THE CRETACEOUS DIMITOBELIDAE (BELEMNITIDA) OF THE ANTARCTIC PENINSULA REGION

by PETER DOYLE

ABSTRACT. The Dimitobelidae is a Cretaceous belemnite family that was restricted to within the 30° S. palaeolatitude for its Aptian–Maastrichtian range. The family is described in detail from the Antarctic Peninsula region for the first time, and the three component genera *Peratobelus* Whitehouse, *Tetrabelus* Whitehouse, and *Dimitobelus* Whitehouse are revised. Species of *Peratobelus* (Aptian) and *Dimitobelus* (Aptian/Albian–Maastrichtian) from Antarctica closely resemble those from Australia, and include the new species *D. praelindsayi* sp. nov. A new species from Australia, *D. dayi* sp. nov., is also described. Species of *Tetrabelus* (Aptian–Albian) are unknown from Australasia, but the single form *T. seclusus* (Blanford) occurs in both the Antarctic Peninsula and southern India. Two new species, *T. willeyi* sp. nov. and *T. whitehousei* sp. nov., apparently endemic to the Antarctic Peninsula, are described.

THE Dimitobelidae constitute a belemnite family that was restricted to within the 30° S. Cretaceous palaeolatitude as part of the marine Austral Realm (Stevens 1965, 1973; Doyle 1985*b*). Despite its biostratigraphical potential in the Southern Hemisphere (e.g. Day 1967, 1969; Taylor *et al.* 1979) a revision of the Dimitobelidae has not been attempted since that of Stevens (1965). The family was first described by Whitehouse (1924) who identified four genera; *Dimitobelus*, *Peratobelus*, *Tetrabelus*, and *Cheirobelus*, all characterized by their uniquely paired ventrolateral alveolar grooves. Later authors have reduced this number (Glaessner 1945, 1957; Stevens 1965; Doyle 1985*b*) and three genera are now recognized as valid: *Dimitobelus* Whitehouse (= *Cheirobelus* Whitehouse), *Peratobelus* Whitehouse, and *Tetrabelus* Whitehouse.

The purpose of this paper is to revise the dimitobelid genera further, and describe in detail the Antarctic species. The dimitobelids of the Antarctic Peninsula region are of great importance, as it is only here that all three genera occur together. The family was first described from this region in a preliminary study by Willey (1972). Since this work, further Dimitobelidae from the Antarctic Peninsula have been recognized by the author in the collections of the British Antarctic Survey. Elsewhere, Dimitobelidae are well known from Australasia (Whitehouse 1924; Glaessner 1945; Stevens 1965, 1973) and to a lesser extent southern India (Whitehouse 1924; Doyle 1985*b*). The Antarctic dimitobelids have great affinities to those from Australia (*Peratobelus*, *Dimitobelus*) and southern India (*Tetrabelus*). Thus, for greater comparison, a number of Australasian specimens were examined and, where appropriate, these are listed with the species described below. In addition, a single new species of *Dimitobelus* from Australia is described.

GEOLOGICAL SETTING

Dimitobelids occur locally towards the top (*c.*1·2 km) of the approximately 4 km-thick Fossil Bluff Formation in south-eastern Alexander Island. The formation ranges from the Upper Oxfordian–Kimmeridgian to the Albian and consists of mainly mudstones, tuffaceous sandstones, and conglomerates that were deposited in a fore-arc environment (Taylor *et al.* 1979; Thomson *et al.* 1983). The relatively few belemnites that have been described from the formation have come from the reasonably well-known Ablation Valley (79° 49′ S., 68° 28′ W., to the north of the area in text-fig. 1) and Keystone Cliffs areas (text-fig. 1; Willey 1972, 1973; Taylor *et al.* 1979). However, many

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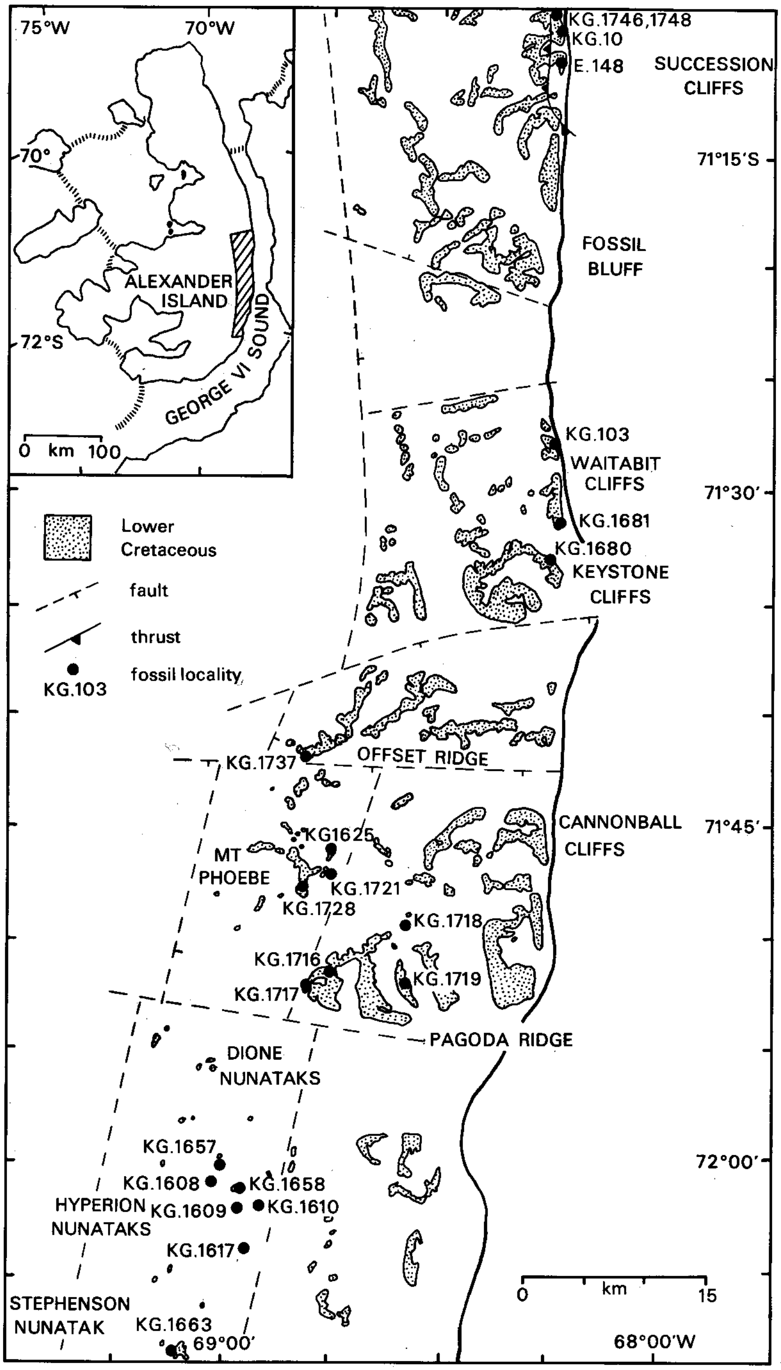
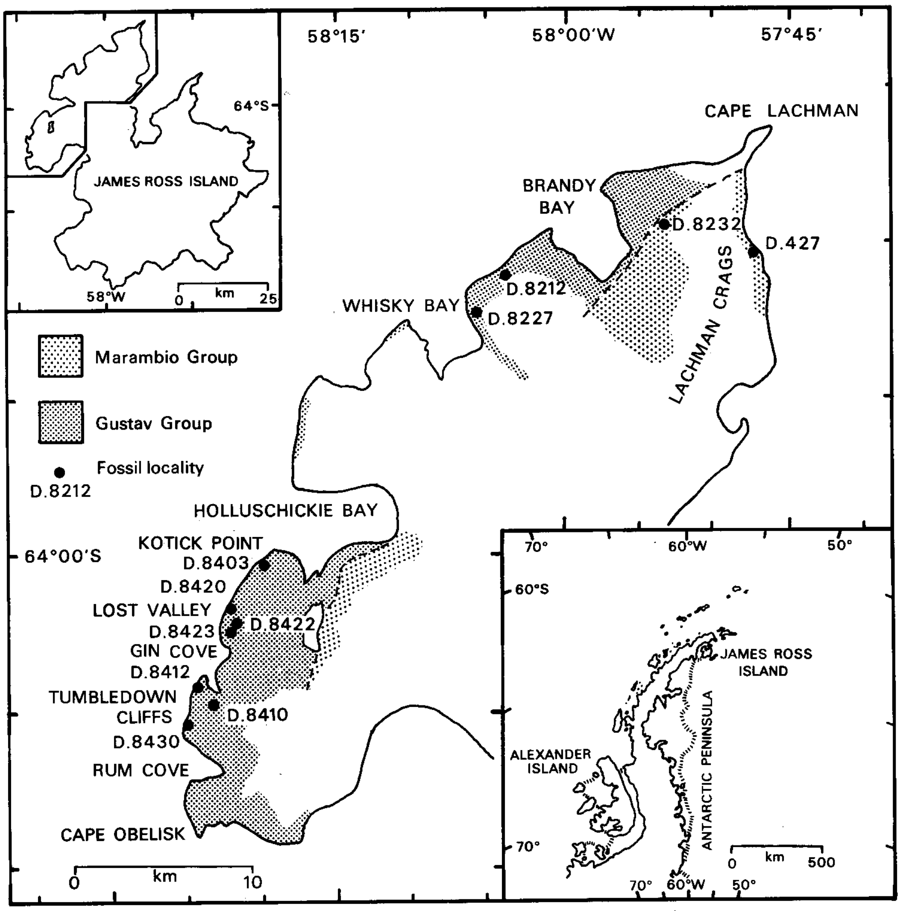


TEXT-FIG. 1. Locality and geological map of the south-eastern coast of Alexander Island (see inset).



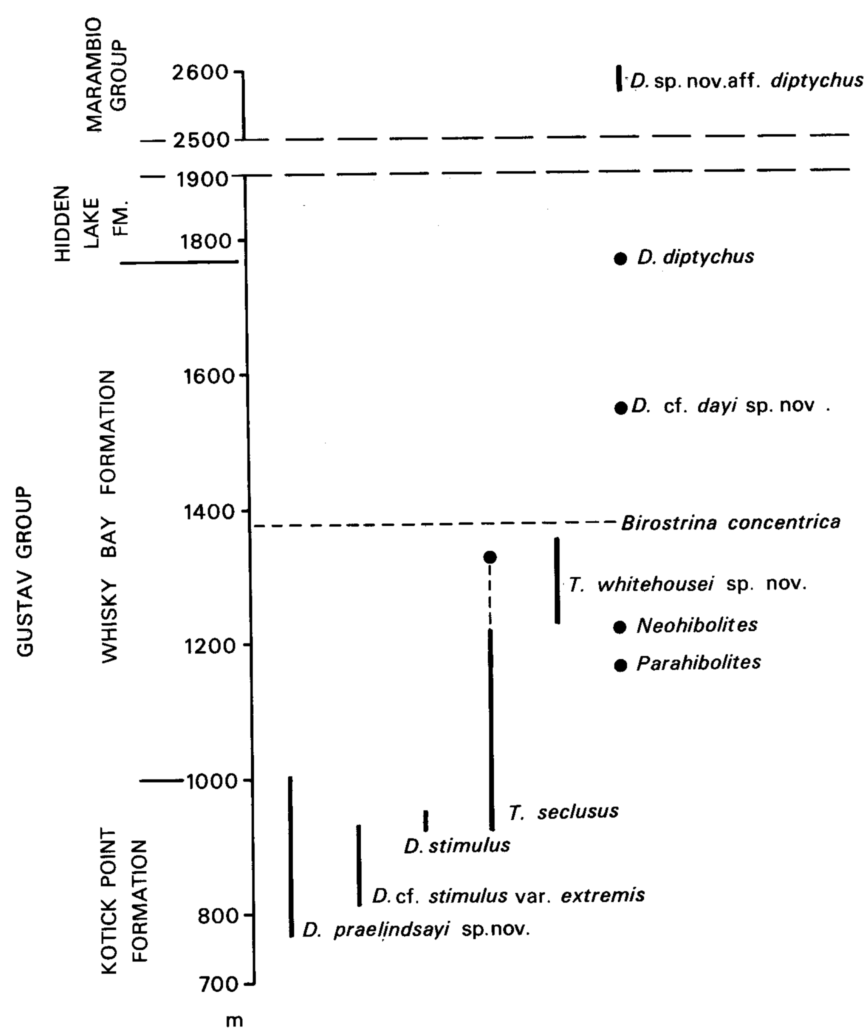
TEXT-FIG. 2. Locality and geological map of the north-eastern coast of James Ross Island (see upper inset). Lower inset; locality map of the Antarctic Peninsula region.

of the belemnites described below were obtained from isolated nunataks to the south of Keystone Cliffs (text-fig. 1), where the only data available for correlation are faunal records of ammonites and bivalves (Table 1).

Similar belemnites have been found in a series of varied clastic sediments deposited in a back-arc setting that is exposed on James Ross Island (text-fig. 2; Thomson *et al.* 1983; Farquharson *et al.* 1984; Ineson *et al.* 1986). The James Ross Island Cretaceous succession may well be in excess of 4·5 km thick (Crame 1985; Ineson *et al.* 1986), all of which, until recently, was thought to be Campanian in age (Bibby 1966). However, recent field-work by geologists of the British Antarctic Survey has revealed that the lowermost 2·4 km (Gustav Group) has an approximate range of Barremian to Santonian (Crame 1981, 1983; Thomson 1982, 1984*a*, *b*; Ineson *et al.* 1986) while the topmost part (Marambio Group) is of Campanian–Maastrichtian age (Thomson 1984*b*; Ineson *et al.* 1986). The majority of belemnites from James Ross Island described below were collected from a 3·0 km sequence measured in the Gin Cove and Brandy Bay areas (text-fig. 2), presented as a composite section in text-fig. 3.

TABLE 1. Belemnites and associated age-diagnostic fauna from the Cretaceous of Alexander Island. Details of fauna other than belemnites compiled from Willey 1972; Thomson 1974; Taylor *et al.* 1979; Crame 1985; and unpublished data.

KG.	Belemnites	Ammonites	Bivalves	Age
10	*Peratobelus* cf. *oxys*, *Dimitobelus* cf. *stimulus* var. *extremis*	*Eotetragonites*, *Australiceras*, *Aconeceras* aff. *nisoides*	—	?late Aptian–early Albian
103	*P.*(?) sp., *Tetrabelus willeyi* sp. nov.	*Emericiceras*, *Eulytoceras* aff. *polare*, *Sanmartinoceras patagonicum*	—	Aptian
1609	*D.* sp. indet	*Aconeceras*, ?*Lytoceras*	*Birostrina*? cf. *concentrica*	Albian
1610	*D. praelindsayi* sp. nov.	—	—	?Albian
1617	*D.* sp. indet.	*Hamites* aff. *tenuis*	—	?Albian
1625	*T. willeyi* sp. nov.	*Aconeceras*	—	Aptian–Albian
1657	*T. willeyi* sp. nov.	?*Theganeceras*, *Eulytoceras*, *Aconeceras*, *Lytoceras*	—	Aptian
1658	*D.* sp. nov. C	*Hypophylloceras*, *Lytoceras*	—	Aptian–Albian
1663	*D. praelindsayi* sp. nov., *D.* sp. nov. A, *D.* sp. nov. B	*Antarcticoceras*, ?*Tropaeum*, silesitids	*Birostrina*? cf. *concentrica*, *Inoceramus* cf. *anglicus elongatus*	Albian
1680	*Tetrabelus willeyi* sp. nov., *D. stimulus*, *D.* sp. nov. A.	*Phyllopachyceras aureliae*, ?*Antarcticoceras*, silesitids	*Birostrina*? cf. *concentrica*, *Inoceramus* sp. aff. *comancheanus*, *Inoceramus* cf. *anglicus elongatus*	Albian
1681	*D.* sp. indet.	*Antarcticoceras*, silesitids	—	Albian
1687	*D.* sp. indet.	—	—	Aptian–Albian
1716	*D. diptychus*	—	—	?late Albian. The ammonite *Lechites* occurs nearby at KG.1718
1717	*D. diptychus*	indet. ammonite fragments	—	
1719	*D. diptychus*	—	—	
1721	*D.* cf. *stimulus* var. *extremis*, *D.* cf. sp. nov. A	*Lytoceras*	*Birostrina*? cf. *concentrica*	Albian
1728	*D.* sp. nov. A	—	—	?Aptian–Albian
1737	*D.* sp. indet.	—	—	?Aptian–Albian
1746	*D.* sp. indet.	?*Tropaeum*	*Birostrina*? cf. *concentrica*	Albian
1748	*D. diptychus*, *D.* sp. nov. B, *D.* sp. nov. C	—	*Birostrina*? cf. *concentrica*	Albian



TEXT-FIG. 3. Diagrammatic composite stratigraphic section from the Gin Cove and Brandy Bay areas of James Ross Island, with the approximate ranges of important belemnites. The inoceramid bivalve *Birostrina concentrica* is indicative of the mid-late Albian (Crame 1985).

SYSTEMATIC DESCRIPTIONS

Many of the specimens described are imperfect and fragmentary. New species have been formally named only where there is a sufficient number of well-preserved specimens available. For other material, a system of open nomenclature has been employed. Forms closely resembling pre-existing species have been designated by the prefix 'cf.', while new forms with affinities to pre-existing species have been designated by the prefix 'aff.' Other forms not resembling already named examples are designated by a letter (e.g. A, B, C).

In the descriptions, approximate size (length) ranges are given by the terms small (< 40 mm), medium (40–70 mm), and large (> 70 mm). Where possible, the following measurements are

TABLE 2. Belemnites and associated age-diagnostic fauna from the Cretaceous of James Ross Island. Details of fauna other than belemnites compiled from Thomson 1984*a*, *b*; Crame 1985; Ineson *et al.* 1986; and unpublished data.

KG.	Belemnites	Ammonites	Bivalves	Age
427	?*Dimitobelus* sp. nov. aff. *diptychus*	*Maorites seymourianus*	—	Campanian
8212	*D. stimulus*, *D.* cf. stimulus var. *extremis*	*Silesites*, *Phyllopachyceras*, aconeceratids	*Anopaea* sp. nov. β, *Inoceramus stonleyi*	Albian
8227	*Teratobelus whitehousei* sp. nov.	—	*Birostrina concentrica*	mid-late Albian
8232	*D.* sp. nov. aff. *diptychus*	*Anapachydiscus*, *Baculites*, *Bostrychoceras*, *Gaudryceras varagurence* var. *patagonicum*	—	Campanian
8403	*D. stimulus*, D. cf. stimulus var. *extremis*, *D. praelindsayi* sp. nov.	*Silesites*, '*Pseudothurmannia*', *Anagaudryceras buddha*	*Inoceramus sutherlandi*, *Aucellina*	Albian
8410	*D. diptychus*	*Newboldiceras*	*Inoceramus pictus* group	?Cenomanian
8412	*T. seclusus*, *T. whitehousei* sp. nov.	?*Labeceras*, *Pachydesmoceras*, *Ptychoceras*, *Anagaudryceras buddha*	*Inoceramus carsoni*, *Maccoyella*, *Aucellina*	Albian
8422	*T. seclusus*, *D. stimulus*	*Beudanticeras*, *Ptychoceras*, ?*Gaudryceras*	*Inoceramus carsoni*, *Aucellina*	Albian
8430	*D.* cf. *dayi* sp. nov.	—	*Inoceramus pictus* group	?Albian–Cenomanian

recorded (in mm): L, total preserved length; X, length from apex to D max (position of maximum inflation); Dv, dorsoventral diameter at the protoconch; Dvmax, maximum dorsoventral diameter at position of maximum inflation; Dvmin, minimum dorsoventral diameter; Dl, lateral diameter at the protoconch; Dlmax, maximum lateral diameter at position of maximum inflation; Dlmin, minimum lateral diameter. In addition to the short glossary of terms given by Doyle (1985*a*), reference to the following definitions may prove useful:

Apical canal. Open canal along apical line of rostrum formed either in-life (by resorption?) or by post-mortal diagenesis. Opens at apex with an *apical foramen*.

Doppellinien. Paired, parallel, and finely spaced lateral lines.

Nadelspitze. Axial projection in centre of pseudalveolus left by decay of alveolar region.

Pseudalveolus. Secondary conical cavity in anterior of rostrum produced by decay of the alveolar region.

All the specimens described below are housed in the collections of the British Antarctic Survey, Cambridge, unless otherwise stated. Specimens prefixed by KG and E come from Alexander Island and those prefixed by D from James Ross Island. Other repositories are abbreviated as follows: BM, British Museum (Natural History), London; GSSA, Geological Survey of South Australia, Eastwood; HM, Hunterian Museum, Glasgow; MUGD, Melbourne University Geology Department, Melbourne; NMV, National Museum of Victoria, Melbourne; SAM, South Australian Museum, Adelaide; SM, Sedgwick Museum, Cambridge.

Class CEPHALOPODA Cuvier, 1794
Subclass COLEOIDEA Bather, 1888
Order BELEMNITIDA Zittel, 1895
Suborder BELEMNOPSEINA Jeletzky, 1965
Family DIMITOBELIDAE Whitehouse, 1924

Type genus. *Dimitobelus* Whitehouse, 1924.

Diagnosis. Belemnopseina with rostra bearing pair of ventrolateral alveolar grooves underlain by splitting surfaces, without apical grooves or unpaired ventral or dorsal alveolar grooves or slits (Whitehouse 1924, p. 410; Jeletzky 1966, p. 147).

Range. Aptian to Maastrichtian of Australasia, Antarctica, and southern India.

Genus PERATOBELUS Whitehouse, 1924

Type species (*by original designation*). *Belemnites oxys* Tenison-Woods, 1884.

Diagnosis. Large, robust, elongate cylindrical, cylindriconical to subhastate Dimitobelidae with weak to moderate depression. Outline symmetrical, cylindriconical to subhastate, apex acute to moderately obtuse. Profile asymmetrical to nearly symmetrical, cylindriconical to cylindrical. Venter generally flattened. Transverse sections subcircular to subquadrate, generally only weakly depressed or compressed. Two pronounced, straight, undeflected ventrolateral alveolar grooves extend adapically one half to two thirds the length of the rostrum. Lateral lines are poorly developed. The phragmocone penetrates one third to one half of the rostrum and is ventrally deflected. Alveolus normal. Apical line weakly cyrtolineate, apical canal common.

Range. Aptian of Australia and Antarctica.

Discussion. The genus *Peratobelus* was erected by Whitehouse (1924, p. 410) to encompass 'cylindrical or clavate [belemnites] with ventro-lateral [alveolar] grooves only. These grooves extend for about half the length of the guard. Alveolus normal.' Most later authors concur with this diagnosis although restricting this genus to cylindriconical, non-hastate (non-clavate) species (e.g. Glaessner

1957; Stevens 1965). However, the type species (*P. oxys* (Tenison-Woods)) and related forms (*P.* cf. *oxys*, *P. australis* (Phillips)) all display some hastation, and that restriction is here considered invalid.

Peratobelus is easily distinguished from *Dimitobelus* by the latter's depressed transverse section (text-figs. 5–8) and dorsally deflected ventrolateral grooves, and from *Tetrabelus* which has a compressed transverse section (text-fig. 4) and ventrally deflected ventrolateral grooves.

Species included: *P. oxys* (Tenison-Woods), *P. australis* (Phillips), *P. bauhinianus* Skwarko (= (?)*Dimitobelus youngensis* Skwarko). Whitehouse (1924, p. 411) referred to a single large belemnite from the Upper Aptian of South Australia (BM.C.5309) as 'an unnamed species of *Peratobelus*'. This specimen was later identified with *Belemnites selheimi* Tension-Woods by Woods (1961, p. 3), even though this species was originally described from phragmocones only (Tenison-Woods 1883, p. 250, pl. 7, fig. 1). Later authors have since listed *B. selheimi* as a species of *Peratobelus* (e.g. Day, 1967, 1969; Hill *et al.* 1968) or even *Dimitobelus* (Ludbrook 1966), even though it is extremely difficult to assign separated phragmocones to any particular rostrum (cf. Etheridge 1902*a*, p. 50), as they are known to protrude some distance from the rostra (see Naef 1922, fig. 67*d*, *e*), and their alveolar angles are often undiagnostic (Schwegler 1961). The name *B. selheimi* should therefore be restricted to Tenison-Wood's type, which cannot be definitely assigned to *Peratobelus*. Whitehouse's (1924) unnamed specimen resembles *P. oxys*, and may be an aberrant form of this species.

Peratobelus cf. *oxys* (Tenison-Woods, 1884)

Plate 21, figs. 1 and 2

cf. *1884 *Belemnites oxys* Tenison-Woods, p. 236, pl. xiii, figs. 1–3.
cf. 1902*b* *Belemnites oxys* Tenison-Woods; Etheridge, p. 48, pl. vi, figs. 4–6; pl. vii, figs. 5–7; pl. viii, figs. 4–6.
v 1972 *Dimitobelus* sp. aff. *Dimitobelus macgregori* (Glaessner); Willey, p. 32, fig. 3*a*, *b non c*.
v 1972 *Peratobelus oxys* (Tennison-Woods); Willey, p. 37, fig. 4*d*, *e*.

Material. Two rostra from the Upper Aptian of Alexander Island: KG.10.61, BM.C.46251 [E.148.1] (text-fig. 1).

Dimensions.

	L	X	Dvmax	Dlmax
KG.10.61	62·6	36·0	11·4	12·3
BM.C.46251	93·7	44·7	—	10·3

Description. Large, slender, subhastate to cylindrical *Peratobelus*. The outline is symmetrical and subhastate to cylindriconical, and the apex is very acute. The profile is nearly symmetrical and similar to the outline. Transverse sections weakly depressed (Dlmax : Dvmax 1·1) and elliptical to subcircular in the stem region, becoming subquadrate in the alveolar region.

Two long, straight ventrolateral alveolar grooves extend adapically for approximately one half of the rostrum (in BM.C.46251). The apparent shortness of the grooves in KG.10.61 is due to the loss of the alveolar region of this specimen. The grooves are undeflected and apparently independent of the poorly defined lateral lines. The phragmocone penetrates one third of the rostrum. The apical line is weakly cyrtolineate, and an apical canal is present in one of the specimens (BM.C.46251).

Discussion. Willey (1972) recognized the affinity of one of these specimens (BM.C.46251) to *P. oxys*, although misidentifying the second specimen (KG.10.61) as *Dimitobelus* sp. aff. *D. macgregori* (Glaessner). This latter specimen possesses the straight, undeflected alveolar grooves typical of *Peratobelus*, quite unlike the dorsally deflected grooves of *D. macgregori* (Glaessner) (see Stevens 1965, text-fig. 29), and greatly resembles the stem and apex of specimen BM.C.46251. Both resemble *P. oxys*, but are much more slender than is typical, and cannot be assigned with any more certainty to this species.

Occurrence. In Australia, *P. oxys* is well known from the Upper Aptian of the Rolling Downs Group (Whitehouse 1924; Day 1969). In Alexander Island (text-fig. 1), *P.* cf. *oxys* occurs in unit A_2 of Succession Cliffs (Taylor *et al.* 1979) with an ammonite fauna of *Eotetragonites*, *Australiceras*, and *Aconeceras* suggestive of an Upper Aptian or Lower Albian age (Table 1; Willey 1972; Taylor *et al.* 1979).

Peratobelus(?) sp.

Plate 21, fig. 7

v 1972 *Peratobelus* aff. *australis* (Phillips); Willey, p. 38, fig. 4*f*.

Material. One natural mould, Upper Aptian, Waitabit Cliffs, Alexander Island: KG.103.148 (text-fig. 1).

Discussion. The single specimen KG.103.148 was described by Willey (1972) as *P.* aff. *australis* (Phillips). It has a medium-sized relatively robust, hastate rostrum with an almost subcircular transverse section, and two long, apparently straight ventrolateral alveolar grooves. The apical region is missing. This specimen is considerably more compressed and somewhat more hastate than the lectotype of *P. australis* designated by Day (1967) (Phillips 1870, pl. xvi, figs. 1 and 2) and is not obviously referable to this species. Some of the specimens described by Skwarko (1966, pl. 15, figs. 1 and 2) as '*Dimitobelus*' (= *Peratobelus*) *youngensis* sp. nov. resemble KG.103.148 in the form of their rostra and grooves, but the Antarctic specimen cannot be definitely assigned to this species, which is based on poorly preserved material. *P.*(?) sp. also approaches *D. praelindsayi* sp. nov., but is distinguished by its undeflected ventrolateral grooves and subcircular transverse alveolar section.

Occurrence. The single specimen of *P.*(?) sp. was collected from a mudflake conglomerate in unit T_{11} of Taylor *et al.* (1979) at Waitabit Cliffs (text-fig. 1) below an Upper Aptian *Eotetragonites* ammonite fauna (Willey 1972; Thomson 1974) and above ammonites indicative of the Lower Aptian (*Eulytoceras* aff. *polare*, *Emericiceras*(?) sp., *Sanmartinoceras patagonicum*) (Table 1; Willey 1972; Thomson 1974; Taylor *et al.* 1979).

Genus TETRABELUS Whitehouse, 1924

Type species (by original designation). Belemnites seclusus Blanford, 1861.

Diagnosis. Small, moderately robust to slender, hastate to cylindriconical, compressed Dimitobelidae. Outline symmetrical, subhastate to cylindriconical. Apex acute. Profile asymmetrical to nearly symmetrical, hastate to cylindriconical. Venter commonly inflated to very inflated. Transverse sections compressed to very compressed, subquadrate to pyriform. Two pronounced ventrolateral alveolar grooves with splitting surfaces extend adapically for one third of the rostrum. Ventrolateral grooves straight in alveolar region, becoming shallow and curving ventrally (a feature reduced in some species). Dorsolateral depressions present. Lateral lines (*Doppellinien*) close to and parallel with the dorsum, extending adapically from the dorsolateral depressions. Fine striae may be present on venter and dorsum. Phragmocone penetrates one quarter to a third of rostrum, ventrally deflected. Apical line (?)goniolineate to (?)cyrtolineate.

Range. Aptian to Albian of Antarctica, southern India, and possibly the Malagasy Republic.

Discussion. Tetrabelus was originally erected by Whitehouse (1924, p. 413) to encompass 'Clavate [hastate] belemnites provided with dorso-lateral lines, but having, in addition, independent ventro-lateral grooves'. The validity of this genus has been questioned by Glaessner (1958) and Stevens (1965), but Doyle (1985*b*) has recently illustrated its independence from *Dimitobelus*. The dorsolateral 'grooves' of Whitehouse (1924) are more properly referred to as 'depressions', and the diagnostic features of true *Tetrabelus* are its compressed transverse section (text-fig. 4) and ventrally curving grooves, while *Dimitobelus* has a depressed section (text-figs. 5-8) and dorsally curving grooves, and *Peratobelus* has straight, undeflected grooves, and a robust transverse section.

Species included: *T. seclusus* (Blanford), *T. willeyi* sp. nov., and *T. whitehousei* sp. nov. Species excluded: '*T.*' *kleini* (Gürich) (= *Dimitobelus kleini*) and '*T.*' *macgregori* Glaessner (= *D. macgregori*), see discussion in Doyle 1985*b*.

Tetrabelus seclusus (Blanford, 1861)

Plate 21, figs. 3-6

* 1861 *Belemnites seclusus* Blanford, p. 4, pl. 1, figs. 43-51; pl. 11, fig. 8.
1865 *Belemnites seclusus* Blanford; Stoliczka, p. 202.
1910 *Belemnites seclusus* Blanford; Spengler, p. 153, pl. xiv, fig. 7.
1920 *Parahibolites seclusus* (Blanford); Bülow-Trummer, p. 166.
1924 *Tetrabelus seclusus* (Blanford); Whitehouse, p. 413, fig. 4.
v 1985*b* *Tetrabelus seclusus* (Blanford); Doyle, p. 29, fig. 5*a*.

Type specimen. Lectotype (designated Doyle 1985*b*), the original of Blanford (1861, pl. 1, fig. 44), Lower Uttattur Group, Uttattur, southern India.

Material. Five complete and three fragmentary rostra from the Kotick Point and Whisky Bay formations (Albian) of James Ross Island: D.8412.49, D.8420.37, 40A, B, D, G, D.8422.107, 119 (text-figs. 2 and 3).

Diagnosis. Small, hastate *Tetrabelus*. Outline symmetrical, subhastate to hastate. Venter inflated. Transverse sections compressed elliptical to rounded subquadrate, pyriform in alveolar region. Ventrolateral alveolar grooves display pronounced ventral curvature in stem region. Dorsolateral depressions broad.

Dimensions.

	L	X	Dvmax	Dlmax	Dvmin	Dlmin
D.8420.37	44·5	19·9	8·9	7·0	—	6·4
D.8420.40A	37·4	18·5	7·1	5·5	6·8	4·9
D.8420.40B	34·9	10·3	5·9	4·8	4·5	3·5
D.8420.40G	25·9	10·4	6·1	5·0	—	—
D.8412.49	33·8	17·6	6·3	4·6	—	—

Description. Small, relatively robust, compressed hastate *Tetrabelus*. Total length approximately five times Dv. The outline is symmetrical, subhastate (accentuated by the dorsolateral alveolar 'pinching'), and the apex is acute. The profile is asymmetrical and hastate to subhastate depending on the ventral or dorsal inflation of the apical and stem regions. The stem and apical sections are compressed (Dlmax : Dvmax 0·8; text-fig. 4) and rounded subquadrate to elliptical, becoming pyriform in the alveolar region (at Dvmin).

Two deep, straight, ventrolateral alveolar grooves with splitting surfaces are developed, reaching adapically for one third of the rostrum. The grooves shallow adapically, curving sharply on to the venter in the stem region. Dorsolateral broad depressions occur (at Dvmin) as 'pinches'. Lateral lines (*Doppellinien*) extend adapically from these pinches, remaining close to the dorsum. The phragmocone commonly penetrates one third to a quarter of the rostrum, and is slightly ventrally displaced. A pseudalveolus may be developed. The apical line is (?)cyrtolineate.

Discussion. *B. seclusus* was the first dimitobelid species to be described (Blanford 1861) and was designated type species of *Tetrabelus* by Whitehouse (1924). *T. seclusus* differs from *T. willeyi* sp.

EXPLANATION OF PLATE 21

Figs. 1 and 2. *Peratobelus* cf. *oxys* (Tenison-Woods). Aptian, Alexander Island. 1, right profile and ventral outline. KG.10.61, × 1. 2, silicone rubber cast, right profile and dorsal outline. BM.C.46251 × 1.

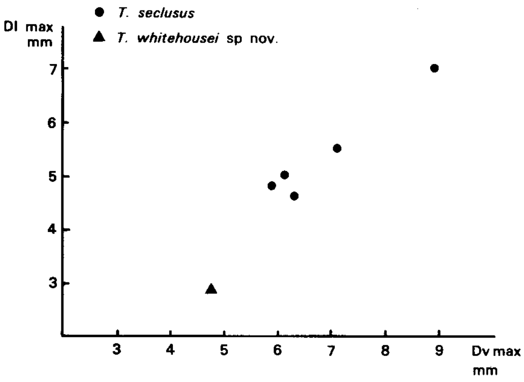
Figs. 3-6. *Tetrabelus seclusus* (Blanford). Albian, James Ross Island. 3 and 6, right profiles and ventral outlines. D.8420.37, D.8420.40B, × 1. 4 and 5, left profiles and ventral outlines. D.8422.107, D.8420.40A, × 1.

Fig. 7. *P.*(?) sp. Aptian, Alexander Island. Latex cast, right profile and ventral outline. KG.103.148, × 1.

Figs. 8-11. *T. willeyi* sp. nov. Aptian, Alexander Island. 8-10, left profiles and ventral outlines. 8, holotype, silicone rubber cast. KG.103.29, × 1. 9, paratype, silicone rubber cast. KG.1625.11, × 1. 10, paratype, latex cast. KG.1657.11, × 1. 11, long section. KG.103.24, × 1.

Figs. 12-14. *T. whitehousei* sp. nov. Albian, James Ross Island. 12, alveolar fragment, left profile, and ventral outline. D.8412.85, × 1. 13, right profile and ventral outline. D.8227.1, × 1. 14, holotype, right profile and ventral outline. D.8412.98, × 1.

DOYLE, *Peratobelus*, *Tetrabelus*



TEXT-FIG. 4. Relationship of maximum diameters in *Tetrabelus seclusus* (Blanford) and *T. whitehousei* sp. nov.

nov. which has a much more conical form, and from *T. whitehousei* sp. nov. which is extremely compressed, with reduced ventral curvature of its ventrolateral grooves.

Bülow-Trummer (1920) considered *B. seclusus* a species of *Parahibolites* (see also Stolley 1919), presumably because of its close association with species of this genus (see Doyle 1985*b*), and its degree of compression. However, its paired ventrolateral grooves clearly distinguish it from species of *Parahibolites*, which possess only a single ventral groove.

Occurrence. T. seclusus occurs in the Lower Uttattur Group of southern India (Splengler 1910), which ranges from the Albian to Lower Cenomanian (Bhalla 1983). This species has also been listed from the Malagasy Republic (Lemoine 1906). In James Ross Island, *T. seclusus* occurs at the 915–1215 m levels in the composite section (text-fig. 3) with ammonites indicative of the Albian (*Anagaudryceras buddha*, *Labeceras*(?), *Ptychoceras*, and *Pachydesmoceras*) (Thomson 1984*b*; Ineson *et al.* 1986).

Tetrabelus willeyi sp. nov.

Plate 21, figs. 8–11

v 1972 *Peratobelus* sp. (?)nov. Willey, p. 34, fig. 4*a–c*.
v 1985*b* *Tetrabelus* sp. nov. A Doyle, p. 29, fig. 5*c*.

Type specimens. Holotype: KG.103.29, Lower Aptian, Waitabit Cliffs, Alexander Island. Paratypes: KG.1657.41, Aptian, Hyperion Nunataks; KG.1625.11, Aptian, Mount Phoebe, Alexander Island (text-fig. 1).

Other material. Two fragmentary natural moulds: KG.1657.25, Lower Aptian, Hyperion Nunataks, Alexander Island; KG.1680.27, (?)Albian, Keystone Cliffs, Alexander Island. A single rostral long section: KG.103.24, Aptian, Waitabit Cliffs, Alexander Island (text-fig. 1).

Derivation of name. In recognition of Dr L. E. Willey who first identified dimitobelids from Alexander Island.

Diagnosis. Small, cylindriconical *Tetrabelus*. Outline symmetrical and cylindriconical. Profile symmetrical, cylindriconical to subhastate. Transverse sections compressed elliptical to subquadrate. Ventrolateral alveolar grooves extend for two thirds of rostrum, with gentle ventral curvature. Dorsolateral depressions reduced.

Description. Small to medium-sized cylindriconical *Tetrabelus*. Total length approximately seven times Dv. The outline is symmetrical and cylindriconical, and the profile is similar, being symmetrical and cylindriconical to subhastate. Transverse sections of the rostrum are compressed elliptical, becoming subquadrate where dorsum or venter are flattened.

Ventrolateral alveolar grooves are well developed, and curve gently towards the venter in the stem region, continuing parallel to the venter for two thirds to three quarters of the length of the rostrum. Lateral lines are poorly developed, dorsally positioned, and independent of the ventrolateral alveolar grooves. The dorsolateral depressions are reduced. The phragmocone (in specimens KG.103.24, 29) is centrally positioned and penetrates one third of the rostrum. The alveolus is normal, and the apical line is weakly cyrtolineate.

Discussion. T. willeyi sp. nov. was previously described as *Peratobelus* sp. (?)nov. by Willey (1972), but not formally identified. Further material was collected by Dr M. R. A. Thomson in January 1973 and this has confirmed the unique characters of the species. *T. willeyi* sp. nov. is clearly a species of *Tetrabelus*, as it possesses the compressed transverse section and ventrally curving alveolar grooves characteristic of this genus. The great length of these grooves in *T. willeyi* sp. nov. probably misled Willey (1972) who assigned this form to *Peratobelus*.

T. willeyi sp. nov., the earliest known *Tetrabelus*, can be distinguished from the later *T. seclusus* (Blanford) which is hastate and inflated with sharply curved grooves, and from *T. whitehousei* sp. nov. which is characterized by its extreme compression and its weakly deflected grooves.

Occurrence. T. willeyi sp. nov. occurs exclusively in Alexander Island. Two specimens (including the holotype) from Waitabit Cliffs (text-fig. 1) occur in unit T_6 of Taylor *et al.* (1979) with a distinct Lower Aptian fauna (*Eulytoceras*, *Emericiceras*, and *Sanmartinoceras*) below the conglomerate containing *Peratobelus*(?) sp. (Willey 1972; Thomson 1974; Taylor *et al.* 1979). At Mount Phoebe and Hyperion Nunataks (text-fig. 1) *T. willeyi* sp. nov. occurs with ammonites of a general Aptian (or older) age (Table 1), while at Keystone Cliffs a fragment of this species was found with the Albian ammonites *Phyllopachyceras aureliae*, *Antarcticoceras*, and *Silesites* (Table 1; Thomson 1974).

Tetrabelus whitehousei sp. nov.

Plate 21, figs. 12–14

v 1985*b* *Tetrabelus* sp. nov. B Doyle, p. 29, fig. 5*b*.

Type specimen. Holotype: D.8412.98, Albian (Whisky Bay Formation), Lost Valley, James Ross Island (text-figs. 2 and 3).

Other material. Five fragmentary rostra: D.8412.70, 78, 84, 85, Albian (Whisky Bay Formation), Lost Valley, James Ross Island; D.8227.1, Albian (Whisky Bay Formation), Whisky Bay, James Ross Island (text-figs. 2 and 3).

Derivation of name. In recognition of the work of Dr F. W. Whitehouse, original author of the Dimitobelidae.

Diagnosis. Medium sized, extremely slender *Tetrabelus*. Outline symmetrical, cylindrical to slightly subhastate. Profile asymmetrical and cylindrical. Transverse sections very compressed. Ventrolateral alveolar grooves with slight dorsal deflection, becoming ventrally curved in stem region. Dorso-lateral alveolar depressions developed as 'pinches'.

Dimensions.

	L	Dv	Dl
D.8412.98	55·3	4·8	2·9

Description. Medium sized, cylindrical *Tetrabelus*. Total length approximately 11·5 times Dv. The outline is symmetrical and cylindrical, becoming slightly subhastate in the alveolar region. For the most part the laterals remain parallel until very near the apex. The profile is asymmetrical and cylindrical, quite often with a somewhat sinuous dorsum and venter. Transverse sections are extremely compressed (Dlmax : Dvmax 0·6; text-fig. 4) and elliptical, becoming slightly pyriform in the alveolar region.

Two well-developed, incised ventrolateral alveolar grooves are slightly deflected dorsally, but a distinct ventral curvature is detectable at their apical-most point. Lateral lines are poorly developed, but *Doppellinien* can be observed confined to a dorsal position on the laterals. Two short, dorsolateral 'pinches' are present in the alveolar region. The phragmocone is relatively central, with a ventrally deflected protoconch, and penetrates up to one quarter of the rostrum. The alveolus is normal. The form of the apical line was not observed.

Discussion. T. whitehousei sp. nov. is a distinctive species, characterized by its very compressed transverse section. Although the ventrolateral alveolar grooves slope gently towards the dorsum before curving ventrally, they are unlike the sharply dorsally deflected grooves characteristic of

Dimitobelus. Thus although *Dimitobelus* sp. nov. C (see below) resembles *T. whitehousei* sp. nov. in its alveolar region, it differs because of its depressed apical region and its dorsally deflected grooves. *T. whitehousei* sp. nov. may be distinguished from all other species of *Tetrabelus* by its extreme compression (text-fig. 4) and distinct groove form.

Occurrence. *T. whitehousei* sp. nov. is known only from James Ross Island, where it occurs approximately 25 m below the *Birostrina concentrica* bio-horizon indicative of the mid-late Albian, at the 1225–1350 m level in the composite section (text-fig. 3). It occurs with the Albian ammonites *Anagaudryceras buddha* and *Labeceras*(?) (Table 2; Ineson *et al*. 1986).

Genus DIMITOBELUS Whitehouse, 1924

= *Cheirobelus* Whitehouse, 1924, p. 414

Type species (by original designation). Belemnites canhami Tate, 1880 (= *Belemnitella diptycha* M'Coy, 1867).

Diagnosis. Small to large, robust to slender, subhastate to hastate Dimitobelidae that are often markedly depressed. Outline symmetrical, subhastate to hastate, apex obtuse to mucronate. Profile asymmetrical to nearly symmetrical, subhastate to cylindriconical. Venter often flattened. Transverse sections depressed elliptical to subcircular in stem and apical regions, subquadrate to pyriform in alveolar region. Two short, pronounced ventrolateral alveolar grooves with splitting surfaces extend adapically for one quarter to one third of the rostrum, where they are dorsally deflected, joining lateral lines. Lateral lines (*Doppellinien*) well developed, ventral lines joining alveolar grooves, dorsal lines extended as dorsolateral alveolar depressions. The phragmocone is slightly dorsally eccentric but with a ventrally incurved protoconch, and penetrates one quarter to a third of the rostrum. Pseudalveolus and *Nadelspitze* common. Apical line weakly cyrtolineate, apical canal commonly developed with apical foramen.

Range. Albian to Maastrichtian of Australia, New Zealand, Antarctica, and New Guinea.

Discussion. *Dimitobelus* was originally described by Whitehouse (1924, p. 412) to encompass 'clavate [hastate] belemnites provided with dorso-lateral [ventro-lateral] grooves and lateral lines, both of which may be straight or somewhat curved. The alveolus is normal, but generally a pseudalveolus with axial projection is developed. A ventro-lateral [dorso-lateral] groove may be formed by the furcation of the lateral lines, but it becomes isolated.' The true position of the incised grooves has been the subject of some debate (Glaessner 1957; Stevens 1965). Whitehouse (1924), in common with earlier authors (e.g. Tate 1880; Etheridge 1902*a*) favoured a dorsolateral position, whilst Woods (1917), Glaessner (1957, 1958), and Stevens (1965) have proved the ventrolateral position of these grooves by their relationship to the siphuncle. The present study confirms the views of these later authors.

Cheirobelus Whitehouse was considered by Glaessner (1957) and Stevens (1965) to be a synonym of *Dimitobelus*. Whitehouse (1924) erected this genus solely on the 'isolation' of its ventrolateral (dorsolateral of Whitehouse) grooves, but Stevens (1965) subsequently determined that these grooves were connected to the lateral lines in its type species *B. lindsayi* Hector. Examination of specimens of this species (SM.B.2916–2918) confirms this view, and the genus *Cheirobelus* should be considered a synonym of *Dimitobelus*.

Both Glaessner (1958) and Stevens (1965) have considered *Tetrabelus* Whitehouse to be only a subgenus or even a synonym of the genus *Dimitobelus*. However, recent work by Doyle (1985*b*) has confirmed the generic validity of *Tetrabelus*, which is a markedly compressed genus (text-fig. 4, cf. text-figs. 5–8) with ventrally curving ventrolateral grooves. *Peratobelus* is also distinct from *Dimitobelus* in possessing long, straight, undeflected ventrolateral grooves.

Species included: *D. diptychus* (M'Coy) (= *D. canhami* Tate), *D. stimulus* Whitehouse, *D. stimulus* var. *extremis* Whitehouse, *D. lindsayi* (Hector), *D. kleini* (Gürich), *D. macgregori* (Glaessner), *D. hectori* Stevens, *D.*(?) *ongleyi* Stevens, *D. praelindsayi* sp. nov., *D. dayi* sp. nov. The species *B. liversidgei* Etheridge has also been assigned to *Dimitobelus* (Hill *et al*. 1968, pl. KII). However, this species was originally described as possessing a 'ventral surface bearing a groove extending for about half the guard length. . . .' (Etheridge, *in* Jack and Etheridge 1892, p. 491), suggesting belemnopseid rather than dimitobelid affinities. This form may possibly be a species of *Neohibolites* (Doyle 1985*b*).

Dimitobelus diptychus (M'Coy, 1867)

Plate 22, figs. 1, 6-10

v* 1867 *Belemnitella diptycha* M'Coy, p. 356.
p 1870 *Belemnites australis* Phillips, p. 258, pl. xvi, figs. 3 and 4 *non* 1 and 2.
v 1880 *Belemnites canhami* Tate, p. 104, pl. iv, fig. 2.
1892 *Belemnites canhami* Tate; Etheridge (*in* Jack and Etheridge), p. 490, pl. 35, figs. 3-5, 7-9, 12-14.
1902*a* *Belemnites canhami* Tate; Etheridge, p. 49.
v 1902*a* *Belemnites eremos* Tate; Etheridge, p. 51, pl. vii, figs. 18-21.
1902*b* *Belemnites canhami* Tate; Etheridge, p. 45, pl. viii, figs. 8 and 9; pl. ix, fig. 2.
v 1924 *Dimitobelus canhami* (Tate); Whitehouse, p. 412, figs. 2 and 3.
v 1925 *Dimitobelus canhami* (Tate); Whitehouse, p. 35, pl. 11, figs. 1-7, 9-11.
v 1966 *Dimitobelus diptychus* (M'Coy); Ludbrook, p. 191, pl. 27, figs. 1-11.
?1966 *Dimitobelus canhami* (Tate); Skwarko, p. 124, pl. 15, figs. 13 and 14.

Type specimen. Holotype: NMV. P2177, Albian, Walker's Table Mountain, Queensland, Australia.

Material. Eleven fragmentary rostra from the (?)Upper Albian, Alexander Island: KG.1716.4, 1717.3, 5-7, 8A-D, 1719.24A, B, 1748.15, 16C. Two fragmentary rostra from the Albian-Cenomanian (Whisky Bay Formation), James Ross Island D.8403.35A, D.8410.64 (see text-figs. 1 and 2 for localities). Also the following from Australia: HM.S.8430-8477, S.5580-5588, Upper Albian, Woodduck Creek, S. Australia; BM.C.59263-59264, Albian, S. Australia; GSSA.M.2473-2476, Albian, Reedy Springs, S. Australia.

Diagnosis. Large, hastate *Dimitobelus*. Outline symmetrical, hastate, apex mucronate. Profile asymmetrical, cylindriconical, venter commonly arched. Transverse sections depressed elliptical in stem region, subquadrate in alveolar region. Ventrolateral alveolar grooves extend for one third of the rostrum, lateral lines (*Doppellinien*) well developed, dorsally placed.

Dimensions.

	L	X	Dvmax	Dlmax
KG.1717.7	85·3	47·5	14·0	18·3
D.8410.64	—	—	14·1	18·3
NMV.P.2177	92·7	47·5	13·5	18·5
GSSA.M.2473	76·9	36·9	10·2	14·3
M.2476	79·3	33·9	11·3	16·2
HM.S.5581	54·5	26·0	8·4	11·8
S.5582	53·2	18·6	7·3	10·6
S.5583	47·7	23·3	6·9	9·8
S.5584	48·1	18·5	6·4	8·8

Description. Large, hastate *Dimitobelus*. Total length of the rostrum is approximately seven times Dv. The outline is symmetrical and hastate with Dlmax at approximately the mid-point of the rostrum, and the apex is mucronate. The profile is asymmetrical and cylindriconical, the venter commonly being flattened and arched, with a corresponding curvature of the dorsum. Where not arched the profile appears symmetrical. Transverse sections are depressed (Dlmax : Dvmax 1·4; text-fig. 5) and elliptical in the stem and apical regions, the venter and dorsum being flattened. The alveolar section is more compressed, approaching subquadrate.

Two deep, ventrolateral alveolar grooves extend adapically for one quarter to one third of the rostrum, curving dorsally to join the ventral-most lines of the well-defined *Doppellinien*. The dorsal-most lines commonly expand into dorsolateral alveolar depressions. The phragmocone is central to slightly dorsal in position, with a ventrally incurved protoconch, and penetrates one quarter of the rostrum. A pseudalveolus is common. The apical line is weakly cyrtolineate, and an apical canal is commonly developed.

Discussion. *D. diptychus* is described here for the first time outside Australia. It most closely resembles *D. stimulus* Whitehouse (from Australia and Antarctica) and *D. superstes* (Hector) (from

New Zealand). However, *D. stimulus* is more slender, less hastate, and weakly depressed (text-fig. 6) and *D. superstes* is more inflated with a pyriform alveolar section, although of a similar size.

D. diptychus was originally described as a species of *Belemnitella* by M'Coy (1867) who mistook its ventrolateral grooves for the dorsolateral depressions of *Belemnitella*. *Belemnites canhami*, a species described by Tate (1880), types: SAM.T.1324A–C, T.1326), and the type species of *Dimitobelus*, has subsequently been identified as a junior subjective synonym of *D. diptychus* (type specimen figured by Dorman and Gill 1959, pl. 8, figs. 1 and 2). Other specimens referable to *D. diptychus* include one example figured as *B. australis* (a species of *Peratobelus*) by Phillips (1870, pl. xvi, figs. 3 and 4 *non* 1 and 2) and those referred to *B. eremos* Tate (a species of uncertain affinities) by Etheridge 1902*a*, pl. vii, figs. 18–21: SAM.T.1311, 1312). The forms described by Skwarko (1966) from the Albian of the Australian Northern Territories are too poorly preserved to be assigned with certainty to this species.

Occurrence. *D. diptychus* is common in the late Albian of the Australian Rolling Downs Group (Whitehouse 1925; Ludbrook 1966), and has also been reported from the Cenomanian of the West Australian Carnarvon Basin (Stevens 1965). *D. diptychus* also occurs in both Alexander and James Ross islands. In Alexander Island it is known from a number of stations grouped around Pagoda Ridge (KG.1717–1719; text-fig. 1). Few other fossils have been found in association, but nearby at station KG.1718 ammonite fragments of the genus *Lechites* occur, indicative of the Upper Albian. *D. diptychus* is also known from north Succession Cliffs (KG.1748; text-fig. 1) where it occurs with the Albian bivalve *Birostrina*(?) cf. *concentrica* (Crame 1985). In James Ross Island, *D. diptychus* occurs as a derived fossil at the 1705 m level (text-fig. 3) with ammonites indicative of the Cenomanian (*Eucalycoceras* of Thomson 1982, 1984*b*), occurring some 180 m above *Lechites* similar to the Alexander Island examples.

Dimitobelus sp. nov. aff. *diptychus* (M'Coy, 1867)

Plate 22, figs. 2–5

aff. v* 1867 *Belemnitella diptycha* M'Coy, p. 356.
aff. v 1925 *Dimitobelus canhami* (Tate); Whitehouse, p. 35, pl. II, figs. 1–7, 9–11.
aff. v 1966 *Dimitobelus diptychus* (M'Coy); Ludbrook, p. 191, pl. 27, figs. 1–11.

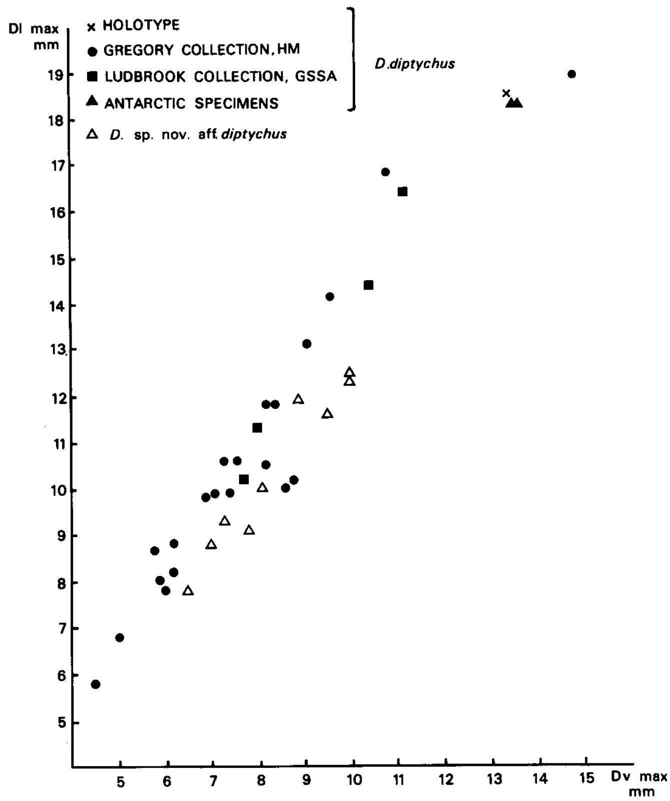
Material. Twenty-two rostra and rostral fragments: D.8232.96A–F, 114A–F, 125A, B, 136A–G, and (?)D.427.1A–C, Campanian (Marambio Group), James Ross Island (text-fig. 2).

Dimensions.

	L	X	Dvmax	Dlmax
D.8232.136A	47·0	21·7	8·9	11·9
D.8232.125B	44·7	17·4	10·0	12·5
D.8232.136B	41·7	18·0	7·8	9·1
D.8232.136C	43·1	23·1	8·1	10·0
D.8232.136D	36·2	21·0	7·3	9·3
D.8232.125A	46·5	14·5	9·6	—
D.8232.96A	44·7	18·2	11·9	—

Description. Medium sized, hastate *Dimitobelus*. The outline is symmetrical and hastate, with a mucronate or obtuse and rounded (e.g. D.8232.125B, 114A) apex. The profile is almost symmetrical and hastate to subhastate, with some bulbous individuals displaying an inflated venter and dorsum. Transverse sections are depressed (Dlmax : Dvmax 1·3; text-fig. 5) and elliptical, becoming very depressed close to the alveolar region, where the venter is flattened. Ventrolateral alveolar grooves are not preserved in these specimens, although the *Doppellinien* are well developed and dorsally placed. The apical line is weakly cyrtolineate, and an apical canal is commonly developed.

Discussion. The description is based on twenty-two rostra, none of which have their alveolar regions preserved. A single alveolar fragment (D.427.1A; Pl. 22, fig. 5) was found in association with stem and apical fragments of juveniles similar to those of *D*. sp. nov. aff. *diptychus* from locality D.8232, west of Lachman Crags (text-fig. 2). This fragment has a similar transverse section to the juveniles in its stem region, becoming attenuated adorally. It possesses two ventrolateral alveolar grooves



TEXT-FIG. 5. Relationship of maximum diameters in *Dimitobelus diptychus* (M'Coy) and *D.* sp. nov. aff. *diptychus* (M'Coy).

that parallel the venter before curving dorsally at the stem region. The rostra described above greatly resemble the Albian-Cenomanian *D. diptychus* (M'Coy) in shape and form, although differing by possession of a more depressed anterior. If the alveolar fragment from Lachman Crags proves representative of the alveolar region of *D.* sp. nov. aff. *diptychus*, it will be necessary to separate this form from the true *D. diptychus*. However, until further collecting can be completed, this cannot be done with certainty.

The alveolar fragment found at Lachman Crags closely resembles that of *D. hectori* Stevens from the Maastrichtian (Haumurian) of New Zealand (Stevens 1965, pl. 25, fig. 21). However, the rostrum of this species differs from *D.* sp. nov. aff. *diptychus* in possessing an almost circular, undepressed transverse section.

Occurrence. D. sp. nov. aff. *diptychus* is unique to James Ross Island and occurs at the 2560–2600 m level in the composite section (text-figs. 2 and 3) in associaton with the ammonites *Anapachydiscus*, *Gaudryceras varagurense* var. *patagonicum*, *Baculites*, and *Bostrychoceras*. A general age of Campanian has been suggested for this fauna (Olivero 1984; Thomson 1984*b*). The alveolar fragment from Lachman Crags (D.427.1A; text-fig. 2) was found in association with the Campanian ammonite *Maorites seymourianus* (Spath 1953, p. 24).

Dimitobelus stimulus Whitehouse, 1925

Plate 22, figs. 11–15

1924 *Dimitobelus simulus* Whitehouse, p. 412.
v* 1925 *Dimitobelus stimulus* Whitehouse; Whitehouse, p. 35, pl. II, figs. 8, 12–17.
v 1966 *Dimitobelus stimulus* Whitehouse; Ludbrook, p. 192, pl. 27, figs. 12–21.

Type specimens. Holotype: HM.S5592. Paratypes: HM.S.5589–5591, 5593, 5594. Upper Albian, Woodduck Creek, Lake Eyre, S. Australia.

Material. One natural mould; KG.1680.55, Albian, Alexander Island. Three rostra: D.8212.253, 8403.46, 8422.94, Albian (Kotick Point Formation), James Ross Island (text-figs. 1 and 2). Also the following from Australia: HM.S.8478–8532, Upper Albian, Woodduck Creek, Lake Eyre, S. Australia; GSSA.M.2484, 2485, 2488, Albian, Reedy Springs, S. Australia.

Diagnosis. Medium sized, slender, subhastate *Dimitobelus*. Outline symmetrical, subhastate. Profile symmetrical, subhastate. Transverse sections elliptical. Lateral lines (*Doppellinien*) well developed, centrally placed.

Dimensions.

	L	X	Dvmax	Dlmax
KG.1680.55	53·4	25·6	—	7·5
D.8403·46	39·8	22·2	7·0	8·4
D.8212.253	64·7	32·2	6·3	7·4
GSSA.M.2485	59·0	30·6	9·1	10·2
M.2484	60·5	27·2	7·6	9·1
M.2488	55·3	26·3	6·9	8·2
HM.S.5592	49·7	19·5	6·2	7·2
S.5591	50·8	17·8	6·9	8·2
S.5590	67·1	25·4	8·4	10·0
S.5589	72·7	25·7	9·5	—
S.5593	48·7	21·2	5·9	7·2
S.5594	47·1	18·6	5·0	6·0

Description. Medium sized, subhastate *Dimitobelus*. The total length of the rostrum is approximately nine times Dv. The outline is symmetrical and subhastate, with Dlmax approximately at the mid-point, or nearer the apex of the rostrum. The apex is non-mucronate and acute. The profile is symmetrical and subhastate, with dorsum and venter slightly inflated. Transverse sections weakly depressed and almost perfectly elliptical, with no perceptible flattening (Dlmax : Dvmax 1·2; text-fig. 6). However, the alveolar region may be more depressed.

Where present, two ventrolateral grooves extend for one quarter of the rostrum, but quite often the grooves are lost through formation of the pseudalveolus. The grooves curve dorsally to join the ventral-most line of the centrally positioned *Doppellinien*. The dorsal-most line may expand into a shallow, dorsolateral depression, but this is also lost in specimens possessing a pseudalveolus. The form of the phragmocone is difficult to assess due to the frequent development of a pseudalveolus and *Nadelspitze* in this species, but it apparently penetrates one quarter of the rostrum. The apical line is weakly cyrtolineate, and an apical canal is common.

Discussion. Dimitobelus stimulus commonly occurs in some numbers with *D. diptychus* (M'Coy) in the Australian Great Artesian Basin, and is here described for the first time outside Australia.

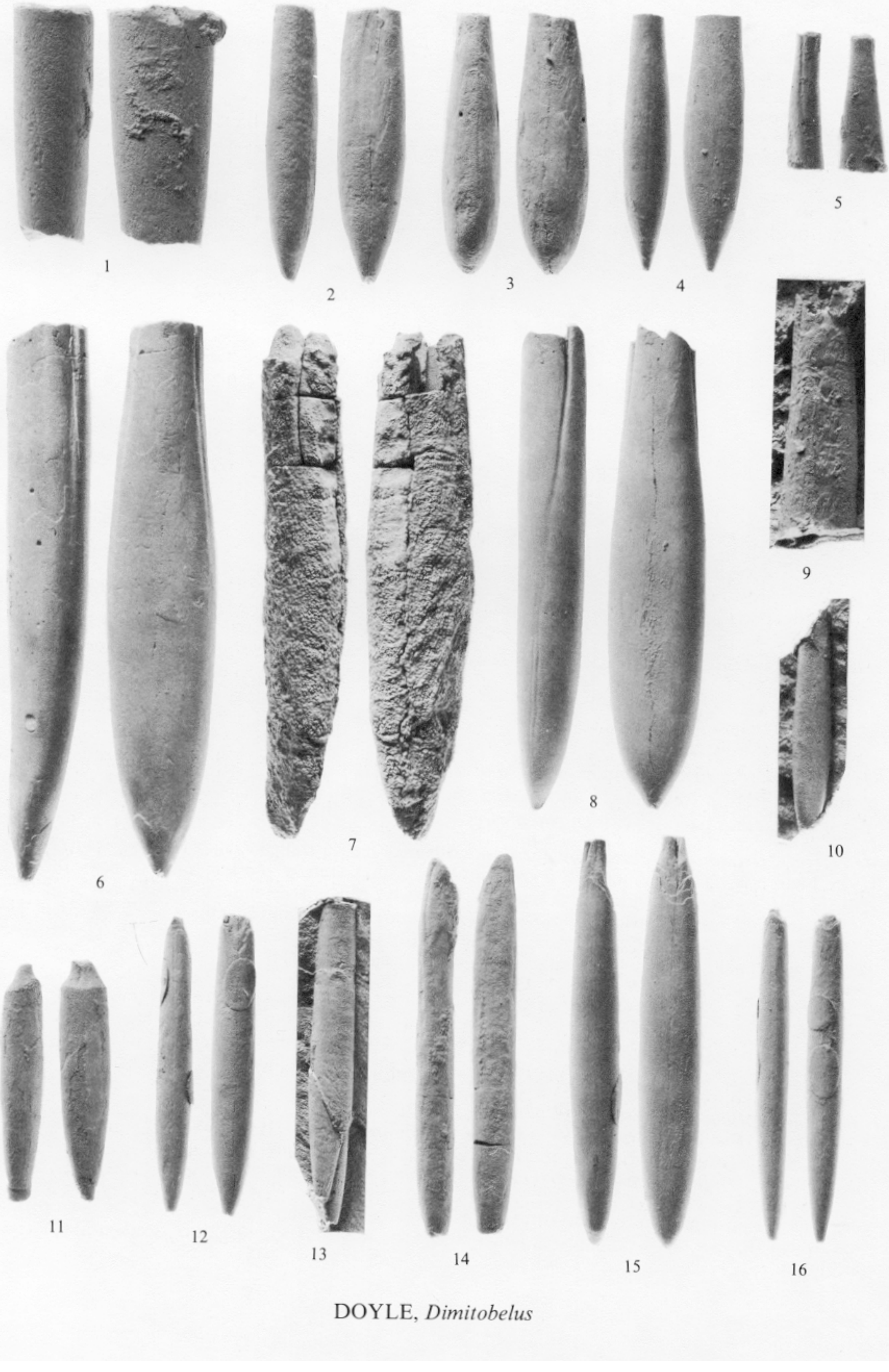
EXPLANATION OF PLATE 22

Figs. 1, 6–10. *Dimitobelus diptychus* (M'Coy). 1, 6–8, right profiles and ventral outlines. 1, Albian–?Cenomanian, James Ross Island. D.8410.64, ×1. 6, plaster cast of holotype, Albian, Queensland, Australia. NMV.P.2177, ×1. 7, Albian, Alexander Island. KG.1717.7, ×1. 8, Albian, South Australia. GSSA.M.2476, ×1. 9, silicone rubber cast, ventral outline, Albian, Alexander Island. KG.1748.16C, ×1. 10, juvenile, silicone rubber cast, (?)ventral outline, Albian, Alexander Island. KG.1748.15, ×1.

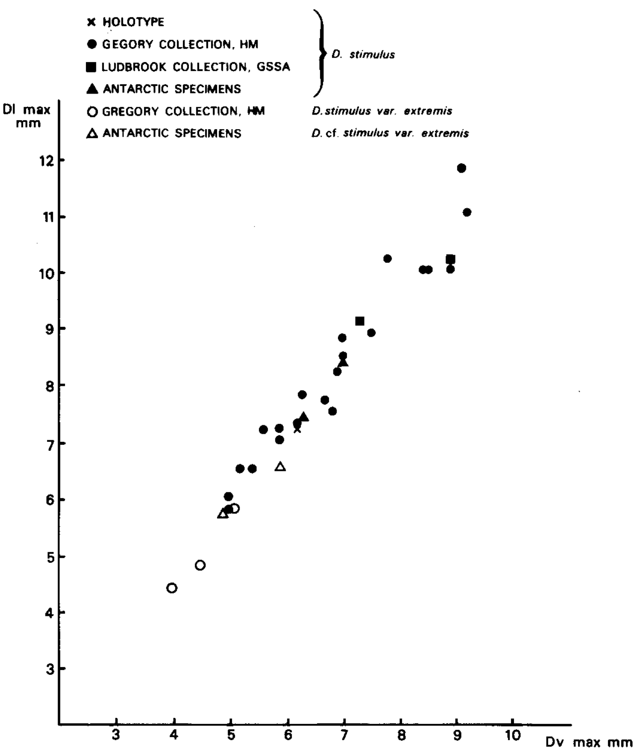
Figs. 2–5. *D.* sp. nov. aff. *diptychus* (M'Coy). Campanian, James Ross Island, left profiles and ventral outlines. 2, D.8232.136A, ×1. 3, D.8232.125B, ×1. 4, D.8232.136C. ×1. 5, D.427.1A, ×1.

Figs. 11–15. *D. stimulus* Whitehouse. 11, specimen with pseudalveolus, left profile and ventral outline, Albian, James Ross Island. D.8403.46, ×1. 12, holotype, right profile and ventral outline, Albian, South Australia. HM.S.5592, ×1. 13, Silicone rubber cast, (?)ventral outline, Albian, Alexander Island. KG.1680.55, ×1. 14, left profile and ventral outline, Albian, James Ross Island. D.8212.253, ×1. 15, right profile and ventral outline, Albian, South Australia. HM.S.5590, ×1.

Fig. 16. *D. stimulus* var. *extremis* Whitehouse. Albian, South Australia. Lectotype, right profile and ventral outline. HM.S.5595, ×1.



DOYLE, *Dimitobelus*



TEXT-FIG. 6. Relationship of maximum diameters in *Dimitobelus stimulus* Whitehouse and *D. stimulus* var. *extremis* Whitehouse.

D. stimulus resembles juveniles of *D. diptychus*, but can easily be distinguished by its elliptical transverse section (text-figs. 5 and 6) and subhastate profile. Most other *Dimitobelus* species are more robust and hastate than *D. stimulus*.

Occurrence. *D. stimulus* is known from the Upper Albian of the Australian Rolling Downs Group (Whitehouse 1925; Ludbrook 1966). In Antarctica it is known from both Alexander and James Ross islands. In Alexander Island, *D. stimulus* has been found at Keystone Cliffs with Albian ammonites (*Phyllopachyceras*, ?*Antarcticoceras*, and *Silesites*) and bivalves (*Birostrina*? cf. *concentrica*, *Inoceramus* sp. aff. *comancheanus*, *I.* cf. *anglicus elongatus*) (Thomson 1974; Crame 1985). In James Ross Island it occurs at the 920-950 m level in the composite section with similar Albian ammonites and bivalves (text-fig. 3; Table 2).

Dimitobelus cf. *stimulus* var. *extremis* Whitehouse, 1925

Plate 22, fig. 16; Plate 23, figs. 1 and 2

cf. *1924* *Dimitobelus extremus* Whitehouse, p. 412.
cf. v* 1925 *Dimitobelus stimulus* var. *extremis* Whitehouse, p. 35, pl. II, figs. 18-20.
cf. *1966* *Dimitobelus stimulus* var. *extremis* Whitehouse; Ludbrook, p. 192.
v 1972 *Dimitobelus macgregori* (Glaessner); Willey, p. 33, fig. 3*d*.

Material. Two rostra from the late Aptian-Albian, Alexander Island: KG.10.41, 1721.24. Two rostra from the Albian (Kotick Point Formation), James Ross Island: D.8403.35B, 8212.132 (see text-figs. 1 and 2 for localities).

Dimensions.

	L	X	Dvmax	Dlmax
KG.10.41	61·5	22·1	—	5·4
D.8403.35B	68·1	20·7	4·9	5·7
D.8212.132	—	—	5·9	6·5
HM.S.5595	54·6	24·0	5·1	5·8
HM.S.5596	—	—	4·5	4·8
HM.S.5597	—	—	4·0	4·4

Description. Medium sized, very slender, subhastate *Dimitobelus*. The total length of the rostrum is approximately ten times Dv. The outline is symmetrical and subhastate with Dlmax in the apical third of the rostrum, and the apex is acute. The profile is symmetrical (in stem and apical regions) and subhastate to cylindrical, but in specimens KG.10.41 and D.8403.35B there is a marked dorsal curvature of the alveolar region, giving the rostrum the general appearance of an antique firearm. Transverse sections are elliptical to subcircular (Dlmax : Dvmax 1·1; text-fig. 6) in stem and apical regions, approaching subquadrate in the alveolar region.

Two deep ventrolateral alveolar grooves join the ventral-most lateral lines of the *Doppellinien*. Some dorsolateral alveolar flattening may be present, extending from the dorsal-most lateral line. The *Doppellinien* are well defined and centrally positioned. In the two best preserved specimens, KG.10.41 and D.8403.35B, information is not available concerning the position of the alveolus. However, D.8212.132 displays a ventrally deflected apical line.

Discussion. Few specimens of *Dimitobelus stimulus* var. *extremis* have been described. Whitehouse (1925) based his description on three syntypes (HM.S.5595–5597) and four other fragmentary rostra (HM.S.8433–8436), and as such was unwilling to separate specifically these slender, almost cylindrical forms from *D. stimulus* s.s. The Antarctic specimens are very similar to the specimen designated as lectotype by Ludbrook (1966, p. 192: HM.S.5595), but they differ in the possession of a complete alveolar region, as all previously described specimens possess only a pseudalveolus. This alveolar region is somewhat unusual, with a distinctive curvature and subquadrate section, and assignment of these specimens with greater certainty to *D. stimulus* var. *extremis*, and the possible revision of its taxonomic status will have to await the discovery of more complete topotypes in Australia.

Specimen KG.10.41, previously considered by Willey (1972) as a typical *D. macgregori* (Glaessner) differs from the holotype of this species (MUGD.1876), which is much larger with a more hastate outline and depressed section (Glaessner 1945, pl. vi, fig. 12). The Antarctic specimen resembles much more closely the cylindrical, slightly depressed lectotype of *D. stimulus* var. *extremis*.

Occurrence. D. stimulus var. *extremis* occurs with *D. stimulus* Whitehouse in the Upper Albian of the Australian Rolling Downs Group (Whitehouse 1924; Ludbrook 1966). Like *D. stimulus*, the related form *D.* cf. *stimulus* var. *extremis* occurs in both Alexander and James Ross islands. However, *D.* cf. *stimulus* var. *extremis* is known from lower levels occurring with *Peratobelus* cf. *oxys* and the late Aptian or early Albian ammonites *Eotetragonites*, *Australiceras*, and *Aconeceras* in Unit A2 of Taylor *et al.* (1979) at Succession Cliffs (text-fig. 1) (Willey 1972; Thomson 1974; Taylor *et al.* 1979). In James Ross Island, *D.* cf. *stimulus* var. *extremis* was found at the 810–930 m levels in the composite section (text-fig. 2) with Albian ammonites (*Anagaudryceras buddha*, '*Pseudothurmannia*', and *Silesites*) and bivalves (*I.* cf. *sutherlandi*) (Ineson *et al.* 1986).

Dimitobelus praelindsayi sp. nov.

Plate 23, figs. 3–7

Type specimens. Holotype: D.8420.11A, Albian (Kotick Point Formation), Gin Cove area, James Ross Island. Paratypes: D.8212.265, Albian (Kotick Point Formation), Gin Cove area, James Ross Island; KG.1610.3, Albian (Fossil Bluff Formation), Hyperion Nunataks, Alexander Island (text-figs. 1 and 2).

Other material. Ten fragmentary rostra from the Albian (Kotick Point and Whisky Bay formations), James Ross Island: D.8403.35A, C–F, 48, 8420.56, 8, 31 (also (?)D.8420.7, 11B). Two fragmentary rostra from the Albian, Alexander Island: KG.1610.2, 1663.10 (text-figs. 1 and 2). Also a single specimen from the Lower Cretaceous of Cootanorina Station, S. Australia: BM.C.5311.

Derivation of name. Prae (Latin), before; *lindsayi*, a Campanian species of *Dimitobelus* that the new form resembles.

Diagnosis. Medium sized, hastate *Dimitobelus*. Outline symmetrical, hastate, Dlmax close to apex. Profile asymmetrical, cylindrical to subhastate. Transverse sections depressed elliptical (stem and apex) to pyriform (alveolar region). Long, straight ventrolateral alveolar grooves deflected dorsally in stem region.

Dimensions.

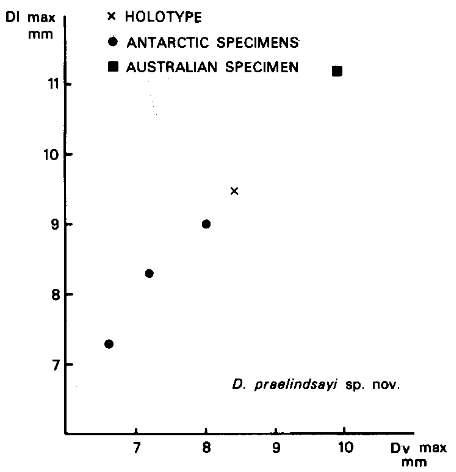
	L	X	Dvmax	Dlmax
D.8420.11A	50·2	14·2	8·4	9·5
D.8212.265	48·7	16·0	8·0	9·0
D.8420.5	33·9	15·3	7·2	8·3
KG.1610.3	59·8	—	—	—
BM.C.5311	59·2	25·2	9·9	11·2

Description. Medium sized, hastate *Dimitobelus*. Total length approximately six times Dv. The outline is symmetrical and hastate, with Dlmax close to the apex, producing a bulbous apical region. The profile is nearly symmetrical, and cylindrical to subhastate. Transverse sections of the rostrum are weakly depressed (Dlmax : Dvmax 1·1; text-fig. 7) and elliptical in the stem and apex, becoming more compressed and pyriform in the alveolar region, where the venter is flattened.

Two deep, straight ventrolateral grooves parallel the venter for the length of the alveolar region, curving dorsally at the stem region to join the *Doppellinien*. The ventrolateral grooves extend adapically for one half to two thirds the length of the rostrum. The lateral lines (*Doppellinien*) are faint. Pronounced dorsolateral alveolar flattened areas or depressions occur for the length of the alveolar region, and may also join the *Doppellinien*. The phragmocone is central or slightly dorsal in position, with a ventrally incurved protoconch, and penetrates one quarter of the rostrum. A pseudalveolus may be developed. The apical line is weakly cyrtolineate, and an apical canal is present in specimen BM.C.5311.

Discussion. Dimitobelus praelindsayi sp. nov. is relatively common in the Albian of the Antarctic Peninsula region, and, although possessing long straight ventrolateral grooves similar to those of *Peratobelus*(?) sp., is clearly a species of *Dimitobelus* due to its distinct depression and dorsally deflected grooves.

D. praelindsayi sp. nov. most closely resembles the New Zealand Campanian species *D. lindsayi* (Hector). Stevens (1965, p. 117) noticed this similarity when he suggested that specimen BM.C.5311, considered here a typical *D. praelindsayi* sp. nov., was identical to the New Zealand species. However, *D. praelindsayi* sp. nov. differs from *D. lindsayi* in possessing much longer ventrolateral



TEXT-FIG. 7. Relationship of maximum diameters in *Dimitobelus praelindsayi* sp. nov.

grooves and alveolar depressions, in addition to a squatter stem and apical region. *D. praelindsayi* sp. nov. is unlike most other species of *Dimitobelus* in possessing a much longer, pyriform alveolar region than is typical.

Occurrence. A single specimen of this species is known from the 'Lower Cretaceous' of South Australia. It occurs in some number in both James Ross and Alexander islands, where it occurs with Albian ammonites and bivalves (Tables 1 and 2); Thomson 1974; Crame 1985; Ineson *et al.* 1986.

Dimitobelus dayi sp. nov.

Plate 23, figs. 8–10

Type specimens. Holotype: BM.C.35019. Paratypes: BM.C.35010, 35002, 35000. Lower Cretaceous (?Albian) of the Hughenden area, North Queensland, Australia.

Other material. Thirteen rostra: BM.C.35001, 35003-35009, 35011-35018, 35020-35027. Lower Cretaceous (?Albian) of Hughenden, North Queensland, Australia.

Derivation of name. In recognition of Dr R. W. Day, who has discussed this species in manuscript.

Diagnosis. Medium sized, robust, hastate *Dimitobelus*. Outline symmetrical, hastate. Profile symmetrical, hastate. Apical region bulbous. Transverse sections elliptical to subcircular.

Dimensions.

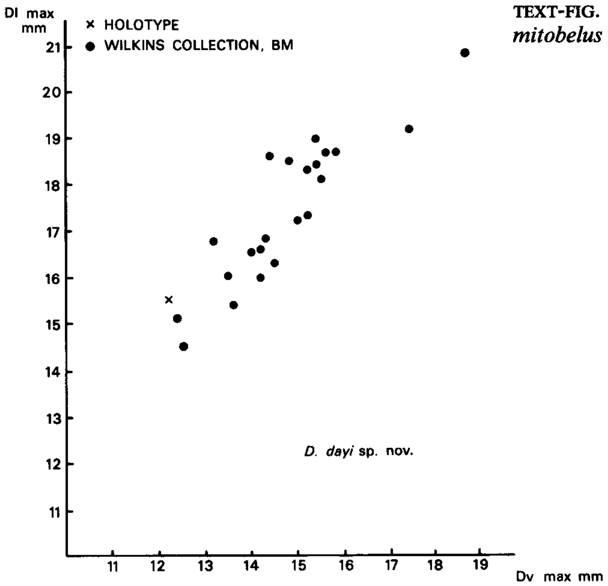
	L	X	Dvmax	Dlmax
BM.C.35019	60·7	20·1	12·2	15·5
C.35010	57·7	22·2	13·5	16·0
C.35002	57·8	20·5	18·6	20·8
C.35000	65·4	28·9	17·4	19·2
C.35003	52·5	19·6	14·2	16·0
C.35004	51·2	79·8	15·2	18·3
C.35005	64·4	23·1	14·3	16·8

Description. Medium sized, hastate *Dimitobelus*. The outline is symmetrical and hastate, with Dlmax in the posterior third of the rostrum. In more robust, rounded individuals, the hastation may be reduced. In some cases the apex may become attenuate, but it is usually obtuse. The profile is symmetrical to slightly asymmetrical, and hastate. The venter and dorsum are inflated to the same degree, but in some cases the venter is flattened. The transverse sections are elliptical (Dlmax : Dvmax 1·2; text-fig. 8), becoming more depressed adorally.

A pseudalveolus is often developed, so that the alveolar grooves are often lost. However, the holotype (BM.C.35019) displays dorsally deflected ventrolateral grooves that join the *Doppellinien*. This specimen also shows evidence of dorsolateral depressions continued from the dorsal-most lateral lines. The *Doppellinien* are often very incised (e.g. BM.C.35010). Because of the presence of a pseudalveolus it is difficult to comment on the phragmocone of this species. However, the apical line is cyrtolineate, and quite often an apical canal is developed.

Discussion. Dimitobelus dayi sp. nov. is based on specimens from the Wilkins Collection at the British Museum, from the Lower Cretaceous of the Hughenden region of Queensland. Dr R. W. Day of the Geological Survey of Queensland had previously identified this species as a variant of *D. diptychus* (M'Coy) from the Albian of Queensland (1969; R. W. Day, pers. comm. 1985), where it characterizes the base of the Albian Tambo fauna at various Queensland localities (R. W. Day, pers. comm. 1985). *D. dayi* sp. nov. is easily distinguished from *D. diptychus* as it possesses a much more inflated, bulbous rostrum, as compared with the depressed rostrum of the latter (text-figs. 5 and 8).

Occurrence. D. dayi sp. nov. is known from Australia, principally the Hughenden district of Queensland, where it was previously identified by Day (1969). Day recognized that this form occurs at the base of the Albian Tambo fauna in this region, occurring 12–15 m above the Aptian ammonite *Australiceras irregulare* (R. W. Day, pers. comm. 1985). The related form *D.* cf. *dayi* sp. nov. occurs in James Ross Island (see below).



TEXT-FIG. 8. Relationship of maximum diameters in *Dimitobelus dayi* sp. nov.

Dimitobelus cf. *dayi* sp. nov.

Plate 23, fig. 11

Material. One rostrum: D.8430.15, Albian (Whisky Bay Formation), James Ross Island (text-fig. 2).

Discussion. Specimen D.8430.15 resembles the holotype of *D. dayi* sp. nov. in possessing a moderately sized, robust, bulbous rostrum, with an obtuse to mucronate apex. It is slightly tectonically deformed, but possesses clear ventrolateral grooves (the position of which is confirmed by the preserved siphuncle) that are dorsally deflected to eroded lateral lines. The alveolar section is quadrate, similar to *D. dayi* sp. nov., and the specimen shows evidence of the development of a

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EXPLANATION OF PLATE 23

Figs. 1 and 2. *Dimitobelus* cf. *stimulus* var. *extremis* Whitehouse. 1, left profile and ventral outline, Albian, James Ross Island. D.8403.35B, × 1. 2, silicone rubber cast, oblique ventral outline, ?Aptian-Albian, Alexander Island. KG.10.41, × 1.

Figs. 3-7. *D. praelindsayi* sp. nov. 3-5, 7, left profiles and ventral outlines. 3, Albian, South Australia. BM.C.5311, × 1. 4, holotype, Albian, James Ross Island. D.8420.11A, × 1. 5, paratype, Albian, James Ross Island. D.8212.265, × 1. 6, paratype, silicone rubber cast, oblique dorsal outline, Albian, Alexander Island. KG.1610.3, × 1. 7, alveolar fragment, Albian, Alexander Island. KG.1610.2, × 1.

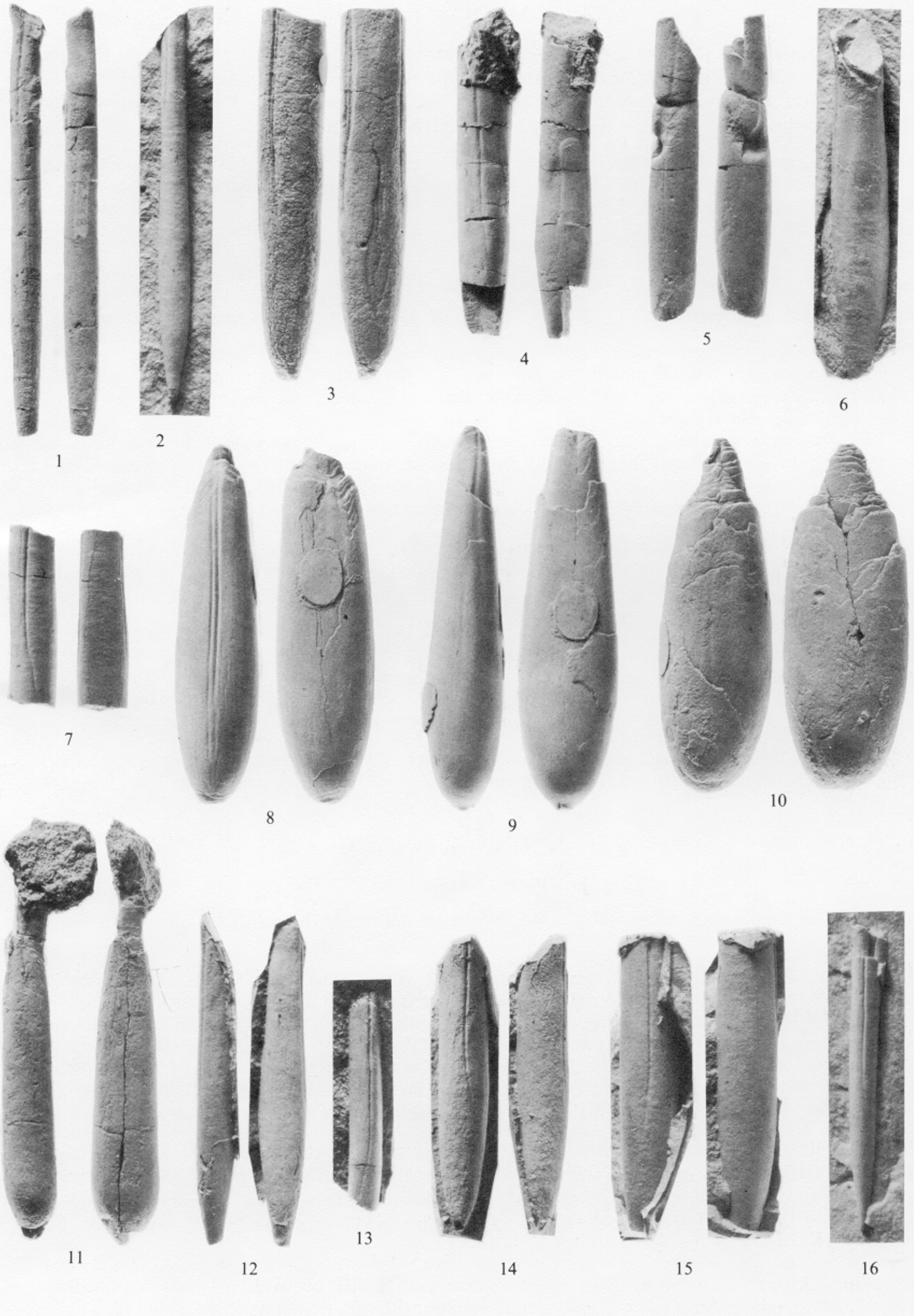
Figs. 8-10. *D. dayi* sp. nov. Albian, Queensland, Australia, right profiles and ventral outlines. 8, paratype. BM.C.35010, × 1. 9, holotype. BM.C.35019, × 1. 10, paratype. BM.C.35002, × 1.

Fig. 11. *D.* cf. *dayi* sp. nov. Albian-(?)Cenomanian, James Ross Island, left profile and ventral outline. D.8430.15, × 1.

Figs. 12 and 13. *D.* sp. nov. A. Albian, Alexander Island. Silicone rubber casts. 12, left profile and ventral outline. KG.1663.13, × 1. 13, right profile. KG.1663.14, × 1.

Figs. 14 and 15. *D.* sp. nov. B. Albian, Alexander Island. Silicone rubber casts. 14, left profile and ventral outline. KG.1663.11, × 1. 15, right profile and ventral outline. KG.1748.20, × 1.

Fig. 16. *D.* sp. nov. C. Albian, Alexander Island. Silicone rubber cast, left profile. KG.1658.16, × 1.



DOYLE, *Dimitobelus*

pseudalveolus. However, owing to the slightly tectonized nature of the rostrum, and the position of Dlmax very close to the apex, this specimen cannot be definitely assigned to *D. dayi* sp. nov.

D. cf. *dayi* sp. nov. also resembles the more bulbous specimens of *D.* sp. nov. aff. *diptychus* (M'Coy), but differs by possessing a compressed alveolar section.

Occurrence. The single specimen of *D.* cf. *dayi* sp. nov. occurs in James Ross Island at the 1540 m level in the composite section (text-figs. 2 and 3) with inoceramids possibly indicative of a later Albian age (Table 2; Crame 1985; Ineson *et al.* 1986).

Dimitobelus sp. nov. A

Plate 23, figs. 12 and 13

Material. Four natural moulds: KG.1663.13, 14, 1680.69, 1728.16, Albian, Alexander Island (see text-fig. 1).

Description. Medium sized, slender, subhastate *Dimitobelus*. The outline is symmetrical and subhastate, with very regular, straight laterals anterior to the apex. The profile is almost symmetrical, and cylindrical to subhastate. Transverse sections are elliptical in the stem and apical regions, becoming pyriform in the alveolar region, with a broad flat venter.

The ventrolateral grooves are deep and well developed, extending to just past the mid-point of the rostrum before being deflected towards the dorsum. Lateral lines are difficult to distinguish on casts, and in specimen KG.1663.13 the deflection of the ventrolateral grooves is barely perceptible, so that it resembles *P.* cf. *oxys* (Tenison-Woods). The form of the phragmocone and apical line are unknown in these casts and moulds.

Discussion. D. sp. nov. A is a slender conical form that closely resembles *P.* cf. *oxys*. However, for the most part *D.* sp. nov. A has a clearly defined dorsal curvature of its grooves, and the depressed section characteristic of *Dimitobelus*. It is easily distinguised from the other Albian *Dimitobelus* due to its flat venter and distinctive anterior.

Occurrence. D. sp. nov. A is restricted to Alexander Island where it occurs with *D. praelindsayi* sp. nov. and Albian ammonites and bivalves at Stephenson Nunatak (text-fig. 1; Table 1; Taylor *et al.* 1979; Crame 1985).

Dimitobelus aff. sp. nov. A

Material. A single natural mould with a rather more robust profile than is normal in *D.* sp. nov. A: KG.1721.27, Mount Phoebe, Alexander Island, occurring with the Albian bivalve *Birostrina*? cf. *concentrica* (Table 1; Crame 1985).

Dimitobelus sp. nov. B

Plate 23, figs. 14 and 15

Material. One fragmentary rostrum: KG.1748.20, one natural mould: KG.1663.11. Albian, Alexander Island (text-fig. 1).

Description. Medium sized, robust, subhastate to cylindrical *Dimitobelus*. The outline is symmetrical and subhastate to cylindrical, and the profile is generally similar. The transverse sections are slightly depressed and elliptical to subcircular. Two deep ventrolateral alveolar grooves extend for approximately one half of the length of the rostrum, where they are deflected dorsally close to the apex of the rostrum. *Doppellinien* are not well developed, but there is evidence of some shallow dorsolateral depressions. The apex of specimen KG.1663.11 exhibits some striations, but this may be due to the erosion of the apex. The phragmocone penetrates an estimated one third of the rostrum, and the apical line is ventrally displaced.

Discussion. Dimitobelus sp. nov. B is a robust form, most closely resembling *D. kleini* (Gürich) from the White Cliffs of W. Australia (Gürich 1901, p. xix, fig. 2, and topotypes BM.C.12086 and 20248) in the length of its grooves and its conical apex. However, *D.* sp. nov. B differs from *D. kleini* in possessing a depressed transverse section, and from most other species of this genus due to its robust form.

Occurrence. Like *D.* sp. nov. A, *D.* sp. nov. B occurs with Albian bivalves and ammonites at Stephenson Nunatak, Alexander Island (Table 1; Thomson 1974; Crame 1985).

Dimitobelus sp. nov. C

Plate 23, fig. 16

Material. One natural mould: KG. 1658.16, Albian, Alexander Island (text-fig. 1).

Dimensions. L, 47·9; X, 18·7; Dvmax, approx. 4·0; Dlmax, 4·5.

Description. Medium sized, slender, subhastate *Dimitobelus*. The outline is symmetrical and subhastate, with Dlmax close to the apex, and with straight laterals anterior to the apical region. The profile is asymmetrical and cylindriconical to subhastate. The transverse sections are slightly depressed (Dlmax : Dvmax approx. 1·1), elliptical in the apical region, becoming compressed and subquadrate in the stem and alveolar regions.

Two rather sinuous ventrolateral alveolar grooves extend for approximately one half of the rostrum, where they curve gently towards the dorsum, joining faint lateral lines.

Discussion. D. sp. nov. C is unlike most other species of *Dimitobelus* as it is slender, with a compressed alveolar section. *D. stimulus* var. *extremis* Whitehouse approaches it in slenderness, but does not possess the long compressed alveolar region of *D.* sp. nov. C. *T. whitehousei* sp. nov. is also similar, but this species does not have the depressed apical region characteristic of *D.* sp. nov. C.

Occurrence. D. sp. nov. C occurs with the biostratigraphically undiagnostic ammonites *Lytoceras* and *Hypophylloceras* at Hyperion Nunataks, Alexander Island (text-fig. 1; Table 1). However, the related form *D.* aff. sp. nov. C. has been found with the Albian bivalve *B.*? cf. *concentrica* at Succession Cliffs (text-fig. 1; Table 1).

Dimitobelus aff. sp. nov. C

Material. A single natural mould with a markedly pyriform alveolar region, although as slender as *D.* sp. nov. C: KG.1746.1, Alexander Island, occurring with the Albian bivalve *B.*? cf. *concentrica* (Table 1; Crame 1985).

Dimitobelus(?) spp.

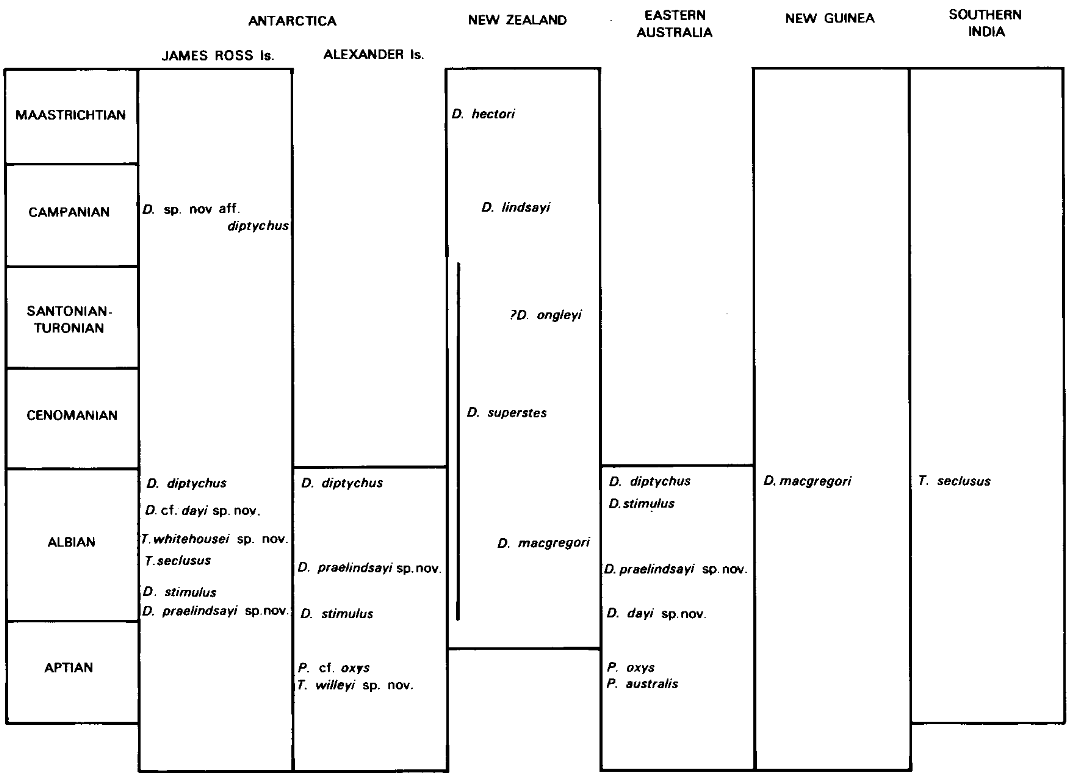
Material. Twelve otherwise unidentifiable alveolar fragments from Alexander Island: KG.10.28, 1687.22, 1721.25, 26, 1610.1, 1748.1, 17, 1681.1, 1658.13B, 1609.7, 1617.3, 1737.21. One alveolar fragment with a markedly quadrate transverse section and dorsally deflected ventrolateral grooves: KG.1657.28. Localities are given in text-fig. 1, and associated faunas are given in Table 1.

RANGE AND DISTRIBUTION OF THE DIMITOBELIDAE

The Dimitobelidae may have evolved from a southern endemic stock of the Tethyan belemnopseid *Hibolithes* in the later early Cretaceous, as this genus possesses well-developed *Doppellinien*, and an often reduced single ventral alveolar groove (see Doyle (in press) for further discussion). The family remained endemic to within the 30° S. palaeolatitude, and 'counterbalanced' the Belemnitellidae which were restricted to the Boreal Realm in the north (this family may also have evolved from endemic northern stocks of *Hibolithes*, Doyle, in press).

The Dimitobelidae first appeared in the Aptian, with *Peratobelus* and *Tetrabelus*. *Peratobelus* is known from Australia and Antarctica (it has also been listed from Southern Mozambique (Wachendorf 1967)), and both regions share forms referable to *P. oxys* (Tenison-Woods), while *Tetrabelus* is only known in Antarctica with the single species *T. willeyi* sp. nov. (Stevens 1973; Doyle 1985*b*) (text-fig. 9). The supposed late Neocomian beds that have yielded dimitobelids (principally *Peratobelus*) in the Australian Northern Territory (Skwarko 1966) are now considered to be of Aptian age on other faunal evidence, principally the occurrence of the ammonite *Australiceras* (Day 1969, p. 154).

By the Albian, *Peratobelus* was replaced by *Dimitobelus*, the first representatives of which probably appeared in the late Aptian or early Albian. *Dimitobelus* is recorded from Antarctica, New Zealand, Australia, New Guinea, and possibly South America (Whitehouse 1924, 1925; Glaessner 1945, 1958; Stevens 1965; Willey 1972; Pettigrew and Willey 1975; Doyle 1985*b*). Faunal links between Australia and Antarctica at this time are indicated by the presence of *D. diptychus* (M'Coy), *D. stimulus* Whitehouse, *D. praelindsayi* sp. nov., and *D. dayi* sp. nov. in both regions (text-fig. 9). Although apparently close to possible migration routes, New Zealand *Dimitobelus* are distinct and probably endemic, remaining so from the Albian to the Maastrichtian (Stevens 1965) (text-fig. 9). *Tetrabelus* survived into the Albian, and increased its range and diversity, occurring in Antarctica, southern India, and possibly the Malagasy Republic (Blanford 1861; Lemoine 1906; Spengler 1910; Doyle 1985*b*). Close faunal links between Antarctica (James Ross Island) and southern India (also possibly the Malagasy Republic), are indicated by the occurrence of the single species *T. seclusus* (Blanford) in these regions (Doyle 1985*b*) (text-fig. 9). Therefore, in the Albian, two distinct distributions became apparent, indicated by the occurrence of *Dimitobelus* (circum-Gondwanian) and *Tetrabelus* (trans-Gondwanian) (Doyle 1985*b*).



TEXT-FIG. 9. Distribution of the Dimitobelidae. Diagram not to scale.

Few dimitobelids have been described from post-Albian sediments, but circum-Gondwanian links were maintained at least into the Cenomanian, and *Dimitobelus* is known from Antarctica, New Zealand, Australia, and possibly New Guinea (Stevens 1973; Doyle 1985*b*). However, no further trans-Gondwanian dimitobelids are known after the last appearance of *Tetrabelus* in the late Albian-Cenomanian (Doyle 1985*b*). In the Coniacian-Santonian interval, *Dimitobelus* is known only from New Zealand (Stevens 1965), but in the Campanian, a single form is known from James Ross Island (*D.* sp. nov. aff. *diptychus* (M'Coy)) in addition to *D. lindsayi* (Hector) from New Zealand (text-fig. 9). The last dimitobelid to appear is *D. hectori* Stevens from the Maastrichtian (Haumurian) of New Zealand (Stevens 1965).

CONCLUSIONS

1. The family Dimitobelidae consists of three genera; *Peratobelus* Whitehouse (Aptian), *Tetrabelus* Whitehouse (Aptian-(?)Cenomanian), and *Dimitobelus* Whitehouse (= *Cheirobelus* Whitehouse) ((?)late Aptian/Albian-Maastrichtian) which were all restricted to within the 30° S. Cretaceous palaeolatitude.

2. In the Aptian-Albian fore-arc and back-arc sediments of the Antarctic Peninsula region a relatively diverse fauna of *Peratobelus*, *Tetrabelus*, and *Dimitobelus* occur. In no other Gondwanian region do all three genera occur together.

3. *Peratobelus* is known from the Aptian sediments of Alexander Island and Australia, and both regions share similar species (e.g. *P. oxys* (Tenison-Woods)).

4. *Dimitobelus* from the Albian sediments of James Ross Island have considerable affinities to those of Alexander Island and Australia. However, they do not resemble the New Zealand *Dimitobelus* which were probably endemic to this region. *D.* sp. nov. aff. *diptychus* (M'Coy) from James Ross Island and *D. lindsayi* (Hector) from New Zealand are the only Campanian *Dimitobelus* so far known.

5. *Tetrabelus* is known from Aptian sediments only in Alexander Island, where *T. willeyi* sp. nov. occurs. In the Albian the single species *T. seclusus* (Blanford) is known from James Ross Island and southern India, but not from Alexander Island. *T. whitehousei* sp. nov. is apparently endemic to James Ross Island in the Albian.

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Note added in proof. Since completion of this paper, Dr J. A. Crame has collected fourteen additional specimens of *T. willeyi* sp. nov. (KG.3401.223, 227, 618, 619, 621, KG.3403.218–221, 224, 225, 229, 230, 232) of possible Aptian age from Spartan Cwm, Alexander Island (71° 04′ S., 68° 25′ W., 10 km north-west of Succession Cliffs). Dimensions of KG.3403.229: L, 38·4; Dv, 5·7; Dl, 5·2.