

Tiarajudens: A significant mammal-like reptile

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Popularly known as the ‘mammal-like reptiles’, the therapsids are well documented in the fossil record. Their abundance in the Karoo basin has made South Africa world renowned for the diversity of Permian and Triassic therapsids. The earliest known therapsid is *Raranimus* from China’s Middle Permian Dashankou Formation,¹ and besides several poorly known taxa (mainly from Russia) six therapsid lineages are well recognised, although there is still controversy concerning their interrelationships^{2,3}: the heavily built, large-bodied Dinocephalia; the Biarmosuchia, which retain many similarities to the sphenacodontian pelycosaurs (better known as the sail-backed reptiles); the carnivorous Therocephalia and Gorgonopsia; the herbivorous Anomodontia; and the Cynodontia (to which mammals and their ancestors belong). *Tiarajudens* sheds light on the evolution of the Anomodontia.

In March 2011, the 260-million-year-old *Tiarajudens eccentricus* from Brazil was announced to the world in the journal *Science* by a team consisting of Brazilian and South African scientists⁴ (Figures 1 and 2). *Tiarajudens* consists of a partial skull with an ~120 mm long, laterally compressed canine, 5 leaf-shaped incisors and 13 expanded palatal teeth that formed a grinding surface. Although the skull is rather fragmentary, Juan Cisneros and his colleagues⁴ were able to recognise its resemblance to *Anomocephalus*, a basal anomodont recovered in 1999 from the *Tapinocephalus* assemblage zone of the Beaufort Group of the South African Karoo beds, near Williston in the Northern Cape.⁵ The Anomodontia were the most successful Permo-Triassic herbivorous therapsids, which included amongst them the widely distributed dicynodonts (which characteristically lose their teeth and develop a keratinised beak for processing herbaceous material).

The large transversely expanded palatal teeth in *Tiarajudens* can be explained as having formed a grinding or occlusal surface with that of the lower jaw (which regrettably, was not found) to process high-fibre plant matter. However, the function of the canines in this herbivore poses an enigma. Considering the presence of canines in extant animals such as the antlerless water



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FIGURE 1: Lateral view of the partial skull of *Tiarajudens eccentricus*. The long arrow indicates the palatal teeth, which show wear surfaces indicative of occlusion with teeth on the lower jaw. The short arrow points to the long sabre-like canine.

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FIGURE 2: *Tiarajudens* was found in Permian aged outcrops near the small village of Tiaraju, close to the city of São Gabriel in Rio Grande do Sul, the southernmost state of Brazil.

deer and the Asian musk deer, Cisneros et al.⁴ propose that perhaps they were used in interspecific interactions (e.g. to ward off predators) or intraspecific interactions such as display and aggression.

Although *Tiarajudens* has similar cranial proportions to the oldest known anomodont, China's *Biseridens*,¹ it is more closely allied to *Anomocephalus*⁵ from South Africa – so much so, that rigorous cladistic analysis by the researchers suggests that there was a Gondwanan radiation of fairly robust, large basal anomodonts, the Anomocephaloidea.⁴ The similarity between *Tiarajudens* and *Anomocephalus* suggests that in the Permian period similar basal anomodonts roamed South America and South Africa. There are many extinct animals that are known from both these continents, but, until now, Brazil and South Africa have had only dinocephalians^{6,7} and a small filter-feeding, aquatic reptile called *Mesosaurus*, in common. Although basal anomodonts are known from China, Russia and South Africa, *Tiarajudens* represents the first basal anomodont from South America and its discovery increases

our understanding of the biogeographical distribution of the Anomodontia and the early radiation of the Therapsida.

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