

First mammal-like reptile from Australia

THE first mammal-like reptile fossil to be found in Australia, from the Arcadia Formation of south-east Queensland, was recently described by Thulborn¹. The specimen in question is a partial left quadrate whose morphology matches a suite of characters which Thulborn feels appear "to be unique to dicynodonts", following Watson's² description. Furthermore, Thulborn states that the specimen, Queensland Museum F12178, finds its closest match in the dicynodont *Kannemeyeria*, being virtually identical to one example illustrated by Watson². He therefore concludes that the quadrate belonged to a dicynodont closely related to (or perhaps identical with) *Kannemeyeria*.

This is an important conclusion because it is implicated in the dating of the Arcadia Formation which various evidence¹ points to being correlated with the *Lystroraurus* Zone of South Africa. However, *Kannemeyeria* is usually thought to be associated with *Cynognathus* Zone (Lower Triassic) deposits, not with those of the earlier *Lystroraurus* Zone. If the new fossil is indeed *Kannemeyeria* then either it is a very early occurrence of this genus, in the Arcadia Formation, or the Arcadia is not correlated with the South African *Lystroraurus* Zone, despite the evidence to the contrary. Even if the fossil is only closely related to *Kannemeyeria*, not actually a member of that genus, this is still a surprising conclusion, as no known relatives of *Kannemeyeria* are found in deposits earlier than those of the *Cynognathus* Zone³.

However, there is little evidence to support the contention that the new specimen is *Kannemeyeria* or a similar genus, because the dicynodontian quadrate has no features of diagnostic significance (except perhaps in two advanced Triassic forms⁴). Although Queensland Museum F12178 is undoubtedly dicynodontian (*sensu* Cluver and King⁵), and although it and *Kannemeyeria* do appear similar, Queensland Museum F12178 also bears similarities to *Lystroraurus*⁶, *Dicynodon*⁷, or indeed to almost any other dicynodontian. The problems of dating mentioned above may be solved by assuming that QM 12178 is not *Kannemeyeria*, or a close relative, but is in fact *Lystroraurus*, the common fossil of the *Lystroraurus* Zone.

Thulborn also mentions that *Kannemeyeria* and *Lystroraurus* might have been contemporaneous in the Puesto Viejo Formation of Argentina, probably the earliest occurrence of *Kannemeyeria*. This is not a widely held view and has no fossil evidence to substantiate it, but it is in any case contradictory to Thulborn's suggestion that the Arcadia is not

necessarily correlated with the South African *Lystroraurus* Zone. If *Kannemeyeria* and *Lystroraurus* did coexist, there is nothing to prevent the Arcadia being correlated with the *Lystroraurus* Zone. The Puesto Viejo cannot be used to illustrate this, however, as it is almost certainly of *Cynognathus* Zone age⁸.

In conclusion, it would seem simpler to regard the quadrate QM F12178 as belonging to a specimen of *Lystroraurus*, and the Arcadia Formation as *Lystroraurus* Zone age. This would be consistent with the evidence from associated remains and palynology mentioned by Thulborn.

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THULBORN REPLIES—King states that no known relatives of *Kannemeyeria* are found in deposits older than those of the *Cynognathus* Zone. However, Bonaparte reported¹ parts of several kannemeyeriid skulls, along with remains of a proterosuchid thecodontian, from the basal part of the Puesto Viejo Formation, Argentina. Radiometric dating confirmed that the fossiliferous beds were probably equivalent in age to the South African *Lystroraurus* Zone.

To some extent dicynodont genera can be distinguished through differences in quadrate morphology—in the relative shapes and proportions of the condyles, in the degree of closure of the quadrate foramen and (in some cases) in the development of an antero-medial wing against the pterygoid. I compared the Arcadia specimen first-hand with the quadrates of various dicynodonts, including *Kannemeyeria* and African and Antarctic specimens of *Lystroraurus*. In its size, and in its gross and detailed morphology, the Arcadia specimen found its closest match in the *Kannemeyeria* quadrate illustrated by Watson²; by contrast, it bears only a general resemblance to the quadrate of *Lystroraurus* (see, for example, those specimens figured by Cluver³).

While the Arcadia quadrate is definitely identifiable as that of a dicynodont, it does not show sufficient detail to warrant its assignment to any new or existing genus,

be it *Kannemeyeria* or *Lystroraurus*. It seems very likely that the Arcadia fauna is equivalent in age to that of the South African *Lystroraurus* Zone⁴⁻⁶, but this fact cannot be used to argue that any dicynodont fragment found in the Arcadia Formation must inevitably represent the genus *Lystroraurus*.

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Correlation of Tulu Bor Tuff at Koobi Fora with the Sidi Hakoma Tuff at Hadar

BROWN¹ correlates the Sidi Hakoma Tuff (SHT) of Hadar with the Tulu Bor Tuff of East Turkana using chemical fingerprinting, and concludes that our K/Ar age² for the variably altered Kada Moumou Basalt (KMB), interpreted to be stratigraphically above SHT, is too old by ~0.5 Myr. This conclusion is hasty.

(1) Brown's statement that the mean of all type A KMB ages² is 3.12 Myr ignores our distinction between types A-1 (more altered) and A-2 (less altered), with mean ages of 2.94+0.12 Myr and 3.33+0.06 Myr, respectively. This evidently resulted from his not realizing that KM-1-74 (lab) and KM-2-74 (lab) were re-labelled from KM-2-74 and KM-1-74 of ref. 3, when we discovered that the latter had been accidentally interchanged after grinding⁴. Brown's correlation places KMB in the Mammoth Event (3.15-3.05 Myr); if this is true, then not only is the unique type B too old, but so is the common A-2 variety. Our oversight in not including the older age measurements obtained for the type A-1 sample in the density fractionation experiment² does blur the age distinction between types A-1 and A-2 somewhat (F. H. Brown, personal communication).

By this reasoning it becomes fortuitous that the most altered petrographic type yields the best K/Ar age, while the progressively less altered types give ages too old because of extraneous ⁴⁰Ar*. Just considering the internal systematics of the KMB data and the lack of geological evidence for extraneous ⁴⁰Ar* leads to the conclusion that the