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The Royal Society of Victoria, 127, 17–27, 2015
10.1071/RS15015

FIRST RECORD OF THE TABULATE CORAL "*LIGULODICTYUM*" IN THE EARLY EMSIAN OF VICTORIA (AUSTRALIA), WITH ADDITIONAL DATA ON AUSTRALIAN *LIGULODICTYUM* SENSU LATO

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ABSTRACT: Well-preserved specimens of "*Ligulodictyum"* belonging to the *mauretanicum* lineage are described from the lower part of the Taravale Formation, of early Emsian age, Buchan area, eastern Victoria (Australia). A short review of the stratigraphic distribution of *Ligulodictyum* sensu lato (*Ligulodictyum* s.l. *megastoma* and undescribed new species) in central and eastern Victoria is presented. The new data show the presence of the *mauretanicum* lineage in Victoria, emphasising the relationships between the Tasman Subprovince and the north-western part of the Gondwana (Ibarmaghian Domain).

Keywords: Tabulata, *Ligulodictyum*, Emsian, Victoria, Gondwana

The *Pleurodictyum*-like corals described from upper Silurian to Lower Devonian (Pragian/Emsian) rocks of south-eastern Australia and New Zealand (McCoy 1866; Foerste 1888; Shirley 1938; Talent 1963) are nearly always preserved as natural moulds — often part and counterpart — in sandstones and finer clastics. This paper presents the results of a study of specimens from the Buchan Caves Entrance section (or BCE section), of the Buchan area, eastern Victoria. Discovered by Alan Pedder, these are well-preserved calcitic specimens that permit the study of morphology, structure and microstructure of corals here assigned to *Ligulodictyum* n. sp.

Mawson (1987) provided all necessary data about the geology of the Early Devonian carbonate stratigraphy of the Buchan area. Three of Mawson's figures are of special interest: the geological map of the Buchan–Murrindal–The Basin carbonate sequence (fig. 1), and the location (fig. 4) and sample numbers of the sampled horizons of the Buchan Caves Entrance section (fig. 7).

According to Pedder (pers. comm. 22 September 2011) his specimens came from 6 m of section around level 19 in Mawson's fig. 7, i.e. about 87–93 m above the base of the Taravale Formation, probably from the upper part of the Australian *dehiscens* conodont Zone (early Emsian), approximately 20 m below the base of the overlying *perbonus* (*gronbergi*) Zone.

In addition to the paleontological study of Pedder's specimens, the opportunity is taken here to revise previously briefly described or undescribed material of *Ligulodictyum* mainly held by Museum Victoria.

SYSTEMATIC DESCRIPTION

Family Cleistoporidae Easton 1944
Genus ***Ligulodictyum*** Plusquellec 1973

Type species

Ligulodictyum paraligulatum Plusquellec 1973 formerly described as *Pleurodictyum*? *constantinopolitanum* Roemer 1863 var. *minor* Plusquellec 1965; late Lochkovian (upper part of the Landévennec Formation) or early Pragian (lower part of the l'Armorique Formation) of the Rade de Brest, Armorican Massif (France).

Remarks

Ligulodictyum was erected for *Pleurodictyum*-like corals bearing a well-marked arcuate deep narrow furrow devoid of reticulate tissue in the initial area of the calicinal base of the corallites (at least in the central part of the corallum). In natural moulds this structure gives rise to a tongue-like protuberance called 'languette' in French (see Figure 5). In addition, interstitial corallites and tabulae are lacking whereas mural pores are present; moreover, the association with the worm-like *Hicetes* is extremely rare in *Ligulodictyum* (known from only one Armorican specimen, LPB 114) while very common in *Pleurodictyum*.

The skeleton of *L. paraligulatum* is known from numerous well preserved specimens and their microstructure has been described and illustrated in four papers (Plusquellec 1965: fig. 13; Plusquellec 1973: fig. 3; Lafuste & Plusquellec 1986: figs 1–4; Plusquellec 2007: fig. 9). The skeleton is fibrous, and the basal plate is built by contiguous trabeculae; no lamellar stereoplasm has

been recorded.

In the 1990s, the discovery of specimens belonging at first sight to *Ligulodictyum*, but having a skeleton consisting of trabeculae of various sizes embedded in a mainly lamellar stereoplasm (e.g. *Pleurodictyum mauretanicum* Le Maître 1959), led to the recognition within *Ligulodictyum*-like corals of three species groups of unequal significance (Lafuste et al. 1993; Plusquellec 2007):

***Ligulodictyum* sensu stricto**: species with skeleton entirely fibrous (=contiguous trabeculae);

"*Ligulodictyum*": species with skeleton made by trabeculae and lamellar stereoplasm (in fact often lamellar to microlamellar, see Lafuste et al. 1993); ***Ligulodictyum* sensu lato**: species only preserved as natural moulds and, accordingly, for which the microstructure is unknown.

I consider that *Ligulodictyum* s.s. and "*Ligulodictyum*" could belong to two lineages of the same genus. The first is the *paraligulatum* lineage and the second the *mauretanicum* lineage.

"*Ligulodictyum*" n. sp.
(Figures 1–6)
? *Cleistopora*.–Talent 1976: 81.

Material

Two specimens collected by A. Pedder in 1964 from the BCE section, *circa* level 19 of Mawson (1987: text fig. 7), Buchan area, eastern Victoria (Australia), lower part of the Taravale Formation, probably upper part of the *dehiscens* conodont Zone, early Emsian. The specimens are housed in the Invertebrate Palaeontology collections of Museum Victoria (formerly National Museum of Victoria), catalogue numbers NMV P73467 and P73468 (donated by A. Pedder). One specimen has been sectioned and now consists of two offcuts and two acetate peels. Plaster casts of Pedder's specimens are held in the Laboratoire de Paléontologie, Université de Bretagne Occidentale, UFR Sciences & Techniques, Brest (France), catalogue numbers LPB 15 417–15 418.

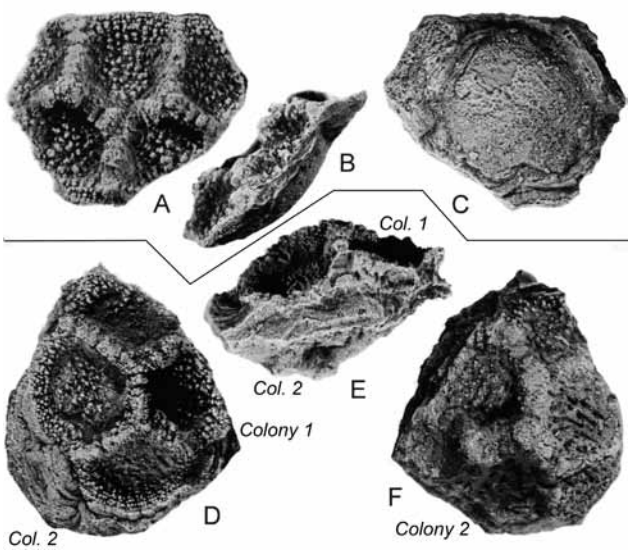


Figure 1: *"Ligulodictyum"* n. sp. (A–C) NMV P73467, (A) distal side, (B) lateral view and (C) proximal side. (D–F) NMV P73468, (D) distal side of colony 1 on which is fixed the colony 2, (E) lateral view (colony 1 on top of the figure, colony 2 on bottom), (F) distal side (not well preserved) of colony 2. Both from the Taravale Formation, BCE section, Buchan area, Victoria. All figures x 2.5.

Description

The calcitic discoid colonies show, where the margin is not worn, a wavy outline in dorsal view (Figure 1D).

Proximal side. The base of the corallum is fixed to organic skeletal material: brachiopod (?) (Figure 1C), trilobite (Figures 3B, 4) and even a colony of its own species (Figures 1D–E). The free part of the proximal side shows concentric growth lines and wrinkles of the so-called 'epitheca'.

Distal side. The low convex distal side consists of partly polygonal corallites which have a more (Figure 1D) or less (Figure 1A) arcuate peripheral margin. The calicinal base is slightly convex and bears rather strong granules. The initial furrow displayed by vertical section of the corallum (Figure 3B) is not directly obvious on the calicinal bases and, consequently, the material could be confused with *Paracleistopora* Plusquellec 1973.

The peripheral margin of the corallites exhibits up to 14 septal ridges bearing numerous granules sometimes in rows of 3–4 units (Figure 1D). The walls are thick and abrasion of their distal margins has revealed sections of mural pores.

Increase of corallum. Owing to the obvious bilateral symmetry of the corallum, the protocorallite (1_1) and the first pair of metacorallites (1_2 1_2) are easily identified in specimen NMV P73467 (Figures 1A, 2A). There is no doubt that the prototriad (1_2 1_1 1_2) belongs to the contiguous type (Plusquellec 2007: 28, fig. 13A). The process of

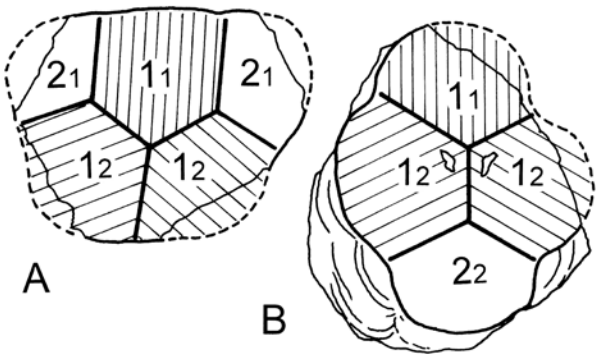


Figure 2: *"Ligulodictyum"* n. sp. Schematic drawings of corallum development, explanation in text. (A) NMV P73467. (B) NMV P73468.

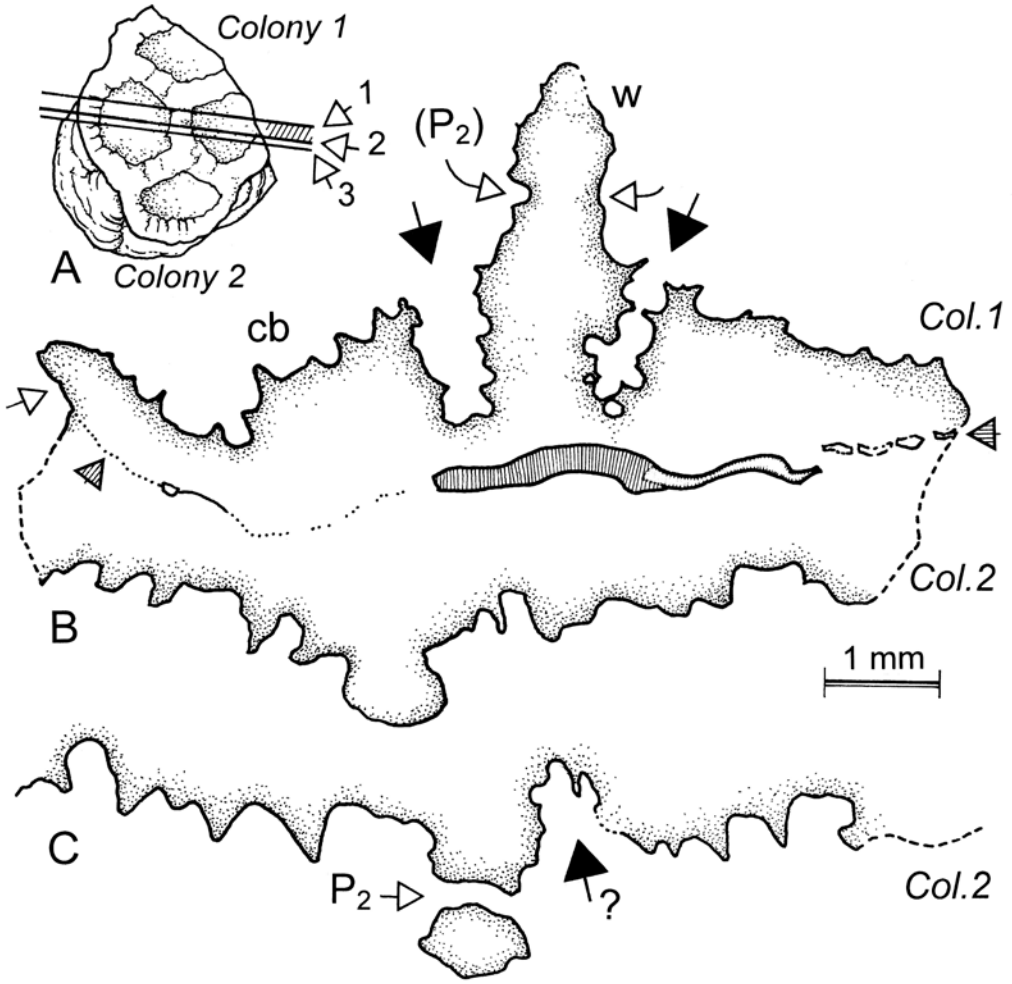


Figure 3: *"Ligulodictyum"* n. sp. Specimen NMV P73468. (A) Diagrammatic drawing of two colonies growing in opposite direction. The first one (colony 1or col. 1), used as bioclast for the development of the second one (colony 2 or col. 2), shows its distal or calicinal side while in the lower, mainly left part of the figure the proximal side of colony 2, showing concentric growth lines, is exposed. Hatched area between solid lines was destroyed by vertical sawing and grinding; the successive surfaces are numbered surfaces 1, 2 and 3. Out of scale, see also Fig. 1D and 2B. (B) Surface 1 (drawing from polished section), longitudinal/axial section, colony 1 on top of figure (in fact not in the living position of the set) showing on both sides of the wall (w) a deep initial furrow (black triangle). Note the spiny calicinal base (cb) and the location of a wall pore situated beyond the plane of section (P2). The colony 1 is attached on a trilobite fragment (tiny striated area) a part of which has come off. Hatched arrows indicate the contact surface between the two colonies, open arrow on the left a small part of the proximal side of colony 1 remaining free. Initial furrow of colony 2 not in the plane of section. (C) Incomplete drawing of surface 3 (polished section of colony 2) showing a section in a wall pore and probably in the initial trench; left–right reverse view.

gemmation continues with the addition of the second pair of metacorallites (2_1 2_1). Hence, the corallum development is the same as in numerous pleurodictyform corals such as *Ligulodictyum*, *Pleurodictyum* and *Paracleistopora* and it seems that, despite the incomplete margin of the corallum, the number of corallites does not exceed five in this colony.

The second specimen (NMV P73468, colony 1), formed by four corallites, shows a rather rare setting of the corallites in pleurodictyforms and, up to now, mainly known in *Paracleistopora* (Plusquellec 1967: pl. 1, figs 15, 17). The location of the initial furrow, visible on section 1 (Figures 3A, B) but not on section 2 (Figure 4), permits the identification of the initial corner of the two adjacent corallites and subsequently the identification of the protocorallite (see the interpretation of the corallum on Figure 2B). Hence, this four-celled colony consists of the prototriade (contiguous type) and the metacorallite 2_2; the pair of metacorallites 2_1 is lacking.

Internal structure. The skeleton is massive and is characterised by a thick basal plate bearing, in the initial corner of (some) corallites, a deep furrow (seen in section on Figure 3B) which constitutes one of the main diagnostic features of the genus. Some sections of mural pores (probably wall pores *sensu* Powell & Scrutton 1978) can be seen on the polished section (surface 3) of specimen NMV P73468 (Figure 3C). Tabulae are lacking.

Microstructure. Owing to the small number of available colonies and, in order to save the most important part of the specimen which has been sawn, only acetate peels and polished sections were made and thus the quality of the observations is less accurate than with thin sections.

The walls and the basal plate consist of trabeculae embedded in a well-developed stereoplasm. The trabeculae reach about 1–1.2 mm in length with an average diameter of about 0.15 mm. As shown on Figure 4, they give rise to spines or granules, especially on the calicinal base. The true nature of the stereoplasm is not known with certainty; it is probably mainly lamellar but the possible change of lamellar to microlamellar microstructure, from proximal to distal part of the skeleton, formerly shown in "*Ligulodictyum*" *mauretanicum* (Lafuste et al. 1993), cannot be seen on acetate peels or in thin sections of usual thickness.

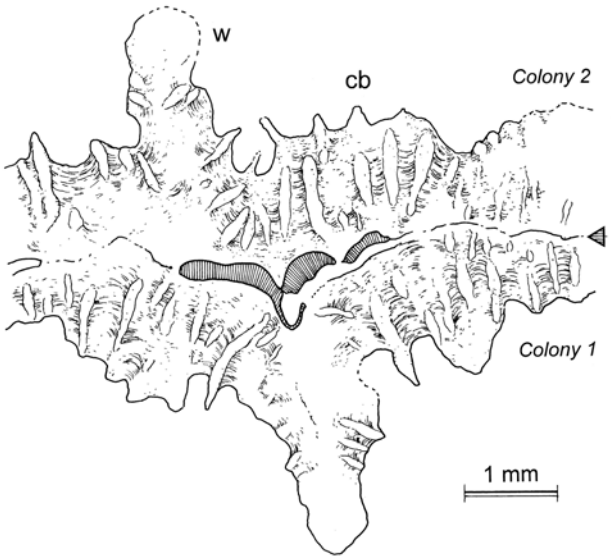


Figure 4: *"Ligulodictyum"* n. sp. Specimen NMV P73468. Vertical/axial section in the same colony as figure 3, surface 2 of the section. Camera lucida drawing of acetate peel showing the microstructure of the corallum. Note the numerous trabeculae embedded in a lamellar (see text) stereoplasm. Same caption as figure 3, but here colony 1 on bottom and colony 2 on top of the figure (i.e. set in life position).

Measurements

The limited biometric data obtained are mainly approximate because the outline of the corallum is incomplete.

1. Diameter of corallum along the plane of symmetry: 8.8 mm (NMV P73467); 11.2 mm, estimated 11.8 mm (NMV P73468); diameter of corallum normal to this plane: 10.6 mm, estimated 11.5 mm (NMV P73467); 9.0 mm, estimated 9.7 mm (NMV P73468).
2. Thickness (height) of corallum: 4.0 mm (NMV P73467); 4.8 mm, measured on longitudinal/axial section (NMV P73468).
3. Diameter of corallites from initial corner to margin: protocorallite 4.5 mm (NMV P73467); metacorallite 1_2 left estimated 4.0 (NMV P73467); 1_2 left 4.0 (NMV P73468), 2_2 4.2 mm (NMV P73468).
4. Thickness of wall about 0.7–0.8 mm.

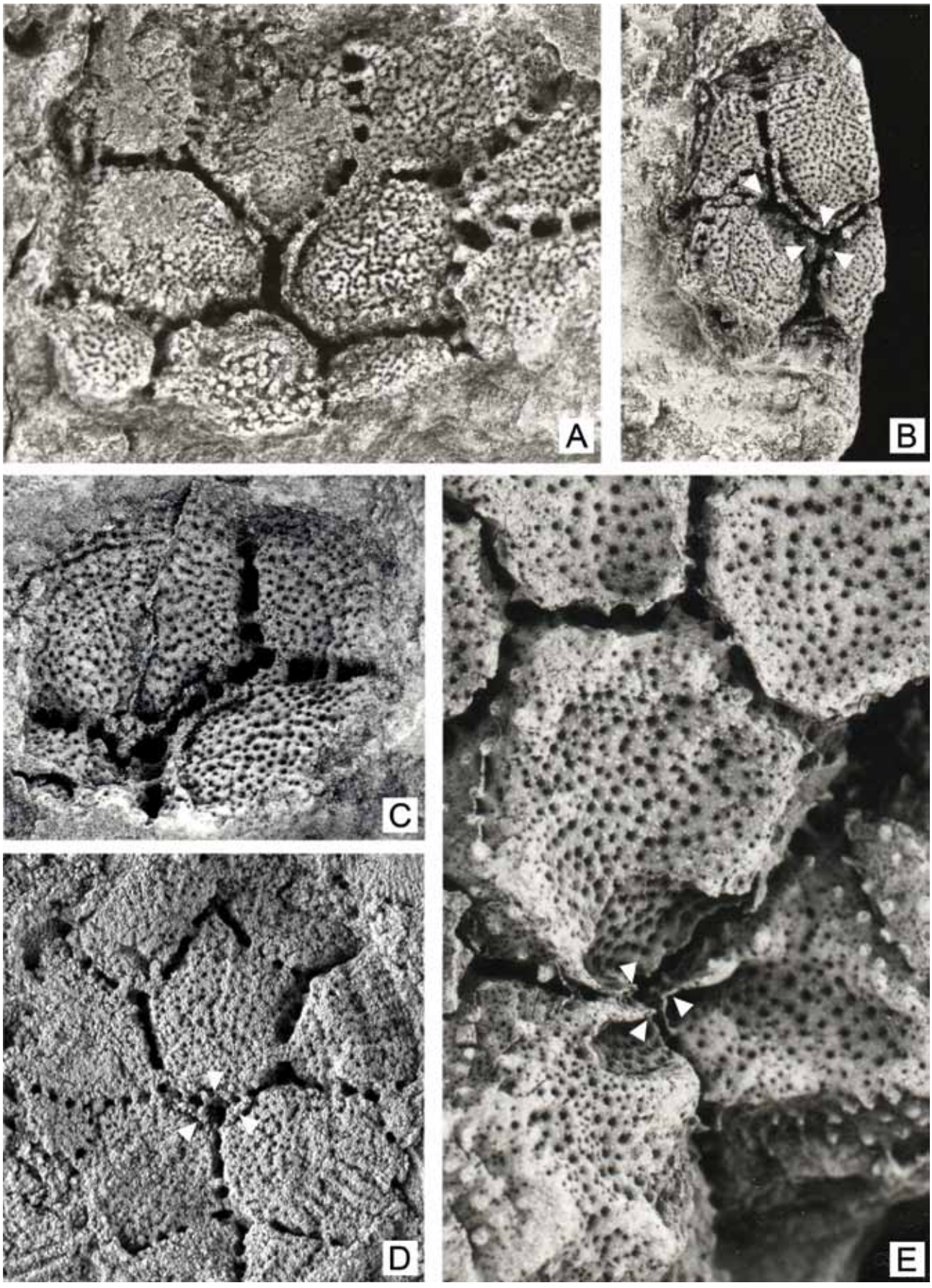
Discussion

The presence, in a pleurodictyform coral devoid of interstitial corallites, of 1) a well-developed furrow in the initial corner of the corallite and 2) a skeleton made by trabeculae and lamellar stereoplasm, lends support to the assignment of the described species to a *Ligulodictyum* of the *mauretanicum* lineage, i.e. "*Ligulodictyum*".

Assignment to *Paracleistopora* Plusquellec 1973, which seems obvious at first sight owing to the setting of the corallites, cannot be supported because the initial furrow is devoid of reticulate tissue. In addition, the presence of indisputable mural pores is inconsistent with assignment to *Paracleistopora*.

Comparison with described species of *Ligulodictyum* can only be with forms belonging to the *mauretanicum* lineage. As far as we know two species are concerned: "*Ligulodictyum*" *mauretanicum* (Le Maître 1959) and cf. *mauretanicum* (see Lafuste et al. 1993), Lochkovian to late Emsian, respectively from Mauritania and Morocco and an undescribed Lochkovian species assigned to "*Ligulodictyum*" n. sp. Lafuste et al. 1993 from the Cantabrian Mountains (Spain) (Lafuste et al. 1993: fig. 3D).

Figure 5 (p. 21): *Ligulodictyum* sensu lato. (A, B) *Ligulodictyum* s.l. n. sp. K Plusquellec 2007 (A) NMV P60613, distal side (= Talent 1963, pl. 17, fig. A1); (B) NMV P60616, distal side (=Talent 1963, pl. 17, fig. A4). Both from Tabberabbera Formation, Kilgower Member, 2 km WSW of Tabberabbera, Victoria. (C) *Ligulodictyum* s.l. ex gr. n. sp. K Plusquellec 2007, NMV P102934, donated G. Sweet, identified by Dun as *P. megastomum*, distal side. Norton Gully Sandstone, Loyola lime Kilns, Loyola, Victoria. (D) *Ligulodictyum* s.l. n. sp. I Plusquellec, 2007, LPB 15 419, distal side, note the small "languette". Mount Ida Formation, Unit 3, Parish of Redcastle (= locality 25 of Talent 1965), Heathcote district, Victoria. (E) *Ligulodictyum* s. l. *megastomum* (McCoy 1866) NMV P102948, distal side, central area of the colony, note the well-developed 'languette'. Label reads 'Humevale Formation, Killara, Victoria'; the Killara localities are now known to lie within the Woori Yallock Formation (information provided by one of the referees) All figures x 5 and specimens preserved as natural moulds. Open triangles show the 'languette'.


A
B
C
D
E

The specimens from BCE section are smaller than those from North Africa and differ from those from Spain in having a distinctly thinner basal plate. Moreover, the Buchan colonies are unique, firstly by the development (in some corallites) of septal ridges with 3 or 4 rows of granules, and secondly by the setting of the corallites, being closer (as far as can be determined from the limited data obtained from two small colonies) to that of *Paracleistopora* than to the one usual in *Ligulodictyum.*

Comparison with other Australasian specimens is limited because their original skeletal material is missing. The colonies from the BCE section differ from the 'small' species of *Ligulodictyum* sensu lato from Victoria, Tasmania and New Zealand and described as *Pleurodictyum megastomum* McCoy (= *Ligulodictyum* s.l. n. sp. I Plusquellec 2007 and *Ligulodictyum* s.l. n. sp. K Plusquellec 2007), in their less developed tongue-like structure (Figures 5A–D), their smaller number of granules on the calicinal base and their thicker wall. The huge *Ligulodictyum* s.l. *megastomum* (McCoy 1866) (Figure 5E) has much larger corallites and corallum.

Comparison with known species of "*Ligulodictyum*" and *Ligulodictyum* sensu lato from Victoria and others localities of the Gondwana margin suggests it is a new species, but it is left in open nomenclature as "*Ligulodictyum*" n. sp. owing to the small number of available specimens.

COMMENTS ON THE DISTRIBUTION OF *LIGULODICTYUM* IN AUSTRALASIA AND ELSEWHERE

With the exception of Plusquellec (2007), *Ligulodictyum* from Australasian faunas has traditionally been described as *Pleurodictyum megastoma* but Plusquellec (2007) assigned this species to *Ligulodictyum* s.l. and showed that only a very small part of the previously described material belongs to the McCoy species.

Stratigraphic distribution

The oldest form of *Ligulodictyum* from Australasia appears to be *Ligulodictyum* s.l. n. sp. I Plusquellec 2007 from the Mount Ida Formation, Unit 1 (= Cornella Member see Talent et al. 2000; Wright & Garratt 2013; Edwards et al. 1998). This member, according to Mawson and Talent (2000: 247) and Talent et al. (2001: fig. 6) has its base respectively at the Pridoli–Lochkovian boundary or within the Lochkovian. However, the correlation chart provided by VandenBerg et al. (2000) shows a mid-Pridoli age for the base of the Mount Ida Formation, whereas Sandford (2005b: fig. 2) indicated that the Cornella Member is late Ludlow to late Pridoli. Wright and Garratt (2013: 192) reviewed this problem and accepted the Cornella Member as being latest Silurian and the Silurian–Devonian boundary as low in the Dealba Member.

Representatives of *Ligulodictyum* are less common in the Humevale Formation than in the Mount Ida Formation. A specimen of *L*. s.l. n. sp. I described by Gill (1942) was collected at the 'Flowerfield' Quarry, Lilydale district, in the upper part of the Humevale Formation, *Boucotia australis* Zone, 'late' Lochkovian (Garratt pers. comm.).

Another specimen of *Ligulodictyum* s.l. n. sp. I was, from the label accompanying the specimen, collected at 'Wilson's', Lilydale area (Central Victoria). Garratt (pers. comm.) considers this locality to be very high in the Humevale Formation and, according to Garratt (1980: 603) and Holloway (pers. comm.), there seems no doubt that it is Early Devonian, probably Pragian, *Boucotia loyolensis* Zone (Garratt & Wright 1988). This is consistent with the specific assignment of the specimen to the Pridoli–Lochkovian species n. sp. I, rather than to the early Emsian species n. sp. K.

Some species such as *Ligulodictyum* s.l. *megastoma* (McCoy 1866) from the Woori Yallock Formation, *Ligulodictyum* s.l. n. sp. K of Plusquellec (2007) from the Kilgower Member of the Tabberabbera Formation, Wentworth Group, and *Ligulodictyum* s.l. e.g. n. sp. K of Plusquellec (2007) from the Norton Gully Sandstone, are late Pragian or more likely early Emsian (Figure 6). In fact, the stratigraphic position of these occurrences in these lithostratigraphic units, as well as the exact age of the base of some of these formations or members near the Pragian–Emsian boundary or within the late Pragian, is not well known and said to be 'a can of worms!' (VandenBerg pers. comm.).

A brief review of papers dealing with these three levels is supplied below.

Woori Yallock Formation. This formation conformably overlies the Wilson Creek Shale (Morand 2010) and is of the same age as the Yeringberg Formation, which is a strike ridge lacking outcrop (VandenBerg, pers. comm.) and whose name has been allowed to lapse (Welch et al. 2011). Its top is not exposed.

According to Sandford (2005a), 'the mid–to late Pragian age for the Wilson Creek Shale provides a maximum late Pragian age for the base of the Yeringberg Formation' [i.e. Woori Yallock Formation] and 'placement of the Pragian–Emsian boundary in the vicinity of the lower horizons of the Yeringberg Formation is suggested'. We follow here the ages advocated by Sandford (2005a).

Norton Gully Sandstone. This is the basal formation of the Walhalla Group and its base correlates with the base of the Woori Yallock Formation — both overlie the Wilson Creek Shale (VandenBerg et al. 2000; Sandford 2005b).

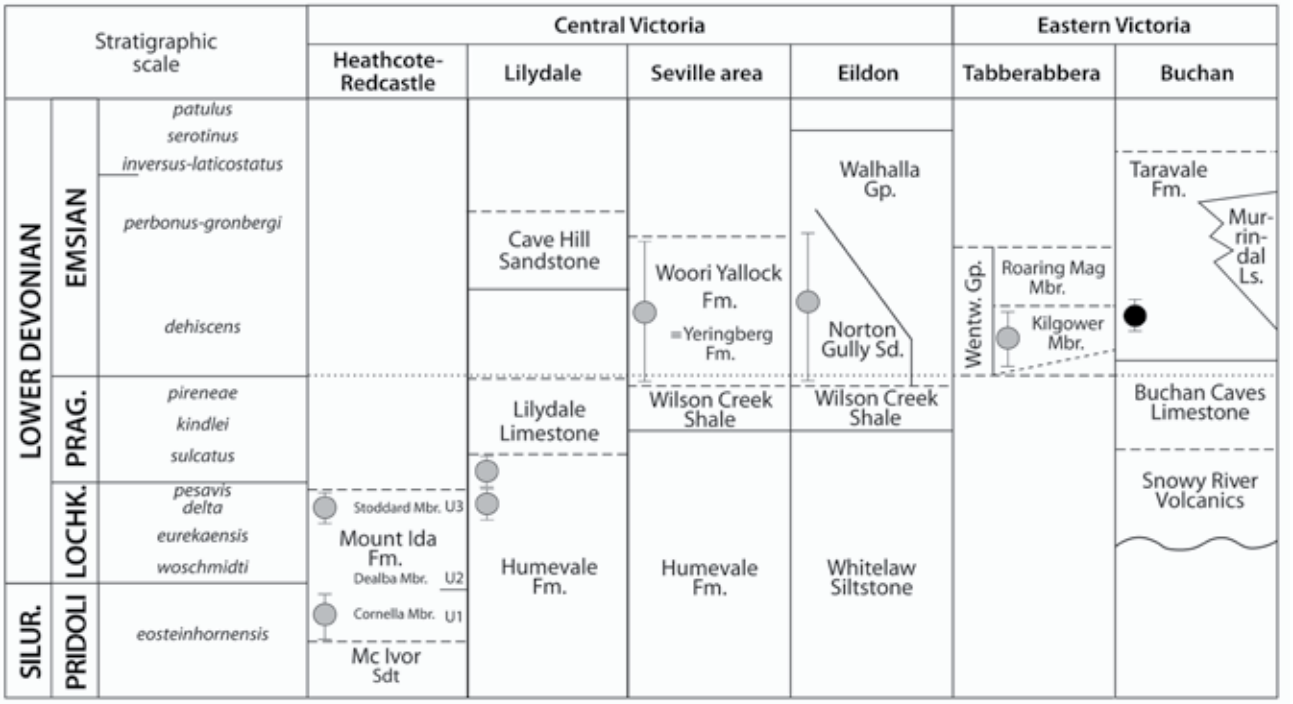


Figure 6: Stratigraphic distribution of the genus *Ligulodictyum* in the Early Devonian of Victoria (stratigraphy mainly from VandenBerg et al. 2000 and Talent et al. 2001). The following species are recorded: *Ligulodictyum* s.l. n. sp. I from Mount Ida Formation, Unit 1 and 3; *Ligulodictyum* s.l. n. sp. K and e.g. K from Kilgower Member and Norton Gully Sandstones; *Ligulodictyum* s.l. *megastomum* from Woori Yallock Formation and *"Ligulodictyum"* n. sp. from Taravale Formation. Black circle for accurate stratigraphic position, grey circle with whisker display indicates that the position of the *Ligulodictyum*-bearing level within the Formation or Member is not known.

According to the correlation chart provided by VandenBerg et al. (2000), its top is placed high in the early Emsian.

Kilgower Member. Talent et al. (2001) stated that the very basal part of the Kilgower Member of the Tabberabbera Formation is late Pragian. However, now that the Subcommission for Devonian Stratigraphy has placed the base of the Emsian at a lower level, the Kilgower Member is probably Emsian (Pedder, pers. comm. 2012).

"*Ligulodictyum*" n. sp. (this paper) is the only species from Victoria for which a precise age is available. The species comes from the Taravale Formation, *ca* level 19, probably in upper part of the Australian *dehiscens* Conodont Zone and hence is the youngest *Ligulodictyum* known in Australia.

Ligulodictyum s.l. is known from Tasmania (see Hill 1942: pl. 2, fig. 5): *Pleurodictyum megastoma*, probably Bell Shale Formation, Lochkovian). Banks (in Talent & Banks 1967: table II), stated that *P. megastoma* ranges from the lower Florence Sandstone to the upper Bell Shale i.e. from Pridoli to late Lochkovian; unfortunately the specimens are not illustrated and thus this early occurrence cannot be taken into account.

In New Zealand, the genus is well known from the Baton River Formation (Shirley 1938), Lochkovian (Talent et al. 2001) or Pragian (Sandford 2005b). The specimens are probably from Member 3, i.e. 700 to 1200 m above the supposed basal limestone that has yielded the diagnostic conodont *Icriodus woschmidti woschmidti*, indicating a basal Lochkovian age (Bradshaw 1988). Nevertheless, their age is not known.

Palaeogeographic distribution

The late Lochkovian to early Emsian representatives of *Ligulodictyum* of Victoria come from different structural units or blocks (terranes *sensu* Talent et al. 2001): Molong–Monaro Zones (Buchan), Melbourne Zone (Seville, Eildon) and Tabberabbera Zone (Tabberabbera). These units, along with the west Tasman oneand the Takaka Terrane (New Zealand) form the Tasman Subprovince (Boucot et al. 1969). Note that in Australia *Ligulodictyum* is not recorded outside Victoria and that during the early Emsian is not recorded from New Zealand, which formed at that time an independent subprovince.

Hence, during the Early Devonian, the occurrences of "*Ligulodictyum*" and *Ligulodictyum* s.l. on the eastern margin of Gondwana are located in a restricted area including the south-eastern part of Australia, Tasmania and New Zealand (Talent et al. 2000: fig.1).

The presence in Victoria of forms belonging to the *mauretanicum* lineage shows close relationships between the fauna of Eastern Australia (Tasman Province) and that of North Africa and Spain (Ibarmaghian Domain, Plusquellec

et al. 1997). In this latter area the *mauretanicum* lineage is known from middle Lochkovian (Cantabrian Mountains) to late Emsian (Anti–Atlas) (Lafuste et al. 1993), thus overlapping the early Emsian occurrence in Victoria.

Taking into account the only specimens for which the microstructure has been observed, the representatives of the *paraligulatum* lineage (*Ligulodictyum* s.s.) are only known in the north-western part of Gondwana in the Armorican Massif, France (Plusquellec 2007) during the late Lochkovian–early Pragian (*L*. s.s. *paraligulatum* and *L*. s.s. *ligulatum*) and in the mid-Pragian of the Tindouf Basin, Algerian Sahara (*Ligulodictyum* s.s. sp.; Gourvennec et al. 1997). On the other hand, in the Armorican Massif, specimens of *Ligulodictyum* preserved as moulds but nevertheless assigned to *Ligulodictyum* s.s. (*L*. s.s. *ligulatum* and *L*. s.s. *paraligulatum*), are known in the Landévennec Formation during the early Lochkovian (Plusquellec 2007).

As specimens of *Ligulodictyum* from the Tasmanian Province are preserved as moulds (except in the BCE section), it is not possible to confirm the presence of the *paraligulatum* lineage from this region.

Clearly, it appears that there are two distinct centres of diversification of *Ligulodictyum* on the Gondwanan margin, one in the east (Tasman Subprovince), the other in north-western Gondwana (Ibarmaghian Domain). The uncertainty about the age of the Cornella Member of the Mount Ida Formation makes it difficult to locate the geographic origin of *Ligulodictyum*. However, if this occurrence is really Pridoli, as stated by VandenBerg et al. (2000), Sandford (2005b) and Wright and Garratt (2013), this makes it the first appearance of the genus.

Other Pleurodictyum-*like corals in the Tasman Province*

Pleurodictyum-like corals appear very early in Victoria and are recorded from late Wenlock onwards. The oldest specimens come from the late Wenlock to early Ludlow Yan Yean Formation — illustrated by Dun (1898: pl. 3, fig.1) as *Pleurodictyum* (? *megastomum* McCoy) and from the late Wenlock Kilmore locality Bb 20 in the Kilmore Siltstone illustrated as *Pleurodictyum* sp. by Talent (1965: pl. 1, fig. 8) (see also Rickards & Sandford 1998; Earp 2007: 294). These specimens share some features with *Petridictyum*. In the Clonbinane Member (base of the Humevale Formation [Talent 1965]), generally assigned to the late Ludlow (Talent 1965; Sandford 2005b) or Pridoli (inferred from Talent et al. 2001), *Pleurodictyum*-like corals are represented by at least two genera: *Petridictyum* ? n. sp. A (see Plusquellec 2007: pl. 2, fig. 10) and a form showing affinities with *Ligulodictyum* s.l. (morphology of corallum and corallites) but devoid of a tongue-like structure (Plusquellec unpublished data, specimens NMV P120697, 120698, 120700 and LPB 17 002–17 003). In addition, Foerste (1888) described "*Pleurodictyum problematicum* Goldfuss ?" from (probably) the Lower Trilobite Bed in the Bowning area of NSW, which is mid to late Ludlow (Pedder pers. comm. 2012); the specimen, owing to its size and the setting of the corallites, shows affinities with cf. *Petridictyum* n. gen. *sensu* Plusquellec 2007.

Moreover, to add to the diversity of *Pleurodictyum*-like corals in Victoria, the Humevale Formation at the Hughes quarry and Steane's Homestead localities, Lilydale (Gill 1940), respectively 'late' Lochkovian and Pragian (Garratt pers. comm.) have yielded an unnamed 'basic' form devoid of both interstitial corallites and mural pores in almost all the colonies and devoid of a tongue-like structure (Plusquellec unpublished data, specimens NMV P102949, 102939 for example).

Although many late Ludlow to early Emsian localities in the Tasman Province contain *Pleurodictyum*-like corals, *Pleurodictyum* itself seems to be unknown. The only doubtful occurrence is in the Reefton Group in New Zealand, of Lochkovian to early Emsian age according to Talent et al. (2001), or early Emsian according to Sandford (2005b). However, the figure given by Allan (1935) is very poor and the specimen needs a revision. *Pleurodictyum* is known from the late Pragian to late Emsian and its presence in the Reefton Group is possible.

As noted by Neil (1985) there is no evidence of the presence of the bioclaustration *Hicetes* associated with *Pleurodictyum*-like corals in the Tasman Province. In the Ibarmaghian domain this occurs commonly with *Pleurodictyum* but is known from only one specimen of *Ligulodictyum* s.s.

Conclusions

1. This is the first record from eastern Victoria of the presence of specimens of "*Ligulodictyum*" (i.e. form belonging to the *mauretanicum* lineage) with their calcitic skeleton.
2. In south-eastern Australia, the oldest *Ligulodictyum* (*L*. s.l. n. sp. I Plusquellec 2007) appears to be from latest Silurian (Pridoli) and the youngest form "*Ligulodictyum*" n. sp. (this paper) from early Emsian (*dehiscens* conodont Zone).
3. In the Tasman Subprovince, *Ligulodictyum* is recorded during Pridoli–Lochkovian and early Emsian; the only possible Pragian material is the specimen from Gill's 'Wilson's' (Lilydale) locality.
4. Based on occurrences of "*Ligulodictyum"*, a close relationship between the Tasman Subprovince and the Ibarmaghian Domain is established.
5. On the Gondwanan margin, the oldest known *Pleurodictyum*-like corals are found in eastern

Australia; they are recorded from late Wenlock onwards and show affinities with the genus *Petridictyum*. This region appears to be an important centre of diversification giving rise to some endemic forms.

Acknowledgements

Special thanks go to Dr. A.E.H. Pedder, Geological Survey of Canada (Emeritus) who donated the studied specimens to the author and provided accurate data about the BCE section and the geology of Victoria. I would like to thank Emeritus Professor J. Talent, Macquarie University, Sydney — who unfortunately could not trace his "*Cleistopora*" — as well as Mr. A.H.M. VandenBerg, Honorary Research Associate at Museum Victoria, M.J. Garratt for stratigraphical comments, and C. Earp for his help dealing with coral localities in the Seville area. I am particularly grateful to D.J. Holloway, Senior Curator of Invertebrate Palaeontology, Museum Victoria, Melbourne, for the loan of numerous specimens of *Ligulodictyum* and other *Pleurodictyum*-like corals from Victoria. Thanks also go to the anonymous referees for valuable suggestions that helped to improve the manuscript. The author also thanks his colleague A.J. Wright, University of Wollongong (NSW) and one of the referees for linguistic reviews of this paper.

Specimens to which Université de Bretagne Occidentale/Laboratoire de Paléontologie, Brest and Museum Victoria, Melbourne, catalogue numbers have been assigned are designated by the prefix LPB and NMV P, respectively.

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Appendix

List of localities having yield specimens of *Ligulodictyum*; the specimens housed in Museum Victoria have been studied by the author and their catalogue number is provided.

Victoria

F25 of Thomas (1940). Mount Ida Formation, Stoddard Member, parish of Redcastle, Heathcote district. *Ligulodictum* s.l. n. sp.I Plusquellec 2007; NMV P34313, NMV P59492, NMV P108691, 108693.

F28 of Thomas (1940). Mount Ida Formation, Cornella Member, parish of Redcastle, Heathcote district. *Ligulodictum* s.l. n. sp. I Plusquellec 2007; NMV P108715.

F30 of Thomas (1940). Mount Ida Formation, Stoddard Member, parish of Redcastle, Heathcote district. *Ligulodictum* s.l. n. sp. Plusquellec 2007; NMV108708.

9 of Talent (1965). Mount Ida Formation, Stoddard Member, parish of Redcastle, Heathcote district. *Ligulodictum* s.l. n. sp. Plusquellec 2007; NMV P59487, 59488.

4 of Gill (1940), 'Flowerfield' Quarry. Humevale Formation (*Boucotia australis* Zone), parish of Yering, Lilydale district. *Ligulodictum* s.l. n. sp. I Plusquellec 2007; NMV P14103.

'Wilson's' (=2 of Gill, 1940). Humevale Formation (probably *Boucotia loyolensis* Zone), parish of Yering, Lilydale district. *Ligulodictum* s.l. n. sp. I Plusquellec 2007; NMV P102938.

NMV PL1834. Woori Yallock Formation, Seville area. *Ligulodictyum* s.l. *megastomum* (McCoy 1866); NMV P340 (lectotype).

Unnumbered locality. Woori Yallock Formation, Killara area, NE of Seville. *Ligulodictyum* s.l. *megastomum* (McCoy 1866); NMV P102948.

LL from the NMV label. Norton Gully Sandstone, Loyola Lime Kilns, Loyola. *Ligulodictum* s.l. e.g. n. sp. K Plusquellec 2007; NMV P102933, 102934, 102937.

50 of Talent (1963). Tabbarabbera Formation, Kilgower Member, 2 km. WSW of Tabbarabbera. *Ligulodictum* s.l. n. sp. K Plusquellec 2007; NMV P60313, 60614, 60615, 60616, 60617.

BCE section, horizon 19 of Mawson (1987). Taravale Formation, road cutting along Buchan-Gelantipy Road. "*Ligulodictyum*" n. sp. (this paper); NMV P73467, 73468.

Tasmania

Unknown locality. Bell shale Formation? *Ligulodictyum* s.l. sp. Tasman. Geol. Surv. 711.

New Zealand

128 of Hector (ref. unknown) New Zealand Geol. Surv. and other localities from Baton River area. Baton River Formation, likely Member 3, Baton River. *Ligulodictum* s.l. sp.; M 441, 442, 437, 438 of Shirley (1938), not traced