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PORIFERA (CALCAREA: LITHONIDA) FROM THE LOWER MIOCENE BATESFORD LIMESTONE, VICTORIA, AUSTRALIA, INCLUDING A NEW SPECIES *MONOPLECTRONINIA MALONEI* SP. NOV.

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ABSTRACT: An exceptional fauna of calcareous sponges (Porifera: Calcarea) from the lowest biofacies of the Batesford Limestone (Lower Miocene), exposed in the Australian Portland Cement Quarry, Fyansford, near Geelong, southern Victoria, is reviewed. Four species have been recognised from this biofacies by the authors: *Tretocalia pezica* Hinde, 1900, *Bactronella australis* Hinde, 1900, *Plectroninia halli* Hinde, 1900 and a new species, *Monoplectroninia malonei* sp. nov., described and named in this paper. The original descriptions of Hinde's species have been expanded to include a more comprehensive description of ontogeny.

Keywords: Porifera, Calcarea, *Monoplectroninia malonei* sp. nov., Batesford Limestone, Miocene, Victoria

The Batesford Limestone is a fossiliferous Miocene calcarenite exposed in the Australian Portland Cement Quarry, at Fyansford, about 8 km northwest of Geelong, Victoria. The limestone formed off the flanks of a granitic inselberg known as Dog Rocks, with preferential accumulation of skeletal carbonate, recording a transgressive sequence, as the island slowly submerged in the Port Phillip Basin of Victoria (Bowler 1963; Foster 1970). The Batesford Limestone contains large foraminifera such as *Orbulina* and corresponds to the 'Miocene Climatic Optimum' of the Lower to Lower Middle Miocene (Gourley & Gallagher 2004). During the earlier Miocene, shallow-water Calcarea described herein flourished off Dog Rocks. These were replaced by the Early Middle Miocene with mid to outer shelf conditions, as reflected in a transition to planktonic and infaunal taxa in the overlying finer grained Fyansford (Gourley & Gallagher 2004).

Figure 1: Location of the outcrop in the Batesford Limestone, Batesford Quarry. Satellite Source DigitalGlobe © 2017. Inset F. McSweeney.

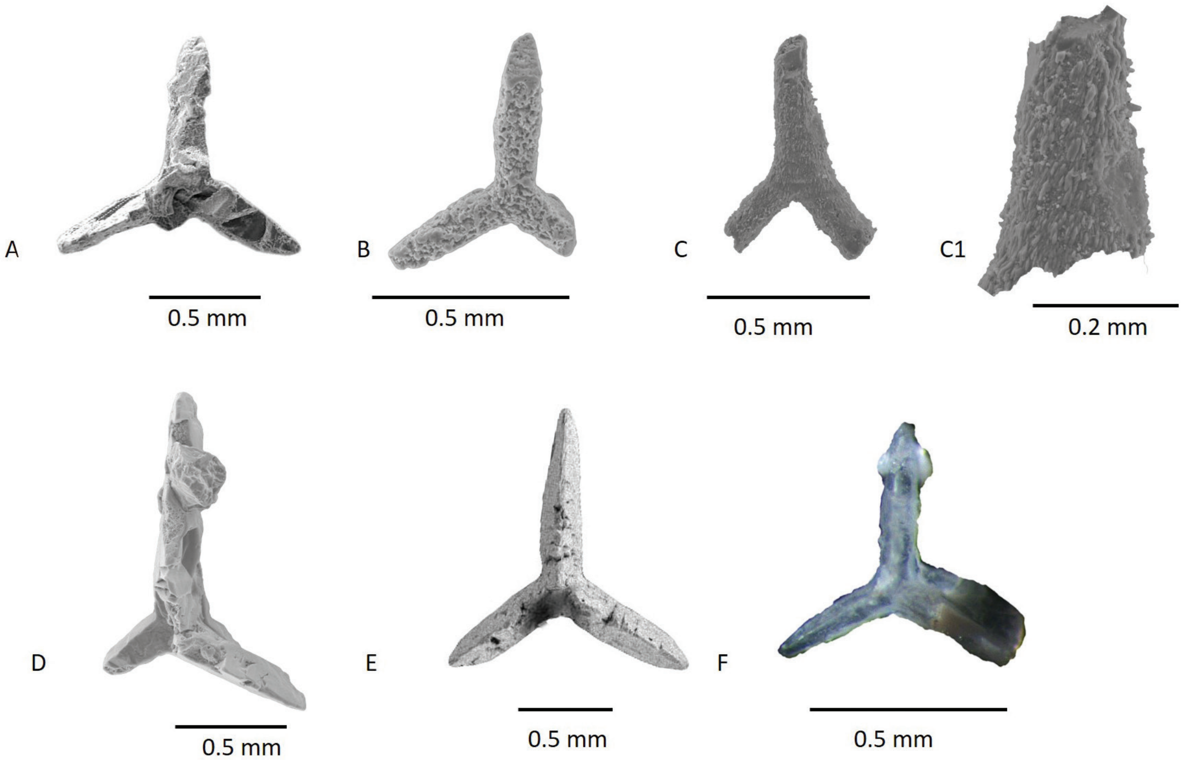

Figure 2: Loose spicules from sediment analysis. Micrograph images (A–E) taken on Philips XL30 SEM and light microscopy image (F). A, E, F: triactine spicules and B as suspected triactine spicule; C1 close-up of C, and D (parasagittal) show epitaxial growth of calcite on the rays; F: triactine with inception thread, visible as darkened central canal.

Sponge body fossils have been collected from the Batesford Limestone (Figure 1) for many years but not formally identified or published. This project was undertaken to evaluate the sponge fauna present and determine the diversity of that group. It was noted by the authors that sponge body fossils are only abundant in the lowermost Batesford Limestone horizon in contact with Dog Rocks. Loose sponge spicules are rare in this formation, with all specimens collected from the surface of the granite, and in detritus from the cleaning of sponge body fossils while using an ultrasonic cleaner. All calcareous spicules possess three rays (triactines) and are partially recrystallised with epitaxial growth evident (Figure 2).

This paper is an outcome of an unpublished BSc honours thesis undertaken by the senior author and is held in the library of RMIT University (McSweeney 2017).

MATERIAL AND GEOLOGICAL SETTING

The lowermost horizon of the Batesford Limestone at Fyansford was accessed with the permission of the management of Australian Portland Cement Quarry (38.1° S, 144.283° E), in 2007 and in 2017. The sponge body fossils from the lowest horizons have been assigned to the Longfordian Australian Stage (c. 27.5–16.5 Ma) of the earliest Miocene, with the Batesfordian being defined by the presence of *Lepidocyclina* in the upper reaches of the outcrop (Buckeridge 1985; Singleton 1941). Although the Dog Rocks exposure is 2.5 x 1.0 km along its main axis and trends WNW to ESE (Foster 1970), the Batesford Limestone accumulated on the east and southeastern flanks, suggesting a prevailing W–NW current during the Miocene (Foster 1970). The limestone is made up of skeletal debris which conformably grades into the argillaceous Gellibrand Marl (Bowler 1963; Foster 1970). A dip of 1–2° to the southeast was interpreted by Bowler (1963) as being due to differential compaction. Although the limestone is essentially biocalcarenite, clastics including poorly sorted biotite, quartz and feldspar are abundant in the lower horizons. During diagenesis, minor secondary carbonate formed around skeletal fragments such as the sponge spicules described herein.

According to Foster (1970), who examined echinoid fossil fauna in the Batesford Limestone, Regularia were fragmented into spines and plates, indicative of being transported from high points of the rocky coastline surrounding the granite island, while Irregularia, such as *Eupatagus*, *Pericosmus* and *Linthia*, were found complete, and were deemed to be in situ on the sandy carbonate bottom on the east side of the island. Predation by molluscs, coralline algae and regular echinoids from hard ground, in conjunction with wave action allowed them to be transported a relatively short distance to the lee side of the granite island, resulting in disarticulation of these communities (Foster 1970). Nonetheless, some fragmentation of fossils was observed in the lower biofacies, suggesting that the shallow-water environment was of higher energy than the later deeper marine setting (Bowler 1963: 99). The porifera collected were found to be intact but lacking their dermal layer; in some cases it had been replaced by a fine film of calcite with no evidence of spicules remaining, even when examined in thin section and under the SEM. In his study of Batesford grain-size/type characteristics, Bowler (1963) deduced that the currents were significantly stronger in the lower part of the limestone sequence based on the greater winnowing out of fines. This changed with the appearance of *Lepidocyclina* later in the sequence; it also corresponded to an increase in carbonate content. Hall and Pritchard (1892; 1895; 1897) noted the fauna present, particularly the molluscs, while Chapman (1910) noted the foraminiferal present. Buckeridge (1985) recognised three zones (in a vertical section of 32.6 m) from a shallow-water fauna at the basal granite contact where the porifera were recovered, through to taxa characteristic of lower subtidal to >100 m in the upper levels, corresponding to a marine transgression.

Repositories of material. Specimens with prefix G are held in the School of Science Collection, RMIT; those with the prefix NMV P are held in the Palaeontological Section, Museums Victoria, Melbourne.

SYSTEMATIC PALAEONTOLOGY

Class Calcarea
Subclass Calcaronea
Order Lithonida Vacelet, 1981
Family Minchinellidae Dendy and Row, 1913

Remarks. The Minchinellidae are typified by the basal actines of tetractines being linked by zygosis and larger actines compounded with additional calcareous cement (Vacelet et al. 2002). The ectosomal skeleton is made up of free spicules generally tangentially arranged in the cortical layer and may contain diapasons (Vacelet et al. 2002). The family contains five Recent genera and about five fossil genera (WoRMS 2018).

Genus *Plectroninia* Hinde, 1900

Hinde, 1900: 51
Pickett, 1983: 106
Vacelet et al., 2002: 1188

Diagnosis (after Hinde 1900). Basal skeleton made up of a level of large and small tetractines, with their basal rays fused, apical rays free and pointing outwards. Small and large basal rays attached by simple and reinforced zygosis respectively. Cortical skeleton composed of free spicules.

Type species. Plectroninia halli Hinde, 1900 by original designation.

Remarks. *Plectroninia* is represented by 13 extant cosmopolitan species; all are encrusting and are found in caves at shallow depths, and at depths of 1600 m in the bathyal zone (Könnecker & Freiwald 2005; Vacelet et al. 2002). Recently Vacelet et al. (2017) found numerous small extant *Plectroninia* from the bathyal zones of the Atlantic, Pacific and Indian oceans. *Plectroninia halli* is the only fossil species known to date from the Miocene of Australia (WoRMS 2018).

Plectroninia halli Hinde, 1900

Plectroninia halli Hinde, 1900: 51, pl. 3, figs 1–83, pl. 4, figs 1–11
Pickett, 1983: 109, figs 4, 7–9
Vacelet et al., 2002: 1188, fig. 3

Diagnosis (after Hinde 1900). Body, irregular to round with a slightly corrugated lateral surface, some with a short pedicel; apex convex around the rim of the osculum.

Material examined. Type material: Holotype NMV P14357; paratype NMV P3490; paratype NMV P55409; paratype NMV P14359; NMV P3487.

Other material. G.116a 15 body specimens, from Batesford Quarry (38.1° S, 144.283° E), collected by JB on 7 May 2007; G.116b 26 body specimens, from north northwest corner of Batesford Quarry, 38.1° S, 144.283° E, collected by JB and FMcS on 17 May 2017.

Description. Collected sponge fossils have a range 4–21 mm high and 5–23 mm wide (n = 39) with overall morphology mushroom, sub-conical or spherical shape similar to Hinde (1900: pl. 3, figs 2–3). Two specimens however fell outside this range, as they are considered to be composites (Figure 3F, G). The basal skeleton is made up of tripods with secondary calcite. The skeletons lack both a recognisable dermal layer, free distal rays and associated spicules, such as oxeas. Possible due to the effects of recrystallisation during diagenesis.

Remarks. Smaller specimens from Batesford Limestone are globular, while larger specimens have a varied morphology (Figure 3). No turbinate specimens were found; however, irregular forms were common suggesting an influx of sediment in those cases. According to Pickett (pers. comm. July 2018) these forms may have been partially buried, before the sponges grew to escape the sediment (Figure 3F). Spongocoel if present, small and shallow; sometimes with radial apochetes similar to the morphology Pickett (1983) described. Canal openings (0.2–0.5 mm diameter) were noted by Hinde (1900) at the summit. These canals were located about their own diameter apart from each other in the centre of the apical region, with wider intervals towards the periphery (Hinde 1900). Body fossil no greater than 16 mm high and 18 mm wide. SEM analysis (Philips

XL30 and Quanta 200 SEM) did not yield tuning-fork like spicules (diapasons) at the surface, and tetractines with lateral spines on the apical ray (0.2–0.35 mm length) as noted by Hinde (1900) were also absent. The skeletons did not show a pronounced increase in calcification on the facial rays of tetractines as Hinde (1900) described, appearing instead uniform.

According to Hinde (1900), the basal region of the skeleton is made up of two types of tetractines. The basal actines of the small tetractines are attached by zygosis while large actines are attached by zygosis and a cement layer (Hinde 1900). However, the specimens recovered did not clearly show a marked contrast. The apical rays were found to be normal to the surface, but no oxeas or diapasons were observed with SEM analysis.

Distribution. Gellibrand Marl Formation, Balcombe Bay and on the northern bank of the Moorabool River, near Griffin's farm, north of Geelong and the Batesford Limestone, Victoria.

Age. Lower Oligocene – Middle Miocene (Abele et al. 1988: 286).

Genus *Bactronella* Hinde, 1884
Bactronella Hinde, 1884: 205
Hinde, 1900: 59

Diagnosis (after Hinde 1900). Body with skeletal small mesh made up of irregular tetractines with the facial rays connected and apical rays free in an overall concentric fashion.

Type species. Bactronella pusilla Hinde, 1884

Remarks. The type species of *Bactronella* is *Bactronella pusilla* Hinde, 1884 from Thurnau, Bavaria (Upper Jurassic); however, as the preservation was poor, Hinde (1900: 59–60) subsequently improved the diagnosis by using *B. australis* and *B. parvula*. *Bactronella* are small, conical, sometimes branching encrusting sponges.

Range. Eocene–Miocene with a cosmopolitan distribution (Finks et al. 2011).

***Bactronella australis* Hinde, 1900**
Bactronella australis Hinde, 1900: 62, pl. 4, figs 12–19
Pickett, 1983: 107, figs 4, 5

Diagnosis (after Hinde 1900). Body small; conical to hemispherical; pedicle short; base concave to flat; external surface smooth, no apparent oscula or canal openings visible; interstitial spaces almost completely infilled with calcite; body made up of minute tetractines with apical rays connected by possibly smaller spicules.

Material examined. Type material; lectotype. Three sponge body fossils, NMV P13453; NMV P16119a-b; NMV P12796.

Other material. G.115 four body specimens, (size range 8–10 mm wide, 8.5–20 mm high) from Batesford Limestone Quarry (38.1° S, 144.283° E), collected by JB and FMcS on 17 May 2017.

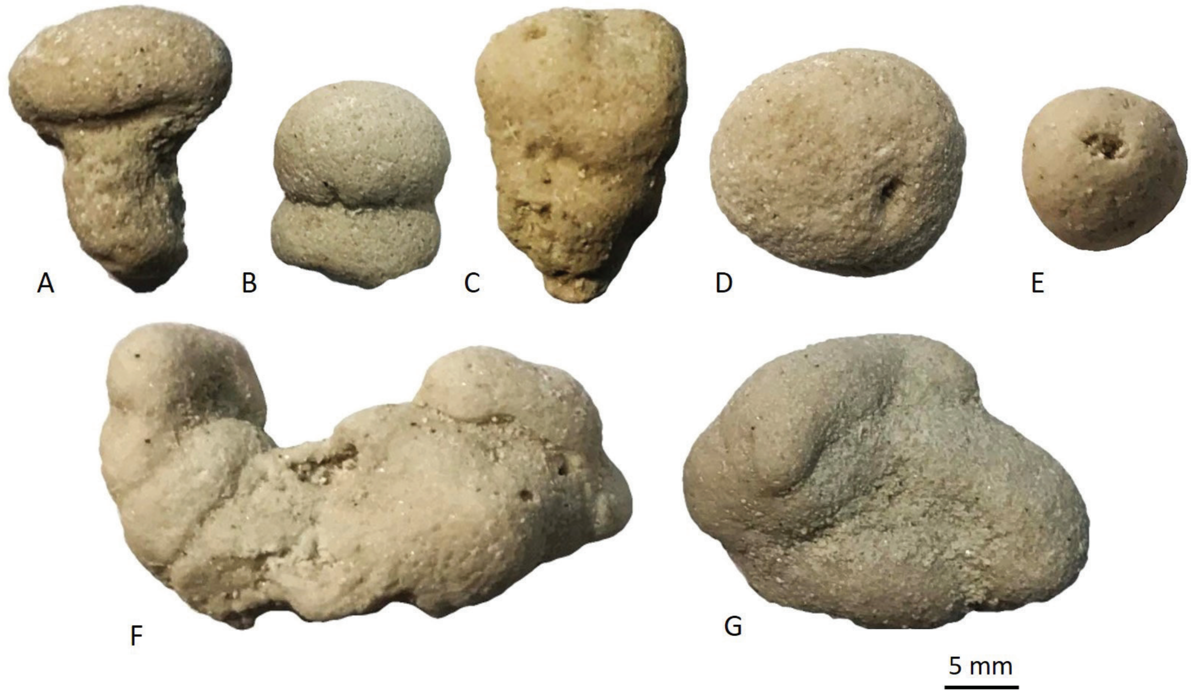

Figure 3: *Plectroninia halli* from Batesford Limestone, Batesford Quarry. A, B: mushroom shaped; C, E: show progressively larger shallow spongocoel; D: globular F, G: excluded from size analysis, as they are likely composites.

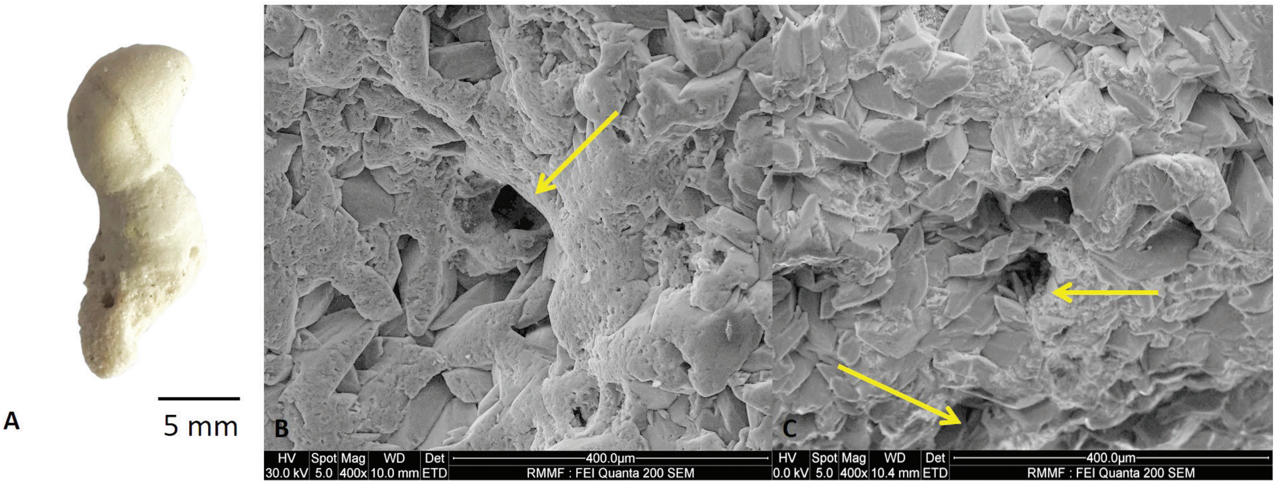

Figure 4: *Bactronella australis*. A: largest specimen 20 mm high from Batesford Limestone. SEM micrographs: B, ostia (lateral region external) — approx. 75 µm diameter C, apical external region showing possible multiple oscula; each osculum approximately 80 µm diameter.

Description. Sponges small. Complete covering of the dermal layer giving its porcellanous exterior (Figure 4a), dense tightly packed skeleton in construction, lack of interspaces and absence of obvious exhalant currents (Hinde 1900; Pickett 1983). Small pedicle or flattened base. Overall smooth to lenticular surface, rounded to conical profile, which are referred to *Bactronella australis*. In this lithology the spicules are practically indistinguishable from the calcite surrounding them, with apical rays not penetrating the dermal layer (Hinde 1900: 62).

Remarks and comparisons with other species. According to Hinde (1900: 63) *Bactronella australis* was found in association with *Tretocalia pezica.* Despite 83 specimens of *T. pezica* collected, only four specimens of *B. australis* were identified from the lower 1–2 m of the Batesford Limestone Formation. Hinde (1900: 60–61) also described *Bactronella parvula* Hinde, 1900; no specimens in their presumed (or previously recorded) size range (height 2–4 mm; width 1.2–1.5 mm) were found. As noted by Pickett (1983: 107) there are no specimens of *B. parvula* in the Museums Victoria collection.

Hinde (1900) recorded a size range (height 5–13.5 mm, width 5–10 mm) in the Sherwood Marl, Victoria. The four specimens recovered from the Batesford Limestone in this study conform closely to these, ranging from: height 8.5–20 mm, width 8–10 mm (Figure 4A).

Pickett (1983: 108) considered that the secondary calcite in *Bactronella australis* was due to the external surface of the sponge possessing a more porous surface, allowing for a greater impact in the recrystallisation of calcite during diagenesis; Hinde (1900: 62) noted that they were commonly hollowed out and infilled with calcite. The four specimens from the Batesford Limestone were not hollowed out, but the presence of secondary calcite as seen on loose spicules suggests the calcite may have formed during diagenesis. *B. australis*, according to Pickett (1983: 108), grew in lenticular increments; Hinde (1900) described only elongate to conical spicules. In this study, no spicules were visible under the SEM (Figure 4). Canal openings measured c. 75 µm and oscula c. 80 µm in diameter.

Distribution. Sherwood Marl Formation (Flinders, Victoria) and the Batesford Limestone, Batesford Quarry.

Age. Lower to Middle Miocene (Abele et al. 1988: 313–319).

Genus *Tretocalia* Hinde, 1900

Tretocalia pezica Hinde, 1900: 62

Diagnosis. Cup-shaped with delineated margin around cloaca; leuconoid canal system; skeletal mesh of triactine and tectractine spicules.

Type species. Tretocalia pezica Hinde, 1900 by monotypy.

Remarks. Extinct genus from the Miocene of Victoria, only one species known. Differs from *Plectroninia* and *Bactronella* species by its broad spongocoel.

Tretocalia pezica Hinde, 1900

Tretocalia pezica Hinde, 1900: 62, pl. 4, figs 20–29

Tretocalia pezica Pickett, 1983: 108, figs 4, 6

Diagnosis. Body subcylindrical to rounded, turbinate and undulose with a tenuous wavy margin; flattened base of attachment; triactine and tetractine spicules forming a hypercalcified skeletal network with small interstices; apical region with funnel-shaped opening (osculum relatively large and spongocoel deep); oval canal widths 0.11–0.35 mm; basal actines fused in calcite cement with free apical rays (emended from Hinde 1900; Pickett 1983).

Type material. NMV P14351 (Syntype); P16120-2 (Syntypes); NMV P128754; P66363; P316804; P3465.

Other material. P339964-68. G.117a five body specimens, from Batesford Quarry (38.1° S, 144.283° E), collected by JB on 7 May 2007; G.117b 78 body specimens, from north northwest corner of Batesford Quarry (38.1° S, 144.283° E), collected by JB and FMcS on 17 May 2017. Size range 4–24.3 mm high, 6–29 mm wide and osculum diameter 1–26.6 mm (*n* = 83).

Description. Juvenile specimens have a cup-shaped to rounded body with a well-defined spongocoel; in the largest specimens the spongocoel is stretched and irregularly shaped, with the sponge having an overall undulose morphology (Figure 6E). There is a clear continuity of change visible among the specimens (Figure 6). The surface exhibits a regular thickened pharetronid skeletal mesh with interspaces, and many rounded exhalent canal openings on the surface (Figures 12–13). Only patches of what may have once been the dermal layer are preserved, but no spicules are evident, and the surface is visibly porous to the naked eye (Figure 12). Because of gross morphology, being contemporaneous with Hinde's specimens and close proximity, these are referred to as *Tretocalia pezica.*

Remarks. Petrological thick sections of juvenile *Tretocalia pezica* specimens reveal a choanosome with relatively large interstitial space, which changes in older specimens to a more compact nature (Figure 5).

Hinde's original material is poorly preserved and does not include mature specimens. In light of this, we have produced a morphological series (NMV P339964–68) for *Tretocalia pezica* illustrating ontogentic change. This is shown in Figure 6.

Sponges below 10 mm in diameter are cup-shaped with a well-developed spongocoel (Figure 6A). Above 10 mm they tend to become globular to subglobular (Figure 6B); in the largest specimens the walls of the spongocoel become foliose.

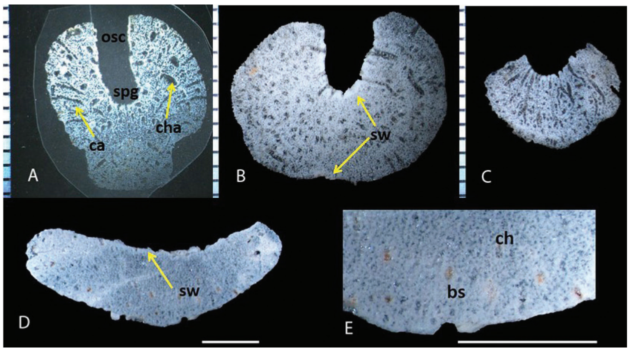

Figure 5: *Tretocalia pezica* thin sections: A, *Tretocalia pezica* Hinde, 1900 NMV P33932 from Flinders Middle Miocene, Mornington, Victoria. Batesford Limestone: B, longitudinal section taken through centre. C, longitudinal section closer to the edge of the sponge. B and C are from the same specimen. Batesford Limestone specimen: D, vertical section taken midway through, E, close up of basal skeleton region, showing marginally higher calcification than choanosome (abbreviations: bs, basal skeleton; ch, choanosome). Scale: graduated scale bar A-C; 5 mm scale bar D, E.

The location for the morphological series of *Tretocalia pezica* is the Batesford Limestone at Batesford Quarry, which is penecontemporaneous with the Upper Lower Miocene Sherwood Marl (Abele et al. 1988: 313). The Sherwood Marl is located at Flinders, Victoria (Figure 7) on the opposite side of Port Phillip Bay to Batesford Quarry.

The thick sections reveal chambers in juvenile specimens; however, in undulose specimens the canal system and chambers appear relatively smaller. Juveniles have a relatively thick sponge wall but this is much reduced in foliose specimens, suggesting a later stage in ontogeny. In juvenile *T. pezica* the sponge wall is more obvious and defined in comparison with the choanosomal skeleton. The relatively thick sponge wall of juvenile specimens is up to 0.75 mm thick at the base and along the spongocoel wall; in foliose specimens it is approximately half this width (Figure 5D, E). Petrological sections of *T. pezica* did not reveal diapasons (tuning-fork spicules). Hinde (1900) also did not note these spicules.

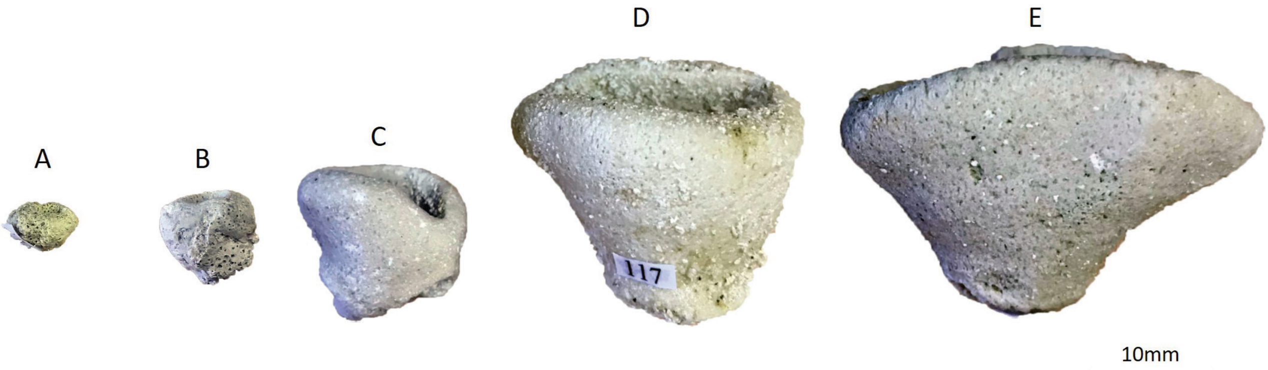

Figure 6: *Tretocalia pezica* morphological series (NMV P339964-68 A-E respectively) showing an increase in foliation (A–E) with age. Specimens below 10 mm (A, B) in diameter tend to be cup-shaped, rounded to sub-spherical; greater than 10 mm they become globular to turbinate (C–D) and eventually foliose (E); osculum large throughout. Scale bar 10 mm.

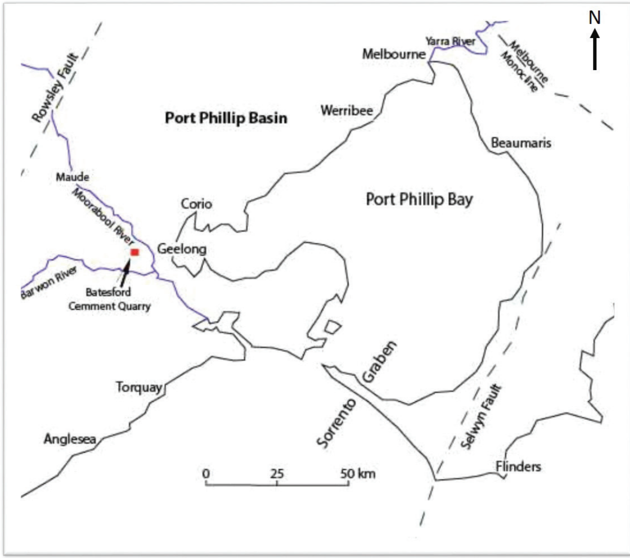

Figure 7: *Tretocalia pezica* type location: 1, 2 Batesford Quarry 4, Flinders, Victoria. Source: after Warne 1986, figure 1.

Hinde (1900) did not designate a holotype for *T. pezica*; instead he used a series of specimens to describe the taxa. The four specimens were NMV P14351, NMV P16120–2 and drawings he used in pl. 4, figs 23, 22, 25 and 26 respectively (Figure 8).

These specimens are hypercalcified ('pharetronid'), as would be expected for Minchinellidae; but Hinde's specimens lacked most of the macroscopic features that would normally be used to define a species. Additionally, the dimensions and morphological features Hinde (1900) recorded suggest he only had access to juvenile taxa, as specimens from the Batesford Quarry attained much greater size in their ontogeny and became foliated as they did so.

Pickett (1983: 108) noted the maximum spongocoel measured 10 mm at the osculum; however, the maximum spongocoel width from the Batesford Limestone material far exceeded this width at 26.5 mm. No small specimens were found to be undulose, supporting our interpretation that this development is ontogenetic (Figure 9).

Figure 8: *Tretocalia pezica* type series NMV P14351 and P16120-2 as drawn by Hinde (1900) in pl. 4 figures 23, 22, 25 and 26 above the actual specimens (now held by Museums Victoria).

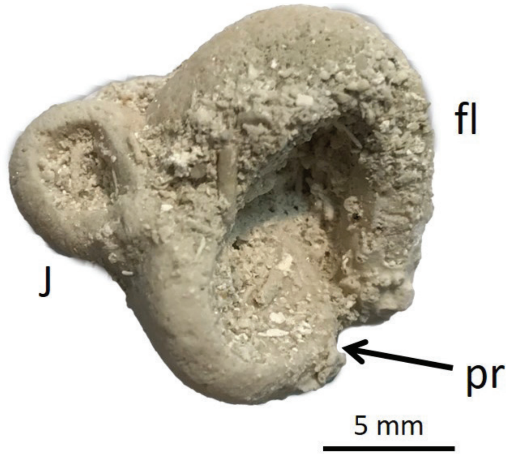

Figure 9: *Tretocalia pezica* Juvenile (J) attached to an older specimen (fl) starting to become more foliose. Evidence of predation, with a bite mark (pr). (Abbreviations: J, juvenile; fl, foliose; pr, predation bite mark.)

Comparisons with other species. The size of the spongocoel relative to overall size suggests that spongocoel develop early in ontogeny. In comparison *Bactronella australis* produce oscula that are minute and have no spongocoel; *Plectroninia halli* generally does not have a spongocoel present, and when it does it is shallow and small. However, in juvenile *T. pezica* the spongocoel is well developed. As noted by Pickett (1983), the base of the spongocoel of *T. pezica* is generally flat with relatively large tripodal spicules with free distal rays directed away from the sponge body. However, we did not find this feature in the larger foliose specimens, which tended to have a conical to subconical shape with a horizontal base (Figure 10).

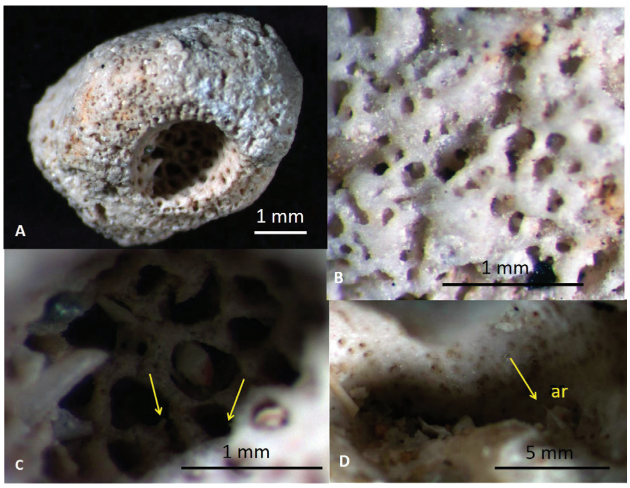

Figure 10: *Tretocalia pezica* (Batesford Limestone). A–C (NMV P339964): A, C, Juvenile with large interstitial spaces between the tetractines. B, Pinacoderm. D (G.117b), Foliose specimen with spongocoel that was etched with dilute HCl, revealing tight interstitial spaces (abbreviation: ar, axial ray and yellow arrow).

Etching of the spongocoel base with HCl acid showed the skeletal mesh to be tightly packed with some remnants of apical rays present (Figure 10). Juvenile *T. pezica* have large interspaces at the base of the spongocoel, but these decrease in size with age as the skeleton becomes more compact.

The dermal skeletal layer is generally absent, but when present is made up of tetractines and oxeas (Figure 11B). The skeleton mesh consists of tetractines (Figure 12); the connections between rays cemented by a film of calcium carbonate; the diameter of rays near the surface is 0.06–0.20 mm, although Hinde (1900) recorded these as 0.06–0.009 mm, supporting our conclusion that he only had juveniles. The canal openings are consistent with the specimens measured by Hinde (1900) and more pronounced than *P. halli* and *B. australis* (Figure 13).

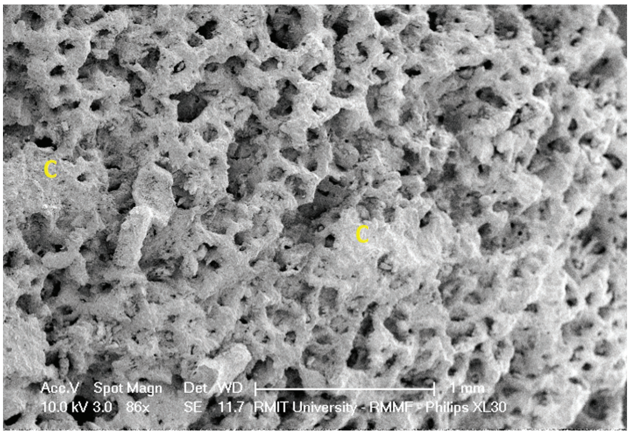

Figure 11: SEM micrograph of *Tretocalia pezica* skeleton mesh of tetractines with fragments of cortical layer (C) present.

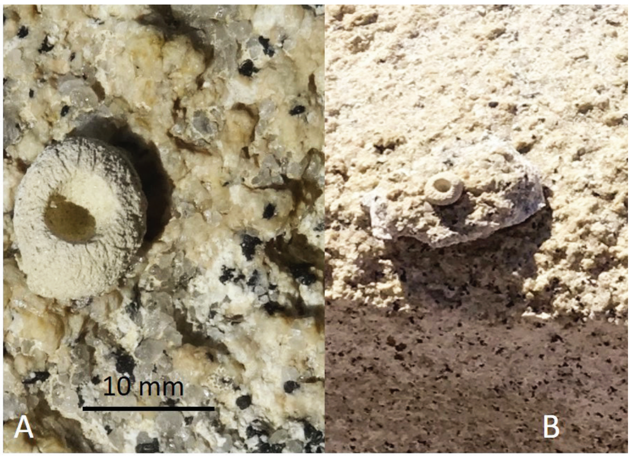

Figure 13: *Tretocalia pezica* before and after extraction (Batesford Quarry, Victoria). A: in situ on Dog Rock Granite. B: After extraction.

A specimen attached to its substrate was collected (Figure 13). It suggested basiphytose attachment with a basidictyonal plate at the base of the sponge in order to hold onto the hard substrate (Buckeridge et al. 2013).

Distribution. Sherwood Marl at Flinders and Batesford Limestone, Batesford Quarry, Victoria.

Age. Lower to Middle Miocene (Abele et al. 1988: 313—319).

Genus *Monoplectroninia* Pouliquen & Vacelet, 1970

Monoplectroninia Pouliquen & Vacelet, 1970: 439

Diagnosis. (after Pouliquen & Vacelet 1970). Skeletal mesh composed of a basal layer made up of small tetractines only; linked by their facial rays, with apical ray free and pointing outwards. Cortical layer made up of unconfined diapasons, diactines and triactines.

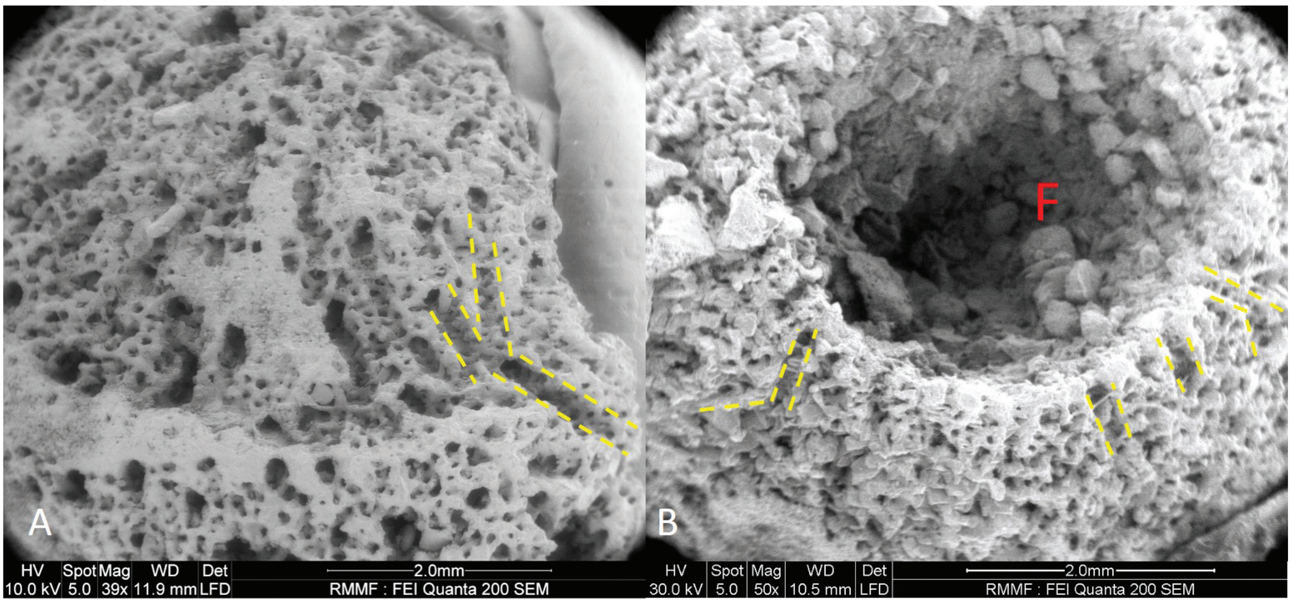

Figure 12: *Tretocalia pezica* lateral view and spongocoel view using FEI Quanta 200 SEM. The specimens in the micrographs were platinum coated. A: outer surface of sponge with canal openings and aquiferous canals. B: apical view of spongocoel (abbreviation: F, foraminifera).

Type species. Monoplectroninia hispida Pouliquen & Vacelet, 1970 (by monotypy); Recent.

Remarks. Genus with only one living species. *M. hispida* Pouliquen & Vacelet, 1970 is found off Marseille in the Mediterranean, in submarine caves down to 20 m (Vacelet et al. 2002). Small, encrusting, basal skeleton made up of small tetractines only, previously unknown as fossil (Vacelet et al. 2002)

***Monoplectroninia malonei* sp. nov.**

Figure 14: *Monoplectroninia malonei* sp. nov. (NMV P339963).

Diagnosis. Small (L = 11 mm, W = 8 mm) minchinellid sponge with sub-turbinate body shape with hypercalcified connections between tetractines all of one size; no basal calcite mass.

Type locality. Basal Batesford Limestone, Geelong 38.1° S, 144.283° E.

Type material. Holotype P339963: a single specimen, L = 11 mm, W = 8 mm (Figure 15) recovered as a float from the Batesford Limestone Formation, Australian Portland Cement Quarry, Batesford, Geelong. Collected by JS Buckeridge, F McSweeney and Mark Malone on 22 May 2017.

Description. Small; subturbinate, tetractines all of one size with hypercalcified skeleton. Canal openings are apparent along flanks (Figures 15–16). Lower portion delineated by a horizontal bevel is likely a restriction during growth rather than a pedicle (Pickett pers. comm. 6 July 2018).

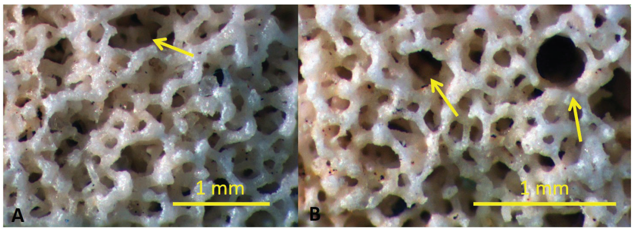

Figure 15: *Monoplectroninia malonei* sp. nov. (holotype NMV P339963) microscopy images. A: lateral view — indentations associated with it aquiferous system links a number of the canal openings, which ranged 0.12-0.32 mm B: apical view canal openings, range 0.17-0.35 mm diameter.

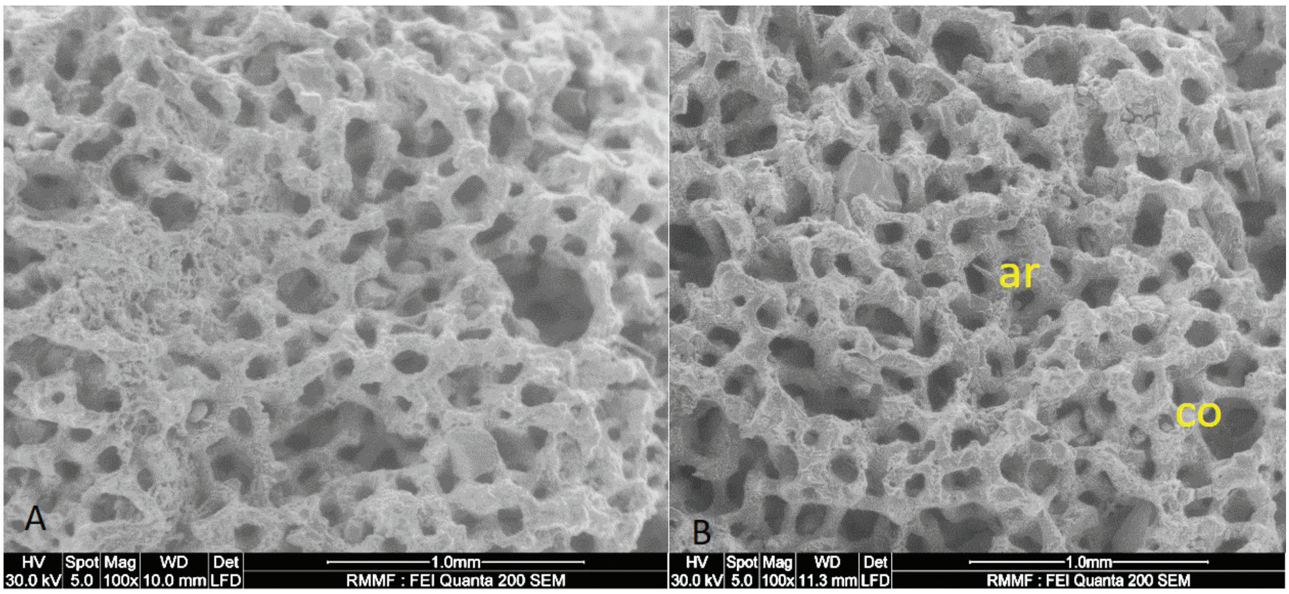

Figure 16: SEM micrograph of *Monoplectroninia malonei* sp. nov. (holotype NMV P339963) basal and lateral view. A: basal view — partial cortex, no calcite mass present B: lateral view — canal opening 0.23 mm diameter (abbreviations: ar, apical ray; co, canal opening).

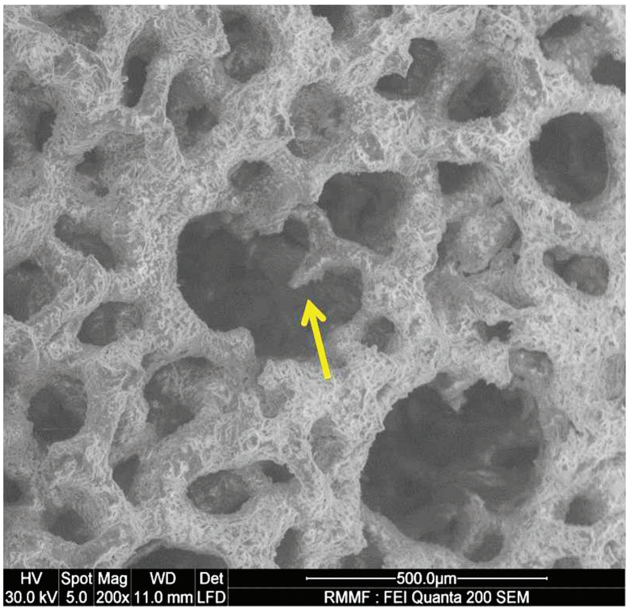

Figure 17: *Monoplectroninia malonei* sp. nov. (holotype NMV P339963) spinose apical rays (arrow) are rarely preserved on the specimen, most are broken off.

Remarks and comparison with other species. Apex determined by presence of oscula. The regular skeletal mesh is firm and composed of highly calcified tetractines (small tetractines are not evident), suggesting placement in the order Lithonida Vacelet, 1981. Spinose apicas rays are preserved on some tetractines (Figure 17), which also occur in *Tretocalia* sp. and *Plectroninia* spp. However, no rigid mass of calcite is evident, nor are diapasons evident. The absence of a rigid calcite mass may suggest it does not belong to *Petrobiona* and *Minchinella* (Vacelet et al. 2002: 1185). As actines are cemented together it cannot be placed in *Tulearina*; the presence of only one type of tetractine would mean that the specimen is best placed within *Monoplectroninia* (Vacelet et al. 2002). The new species is known only from its type location in the Batesford Limestone of Batesford Quarry.

Etymology. Named for Mark Malone, the Batesford Quarry manager, who generously gave of his time and knowledge in the quarry.

Distribution. Batesford Limestone Formation, Batesford Quarry, Victoria.

Age. Lower Miocene (Longfordian) (Abele et al. 1988: 313).

CONCLUSION

This study demonstrates that a diverse fauna of Calcarea sponges inhabited the warm, shallow waters off Dog Rocks during the Early Miocene. As the environment deepened, the sponge fauna was replaced by open-water taxa, typical of what could be anticipated in a mid to outer shelf setting.

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