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FIRST DISCOVERY OF A CYNODONT FROM THE MOENKOPI FORMATION (MIDDLE TRIASSIC) OF NORTHEASTERN ARIZONA

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Abstract : An incomplete tooth crown from the upper part (Holbrook Member) of the Moenkopi Formation (Middle Triassic) of northeastern Arizona is described and attributed to Cynodontia *incertae sedis*. It is the only record of cynodonts from the Middle Triassic of the southwestern United States.

Keywords : Therapsida, Cynodontia, Middle Triassic, Moenkopi Formation, Southwestern United States.

Première découverte d'un cynodonte dans la Formation Moenkopi (Trias moyen, Nord-Est de l'Arizona).

Résumé : Une dent incomplète provenant de la partie supérieure de la Formation Moenkopi (Membre Holbrook, Trias moyen) en Arizona est ici décrite et attribuée à un cynodonte *incertae sedis*. C'est pour l'instant le seul fossile attribuable à un cynodonte découvert dans le Trias moyen du Sud-Ouest des Etats-Unis.

Mots clés : Therapsida, Cynodontia, Trias moyen, Formation Moenkopi, Sud-Ouest des Etats-Unis.

INTRODUCTION

An incomplete tooth crown, from the Middle Triassic Moenkopi Formation of northeastern Arizona, was discovered by Gauffre in a grayish sandstone at Radar Mesa during the 1993 Nonmarine Triassic Symposium excursion (fig. 1). The outcrop, in the Holbrook Member, is Anisian in age (Benz, 1980; Morales, 1987; Hunt, 1993). The tooth is now housed in the palaeontological collection of the Muséum National d'Histoire Naturelle de Paris (M.N.H.N., France) with the provisional number MAM.1. The Holbrook Member has the richest vertebrate fauna in the Moenkopi Formation (Morales, 1987), the reptile component including procolophonids and archosauromorphs (Morales, 1987). No therapsid had previously been reported.

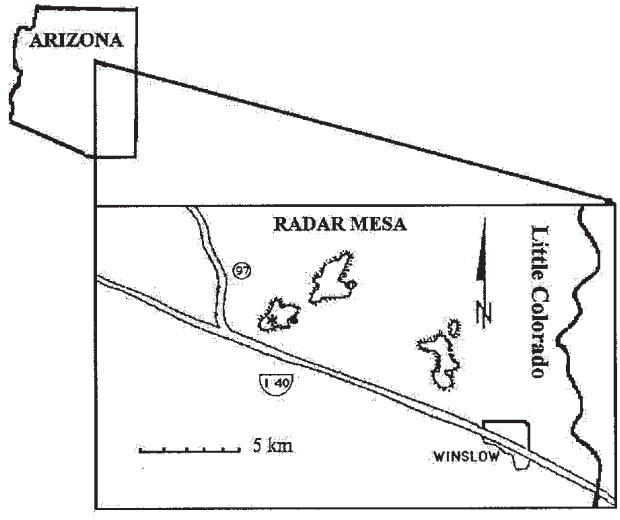


Fig. 1 : Location map of Radar Mesa. The tooth has been found in the South part of the first mesa, where is the star.
Fig. 1 : Carte de localisation de Radar Mesa. La dent a été trouvée dans la partie Sud de la première mesa, où se situe l'étoile.

DESCRIPTION OF THE SPECIMEN

The crown is tricuspid (fig. 2), with the two secondary cuspids arranged symmetrically on the mesial and distal edges of the main cusp. The root, the tips of the main cusp, and one of the secondary cusps are not preserved. The tooth is 2.5 mm high, 2.1 mm wide, and 1.3 mm thick at the base of the labiolingual surface. The crown is compressed labiolingually. The main cusp is at least four times the height of the accessory cusps. In lingual/mesial aspect, the main cusp has the shape of a high and relatively narrow triangle, of which the mesial and distal edges form fine keels. The enamel of the main cusp lacks ornament but exhibits weak grooves on the side tentatively interpreted here as the lingual side (Fig. 2C). The preservation of the labial side is very poor (Fig. 2B). There is a weak cingulum-like bulge at the base of the lingual side (Fig. 2A), and the secondary cusps are weakly oriented lingually in mesiodistal view (Fig. 2D). Each secondary cusp is separated from the main cusp by a shallow furrow.

Fig. 2: Isolated tooth of a cynodont from Radar Mesa in A: mesial (?) or distal (?) view, with the secondary cusp broken, B: labial view, C: lingual view and D: mesial (?) or distal (?) view, with the secondary cusp preserved. Scale bar: 1 mm.

Fig. 2: Dent isolée de cynodonte de Radar Mesa en vue mésiale (?) ou distale (?), du côté où la cuspide accessoire est brisée (A), vue labiale (B), vue linguale (C) et vue mésiale (?) ou distale (?), du côté où la cuspide accessoire est intacte (D). La barre d'échelle représente 1mm.

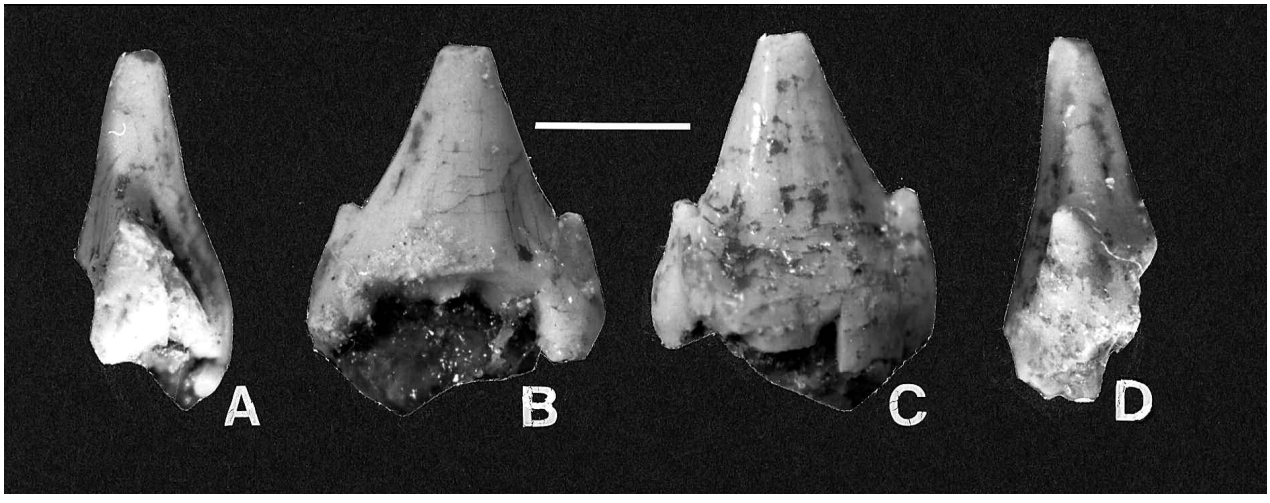
DISCUSSION

The difficulties inherent in taxonomically assigning isolated teeth are exacerbated by the fragmentary nature of this specimen, which permits only the use of the absence of characters to place it in taxonomic context.

Chondrichthyans can immediately be eliminated due to the very low position of the secondary cusps on the crown, as can osteichthyans, due to the absence of acrodine cap in the Radar Mesa tooth. On the other hand, the tricuspid nature of the tooth superficially resembles that of teeth of the Triassic pterosaur *Eudimorphodon* (Norian), the prolacertiform *Tanystropheus* (Ladinian) and some cynodonts.

Within the prolacertiforms, tricuspid teeth are restricted to juvenile *Tanystropheus* (Wild, 1980), in which secondary cusps are usually more developed with respect to the main cusp than is the case in the Radar Mesa tooth. Moreover, the cross-section of *Tanystropheus* teeth is almost circular at the base of the crown (Wild, 1980), whereas the Radar Mesa tooth is strongly compressed labiolingually.

Some teeth of *Eudimorphodon*, in particular from the Norian fossil locality of Medernach (Luxembourg), are reminiscent of the Radar Mesa tooth, although these lack the cingulum-like bulge observed at the base of the lingual side. In addition, *Eudimorphodon* enamel is typically ornamented by weak, albeit well defined, ridges (Cuny *et al.,* 1995; Godefroit & Cuny, 1997; Hahn *et al.*, 1984; Wild, 1978) with the exception of *E. rosenfeldi*, a new



species with smooth teeth recently described by Dalla Vecchia (1995).

Among the few groups of cynodonts showing similarities with the Radar Mesa tooth, there are also a number of differences. Teeth of Chiniquodontidae (Anisian - Carnian) typically have a low main cusp which curves backwards. The secondary cuspids, particularly the mesial one, are not very distinct from the main cusp (Battail, 1989). In Cynognathidae (Scythian), the main cusp is usually curved backwards and the crown is often distally inclined (Battail, 1989). Moreover, cynognathid postcanines lack a cingulum and the cusps are perfectly aligned antero-posteriorly (Godefroit & Battail, 1997), while they are slightly displaced lingually in the Radar Mesa tooth. Teeth of the Galesauridae (Upper Permian - Scythian) differ in that the main cusp is curved backwards and/or the secondary mesial cuspids are indistinct (Battail, 1989; Godefroit & Battail, 1997). In Dromatheriidae (Upper Triassic, *sensu* Hahn *et al.,* 1994), the postcanines do not exhibit a cingulum and, with the exception of *Tricuspes,* the cusps are usually perfectly aligned antero-posteriorly (Godefroit & Battail, 1997). The Radar Mesa tooth differs from *Tricuspes* in having less well developed secondary cusps and lacking an arched aspect in occlusal view (Godefroit & Battail, 1997). Small carnivorous cynodonts *incertae sedis* from the Late Triassic of Western Europe (*Gaumia, Hahnia, Lepagia)* possess teeth which are more compressed labio-lingually than the Radar Mesa tooth (Godefroit & Battail, 1997).

Among cynodonts, cusp proportions and crown shape of the Radar Mesa tooth are closest to those assigned to «Hallau LVIII» from the Rhaetian of Switzerland (Peyer, 1956: plate 2, fig. 58). However, the tooth illustrated by Peyer differs from the Radar Mesa tooth in that the tips of its cusps are ornamented by weak ridges, similar to those observed in the teeth of *Eudimorphodon.* The Radar Mesa tooth is also very similar to that of an indeterminate cynodont found in the Norian of Medernach (IRSNB 27825/11, Cuny *et al.*, 1995, specimen not figured). However, labiolingual compression and the tricuspid state are ubiquitous amongst cynodonts in the Chiniquodontidae, Cynognathidae and Thrinaxodontidae so it is unadvisable to definitively exclude these three groups as sources for the Radar Mesa tooth. Furthermore, in smaller cynodont teeth, the main cusp is likely to be less curved and the secondary cusps less distinct.

CONCLUSION

In the absence of sufficient characters to place the fossil more precisely within the cynodonts, the tooth crown is considered as Cynodontia *incertae sedis*. Rare occurences of cynodonts in the Triassic of the southwestern United States are restricted to tooth-bearing bone and teeth from the Norian Bull Canyon Formation of New Mexico (Lucas & Oakes, 1988) and tricuspid teeth from the Carnian *Placerias* and Downs Quarries of Arizona (Tannenbaum-Kaye & Padian 1994). The Radar Mesa tooth is the only record of cynodonts from the Middle Triassic of the southwestern United States.

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