

A new species of *Bothriembryon* (Mollusca: Gastropoda: Bulimulidae) from the Pliocene Roe Calcarenite, Eucla Basin, Western Australia

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Abstract – *Bothriembryon kremnobates* sp. nov., a terrestrial snail, is described from the marine Roe Calcarenite of the southern Eucla Basin. This constitutes a first Pliocene record for the genus, hitherto known only from the Miocene? and Quaternary.

INTRODUCTION

The Roe Calcarenite (Lowry 1970) is a thin (up to 7.5 m thick but usually much less), bioclastic, sandy limestone, which mantles at shallow depth most of the Roe Plains along part of the southern, onshore Eucla Basin in Western Australia, between about Twilight Cove and Eucla (approximate longitudes 126°–129° E). The formation is richly fossiliferous, notably of mollusc shells; the milioloid foraminifer *Marginopora* sp. is conspicuously large and abundant throughout.

The Roe Calcarenite overlies unconformably an erosion surface of, variously, either Wilson Bluff (Eocene) or Abrakurrie (Oligo-Miocene) Limestone (Lowry 1970; Li *et al.* 1996). The Roe substrate was formed by a fine (toward the base, silty) to medium grained, transgressive, carbonate sand, with extensive seagrass growth, in shallow, inshore, well-circulated water along an open rocky coast. At the time of principal deposition, the shoreline was probably a high sea cliff, now represented by the broadly arcuate Hampton Escarpment, separating the Roe Plains from the more elevated Hampton Tableland and Nullarbor Plain (Lowry 1970).

The study material, from the palaeontological collections of the Western Australian Museum, was collected between 1976 and 1980 from excavations in the Roe Calcarenite, all in proximity to the Hampton Microwave Repeater Tower, a conspicuous landmark (lat. 31°57'57"S, long. 127°34'45"E) located 50 km east of the Madura road house and seven km south of the Eyre Highway.

Stratigraphy

The type locality of the present species is a pit, excavated for road fill, and 0.5 km north from the Hampton Microwave Repeater Tower. There, beneath a thin, brown soil cover, the Roe

Calcarenite measures 2.84 m in thickness. The uppermost 1.1 m of the formation presents a strong, top-down, weathering profile.

Here, the base of the Roe Calcarenite overlies unconformably a pitted erosion surface of hard, white limestone, probably the Wilson Bluff Limestone. The basal unit of the Roe is an unlithified, free-running, pale, silty, carbonate sand, 0.55 m thick and richly fossiliferous, including occasional specimens of the arcoid bivalve *Cucullaea* sp. This is overlain conformably by a greyish to yellowish, horizontal, shelly calcarenite, 0.15 m thick and without internal bedding. Passing upward, between 0.7 and 1.1 m above the base, is a carbonate sand (0.4 m thick), weakly and unevenly lithified and with numerous, large bivalve shells. The holotype of the present species (WAM 81.847) was collected *in situ* from this unit.

Higher units show the effect of strong, subaerial weathering, with increasing lithification and calcretisation toward the top. The fourth unit (from the base) is a pink, shelly calcarenite, 0.7 m thick, with extensive, pink, calcrete encrustation of fossil shells and the formation of calcrete nodules. Paratype WAM 81.1774, from an adjacent excavation, appears to have originated from an extension of this unit. The top of the Roe Calcarenite at the type locality is a hard, dense, greyish-brown, shelly, pisolithic calcrete with a laminar surface capping and about 0.4 m thick.

Age

Early studies of the Mollusca of the Roe Calcarenite (Ludbrook 1958a,b) supported an Early Pleistocene age for the formation and this conclusion was followed by Lowry (1970), Playford *et al.* (1975) and Ludbrook (1978). However, subsequent collecting enlarged significantly the

known fauna, enabling a re-evaluation of age in favour of the Late Pliocene (Kendrick *et al.* 1991: 424). Endorsing this conclusion, Beu and Darragh (2001, figure 6) located the Roe Calcarenite in the Late, though not latest, Pliocene, a view with which the writer fully concurs.

Systematics

Family Bulimulidae Wenz, 1938

Genus *Bothriembryon* Pilsbry, 1894

Type species: By original designation, *Bulimus melo* (Quoy and Gaimard) = *Helix melo* Quoy and Gaimard.

Bothriembryon kremnobates sp. nov.

Figure 1A

Material examined

Holotype

WAM 81.847, from Roe Plains, Madura district, Western Australia. Excavation 0.5 km north of Hampton Microwave Repeater Tower. Taken *in situ* from carbonate sand with large marine shells, 0.7–1.1 m above base of Roe Calcarenite. Late Pliocene. Map reference: Yalganimirra 1:100,000 topographical series (1966), 655 630. Collected V.A. Ryland and G.W. Kendrick, 29 September–4 October, 1980. Shell damaged on part of fourth whorl.

Paratypes

WAM 81.1762, from Roe Plains, Madura district, Western Australia. Excavation 0.5 km north of Hampton Microwave Repeater Tower. Sieved from spoil heaps on floor of excavation. Roe Calcarenite. Late Pliocene. Collected V.A. Ryland, G.W. and W.E. Kendrick, 20–23 September, 1976. One shell.

WAM 81.1774, from Roe Plains, Madura district, Western Australia. Excavation 1.5 km north of Hampton Microwave Repeater Tower. From floor of excavation. Collected V.A. Ryland, G.W. and W.E. Kendrick, 22–28 September, 1976. One shell encrusted with pink calcrete.

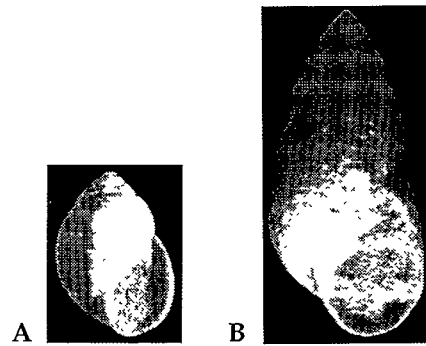


Figure 1 A, *Bothriembryon kremnobates* sp. nov. Holotype, WAM 81.847. From Roe Plains, Madura district, W.A. Pit 0.5 km north of Hampton Microwave Repeater Tower: calcarenite with large marine shells, 0.7–1.1 m above base of Roe Calcarenite. Late Pliocene. Natural size. B, *Bothriembryon barretti* Iredale. WAM 70.2160d. Large specimen, from excavation, 1–3 m deep, beside Eyre Highway, 78 km west of Eucla motel, W.A. Probably from colluvium/soil mantle above Roe Calcarenite. Probably Pleistocene. Natural size.

WAM 81.1796, from Roe Plains, Madura district, Western Australia. Spoil heaps from foundation holes around base of Hampton Microwave Repeater Tower. Collected E. and N. Zeffert, January 1976. One shell.

Diagnosis

Medium sized, ovate-conical species of *Bothriembryon*, with about 5.5 whorls in height of 22 mm; higher than wide, maximum diameter exceeding apertural height; spire short, apex blunt, rounded; teleoconch sculpture of weak co-labral growth ridges, lacking subsutural spiral granulation; protoconch with very fine axial wrinkling and punctation.

Description

Shell of medium size for genus, robust, ovate-conical, height exceeding maximum diameter, about 5.5 convex whorls in height of 22 mm; last whorl inflated, spire short, suture impressed; apertural height less than maximum diameter and

Table 1 Dimensions (mm) of *Bothriembryon kremnobates* sp. nov.

Specimens	Shell height	Apertural height	Max. diameter	Total whorls	Protoconch whorls
WAM 81.847 holotype	21.5	12.4	14.7	5.5	2.0
WAM 81.1762 paratype	20.3	12.0	13.6	5.4	1.7
WAM 81.1774 paratype	19.3	10.9	12.9	5.0	1.6
WAM 81.1796 paratype	22 (est.)	13.0 (est.)	14.7 (est.)	5.4	2.0

Whorl counts (protoconch and teleoconch) followed the method of Kendrick and Wilson, (1975: 314, figure 1).

greater than half total shell height; columella short, reflexed across narrow umbilical fissure; teleoconch sculpture of weak, irregular, axial (co-labral) growth ridges, each with a prominent subsutural flexure; no spiral sculpture or subsutural granulation apparent; protoconch of 1.6–2.0 whorls, blunt, tip slightly immersed; microsculpture of very fine, axially aligned wrinkles and punctation.

Etymology

The name of the species is derived from the Greek *kremnobates*, a cliff dweller; from the presumed habitat of the species in life.

DISCUSSION

The presence of a land snail, represented by four separately collected specimens, from a typical marine formation such as the Roe Calcarenite, is noteworthy and invites attention. The formation accumulated along a shallow, near-shore, energised inner shelf in proximity to a cliffed, limestone coastline, now represented by the Hampton Escarpment, a conspicuous land-form of the southern Nullarbor Region (Lowry 1970).

There can be little doubt that the present species lived near or even on the Hampton sea cliff of the Late Pliocene, with the inevitable collapse, from time to time, of rock, soil and associated snail shells into the eroding, transgressive sea below.

Unknown from any other source, the present species is clearly distinct from all known congeners, in particular those now inhabiting the southern Nullarbor Region (Iredale 1939) (Figure 2). *Bothriembryon distinctus* Iredale differs from the present species in its markedly narrower, more elevated spire (up to seven whorls), its more acute apex and weak subsutural, spiral granulation. Immature (to about five whorls) shells of the large *B. dux* (Pfeiffer 1861) from the western Nullarbor Region differ strongly in their greater size and in the presence of subsutural spiral granulation. *B. mastersi* (Cox 1867) from western South Australia differs in its smaller, thinner shell, more acute spire with fewer, less inflated whorls, more elevated protoconch with very fine, even micropunctation.

The common, widespread and variable *B. barretti* Iredale, 1930 more closely resembles the present species than any of the foregoing, especially specimens (of *B. barretti*) from the wider end of its size-range. It differs consistently however in its

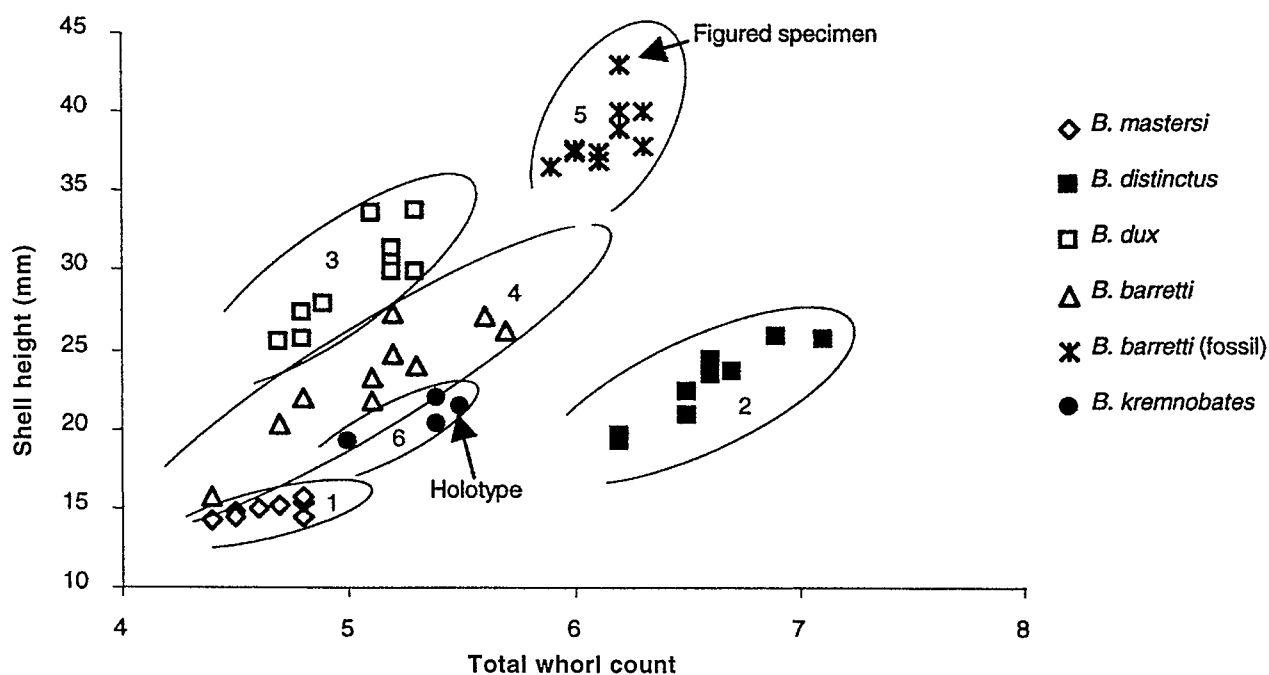


Figure 2 Morphometric comparison (shell height against total whorl count) of *Bothriembryon kremnobates* sp. nov. with modern and fossil congeners from the southern Nullarbor Region and western South Australia. 1. *Bothriembryon mastersi* (Cox), WAM S3017, Ceduna, South Australia. Coll. A.R. Main, 21.xii.1952. Modern. 2. *B. distinctus* Iredale, WAM S2197, 1 km east of Caiguna, W.A. Coll. S.M. Slack-Smith, 2.i.1977. Modern. 3. *B. dux* (Pfeiffer), WAM S2526, immature shells from 22.5 km east of Cocklebidly, W.A. Coll. W.K. Youngson and A. Baynes, 4.ix.1969. Modern. 4. *B. barretti* Iredale, WAM S1728, 28 km west of Madura, W.A. Coll. G.W. Kendrick, 18.ix.1976. Modern. 5. *B. barretti* Iredale, WAM 70.2160d, large specimens from excavation, 1–3 m deep, beside Eyre Highway, 78 km west of Eucla motel, W.A. Probably from colluvium/soil mantle above Roe Calcarenite. Probably Pleistocene. 6. *B. kremnobates* sp. nov., WAM 81.847 (holotype), WAM 81.1762 (paratype), WAM 81.1774 (paratype) and WAM 81.1796 (paratype). For localities, see text. Roe Calcarenite. Late Pliocene.

more elevated spire and apex and in the well-developed, subsutural, spiral granulation. The protoconch of *B. barretti* shows a distinct axial alignment of its microsculpture, not unlike that of the present species.

Ludbrook (1978: 193–194, plate 23, figures 17–19) recorded *Bothriembryon barretti barretti* Iredale, 1930 and *B. barretti indictus* Iredale, 1939 from several disturbed surface sites of the Roe Calcarenite, crediting these records to that formation. Specimens of these taxa, often considerably larger (e.g., WAM 70.2160d, of six whorls in a height of 43 mm) than any known modern example of the species, are commonly found on the disturbed surfaces of the many, shallow bulldozer scrapes that characterise the Roe Plains sector of Eyre Highway (Figure 1 B). Such excavations, many of which entered the upper levels of the Roe Calcarenite, were a significant source of the marine fossil material described in Ludbrook's (1978, figure 1, table 2) study of the molluscan assemblage.

The stratigraphic provenance of marine fossils from these disturbed, shallow, roadside sites is beyond challenge but the same cannot be assumed for the associated *Bothriembryon* specimens, few of which were collected *in situ* from undisturbed sources (see Kendrick, G.W. in Lowry 1970: 114). Examination of the sedimentary infilling of all *B. barretti* specimens to hand from these disturbed situations (Figure 1B) has shown this infilling invariably to be of non-marine origin and consistent with pedogenic processes located within the colluvium overlying the marine fossil bed. Without knowledge of the precise stratigraphic source of these large *B. barretti* specimens, it would be prudent to view their attribution to the Roe Calcarenite as doubtful and subject to confirmation. A biometric comparison of the above species with *B. kremnobates* is shown in Figure 2.

By contrast, each of the four known specimens of *B. kremnobates*, comprising the type material, retains, as cavity infilling, sediment typical of the Roe Calcarenite, including small marine fossils. This, and the collection of the holotype from *situ*, confirms their stratigraphic authenticity and age.

Lowry (1970: 114, fig. 39) reported poorly preserved fossil *Bothriembryon*, comparable with *B. barretti*, from a palaeosol ("oolitic and pisolitic kankar") overlying Nullarbor Limestone, located 80 miles (128 km) north of Rawlinna, a locality well beyond the modern geographic range of Iredale's species and possibly significant to regional palaeoclimate.

Fossil records of bulimulid snails in Australia are few. *Bothriembryon praecursor* McMichael, 1968 was described from Tertiary, possibly Miocene, sediments in the southern Northern Territory (McMichael 1968, Solem 1988) and reported also from dolomitic limestones of the Miocene

Etadunna Formation of northern South Australia (Ludbrook 1980). This species is known only from internal and external moulds and its affinities with other species of the genus and precise age remain to be clarified.

Bulinus gunnii G.B. Sowerby in Strezelecki, 1845 from travertine limestones of uncertain but possible Tertiary age near Hobart, Tasmania, was referred to *Bothriembryon* by Ludbrook (1980). This species is extremely rare, poorly known and, likewise, its affinities with congeners remain speculative (Solem 1988).

Four fossil species of *Bothriembryon* from palaeosols in the Pleistocene Tamala Limestone of coastal Western Australia have been described by Kendrick (1978). Two of these, from the Shark Bay district, appear to represent lineages that have become extinct since the Middle Pleistocene.

The present species from the Roe Calcarenite provides the first confirmed record of the genus *Bothriembryon* from the Pliocene.

ACKNOWLEDGEMENTS

Contributions in photography and graph preparation by Ms Karen Edward and Mr Corey Whisson are acknowledged with thanks. Access to the collection of modern land snails of the Western Australian Museum was kindly provided by Mrs S.M. Slack-Smith. Mrs A. Nevin prepared the manuscript.

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