A NEW VERTEBRATE BIOZONE AT THE BASE OF THE BEAUFORT GROUP, KAROO SEQUENCE (SOUTH AFRICA).

by

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ABSTRACT

A new vertebrate biozone at the base of the Beaufort Group has been identified. This biozone is the oldest vertebrate biozone of the Beaufort Group and contains fossils of various therapsid genera which are more primitive than previously known related forms from the Karoo. The name *Eodicynodon – Tapinocaninus* Assemblage Zone is proposed as these two genera of therapsid are the most plentiful from this biozone and have not been found in the rocks of the overlying Dinocephalia Assemblage (*Tapinocephalus*) Zone.

INTRODUCTION

James Kitching has undoubtedly made the greatest single contribution to research on Karoo biostratigraphy in South Africa and it is fitting that this volume, published in his honour, should contain a contribution on biostratigraphy of the Beaufort Group.

Ever since the original description of *Eodicynodon* as coming from the rocks of the Ecca Group (Barry 1973; 1974) there has been much speculation amongst palaeontologists as to whether *Eodicynodon* is indeed from the Ecca or the Beaufort (Kitching 1977; Rubidge 1984; Rubidge & Oelofsen 1981), as the contact between the Ecca and Beaufort Groups was inadequately defined in the southern Karoo. Recently, by independently using lithological and palaeontological criteria, a workable synthesis of the Ecca-Beaufort boundary in the southern Karoo has been achieved and an even older vertebrate biozone has been identified at the base of the Beaufort Group (Rubidge 1987; 1988).

After the first discovery of fossil reptiles in Beaufort strata near Fort Beaufort in 1838 by Andrew Geddes Bain (Bain 1845a; 1845b) and their description by Owen (1845), the rocks of the Beaufort Group have become world famous for their record of Permian and Triassic mammal-like reptiles, as well as the evolutionary transition from reptiles to mammals (S.A.C.S. 1980). Because of the number and variety of fossil vertebrates from the Beaufort Group, these rocks have been biostratigraphically subdivided. Seeley (1892: 1312) was the first to divide the Beaufort into three biostratigraphic zones:

3. Zone of "highly specialized group of theriodonts" (uppermost zone)
2. Zone of "Dicynodonts"
1. Zone of "Pareiasaurians" (lowermost zone).

Broom (1907b; 1909) proposed a new biozonation of the Beaufort "Series":

6. *Cynognathus* Zone (uppermost zone)
5. *Procolophon* Zone
4. *Lystrosaurus* Zone
3. *Cistecephalus* Zone
2. *Endothiodon* Zone
1. *Pareiasaurus* Zone (lowermost zone)

Watson (1914a) agreed with Broom's biozonation and was the first to indicate the distribution of these biozones on a map. Later he replaced the *Pareiasaurus* Zone with the *Tapinocephalus* Zone (Watson 1914 b). Huene (1925) also mapped the biozones. Hotton and Kitching (1963) pointed out that *Procolophon* occurs throughout the *Lystrosaurus* Zone.

Kitching (1970; 1977) introduced the *Daptocephalus* Zone to encompass the strata between the level where *Cistecephalus* became extinct and the first appearance of *Lystrosaurus*, and discarded Broom's *Endothiodon* and *Procolophon* Zones.

Keyser and Smith (1978) proposed a new vertebrate biozonation for the Beaufort Group west of 260° E and linked the assemblage zones to the new lithostratigraphy which was proposed by S.A.C.S. (1980).

Beaufort Assemblage Zones proposed by Keyser and Smith (SACS 1980) are:

7. *Kannemeyeria-Diademodon* Assemblage Zone (uppermost)
6. *Lystrosaurus-Thrinaxodon* Assemblage Zone
5. *Dicynodon lacerticeps-Whaitsia* Assemblage Zone
4. *Aulacephalodon-Cistecephalus* Assemblage Zone
3. *Tropidostoma-Endothiodon* Assemblage Zone

2. *Pristerognathus-Diictodon* Assemblage Zone
1. Dinocephalia Assemblage Zone (lowermost)

With the discovery of a reptilian fauna from below the Dinocephalia Assemblage Zone (*Tapinocephalus* Zone) in rocks which have previously been described as belonging to the Waterford Formation (Rubidge 1984; Rubidge and Oelofson 1981; Rubidge *et al.* 1983), it is necessary to consider defining a new vertebrate biozone.

FACIES ASSOCIATIONS AT THE ECCA-BEAUFORT TRANSITION

A survey of the geology of the Ecca-Beaufort transition in the Southern Karoo between the towns of Prince Albert and Rietbron has revealed that three independent facies associations, called 1, 2 and 3, are represented in the stratigraphic interval between the top of the Fort Brown Formation and the base of the Beaufort Group (Rubidge 1987; 1988).

Facies association 1 forms the top of the Fort Brown Formation of the Ecca Group and is characterised by thinly bedded dark organic-rich mud or siltstone with thin beds (1-2 cm thick) of lighter coloured sandstone. The siltstones consist of fine planar bedded laminations which appear to have resulted from suspension deposition in a relatively low energy environment. Sedimentary structures in the sandy horizons range from horizontal bedding to ripple laminations. The thickness of ripple laminated layers varies and in places starved ripples are formed. *Plagiogmus* traces are plentiful in the western portion of the study area. Horizontal worm traces are found in places, sometimes on top of beds or as backfilled burrows between beds.

Directly overlying facies association 1 is facies association 2, which consists of several mainly arenaceous facies of the Waterford Formation, with very little mudstone present. The five separate facies which make up this facies association are repeated several times in vertical sequence (Rubidge 1988).

Fossils recovered from facies associations 1 and 2 include isolated scales of the palaeoniscid fish *Namaichthys digitata*, occasional imprints of fragmented *Glossopteris* and *Schizoneura* leaves, and numerous unidentifiable plant fragments like those often referred to as "coffee grounds" in the Mississippi delta (Coleman and Prior 1982). Fragments of silicified wood and fossil tree stumps are also present in the rocks of facies associations 1 and 2. As the rocks of facies associations 1 and 2 are considered to have been deposited respectively in a distal bar and subaqueous delta plain environment (Rubidge 1988), it appears that this wood probably drifted in (Visser and Loock 1978), became waterlogged and sank. The fact that no fragments were present in the overlying upward fining sequences appears to indicate that the fossilized wood is characteristic only of the subaqueous facies of the Waterford Formation (Rubidge 1987).

Facies association 3 overlies facies association 2 between 150 and 580 m from the base of the Waterford Formation, depending on the locality. Although sandstone still comprises a major percentage of the rocks present, relatively thick units of mudstone are present as well. These sequences consist of erosively based sandstones, in many cases with a pebble lag at the base, which fine upwards to siltstone and mudstone. Mudcracks, wrinkle marks, and raindrop impressions have been found on the upper surface of the mudrocks and suggest subaerial exposure. Horizons containing reddish-brown calcareous nodules considered to have been pedogenic horizons (Smith 1980; McPherson and Germs 1979), are also present. These rocks are considered to have been deposited in a subaerial delta plain environment (Loock *et al.* 1979; Rubidge 1988; Stear 1980).

Fossils include complete well preserved fossilized leaves of *Glossopteris* and stems and leaves of *Schizoneura*, some of which have been found in growing position. Well-preserved fossilized skulls and skeletons of various therapsids have also been recovered. The most common are the remains of *Eodicynodon* (Barry 1973; 1975; Rubidge 1984; 1985), which is the most primitive dicynodont known (Cluver & King 1983; King 1988), and an extremely primitive newly described genus of tapinocephaline dinocephalian for which

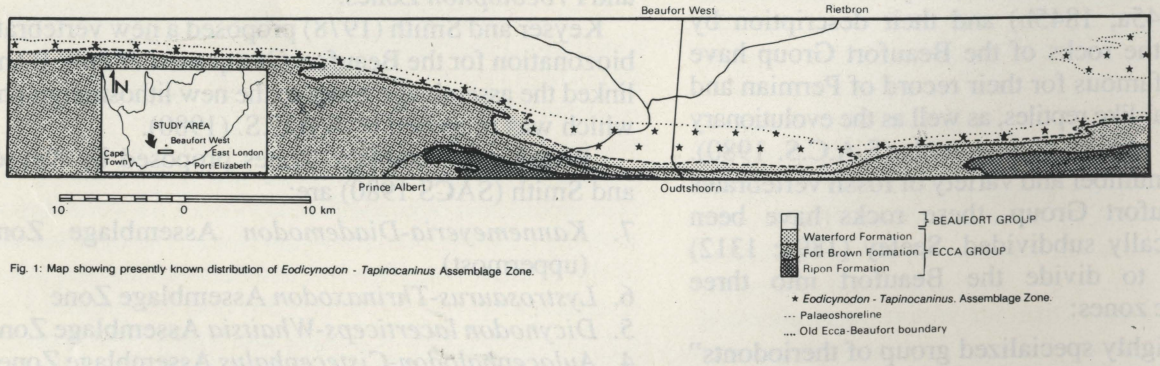

Fig. 1: Map showing presently known distribution of *Eodicynodon - Tapinocaninus* Assemblage Zone.

Figure. 1 Map showing presently known distribution of the *Eodicynodon-Tapinocaninus* Assemblage Zone.

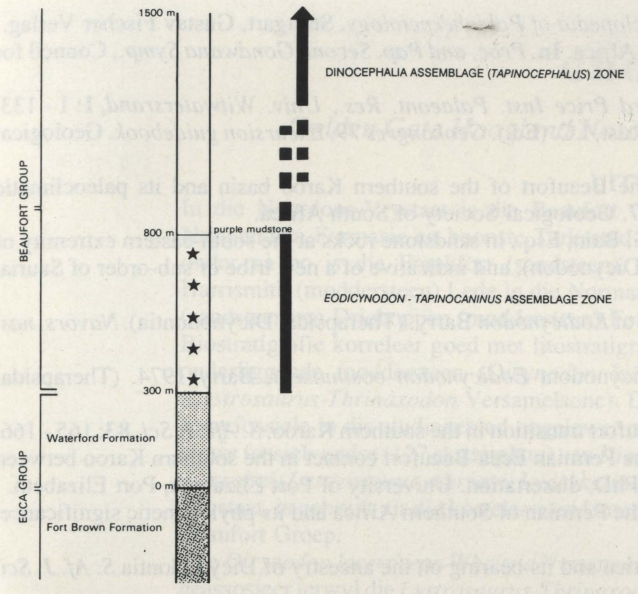

Fig.2 Schematic stratigraphic section indicating the stratigraphic relationship between the *Eodicynodon-Tapinocaninus* Assemblage Zone and the Dinocephalia Assemblage (*Tapinocephalus*) Zone.

the name *Tapinocaninus* has been proposed (Rubidge, in press.). One of the more important fossils is the skull of the most primitive anomodont yet found (Rubidge and Hopson, 1990). More fragmentary remains of pristerognathid therocephalians (Rubidge 1988; Rubidge *et al.* 1983), and gorgonopsians are also present. This assemblage of fossils is more primitive than therapsid assemblages previously described from the lowermost biozones of the Beaufort Group (*Tapinocephalus* Zone (Kitching 1977); Dinocephalia Assemblage Zone (Keyser & Smith 1978)), and are the oldest fossils of terrestrial reptiles yet reported from the Karoo (Rubidge 1984; Rubidge *et al.* 1983). Because these fossils have been found immediately above the stratigraphic position of the palaeoshoreline of the Ecca Basin, it is unlikely that remains of older terrestrial reptiles will be found in the Karoo sequence of South Africa, unless their remains were washed into the Ecca sea (Rubidge 1987).

THE POSITION OF THE ECCA-BEAUFORT CONTACT

It has recently been suggested that the rocks bearing *Eodicynodon* fossils should be included in the Beaufort (Rubidge 1988) rather than the Ecca as was previously accepted (Barry 1970; 1973; 1975; Rubidge and Oelofson 1981). This implies that the Ecca-Beaufort contact as currently mapped in the southern Karoo (Geological Survey 1980a; 1980b) should be moved down by a stratigraphic interval of between 300 and 650 m, depending on the locality, to include the *Eodicynodon*-bearing strata.

The therapsid fossil assemblage from these rocks thus constitutes a newly identified vertebrate biozone at the base of the Beaufort Group for which the name *Eodicynodon-Tapinocaninus* Assemblage Zone is proposed (fig. 1). Both of these genera are presently known only from this zone. Further collecting will determine the vertical and lateral distribution of this zone. Presently it is known to exist between the top of the Waterford Formation and the first maroon mudrocks of the Beaufort Group (fig. 2) between the towns of Rietbron and Prince Albert in the southern Karoo. As the uppermost limit of this zone is not known as yet, it is possible that future collecting may reveal that the *Eodicynodon-Tapinocaninus* Assemblage Zone extends slightly into the overlying Dinocephalia Assemblage Zone.

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