

2 Evolution

Life, almost certainly, began in the sea, and the first terrestrial vertebrates were amphibians. During the Upper Devonian period, the descendants of certain crossopterygian fishes ventured out of the water and began crawling from one pool to another. The Late Devonian was a time of increasing aridity, so that a selective advantage would have been obtained from being able to remain for a while on dry land. These first amphibians, or Ichthyostegalia, evolved in directions quite different from those followed by their ancestors. Although they had many characters in common, important differences appeared between the lung fishes and their allies and these early amphibians. This resulted from the specialization of the former for aquatic and, of the latter class, for terrestrial life. The Ichthyostegalia were four-limbed tetrapods and, while some were scaly, others had dry, leathery skins. Moreover, the ventral sides of the body were occasionally protected by bony plates. The skull of *Ichthyostega* shows the characteristic features of an amphibian whilst simultaneously retaining traces of its fish ancestry both in its shape and by the presence of a preopercular bone. In addition to the Ichthyostegalia (fish vertebrae), there were two other orders of Palaeozoic amphibians (Labyrinthodontia), viz. the Temnospondyli (divided vertebrae) and Anthracosauria (coal lizards). The reptiles evolved from Anthracosauria.

Throughout this book I have referred to Reptilia, although these animals are not today always regarded as a valid monophyletic group. Monophyly is the condition in which a group of taxa shares a common ancestry, being ultimately derived from a single interbreeding population, whereas polyphyletic groups are derived from many such populations. Reptiles are, nevertheless, united in the possession of a particular kind of life strategy – although there are even some exceptions to this.

Once established on land, both amphibians and reptiles diversified and became adapted to a variety of habitats. Some became specialized for

climbing rocks and trees, some for burrowing in the soil or for flight, while others returned to life in the sea, or in freshwater. This is one of the kinds of diversity to be discussed in the present book. When several unrelated groups of animals become adapted to the same habitat we speak of it as 'convergence'. Seen laterally, as it were, this is 'parallel evolution' among the diverse groups or taxa. When considered from the viewpoint of the earliest forms, however, 'radiation' is observed to have taken place. Indeed, convergence, parallel evolution and radiation are really aspects of the same phenomenon – adaptation – seen from different points of view.

Amphibians thus evolved from the Crossopterygii, a subclass of lobe-finned lung fishes. Even the most primitive crossopterygians possessed lungs; some also had internal nares (passages connecting the mouth to the exterior of the body); and their skeletons were well-ossified and bony, a prerequisite for life on land. The fossils of the earliest amphibians are always associated with freshwater deposits, and all the evidence suggests that they evolved from crossopterygian fishes of the order Rhipidistia which, likewise, inhabited shallow freshwaters during the Devonian and Carboniferous periods (Fig. 3). Both groups were carnivorous.

There is no general agreement about the classification and relationships of Late Palaeozoic amphibians. One series, the Lepospondyli, was characterized by the spool-shaped central portions of the vertebrae. It included the Aistopoda – limbless, elongated, snakelike forms. Although the earliest known in the fossil record, and almost certainly primitive to other Lepospondyli, the loss of legs is a specialized feature and their ancestors must have had two pairs of legs. A third group was the Nectridea. This followed two lines of evolutionary development, one characterized by an elongation of

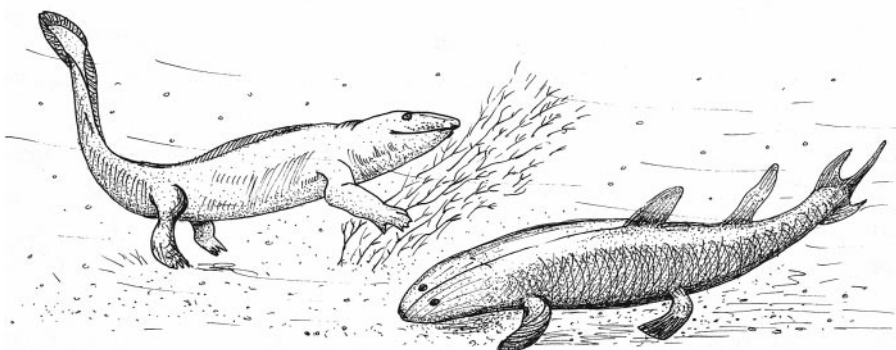


Fig. 3. A tetrapod-like crossopterygian fish (*right*) and a primitive amphibian (*Ichthyostegia*) (*left*), both Devonian. (Based on Colbert 1965)

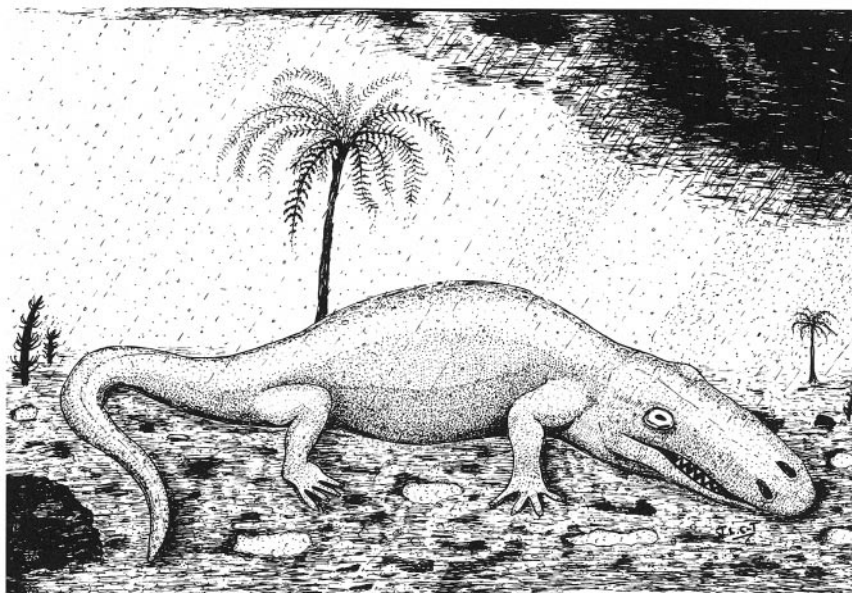


Fig. 5. Reconstruction of *Eryops*, a large, Early Permian labyrinthodont amphibian. An effective competitor of contemporary reptiles, it inhabited freshwater and preyed on fishes (length 2 m)

The two major groups of extinct amphibians, the Lepospondyli and the Labyrinthodontia, are fully distinct when they first appear in the Late Palaeozoic fossil record. They were somewhat less well adapted to aquatic conditions than were the rhipidistian ancestors from which they evolved, yet the evidence indicates that they too were still primarily aquatic. According to some authorities, there was then a vast terrestrial niche available for vertebrates, while competition in water had become so severe that it placed a premium on the ability to be at least partially terrestrial. Another school of thought suggests that terrestrial adaptations may have evolved because they increased the probability for survival of their possessors not as terrestrial animals but in an aquatic environment. The survival of aquatic animals would have been enhanced during periods of drought if they could travel overland to reach larger and less crowded bodies of water at times when those in which they were living became greatly overcrowded with predators and competitors, or dried up (Porter 1972).

There are such close resemblances between the skulls of the Devonian crossopterygian fishes and the earliest labyrinthodont amphibians that their relationship is not in doubt, although there is no detailed fossil evidence of the stages of transition between the two types. While modern amphibians are

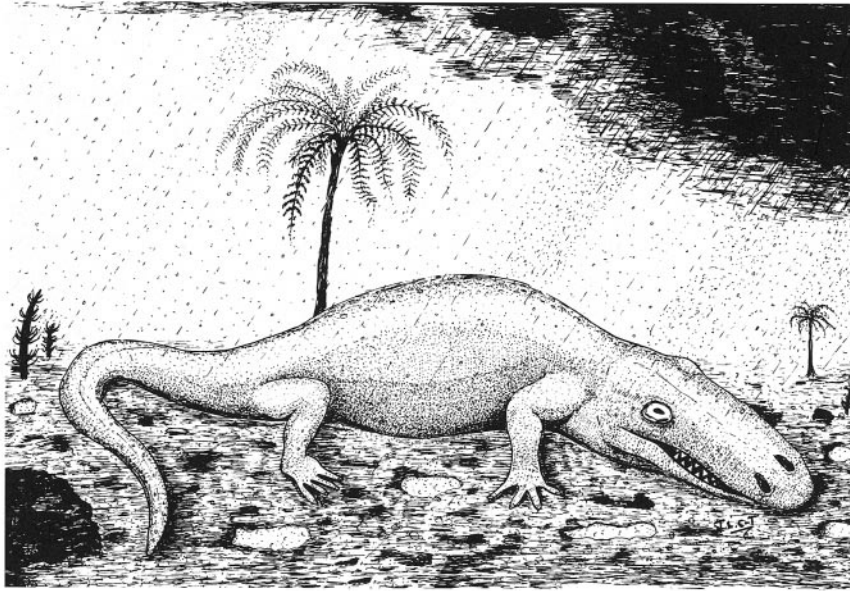


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