BELEMNITES FROM SOUTH-EASTERN ALEXANDER ISLAND: I. THE OCCURRENCE OF THE FAMILY DIMITOBELIDAE IN THE LOWER CRETACEOUS

By L. E. WILLEY

ABSTRACT. Five species of the family Dimitobelidae (Belemnoidea) are described from sediments of Lower Cretaceous age on the south-eastern coast of Alexander Island. *Peratobelus* is described for the first time from outside Australia. Two species appear to be new but they are not considered to be preserved sufficiently well to be formally described. The stratigraphical distribution of this family in Alexander Island is discussed.

BELEMNITES were first collected from the marine sediments of south-eastern Alexander Island (Fig. 1) by members of the southern sledge party of the British Graham Land Expedition, 1934–37, when visiting both Fossil Bluff and Ablation Point. They collected plants and a varied molluscan fauna including several poorly preserved belemnite guards. Additional belemnites were collected by V. E. Fuchs and R. J. Adie of the Falkland Islands. Dependencies Survey during the summers of 1948–49 and 1949–50 from several other localities in this area (Adie, 1962, p. 33, 1964, p. 310–11; Stevens, 1967, p. 365). Through the courtesy of Dr. M. K. Howarth, both collections (housed at the British Museum (Nat. Hist.)) have been made available to the author. More recently, detailed palaeontological–stratigraphical investigations have been undertaken by members of the British Antarctic Survey, notably B. J. Taylor and M. R. A. Thomson, both of whom have made available their belemnite collections and field notes. Further material was collected by the author in 1967–68 and by M. H. Elliott in 1969–70. This paper, the first of a series describing these collections, deals with the belemnites collected from Waitabit Cliffs and Succession Cliffs (Fig. 1).

The presence of the family Dimitobelidae in the Lower Cretaceous argillaceous sediments of south-eastern Alexander Island is of considerable significance in assessing the relationship between the southern continents during the Lower Cretaceous. The family was first established by Whitehouse (1924) for a distinctive group of Cretaceous belemnites which is now known to occur mainly in Australia and New Zealand; isolated occurrences are also known from India (Blandford, 1861–65; Spengler, 1910) and New Guinea (Glaessner, 1945, 1958). A single specimen from North America (Jeletzky, 1950, p. 21) has subsequently been declared indeterminate (Stevens, 1965, p. 166).

In discussing the late Jurassic faunal affinities of New Zealand, western Antarctica and South America, Stevens (1967, p. 369–71) considered that belemnites would require an uninterrupted shelf sea in order to migrate and that deep-water rifts, other than of local extent, would probably halt even most groups of ammonite. The existence of continuous Mesozoic geosynclines between South America, the Antarctic Peninsula, New Zealand and Australia has been proposed by several authors (Hamilton, 1964; King and Downard, 1964). Elliot (1971, figs. 2 and 3) believed that in the Upper Jurassic these areas formed the compressive margin of a continental plate. Presumably, migration along this margin would enable the intermingling of faunas. The relative paucity of South American belemnoid species and the absence of the Dimitobelidae may be attributable to several factors, including inadequate palaeontological collecting, rather than a true indication of their absence. Climatic barriers may have prevented a northward migration of the family. Stevens (1965, p. 189) suggested that the belemnites were stenothermal with different temperature tolerances for different subfamilies.

Palaeotemperature results from New Zealand and Australian Dimitobelidae (Lowenstam and Epstein, 1954; Dorman and Gill, 1959; Bowen, 1961; Clayton and Stevens, 1965, 1968) have indicated a considerable range of sea-water temperatures. After plotting a graph of palaeotemperature against time for the Jurassic and Cretaceous belemnites of New Zealand and the Dimitobelidae of Australia, Clayton and Stevens (1968, p. 4) drew a curve for the minimum temperatures obtained. From a low of approximately 12° C in the Aptian, the curve indicates a slow rise in sea-water temperature through the Albian.

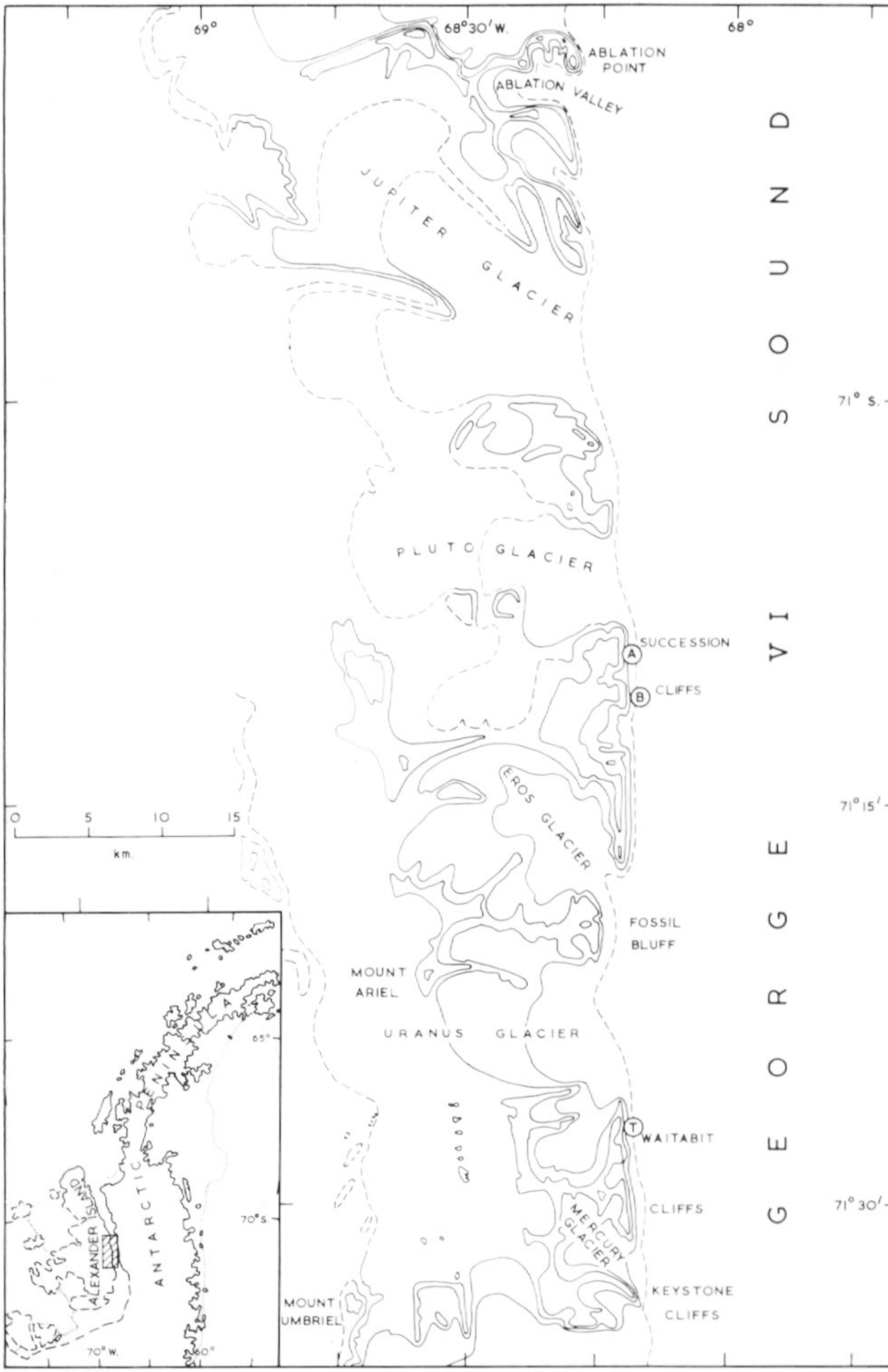

Fig. 1. Sketch map showing the location of the area discussed and the locations from which specimens of the family Dimitobelidae were obtained.

Palaeotemperatures, as recorded from Australian belemnites, were believed by Ludbrook (1966, p. 25) to represent temperatures existing at water depths in excess of 198 m., but Lowenstam and Epstein (1954, p. 243) concluded that most belemnites inhabited near-shore surface waters. From belemnite growth-ring analysis, Dorman and Gill (1959, p. 91, 94, text-fig. 7) and Clayton and Stevens (1965) recorded well-defined seasonal fluctuations in temperature, which Clayton and Stevens (1968) suggested would not be expected to occur at depths substantially below sea-level. On the basis of mean annual sea-water temperatures, they therefore correlated the environment of the Dimitobelidae with present-day areas between lat. 48° and 41°S., i.e. climates probably ranging from temperate to cool temperate (Stevens, 1963, p. 419). The difference between the palaeolatitudes for the Lower Cretaceous of, for example, the Great Artesian Basin, as indicated by oxygen-isotope determinations (lat. 41°–48°S.) and those derived from palaeomagnetic studies (lat. 55°–65°S.) (Irving, 1964, p. 230–33) can perhaps be explained by assuming that, as a polar ice sheet was probably absent during the Cretaceous, the temperate zone may have extended farther towards the Cretaceous South Pole than it does today.

Measurement of Belemnite Guards

The system of measurement for belemnite guards suggested by Avias (1953, p. 158–59) and adapted by Stevens (1965, p. 44–47) has been used in this study (Fig. 2).

The Alexander Island belemnites are generally not well preserved and complete specimens, from which a full range of measurements could be obtained, are rarely found in sufficient numbers to provide a satisfactory indication of the range of variation within a species. The following is a description of the symbols used:

L Total length, i.e. from the apex to a point where the sides of the guard intersect those of the phragmocone. This measurement can seldom be obtained as the anterior of the phragmocone is usually missing or is badly crushed.

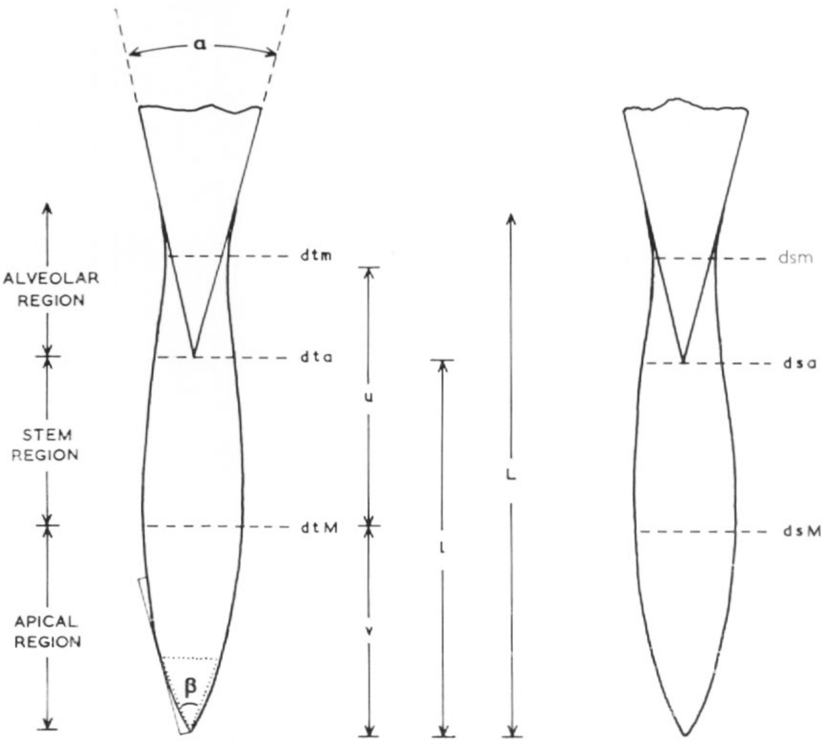

Fig. 2. Diagrammatic illustration of the outline (left) and profile (right) of a belemnite guard, indicating the symbols used in measurement. (Adapted from Avias (1953, p. 158–59) and Stevens (1965, p. 44–45).)

l	Distance from apex to protoconch (length of stem and apical regions).
dta, dsa	Transverse and sagittal diameters at the level of the protoconch, respectively.
dtM	Maximum transverse diameter.
dtm	Proximal minimum transverse diameter (in hastate forms).
dsM	Maximum sagittal diameter.
dsm	Proximal minimum sagittal diameter (in hastate forms).
v	Distance from apex to *dtM* (length of apical region of guard).
u	Distance between *dtM* and *dtm*, or in instances where *dtm* = *dta*, length of the stem region.
α, β	Alveolar and apical angles, respectively.

Systematic Descriptions

Family Dimitobelidae Whitehouse 1924

Genus *Dimitobelus* Whitehouse 1924

Type species: *Belemnites canhami* Tate 1880

Dimitobelus sp. aff. *Dimitobelus macgregori* (Glaessner 1945)

Figs. 3a–c and 5a–c

Material

Two fragmentary guards (KG.10.28 and 61), the second of which is almost complete in the stem and apical regions. Both specimens were obtained from locality A at Succession Cliffs (Fig. 1).

Age: Uppermost Aptian.

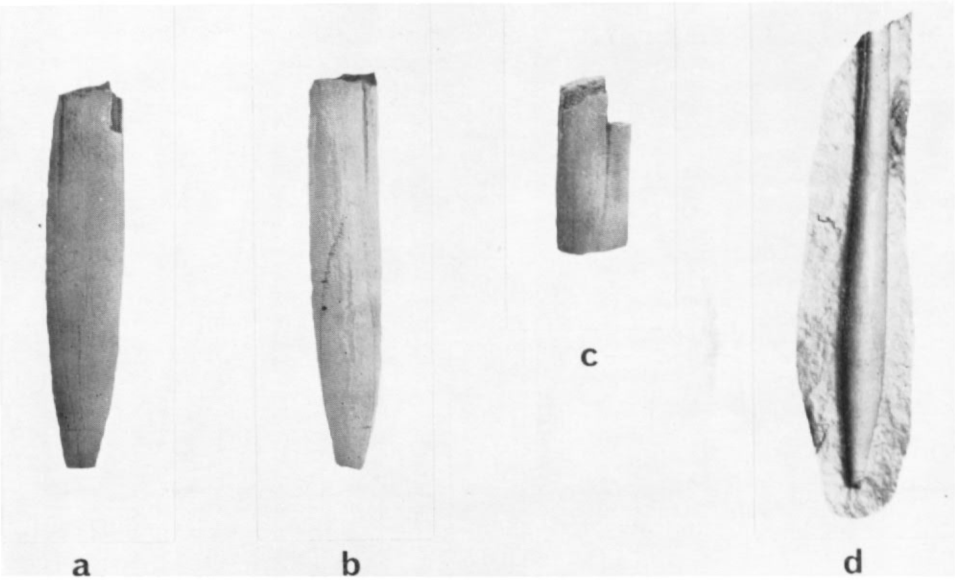

Fig. 3. a. *Dimitobelus* sp. aff. *D. macgregori* (Glaessner); ventral aspect of a guard showing the development of ventro-lateral grooves; ×1, coated (KG.10.61).
b. Right lateral aspect of the same specimen with one lateral groove visible at the alveolar end; ×1, coated (KG.10.61).
c. Right lateral aspect of a fragment from a larger specimen, showing the development of both ventro- and dorso-lateral grooves; ×1, coated (KG.10.28).
d. *Dimitobelus macgregori* (Glaessner); "Silastomer" cast from the natural mould of a guard preserved in a mudstone, showing the right ventro-lateral aspect and the development of a ventro-lateral groove; ×1 (KG.10.41).

Description

Specimen KG.10.61 (Fig. 3a) is a medium-sized clavate guard with an elongated apical region. Its outline is symmetrical and hastate, the position of maximum transverse inflation occurring at approximately the level of the apical end of the ventro-lateral grooves. Apically from this point, the sides of the guard converge gradually at first, then at a slightly steeper angle to produce a moderately acute apical region with an apical angle of approximately 30°. The apex of this guard has been broken and there is no apical perforation. The guard is about six to seven times as long as the maximum transverse diameter.

In profile the guard is slightly hastate and asymmetrical, the venter being flattened throughout the stem region (Fig. 3b). There is also lateral flattening in the upper stem region. Cross-sections of the upper stem and apical regions emphasize the depressed outline of the guard and the slight ventral position of the apical line throughout the stem and apical regions (Fig. 5b and c).

Well-defined and deeply incised ventro-lateral grooves (Fig. 5b) produce splitting surfaces (S) which extend a considerable distance into the guard. From the broken alveolar end, the grooves parallel the venter in the upper stem region before terminating approximately 45 mm. from the apex in a slight dorsal flexure; here the groove shallows markedly. In a second fragment from a larger specimen (KG.10.28; Fig. 3c), a dorso-lateral groove extends parallel to the dorsum and merges into the lateral flattened area in the upper stem region. The lateral lines are not easily differentiated because of considerable abrasion. From the apical end of the ventro-lateral groove, the ventro-lateral line maintains the slight dorsal flexure before reverting to a sub-parallel course and occupying a sub-central position on the lateral surface (Fig. 5a). It terminates approximately 15 mm. from the apex. The dorso-lateral line appears to continue linearly along the dorso-lateral surface and eventually disappears about 10 mm. from the apex.

Measurements

Specimen KG.10.61 has the following dimensions: $l = 70$ mm. (estimated), $dtM = 12 \cdot 8$ mm., $dsM = 11 \cdot 6$ mm. and $\beta = 30°$.

Remarks

The ventro- and dorso-lateral grooves and lines of the Alexander Island specimens are very similar to those developed in a specimen of *Dimitobelus* (*Tetrabelus*) *macgregori* from the Albian–Cenomanian of New Guinea (Glaessner, 1958, p. 219–22, pl. XXIV, fig. 5a and b). Specimen KG.10.28 would appear to represent a guard whose dimensions are similar to those of the New Guinea example, whereas specimen KG.10.61 possibly represents an immature specimen. Specimens of *D. macgregori* from the (?) Upper Albian–Lower Cenomanian of South Island, New Zealand (Stevens, 1965, p. 121–22, pl. 21, figs. 10–12, pl. 24, figs. 1–3, text-fig. 29c), are more closely comparable in size to specimen KG.10.61 and have similar developments of lateral lines and grooves. However, in the holotype of the species (Glaessner, 1945, p. 160, pl. 6, fig. 12a and b), the guard has a more elongate clavate outline with a highly constricted alveolar region, and the position of maximum transverse inflation occurs relatively closer to the apex than in the Alexander Island specimen.

Specimens of *D. superstes* (Hector) from the Middle and Upper Albian to Coniacian–Santonian of Clarence Valley, New Zealand (Stevens, 1965, p. 117–21, pl. 22, figs. 1–3, pl. 23, figs. 9–14), and one from the Cretaceous of South Island, New Zealand (Woods, 1917, p. 12, pl. V, fig. 5a–c), show some similarities to the Alexander Island specimens, as pointed out by R. G. Stevens (personal communication). However, the guard of *Dimitobelus* sp. aff. *D. macgregori* is comparatively slender and has a more elongate, moderately acute apex, whereas that of *D. superstes* is blunt and obtuse. Lateral flattening of the guard in the upper stem region does not appear to be developed in *D. superstes*. The apical termination of the ventro-lateral groove has a more distinct curve towards the mid-line of the flanks in the Alexander Island specimens than that developed in the New Zealand specimens.

Dimitobelus macgregori (Glaessner 1945)

Tetrabelus macgregori, Glaessner, 1945, p. 160, pl. 6, fig. 12a and b.

Dimitobelus (*Tetrabelus*) *macgregori* (Glaessner); Glaessner, 1958, p. 219–22, text-fig. 5, pl. 26, figs. 5 and 6.
Dimitobelus macgregori (Glaessner); Stevens, 1965, p. 121–22, pl. 21, figs. 10–12, pl. 24, figs. 1–3, text-fig. 29c.

Fig. 3d

Material

One partly eroded guard (KG.10.41), with phragmocone, embedded in a dark mudstone. The guard has been completely dissolved and a "Silastomer" mould was prepared to demonstrate lateral groove development. Obtained from locality A.
Age: Uppermost Aptian.

Description

Guard elongate and slender, the length being about 14 times the maximum transverse diameter. The outline is symmetrical and markedly hastate (Fig. 3d), the maximum transverse diameter occurring towards the apical end of the guard. Apically from this point, the sides converge at a moderate rate producing a slightly elongate apex with an apical angle of 25°. The sides converge slowly towards the alveolar region and the position of minimum transverse diameter corresponds approximately with that of the level of the protoconch. Slight ventral flattening occurs in the alveolar region. The dorsal surface of this specimen has been dissolved and the profile can only be surmised as being hastate with a centrally placed apex. Cross-sections throughout the length of the guard appear to be depressed. The alveolus is circular in cross-section and has an alveolar angle of about 22°, terminating in a centrally placed protoconch. Observed during the systematic dissolving of the guard, an apical canal parallels the central apical line and terminates in an apical perforation. Deeply incised ventro-lateral grooves, accompanied by splitting surfaces, commence at the anterior end of the specimen, extend through the alveolar region and, at about the level of the protoconch, swing dorsally and shallow rapidly before being lost on the flanks. No dorso-lateral grooves or lateral lines are preserved.

Measurements

Specimen KG.10.41 has the following dimensions: $L = 70$ mm. (estimated), $l = 51{\cdot}5$ mm., $v = 18{\cdot}9$ mm., $u = 32{\cdot}6$ mm., $dtM = 5{\cdot}1$ mm., $dtm = 3{\cdot}4$ mm., $u/v = 1{\cdot}725$, $\alpha = 22°$ and $\beta = 25°$.

Remarks

Several slender examples of *Dimitobelus canhami* (Tate) from the Rolling Downs Formation of Australia (Whitehouse, 1925, pl. II, figs, 4–7 and 11a–c) resemble the Alexander Island specimen. However, the holotype of *D. canhami* (Tate, 1880, p. 104–05, pl. IV, fig. 2a–c), from central Australia is considerably more robust and is compressed throughout its length. Tate's specimen has also a sub-mucronate moderately acute apex. The development of the ventro-lateral grooves is similar to that in the Alexander Island specimen ". . . a deep and sharply cut furrow. In the region of the alveolar apex it makes an abrupt turn onto the median line of the side of the guard . . ." (Tate, 1880, p. 104), which suggests that though distinct these species are closely related.

Specimens of *D. stimulus* Whitehouse from the Rolling Downs Formation of Australia (Whitehouse, 1925, pl. II, figs. 8 and 12–20) are also similar in outline to the Alexander Island specimen. However, the Australian specimens lack the distinct dorsal flexure of the ventro-lateral grooves in the region of the apical termination of the alveolus.

Genus *Peratobelus* Whitehouse 1924
Type species: *Belemnites oxys* Tennison-Woods 1884
Peratobelus sp. (?) nov.

Figs. 4a–c and 5d

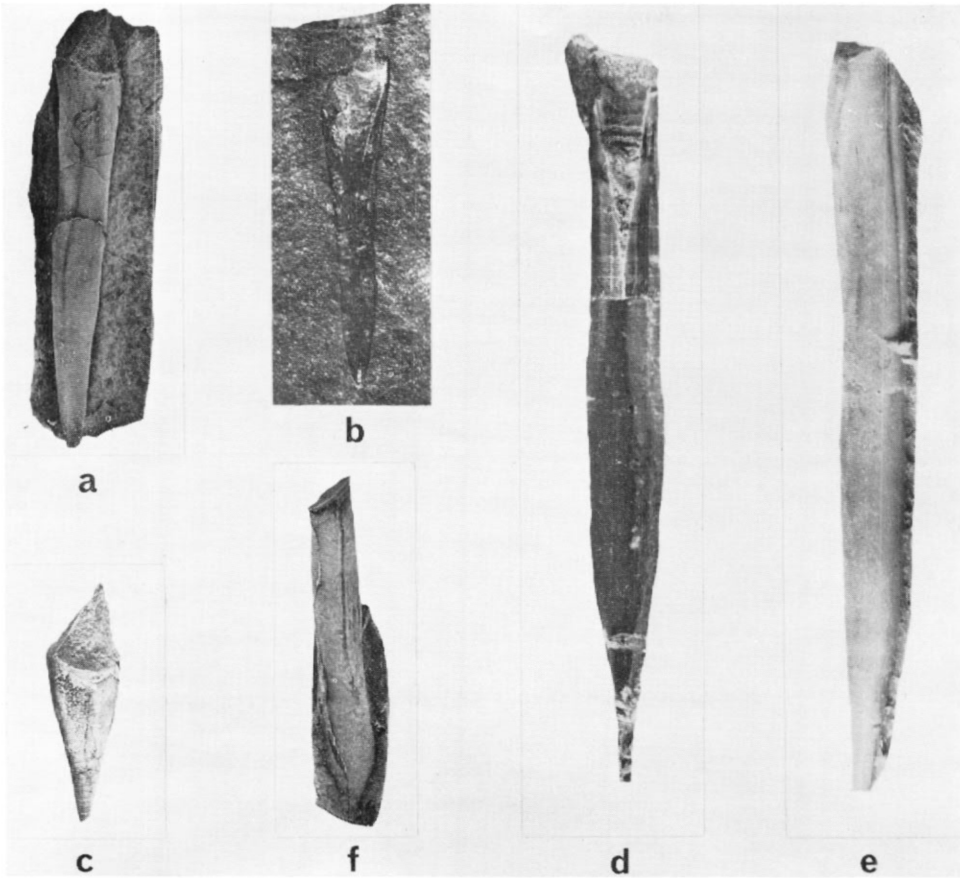

Fig. 4. a. *Peratobelus* sp. (?) nov.; latex cast of the natural mould of a guard preserved in a mudstone, showing the left lateral aspect and the development of the lateral grooves; ×1, coated (KG.103.29).
b. Longitudinal section of an eroded guard preserved in a mudstone; ×1 (KG.103.24).
c. Left lateral aspect of a phragmocone; ×1, coated (KG.103.29).
d. *Peratobelus oxys* (Tennison-Woods); longitudinal section of a partially eroded guard, showing the ventral aspect of the phragmocone; ×1 (E.148.9).
e. "Vinamould" cast of the natural mould of the same specimen preserved in mudstone, showing the right flank and the development of a ventro-lateral groove; ×1 (E.148.9).
f. *Peratobelus* aff. *australis* (Phillips); latex cast of the natural mould of a guard preserved in a mud-flake conglomerate; ×1, coated (KG.103.148).

Material

Two partly eroded guards (KG.103.24 and 29), both with phragmocones, embedded in a dark mudstone. One guard (KG.103.29) has been completely dissolved and latex moulds were prepared to demonstrate lateral-groove development. Both specimens from locality T (Fig. 1). *Age:* Lower Aptian.

Description

The larger specimen (KG.103.29) has a medium-sized cylindro-conical guard with an elongate apical region and an apical angle of approximately 22° (Fig. 4a). In outline the guard is symmetrical and slightly hastate, the position of maximum transverse inflation corresponding to that of the approximate apical termination of the protoconch. The profile is non-hastate and asymmetrical, the venter being flattened in the alveolar region. Both the apical and stem regions are in cross-section circular, whereas the alveolar region is flattened laterally and ventrally.

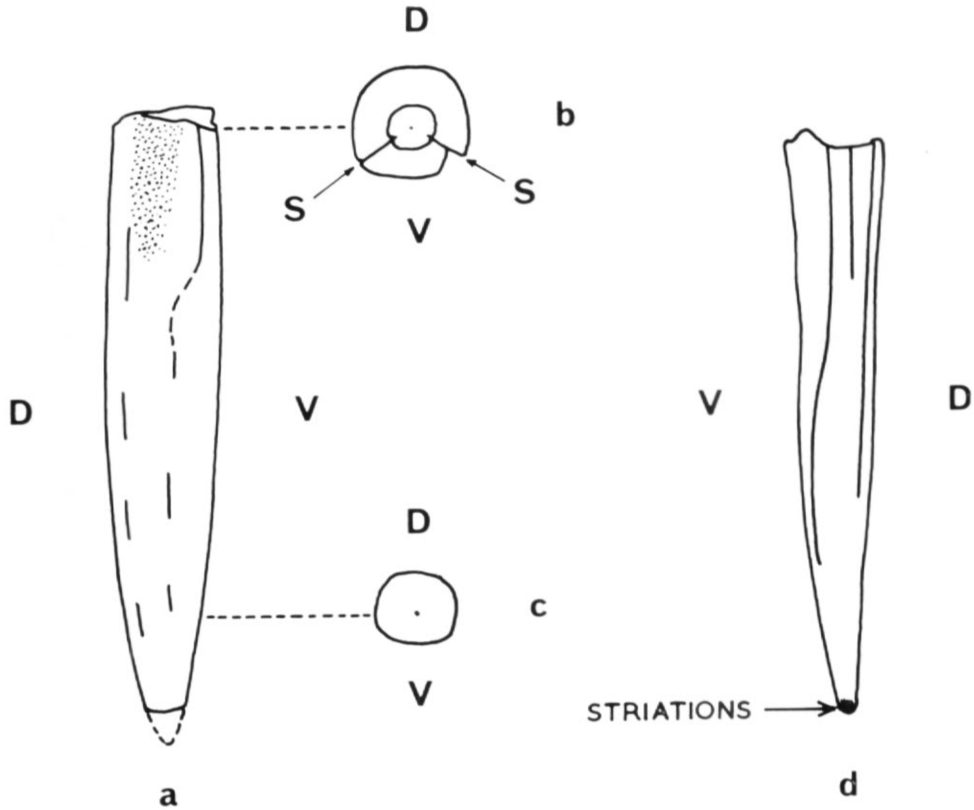

Fig. 5. a. *Dimitobelus* sp. aff. *D. macgregori* (Glaessner); composite diagrammatic illustration of the right flank, showing the lateral line and groove development; ×1·5 (D, dorsal; V, ventral).
b. Diagrammatic illustration of the upper stem cross-section, showing the development of splitting surfaces (S) along the trace of the lateral groove; ×1·5 (D, dorsal; V, ventral).
c. Diagrammatic illustration of the cross-section about 10 mm. from the apex of the guard; ×1·5 (D, dorsal; V, ventral).
d. *Peratobelus* sp. nov.; diagrammatic illustration of the left flank of a guard, showing the development of lateral grooves; ×1·5 (D, dorsal; V, ventral).

Lateral compression has accentuated the natural flattening at the alveolar end of this guard. The length of the guard is approximately nine times the maximum transverse inflation. An elongate, moderately acute phragmocone extends a considerable distance into the guard, its length being nearly half the total length of the guard (Fig. 4b and c). The alveolus is circular in cross-section except anteriorly where lateral compression has distorted the phragmocone. The alveolar angle of approximately 25° terminates in a protoconch which is situated slightly ventrally within the guard. An enclosed siphuncle lies close to the venter of the phragmocone. The apical line is ventral throughout the length of the guard. An apical canal parallels the apical line before terminating in an apical perforation. Close-set vertical striations occur a few millimetres behind the apex on the surface of the guard (Fig. 5d) and these may represent areas of muscle attachment.

Moderately incised ventro-lateral grooves commence anteriorly in specimen KG.103.29 and remain linear in the alveolar region before curving ventrally at a level approximately equivalent to that of the protoconch (Fig. 5d). Several millimetres apically, the grooves revert to a sub-parallel course before terminating, with a slight dorsal flexure, about 11 mm. from the apex. Narrow, feebly incised medio- and dorso-lateral grooves are also present. The medio-lateral groove is short and confined to the anterior of the alveolar region, whereas the linear dorso-lateral groove extends from the alveolar region to approximately 17 mm. from the apex.

Measurements

Specimen number	*L* (mm.)	*l* (mm.)	*u* (mm.)	*v* (mm.)	*dtm* (mm.)	*dsa* (mm.)	*dtM* (mm.)	*u/v*	α°	β°
KG.103.29	51·0*	30·8	19·0	30·8	6·0	6·4	6·4	0·62	25	22
KG.103.24	37·0*	19·3	—	19·0	—	4·9	—	—	30	28

Remarks

The cylindro-conical outline with an elongate apical termination is reminiscent of that developed in the type species of *Peratobelus*, *Belemnites oxys*, from the Lower Cretaceous of central Australia (Tennison-Woods, 1884, p. 236–37, pl. 13, figs. 1–3). However, the Alexander Island specimens are considerably smaller and do not possess such a marked transition from the conical to the cylindrical region. Tennison-Woods described the two ventro-lateral grooves of the Australian specimen as being "sharply cut and approximating to the ventral face in the alveolar region, thence bending towards the dorsal aspect with scarcely perceptible curve and continued in a fine stria on the ventral margin". Their arrangement in the alveolar region is therefore similar to that in the specimens from locality T but posteriorly the lateral groove development is significantly different.

No specimens of *P. oxys* have as yet been recorded with both medio- and dorso-lateral grooves; indeed, records of such occurrences in the genus are rare. Specimens of (?) *P. australis* (Phillips) from the Lower Cretaceous of Queensland (Day, 1967*a*, p. 6–7, pl. 1, figs. 22 and 23, text-fig. 1a–d) and one of *Peratobelus* sp. from the Aptian Blackdown Formation of Queensland (Woods, 1961, p. 7) were reported by Day (1967*a*, p. 7) to possess ventro-, medio- and dorso-lateral grooves. The medio- and dorso-lateral grooves, illustrated by Day (1967*a*) from (?) *Peratobelus australis* are similarly located to those in specimen KG.103.29 from Alexander Island but they are much broader and the medio-lateral groove extends further down the stem region; the ventro-lateral grooves also lack a distinct ventral flexure. Woods (1961) provided neither illustrations nor detailed descriptions of the development of the grooves in *Peratobelus* sp., but Day (1967*a*) observed that the guard was "approximately the same size (65 mm) as those from the Minimi Member but [is] more tapering apically". These observations suggest that the outline of the guard of *Peratobelus* sp. closely approximates to that of the Alexander Island specimens.

Peratobelus (?) *bauhinianus* Skwarko, from the late Neocomian–early Aptian of Northern Territory, Australia (Skwarko, 1966, p. 124, pl. 15, figs. 7–11), also shares some similarities with the Alexander Island specimens as suggested by G. R. Stevens (personal communication) but differs in having a less elongate apical region and dorsally located apex, a phragmocone which is relatively short compared with the overall length of the guard and sinuous ventro-lateral grooves lacking the distinct flexure near the protoconch. The specimens of *Peratobelus* sp. (?) nov. are otherwise unlike any of those so far described but neither is suitable for description as a holotype; therefore, the species remains unnamed in the hope that further and better-preserved material may be collected in the future.

Peratobelus oxys (Tennison-Woods 1884)

Belemnites oxys Tennison-Woods, 1884, p. 237, pl. 13, figs. 1–3.
Belemnites oxys Tennison-Woods: Etheridge, *in* Jack and Etheridge, 1892, p. 48.
Belemnites oxys Tennison-Woods; Etheridge, 1902*a*, p. 48.
Belemnites oxys Tennison-Woods; Etheridge, 1902*b*, p. 48, pl. VI, figs. 4–6, pl. VII, figs. 5–7, pl. VIII, figs. 4–6, (?) 7.
Peratobelus oxys (Tennison-Woods); Whitehouse, 1924, p. 410, text-fig. 1a and b.

Fig. 4d and e

* Estimated.

Material

One guard specimen E.148.9 (C.46251)* collected from locality B.
Age: Upper Aptian.

Description

This specimen has an elongate, moderately robust, cyclindro-conical guard, with a drawn out apical region (Fig. 4d). The apical angle is approximately 19°. In outline the guard is symmetrical and hastate, the position of maximum transverse inflation occurring approximately midway along the total length of the guard. The ventral surface of this specimen has been dissolved and the profile can only be surmised. In the apical region it is symmetrical and conical and ventral flattening occurs in the stem and alveolar regions. Dorso-lateral flattened surfaces are also developed in the alveolar region. The length of the guard is about ten times the maximum transverse inflation. Cross-sections in the alveolar and stem regions are depressed, whilst those in the apical region are circular. The alveolus is circular in cross-section and it has an alveolar angle of approximately 19° terminating in a centrally placed protoconch. An apical canal parallels the apical line and terminates in an apical perforation.

Deeply incised ventro-lateral grooves, accompanied by splitting surfaces, commence at the anterior end of the specimen (Fig. 4e), extend through the alveolar and stem region, and terminate with a slight dorsal flexure in the region of maximum transverse inflation. No lateral lines are preserved.

Measurements

Specimen E.148.9 has the following dimensions: $L = 105$ mm. (estimated), $l = 75$ mm., $u = 45$ mm. (estimated), $v = 55$ mm., $dtM = 10{\cdot}9$ mm., $dta = 10{\cdot}1$ mm., $u/v = 0{\cdot}818$, $\alpha = 19°$, $\beta = 19°$.

Remarks

Specimens of *Peratobelus* sp. nov. (Fig. 4a–c) collected from locality T have a similar, though much smaller, cylindro-conical guard with an elongate tapering apex. However, these specimens have proportionally a much longer alveolus; their outline has not such a marked transition from the conical apical to cylindrical stem regions, and the development of ventro-lateral grooves is distinct from those in *Peratobelus oxys.*

Peratobelus aff. *australis* (Phillips 1870)

aff. *Belemnites australis* Phillips *in* Moore, 1870, p. 258–59, pl. XVI, figs. 1 and 2, *non* figs. 3 and 4.

Fig. 4f

Material

A single broken guard (KG.103,148) embedded in a matrix of a mud-flake conglomerate from locality T.
Age: Aptian.

Description

The broken fragment is from a medium-sized cylindrical guard approximately ten times as long as its maximum transverse diameter and with a moderately obtuse apex (Fig. 4f). In outline the guard is symmetrical and hastate. Slight ventral and lateral compression in the stem region has resulted in sub-elliptical cross-sections in this area. The apical line is located ventrally in the stem region. Two deeply incised, slightly sinuous ventro-lateral grooves extend from the broken alveolar end before terminating with a slight dorsal flexure approximately 17 mm. from the apex.

* Specimens prefixed with "C" are in the British Museum (Nat. Hist.) collections.

Measurements

Specimen KG.103.148 has the following dimensions: $l = 47{\cdot}7$ mm. (estimated), $v = 21{\cdot}0$ mm., $dtM = 6{\cdot}2$ mm., $dta = 5{\cdot}1$ mm. (estimated), $dsa = 6{\cdot}4$ mm., $\beta = 38°$ (estimated).

Remarks

The Alexander Island specimen compares in apical characters, outline, profile and development of the deeply incised ventro-lateral grooves with those of the lectotype (Day, 1967*a*, p. 6–7) of *Peratobelus australis* (Phillips *in* Moore, 1870, p. 258–59, pl. XVI, figs. 1 and 2, *non* figs. 3 and 4) from the Aptian marine sediments of the Great Artesian Basin of Australia. The small size of the belemnite from locality T suggests that it probably represents an immature individual but it cannot be considered conspecific with *P. australis* or a closely related form until better-preserved material is available.

Specimens of (?) *P. australis* from the Aptian of the Great Artesian Basin, Australia (Day, 1967*a*, p. 6–7, pl. 1, figs. 22 and 23, text-fig. 1a–d), are similar in size to the Alexander Island specimen. Although they are linear in the alveolar region, the ventro-lateral grooves in the Australian specimen have a more pronounced ventral curvature towards the venter before terminating with a dorsal flexure 10 mm. from the apex. The medio- and dorso-lateral grooves, which are present in the Australian specimens, may have been abraded from the belemnite from locality T, and it may not necessarily be a case of their non-development.

Specimens of *Peratobelus* (?) *bauhinianus* Skwarko, from the late Neocomian–early Aptian of Northern Territory (Skwarko, 1966, p. 124, pl. 15, figs. 7–11) also compare with specimen KG.103.148 but the Australian specimens have a more acute and strongly asymmetric apex, and poorly incised and more sinuous ventro-lateral grooves.

Stratigraphical Discussion

Peratobelus was considered by Day (1969, p. 158) to be endemic to Australia and its absence from New Zealand was thought to be related to the rupture of the shelf link between the two areas after the Rangitate orogeny (Stevens, 1967, p. 375). Brown and others (1968, p. 278) have also pointed out that marine Aptian sediments in New Zealand are poorly developed.

The earliest known species of the genus, *Peratobelus* (?) *bauhinianus*, was described from the late Neocomian–early Aptian beds of Northern Territory, Australia (Skwarko, 1966). Every other example of the genus has so far been collected from Aptian strata in Australia. Their occurrence in a coquina above the Roma Series intermixed with a distinct Albian fauna (Bryan and Jones, 1946; Day, 1967*b*) has been attributed to re-working of the underlying Aptian strata during an early Albian regression (Day, 1967*b*, p. 10). Whitehouse (1928) subdivided the Roma Series into four stages, three of which contained different species of *Peratobelus*. In his work on Lower Greensand ammonites, Casey (1960, p. 19, text-fig. 5, 1961, p. 45) suggested that on a world-wide scale the crioceratidid coiling of members of the genus *Australiceras* was late and not early Aptian in age as suggested by Whitehouse. Further collections from the Roma Series (Vine and Day, 1965) have shown that crioceratitid coiled forms of *Australiceras* occur throughout the Roma Series. As a result, Day (1967*c*, p. 22, 1969, p. 159) concluded that, if the Australian species of *Australiceras* are the same age as their equivalents elsewhere in the world, the Roma Series can only represent the late Aptian.

The single specimen of *Peratobelus oxys* (Tennison-Woods) was collected by V. E. Fuchs and R. J. Adie in 1948 from station E.148, "11 miles [17·6 km.] north of Fossil Bluff on the east coast of Alexander Island". Other specimens collected from this locality include Aptian lamellibranchs (Cox, 1953) and ammonites (Howarth, 1958). This locality has been correlated with Taylor's (1971) locality B (Fig. 1) for which Thomson (1971), on the basis of the ammonite fauna, suggested a late Aptian age.

The Alexander Island specimen of *Peratobelus* aff. *australis* (Phillips) was obtained from a mud-flake conglomerate exposed at Waitabit Cliffs (Fig. 1). Below this conglomerate are argillites with an ammonite fauna comprising *Eulytoceras* aff. *polare* (Ravn), *Emericiceras* (?) sp. and *Sanmartinoceras patagonicum* Bonarelli, which has been assigned a Lower Aptian age (Thomson, 1971). Above the conglomerate, argillites containing *Eotetragonites* sp. (?) cf. *E. gardneri* Murphy and *Aconeceras* aff. *nisoides* (Sarasin) have been assigned an uppermost

Aptian age by Thomson (1971). Although the mud-flake conglomerate probably represents a considerable period of re-working and the specimen of *Peratobelus* aff. *australis* has been considerably abraded, it may or may not have been derived from elsewhere. Further collecting from the conglomerate and from both the underlying and overlying sediments is necessary to determine the time range of this species in Alexander Island. Both specimens of *Peratobelus* sp. (?) nov. were obtained from the Lower Aptian sediments below the conglomerate.

Dimitobelus macgregori (Glaessner) was first described by Glaessner (1945) from the Upper Albian and Cenomanian sediments of New Guinea; similar forms were also reported from the Albian of the Great Artesian Basin of Queensland (Glaessner, 1958, p. 201). Wellman (1955, p. 98, 105) also recorded this species in the Wharfe Gorge Sandstone of the Clarence Valley, New Zealand, which he subsequently placed in the Korangan stage (Aptian) (Wellman, 1959). More recently, Hall (1962) transferred the Wharfe Gorge Sandstone to the Motuan stage of the Upper Albian. Specimens of *D. macgregori* collected by J. A. Thomson from the Wharfe Gorge area have been described by Stevens (1965, p. 121–23), who, using Thomson's stratigraphical observations, has correlated their occurrence with Wellman's (1955, fig. 5) *concentricus* zone dated by Wellman (1959, p. 147) as Coverian (Albian–Lower Cenomanian) and by Hall (1962) as Lower Ngaterian (Lower Cenomanian). A range of Upper Motuan to Lower Ngaterian (? Upper Albian–Lower Cenomanian) was suggested by Stevens (1965, p. 122) for the New Zealand examples.

At locality A on Succession Cliffs (Fig. 1), where the Alexander Island specimens of *Dimitobelus* were collected, there is a mixed molluscan fauna including the ammonites *Eotetragonites* sp. (?) cf. *E. wintunius* (Anderson), *Australiceras* sp. and *Aconeceras* aff. *nisoides* (Sarasin) and this has been assigned an uppermost Aptian age (Thomson, 1971).

The occurrence of Dimitobelidae in south-east Alexander Island represents an extension of the geological and geographical range of this important family and a further stratigraphical link between the Lower Cretaceous of Alexander Island and that of the Indo-Pacific region. *Peratobelus* is recorded for the first time outside Australia and the range of *Dimitobelus* has been extended down to the uppermost Aptian.

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