups like dinosaurs, synapsids and the primitive pareiasaurs. This is still the common definition of the term.

Skull openings in 20th century classification

The synapsid/sauropsid division supplemented, but was never as popular during the 20th century as a Linneean approach splitting the reptiles into four subclasses based on the number and position of *temporal fenestrae*, openings in the sides of the skull behind the eyes. This classification was initiated by Henry Fairfield Osborn and elaborated and made popular by Romer's classic *Vertebrate Paleontology*. Those four subclasses were:

- Anapsida – no fenestrae - cotylosaurs and Chelonia (turtles and relatives)
- Synapsida – one low fenestra - pelycosaurs and therapsids (the 'mammal-like reptiles')
- Euryapsida – one high fenestra (above the postorbital and squamosal) - protosauropsids (small, early lizard-like reptiles) and diverse marine reptiles like plesiosaurs and ichthyosaurs, the latter called Parapsida in Osborn's work.
- Diapsida – two fenestrae - most reptiles, including lizards, snakes, crocodilians, dinosaurs and pterosaurs

The composition of Euryapsida was uncertain. Ichthyosaurs were at times considered to have arisen independently of the other euryapsids, and given the older name Parapsida. Parapsida was later discarded as a group for the most part (ichthyosaurs being classified as *incertae sedis* or with Euryapsida). This schema remained more or less universal for non-specialist work throughout the 20th century, and has only been challenged with the rising popularity of phylogenetic nomenclature.

Phylogenetics and modern definition

By the 21st century, most vertebrate paleontologists had adopted phylogenetic taxonomy, in which all groups are defined in such a way as to be monophyletic; that is, groups include all descendants of a particular ancestor. The reptiles as historically defined would be paraphyletic, since they exclude both birds and mammals, although these also evolved from the original reptile. Colin Tudge wrote:

Mammals are a clade, and therefore the cladists are happy to acknowledge the traditional taxon Mammalia; and birds, too, are a clade, universally ascribed to the formal taxon Aves. Mammalia and Aves are, in fact, subclades within the grand clade of the Amniota. But the traditional class Reptilia is not a clade. It is just a section of the clade Amniota: the section that is left after the Mammalia and Aves have been hived off. It cannot be defined by synapomorphies, as is the proper way. It is instead defined by a combination of the features it has and the features it lacks: reptiles are the amniotes that lack fur or feathers. At best, the cladists suggest, we could say that the traditional Reptilia are 'non-avian, non-mammalian amniotes'.

Despite the early proposals for a monophyletic Sauropsida, that term was never adopted widely or, when it was, applied consistently. When Sauropsida was used, it often had the same content or even the same definition as Reptilia. Reptilia was first defined as a clade in 1988 by Gauthier, as a monophyletic node-based crown group containing turtles, lizards and snakes, crocodilians, and birds, their common ancestor and all its descendants. A variety of other definitions were proposed by other scientists in the years following Gauthier's paper. The first which attempted to adhere to the standards of the PhyloCode was published by Modesto and Anderson in 2004. They reviewed the many previous definitions, and proposed a modified definition which they intended to retain most traditional content of the group while keeping it stable and monophyletic. They defined Reptilia as all amniotes closer to *Lacerta agilis* and *Crocodylus niloticus* than to *Homo sapiens*. This stem-based definition is equivalent to that of Sauropsida, which Modesto

and Anderson synonymized with Reptilia, since the latter is more well known and more frequently used, despite their definition including birds.

Taxonomy

Classification to order level, after Benton, 2004.

Series Amniota

Class Synapsida

Order Pelycosauria*

Order Therapsida

Class Mammalia

Class Sauropsida

Subclass Anapsida

Order Testudines (turtles)

A series of unassigned anapsid families, corresponding to Captorhinida, Mesosauria and

Procolophonomorpha

Subclass Diapsida

Order Araeoscelidia

Order Younginiiformes

Infraclass Ichthyosauria

Infraclass Lepidosauromorpha

Superorder Sauropterygia

Order Placodontia

Order Nothosauroida

Order Plesiosauria

Superorder Lepidosauria

Order Sphenodontia (tuatara)

Order Squamata (lizards & snakes)

Infraclass Archosauromorpha

Order Prolacertiformes

Division Archosauria

Subdivision Crurotarsi

Superorder Crocodylomorpha

Order Crocodylia

Order Phytosauria

Order Raurisuchia

Order Rhynchosauria

Subdivision Avemetatarsalia

Infradivision Ornithodira

Order Pterosauria

Superorder Dinosauria

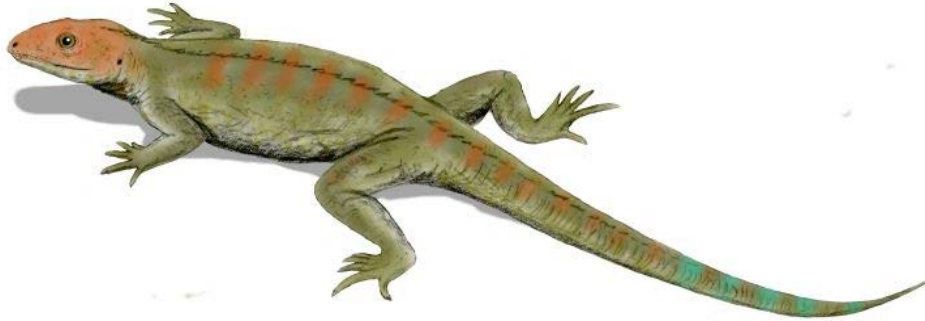
Order Saurischia

Class Aves

Order Ornithischia

Evolutionary history

Rise of the reptiles



A early reptile *Hylonomus*



Mesozoic scene showing typical reptilian megafauna: the dinosaurs *Europasaurus holgeri* and *Iguanodon*, and the early bird *Archaeopteryx* perched on the foreground tree stump.



Megalania was a giant, carnivorous goanna that might have grown to as long as 7 metres, and weighed up to 1,940 kilograms (Molnar, 2004).

The origin of the reptiles lies about 320–310 million years ago, in the steaming swamps of the late Carboniferous period, when the first reptiles evolved from advanced reptiliomorph labyrinthodonts. The oldest known animal that may have been an amniote, i.e. a primitive reptile rather than an advanced amphibian is *Casineria*. A series of footprints from the fossil strata of Nova Scotia, dated to 315 million years show typical reptilian toes and imprints of scales. The tracks are attributed to *Hylonomus*, the oldest unquestionable reptile known. It was a small, lizard-like animal, about 20 to 30 cm (8–12 in) long, with numerous sharp teeth indicating an insectivorous diet. Other examples include *Westlothiana* (for the moment considered a reptiliomorph amphibian rather than a true amniote) and *Paleothyris*, both of similar build and presumably similar habit. One of the best known early reptiles is *Mesosaurus*, a genus from the early Permian that had returned to water, feeding on fish. The earliest reptiles were largely overshadowed by bigger labyrinthodont amphibians such as *Cochleosaurus*, and remained a small, inconspicuous part of the fauna until after the small ice age at the end of the Carboniferous.