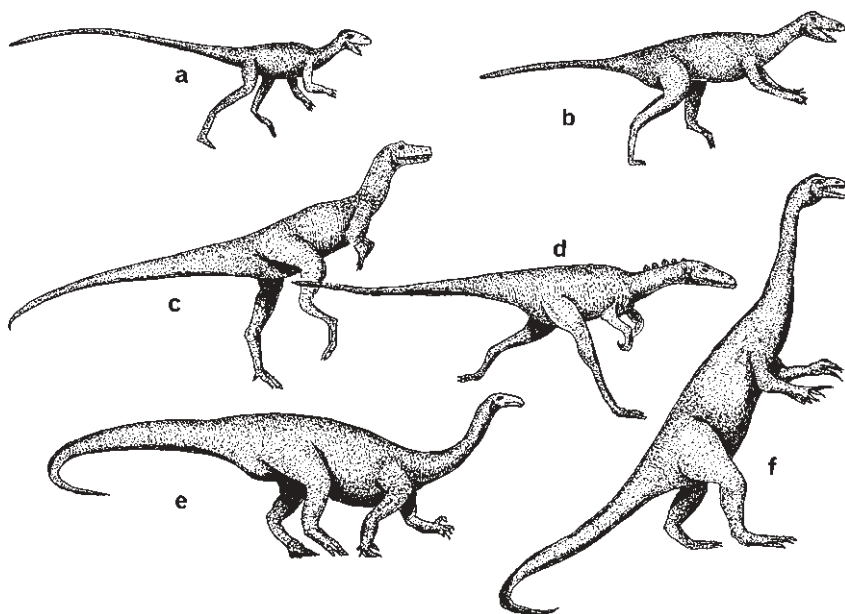


9.1

The Earliest Dinosaurs

The Dinosauria arose in the Upper Triassic period, some 230 mya, and dominated the terrestrial faunas of the world for the next 165 my. The earliest genera were medium-sized, three-toed bipedal carnivores that grabbed their prey with the forelegs. A sister group is represented by the ornithosuchid or basal dino-sauromorph *Marasuchus* (Fig. 83a) (Sect. 8.4.3), a lightly-built flesh-eater that presumably caught small and speedy animals such as cynodonts and proco-phonids, as well as feeding, no doubt, on worms, arthropods, and the like



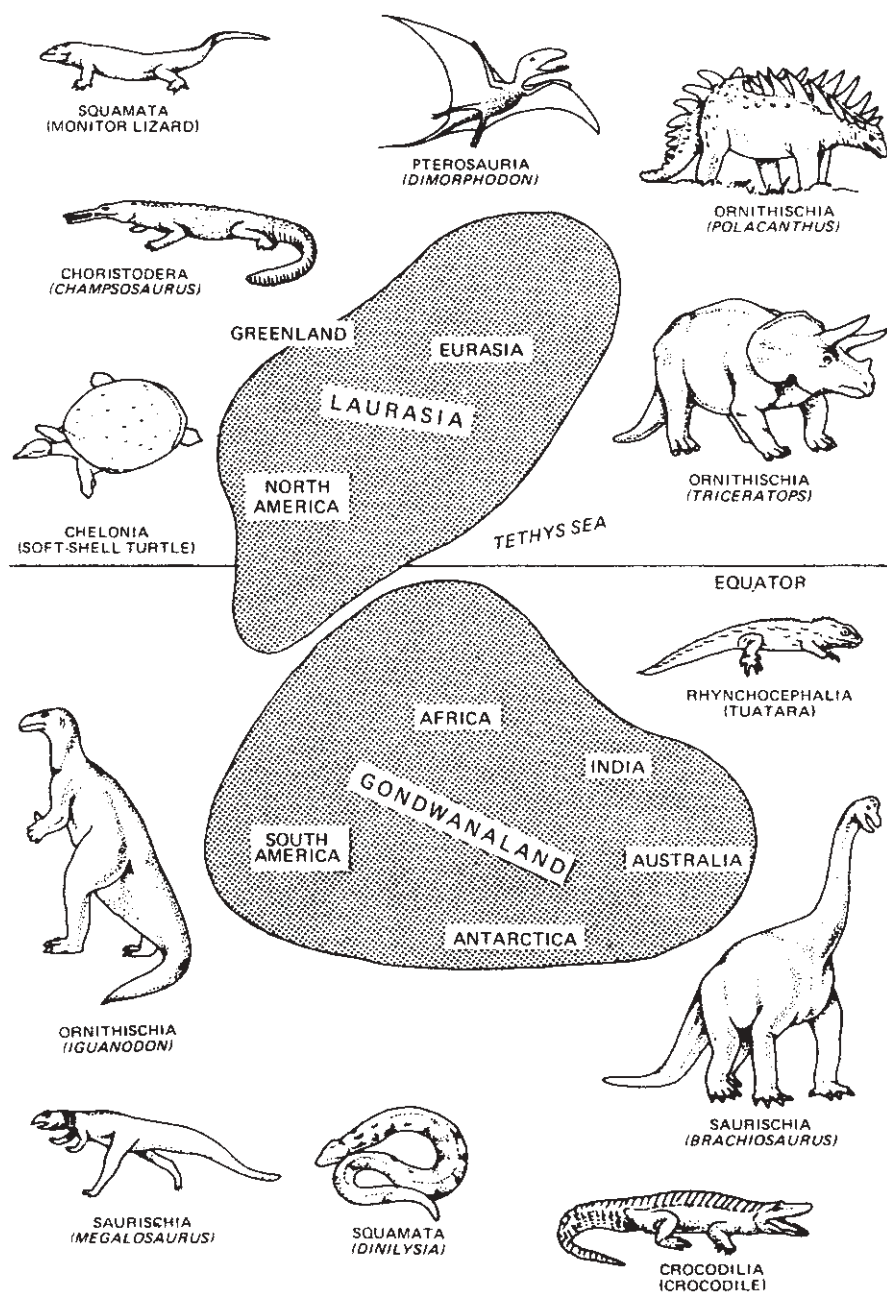
■ Fig. 83a–f. Early Upper Triassic dinosaurs. a *Marasuchus* (Dinosauromorpha; length ca. 1.2 m), b *Eoraptor* (Theropoda; length ca. 1 m), c *Herrerasaurus* (Herrerasauridae; length ca. 11 m), d *Staurikosaurus* (Herrerasauridae; length ca. 3 m), e *Plateosaurus* (Plateosauridae; length ca. 7 m), f *Massospondylus* (Plateosauridae; length ca. 4 m). (Adapted from Lambert 1992 and original)

(Benton 2004). Although *Eoraptor* (Fig. 83b) from Argentina and the *Herrerasauridae* (Fig. 83c, d) appear to have been true theropods, there is some disagreement as to whether they evolved before or after the split between *Ornithischia* and *Saurischia* (Benton 2004). The taxonomy and systematics of dinosaurs have been outlined by Holtz and Brett-Surman (1997).

Large quadrupedal herbivorous dinosaurs had also appeared before the end of the Triassic period. Probably the best known of these is *Plateosaurus* (Figs. 65, 83e), of which numerous skeletons and fragments have been recovered from Germany, France, England and Switzerland. Another member of the *Plateosauridae* was *Massospondylus* (Fig. 83f), the most common prosauropod of southern Africa. Specimens have also been unearthed in North America. *Massospondylus* was named by Richard Owen in 1854 on the basis of a few large vertebrae. Its small head was carried on a long, flexible neck. Like *Plateosaurus*, it probably walked about on all four legs, rearing up on its hind limbs when necessary to obtain leaves from higher levels of vegetation (Sect. 10.3). *Plateosaurus* had weak, leaf-shaped teeth which, in association with its size and abundance, strongly indicate that it must have been herbivorous. Some controversy has arisen because dagger-like teeth have also been found mingled with the bones of plateosaurs. The explanation is that these carnivorous teeth were almost certainly shed by rauisuchians scavenging on plateosaur carcasses (Lambert 1992; Benton 1997b). The prosauropods such as *Plateosaurus* (Fig. 83e) and *Massospondylus* (Figs. 65, 83f) of the Late Triassic were at one time believed to be ancestral to the true sauropods of the Jurassic. After all, they had only to increase in size and return to a fully quadrupedal mode of locomotion! They are now, however, regarded as a side-branch of the sauropodomorphs that died out at the end of the Triassic period (Moody 1977; Charig 1979; Benton 2004) (Sect. 10.3).

The first of the true dinosaurs was *Eoraptor* (Fig. 83b) from Argentina, a light-weight animal measuring only about 1 m in length. The fossil does not exhibit the specialisation of major dinosaur clades – *Ornithischia*, *Sauropodomorpha* and *Theropoda*. Nevertheless, its forelimbs were less than half the length of the hind limbs, indicating a bipedal posture, while its functionally tridactyl grasping/raking hands and other features show that it was allied phylogenetically to the theropods. Its discovery supports the hypothesis that the dinosaurs diverged rapidly from a common ancestor while they were small, and that the principal carnivorous and herbivorous lineages were present in the Middle Carnian (Sereni et al. 1993). (The Carnian age was the early part of the Upper Triassic period, 230–225 mya.)

More heavily built were *Herrerasaurus* (Fig. 83e), *Staurikosaurus* (Fig. 83d), and *Pisanosaurus*, all from South America, as well as the North American *Coelophysis*. *Staurikosaurus* and *Herrerasaurus* were members of the same family (*Herrerasauridae*), and several specimens of the latter genus have been discovered over the years. When these animals first evolved, in every case they comprised only minor components of the faunas to which they belonged (Benton 1990b, 2004).



■ Fig. 84. Laurasia and Gondwanaland showing the 12 major types of reptiles, represented by typical species whose fossils are found in Cretaceous formations. (Cloudsley-Thompson 1977 after Kurtén 1969)

These early dinosaurs were all members of the order Saurischia, which included the suborders Theropoda and Sauropoda (Fig. 2; Table 2). The Ornithischia and Sauropoda had evidently separated before the time of these earliest known dinosaurs. The first massive radiation of the Dinosauria, however, took place in the Upper Triassic period, 225 mya, when or after the Therapsida and Rhynchocephalia had declined (Sect. 8.2).

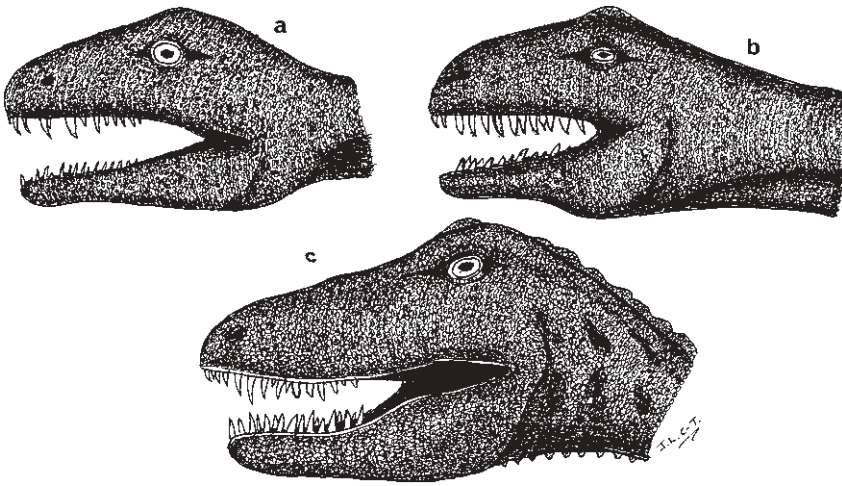
Throughout the later part of the Mesozoic Era the land mass of the world was divided into the two supercontinents, Laurasia in the north and Gondwanaland in the south (Fig. 84). Most reptilian orders were represented in both of these. Migrations probably took place between them by way of a land bridge in the west where the Tethys Sea was narrowest. Nevertheless, the partial separation explains some of the major differences between the dinosaurs that inhabited the northern and southern continents. During the Upper Cretaceous, these continents gradually separated when Laurasia and Gondwanaland began to break up and, by the end of the Mesozoic, the Atlantic Ocean had become well established – although India was still far from the rest of Asia (see Halstead and Halstead 1981; Benton 1996).

9.2 Dinosaur Weapons

Weapons are of three kinds – those that are used by predators to attack their prey, weapons of defence including armour (Sect. 10.6.4), and agonistic weapons used in intraspecific sexual rivalry. These functions, however, can often be interchangeable; weapons of attack are also employed by carnivores in defensive situations when they are attacked by enemies larger or more formidable than themselves. They may also be used in agonistic combat (Sect. 9.3.1). Again, weapons whose primary function is agonistic may well be used in defence against predators, and so on. The scales of dinosaurs, like those of crocodilians, were embedded and sunk into the thick, protective skin.

9.2.1 Weapons of Attack

The offensive weapons of predatory dinosaurs, including the so-called carnosaurs (Sects. 11.1, 11.3.2), were primarily their sharp, inwardly curved, and serrated teeth (Fig. 85). Especially in the case of bipedal forms, however, the action of these teeth was often supplemented by forelimbs which grabbed the prey while it was being bitten. In numerous cases, curved jaws helped to hold the struggling prey securely. Many predators also had formidable claws that were used to slash the bodies of their prey. For instance, the Early Cretaceous theropod *Deinonychus* ('terrible claw'; Figs. 86, 87) from North America, like other members of the family Dromaeosauridae, was equipped with vicious claws on its hind legs with which it could easily disembowel other dinosaurs. So, too, was *Velociraptor* (Sect. 9.2.2).



■ Fig. 85a–c. Carnivorous dinosaur heads (not to scale). a *Teratosaurus* (Upper Triassic), b *Allosaurus* (Upper Jurassic), c *Tyrannosaurus* (Upper Cretaceous). The apparent similarity is the result of convergence in diet and mode of life

The use of weapons by extant animals is invariably supplemented by numerous behavioural and ecological attributes. Similar attributes can only be inferred among fossil forms. For instance, cryptic coloration not only enables potential prey to avoid the attention of predatory enemies, but may also make it possible for the latter to creep upon their victims, unnoticed until the final attack is delivered. By living together in herds, potential prey animals may be relatively safe from attack by predators and also protect their young. Again, by



■ Fig. 86. *Deinonychus* (Dromaeosauridae; Lower Cretaceous; length ca. 3.5 m). (Cloudsley-Thompson 1999 after Halstead and Halstead 1981)

Ecology and Behaviour of Mesozoic Reptiles

Cloudsley-Thompson, J.L.

2005, XII, 219 p. 129 illus., Hardcover

ISBN: 978-3-540-22421-1