UPPER JURASSIC MOLLUSCA FROM CARSE POINT, PALMER LAND

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ABSTRACT. A sequence of dark-coloured pyritiferous mudstones and siltstones, exposed beneath rocks correlated with the Upper Jurassic Volcanic Group at Carse Point, contain the first marine fossils discovered in western Palmer Land. Bivalves, ammonites and belemnites are consistent with a late Jurassic age. The ammonite fauna is dominated by the genus *Kossmatia* Uhlig, of which one new species, *K. carsensis*, is described.

CONFORMABLY underlying nearly 900 m. of volcanic rocks at Carse Point, Palmer Land (Figs. 1 and 2), there is a sequence of black to grey pyritiferous mudstones and siltstones, sporadically exposed in rock bluffs at the base of the cliffs. Field observations by Culshaw (1975) and Skinner (1973) indicate the following generalized succession for the Carse Point area:

Tuffs and andesitic to basaltic lavas	~850 m.
Green tuff and agglomerate bands	~20 m.
Black crystal tuff	16 m.
Shales, mudstones and conglomerates with a bivalve, ammonite and belemnite fauna	15 m.
Blocky pyritic mudstones with a sparse marine fauna	>60 m.

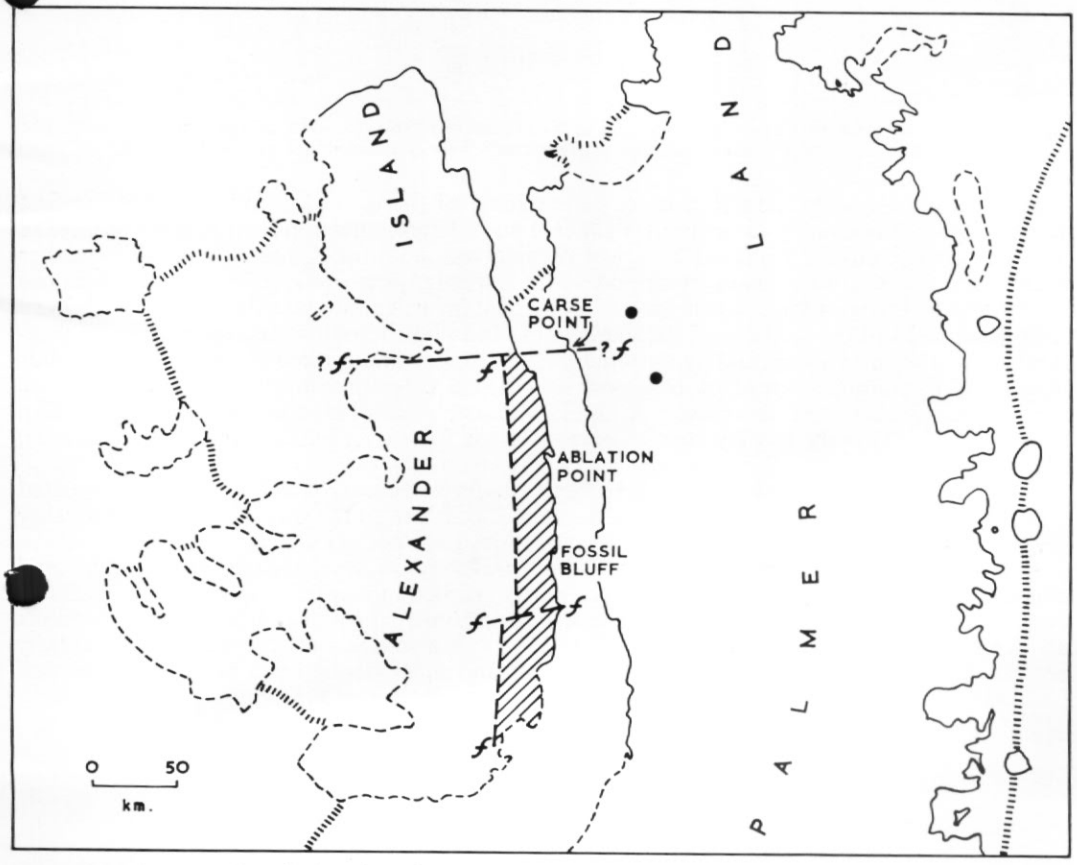

Fig. 1. Sketch map to show the location of Carse Point in relation to the Upper Jurassic and Lower Cretaceous sedimentary sequence of eastern Alexander Island (hatched). The two solid circles indicate other localities in Palmer Land where sedimentary rocks, similar to those at Carse Point, occur in association with volcanic sequences (after Skinner, 1973).

Fig. 2. Oblique air view of Carse Point looking eastward, showing the location of the mudstone sequence (arrowed) at the base of a volcanic succession. The fossils were obtained from station KG.1258.

The mudstone sequence, and to a lesser extent some of the overlying tuffs, contain the first marine fossils discovered in western Palmer Land. From mudstones at station KG.1258 (Fig. 2) N. G. Culshaw collected a variety of bivalves, ammonites and belemnites, together with a very doubtful turriculate gastropod and a few fragments of an echinoid. Fallen blocks from some of the overlying volcaniclastic rocks contain belemnite guards. Trace fossils have been identified in thin sections of the mudstones, and plant remains are represented by fragments of carbonized wood and some unidentified fronds. The limited damage to the fronds suggests a minimum amount of transport and hence close proximity to the land for the depositional area of the sediments. A similar mudstone and siltstone sequence at station KG.1173 (Fig. 2), only 1·5 km. to the north, has so far only yielded trace fossils (Skinner, 1973).

Comparable mudstone sequences have been observed beneath volcanic rocks at isolated exposures in Palmer Land, over an area extending for 50 km. to the east of the present locality (Fig. 1; Skinner, 1973, p. 6). However, these localities have not yet yielded any fossils.

Although most of the belemnite guards are preserved in solid calcite, the bivalves and ammonites nearly always occur as moulds of partly crushed individuals. Specimen KG.1258.[illegible] (an ammonite) is preserved as an uncrushed *steinkern* from a calcareous siltstone, and represents an exception; a group of *Inoceramus* (KG.1258.9) in a calcareous concretion is similarly preserved. The mudstones are highly pyritiferous and most joints, open bedding planes and fossil moulds are coated with a thin layer of purplish ferruginous "varnish".

Bivalvia

Genus *Grammatodon* Meek and Hayden 1861
Grammatodon sp.

Fig. 3a

Material

Four internal moulds (KG.1258.59, 69, 87 and 91) and two fragments of external mould (KG.1258.63 and 88).

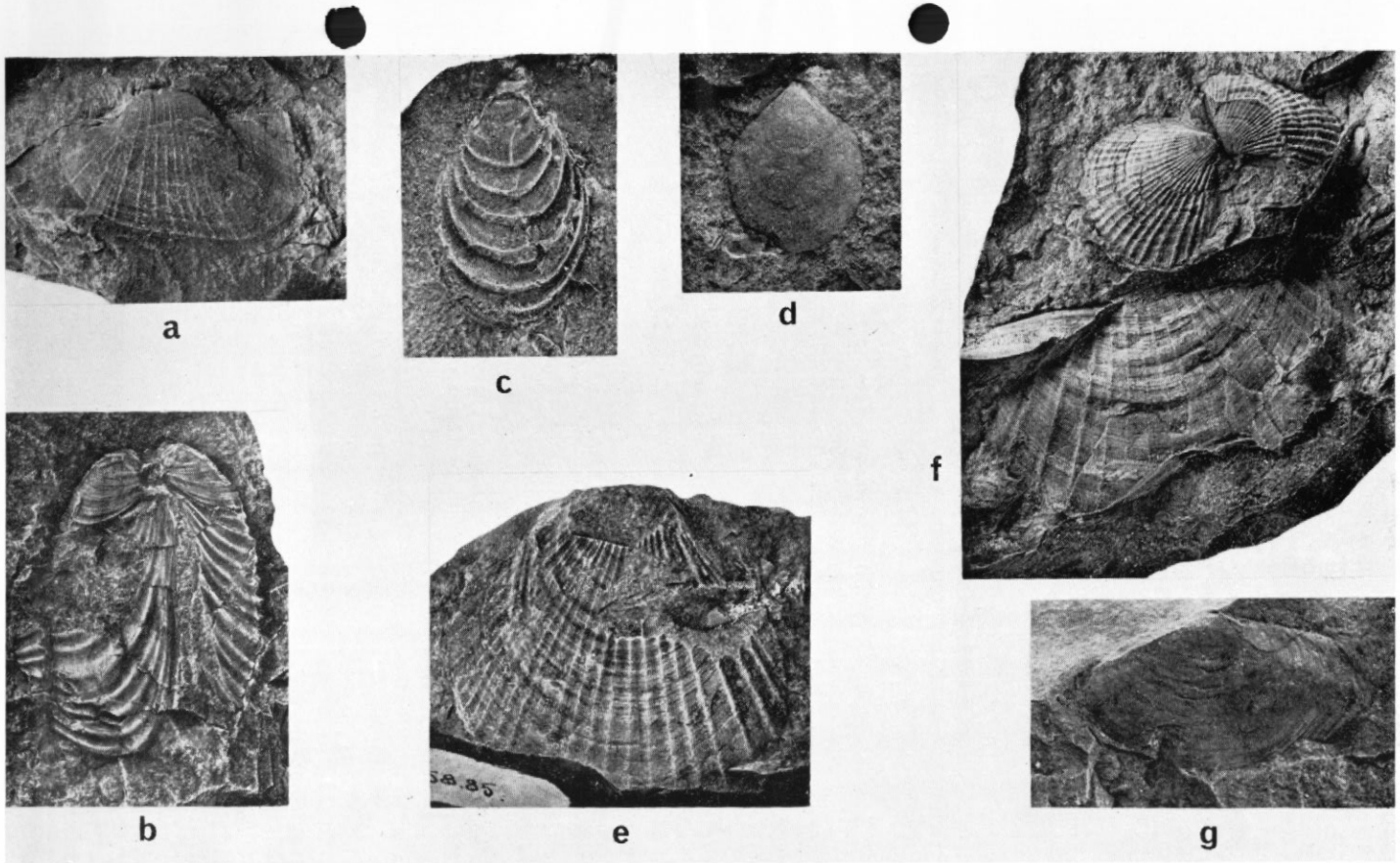

Fig. 3. a. *Grammatodon* sp.; internal mould of a left valve; × 1·5, coated (KG.1258.91).
b. *Inoceramus* cf. *subhaasti* Wandel; partially crushed paired valves showing the finely ornamented early stage; × 1, coated (KG.1258.66).
c. *Inoceramus* cf. *subhaasti* Wandel; latex cast from the external mould of a small specimen; × 1·5, coated (KG.1258.71).
d. *Entolium* sp.; internal mould of an isolated valve; × 1, coated (KG.1258.67).
e. *Chlamys* (*?*) sp.; fragmentary internal mould of a large specimen; × 1, coated (KG.1258.85).
f. *Chlamys* (*?*) sp.; latex cast from an external mould showing part of a large individual and a pair of small valves; × 1, coated (KG.1258.58).
g. *Thracia* sp. nov. (*?*); internal mould of a left valve; × 1, coated (KG.1258.83).

Description

The best specimen (KG.1258.91; Fig. 3a) is an internal mould of a left valve, 20·5 mm. long and 12 mm. high. The valve is trapeziform in outline, moderately inflated, and is slightly higher posteriorly than anteriorly. The inflated part of the shell drops steeply to flattened triangular areas adjacent to the antero- and postero-dorsal margins. The umbo is broad and square, and is situated in the anterior half of the valve. Ornament on internal moulds is largely confined to the middle and anterior parts of the inflated region, and consists of fine, widely spaced radial ribs, occasionally interspersed with one or two riblets. The antero-dorsal region is smooth, apart from two ribs, whereas there are numerous radial riblets on the larger postero-dorsal area. The ornament is crossed by growth lines which often are deeply impressed in the later growth stages.

Traces of dentition are present on two internal moulds (KG.1258.87 and 91) of left valves. On the best specimen (Fig. 3a) two short cardinal teeth are visible on the anterior part of the hinge area, and there are three pseudolaterals on the posterior area.

Remarks

The material available is too poor to make a confident specific identification. However, this species closely resembles another commonly found in the Upper Jurassic and early Cretaceous rocks of Alexander Island.

Genus *Inoceramus* Sowerby 1814
Inoceramus cf. *subhaasti* Wandel 1936

Fig. 3b and c

Material

About a dozen rock slabs bearing numerous internal and external moulds.

Description and remarks

On none of the specimens is the hinge line well preserved, and the general outline of the shell is not known. However, the features preserved in the collection as a whole suggest a possible identification with *Inoceramus subhaasti* Wandel. There is a strong resemblance between the dorso-ventrally crushed valves on specimen KG.1258.66 (Fig. 3b) and Wandel's (1936, pl. XVI, fig. 5b) example of *I. subhaasti* var. *denseplicata*. Furthermore, the present specimen shows a trace of the hinge margin and it appears that the umbo is projected well beyond it; a characteristic feature of *I. subhaasti* not present in examples of *I.* aff. *subhaasti* previously described from Alexander Island (Thomson and Willey, 1972) and Adelaide Island (Thomson, 1972). The Carse Point specimens show a similar variation in the density of concentric plicae to the examples first described from Indonesia (Wandel, 1936, p. 469–73). Small individuals with widely spaced plicae but with no trace of the hinge line preserved (Fig. 3c) could be mistaken for *I. galoi* Boehm. On some specimens (notably KG.1258.66; Fig. 3b) an early stage, ornamented with dense concentric threads only, is preserved. This persists to a shell length of about 13 mm. and is similar to that described by Wandel on *I. subhaasti* from Indonesia. The change from this ornament to the coarse plicae of the adult is abrupt.

On three slabs (KG.1258.70, 89 and 90), which appear to represent shell beds, *I.* cf. *subhaasti* is associated with indeterminate *Buchia*-like bivalves.

Inoceramus sp. indet.

A single poorly preserved specimen (KG.1258.78) has certain anomalous features of the ornament which suggest that it may belong to a species different from *I.* cf. *subhaasti* described above. Its concentric plicae are irregular and less sharply formed than in *I.* cf. *subhaasti*, and there are subsidiary plicae superimposed on the major ones.

Genus *Entolium* Meek 1865
Entolium sp.

Fig. 3d

Material

One internal mould (KG.1258.67) of a single valve.

Description and remarks

The valve (Fig. 3d) is feebly inflated and is sub-ovate in outline except for the sharp angle subtended by the umbo. It is higher ($h = 20{\cdot}5$ mm.) than long ($l = 16{\cdot}5$ mm.), and the umbonal angle of about 92° is relatively narrow for the genus. The auricles are more or less equal in size and their lateral margins converge upwards; the dorsal margins of both lie in the same horizontal line through the umbo. Ornamentation on the internal mould is very faint but it consists of dense, fine growth lines and broad, feeble growth corrugations. There are no traces of cardinal or auricular crura.

This single specimen is too poorly preserved to warrant a detailed comparison with named species. The genus is represented by several species in the Upper Jurassic and Lower Cretaceous of south-eastern Alexander Island but none of these appears to be conspecific with the present one. An Aptian form from the sequence in the Fossil Bluff area is perhaps the closest in overall shape but it has prominent auricular crura, demarcating the auricles from the disc, and stout cardinal crura.

Genus *Chlamys* Röding 1798
Chlamys (*?*) sp.

Fig. 3e and f

Material

Six rock specimens (KG.1258.64, 65, 79, 80, 85 and 92) bearing several internal and external moulds.

Description

The shell (Fig. 3e and f) is equivalve, slightly asymmetrical and feebly inflated; its valves are sub-circular in outline and have medial umbones. In the antero- and postero-dorsal regions of the smaller and better-preserved specimens (Fig. 3f) there are two flattened triangular areas, but on none of the specimens is the hinge line preserved. Both valves are ornamented with about 20 sharp radial ribs, separated by wide concave interspaces, and there are numerous finer ribs on one of the flattened triangular areas. The interspaces increase in width towards one end of the valve and are themselves ornamented with fine radial threads; there are seven or eight of these in each interspace on the smaller paired valves (Fig. 3f) but on larger fragments the number is nearer 20. The growth lines are fine and closely spaced.

Remarks

The lack of preservation of the hinge line makes it impossible to identify these specimens generically with any certainty. However, the almost circular outline and feeble inflation of the valves, and the prominent radial ornament, suggest that they probably belong to one of the many subgenera of *Pecten* or *Chlamys*. The slight asymmetry in shape and ornament would favour an identification with *Chlamys*.

The larger specimens appear to be almost identical with "*Aequipecten*" sp. from the Upper Jurassic of Indonesia (Wandel, 1936, p. 483, pl. XV, fig. 3). Fragments, belonging to a species the same as, or similar to the present one, have been found in Upper Jurassic rocks near Ablation Point.

Genus *Thracia* Sowerby 1823
Thracia sp. nov. (?)

Fig. 3g

Material

One internal mould of a left valve (KG.1258.83), lacking the tip of the umbo and a little of the antero-dorsal margin.

Description and remarks

This is an elongate species which is almost twice as long as it is high (l = 34 mm., h = 18 mm.). The shell is ovate in outline and it is sharply curved at its anterior and posterior extremities; the umbo is nearer the anterior than the posterior end of the shell. A faint curved carina extends from the umbo to the sharp curve in the middle of the posterior margin, and makes an angle of about 16° with the postero-dorsal margin. Ornament is restricted to widely spaced growth undulations and fine dense concentric threads.

Because the antero-dorsal margin of this specimen is incomplete, it is difficult to orientate the valve precisely. However, it appears to differ from many described species not only by its elongate form, but also by having a posterior carina that meets the posterior margin near the middle, instead of close to the postero-ventral corner.

Other bivalves

In addition to the possible occurrences of *Buchia* in shell beds of *Inoceramus* (p. 34), specimen KG.1258.81 appears to be the internal mould of the left valve of a medium-sized *Buchia*. A fan-shaped mould on specimen KG.1258.77 is suggestive of the genus *Pinna* but it is too poorly preserved for detailed description, and specimen KG.1258.78 is a fragment of external mould showing a simple form of concentric bivalve ornament not seen on any of the other species described here.

AMMONOIDEA

Genus *Kossmatia* Uhlig 1907
Kossmatia carsensis sp. nov.

Fig. 4a–g

Material

Twelve internal and external moulds (KG.1258.2, 3, 11, 31, 94, 96, 97, 99, 101, 103, 104 and 109) and a few small fragments on other specimens containing bivalves.

Diagnosis

Shell moderately evolute, composed of compressed whorls which increase slowly in size and embrace about one-third to one-half of the preceding volution; venter bluntly rounded. Ribs closely spaced, usually bifurcate but sometimes simple with intercalated ribs, feebly flexuous and projected on the venter; becoming relatively coarser and more widely spaced with increase in size, and finally very coarse and blunt on the body chambers of large individuals. Occasional constrictions are present.

Specimen KG.1258.31, a medium-sized internal mould of about one-half of an individual, is selected as holotype.

The name is derived from the locality, Carse Point.

Description

The holotype (Fig. 4a and b) is unusual in that it is preserved as a more or less discrete internal mould in a calcareous concretion, whereas all the other specimens (Fig. 4c–g) are

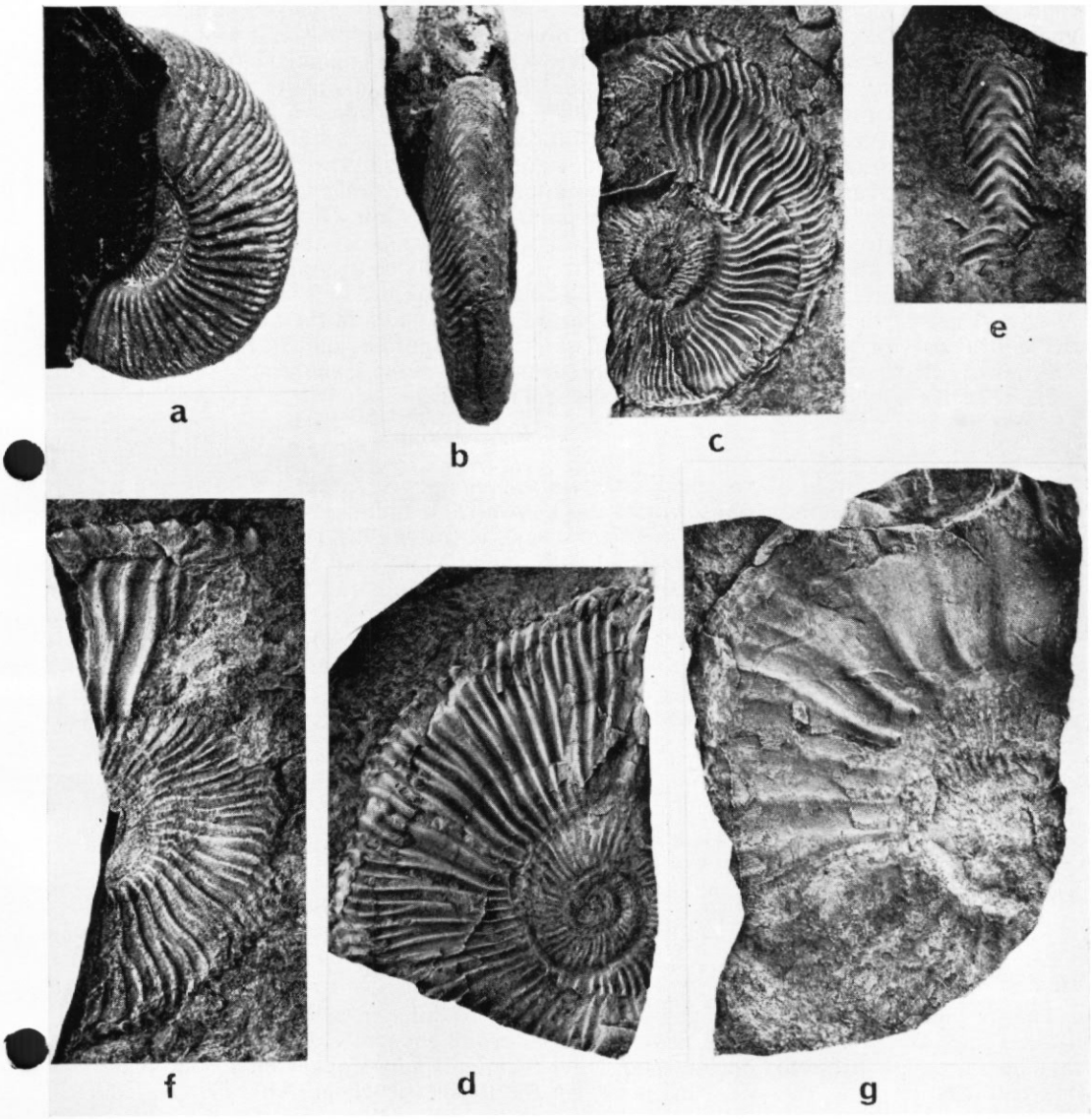

Fig. 4. *Kossmatia carsensis* sp. nov.
a. Lateral view of the holotype; × 1, coated (KG.1258.31).
b. Ventral view of the holotype; × 1, coated (KG.1258.31).
c. Latex cast of a crushed individual slightly larger than the holotype; × 1, coated (KG.1258.99).
d. Latex cast from the external mould of a medium-sized individual; × 1, coated (KG.1258.3).
e. Latex cast from the external mould of a ventral fragment, corresponding roughly in size to the last stage of the example in Fig. 4d; × 1, coated (KG.1258.94).
f. Fragment of a large internal mould showing development of coarse ribbing near the aperture; × 1, coated (KG.1258.109B).
g. Latex cast from a poorly preserved external mould, showing late-stage modification of the ornament to coarse, widely spaced ribs; × 1, coated (KG.1258.103).

one-sided moulds of crushed individuals in mudstone. Its outer whorl embraces about one-half (possibly a little more) of the penultimate one. The outer whorl is high compared to its width and has feebly convex flanks which converge from the short steep umbilical wall to the bluntly rounded venter. The maximum width of the whorl occurs near the umbilical rim and measures about 10·5 mm. where the whorl height is 16·5 mm. Ornament consists of numerous feebly flexuous ribs, most of which bifurcate near the mid-line of the flank; a few simple and intercalated ribs are also present. The ribs lean back as they cross the umbilical wall, curve feebly forwards (or pass radially) across the lower third of the flank, and then curve gently back until they are projected forwards once more as they approach the ventral shoulder. They reach their greatest prominence at, or a little below, the point of bifurcation. On the venter (Fig. 4b) the ribs are all projected forwards in a chevron with an apical angle of about 70°.

With increase in whorl size, the ribbing becomes gradually coarser and more widely spaced (Fig. 4d and f) until, at a shell diameter of about 70 mm. and at a whorl height of about 28 mm. (Fig. 4g), the interspaces are two to three times the width of the ribs. At the same time the ventral part of the ornament becomes less distinct. Sporadic and feebly developed constrictions or interruptions of the ornament occur on some of the specimens.

None of the specimens shows traces of the septal sutures.

Remarks

Although the genotype of *Kossmatia* (*Ammonites tenuistriatus* Gray) is a finely and densely ribbed species, more stoutly ribbed forms are known from Indonesia (Kruizinga, 1926), and Imlay (1943) has demonstrated that there are species in the Middle Tithonian of Mexico with even coarser ribbing, which may be referred to this genus. Two such Mexican species, *K. kingi* and *K. rancheriasensis*, have extremely coarse late-stage ribbing, similar to that on the present species. However, *K. kingi* (Imlay, 1943, p. 540, pl. 94, fig. 4) differs from *K. carsensis* sp. nov. in having trifurcate ribs, relatively coarser ornament on the earlier whorls, and a more tightly pinched chevron on the venter. *K. rancheriasensis* (Imlay, 1943, p. 541, pl. 95, fig. 4) is known only from fragments of adult whorls but these differ from the present species in the higher position of bifurcation of the ribs, and in the more pronounced expression of the ventral part of the ribbing.

Kossmatia carsensis sp. nov. var. (*?*)

Fig. 5a and b

Material

Three external moulds (KG.1258.101, 106 and 107) and an internal mould (KG.1258.102).

Description and remarks

The specimens included here (Fig. 5a and b) appear to differ from *K. carsensis* (above) only in their finer and denser wire-like ribs. The curvature of the ribs is the same, although they may be a little less projected on the venter, and the minor deviations from a basic pattern of bifurcate ribbing in *K. carsensis* also occur on the present material. Although the coarsely ribbed final stage is missing, the largest specimen available (KG.1258.102; Fig. 5b) is only 57 mm. in diameter, and even that exhibits the first signs of more widely spaced ribbing as in *K. carsensis s.s.*

Specimen KG.1258.106 (Fig. 5a) resembles a (?) microconch of *K. exceptionalis* (Aguilera) illustrated by Verma and Westermann (1973, pl. 46, fig. 1a) from the Upper Tithonian of Mexico. However, the variation shown by all of the specimens suggests that those included here are more likely to represent a variant of *K. carsensis* than a separate species.

Genus *Aulacosphinctoides* Spath 1923

Aulacosphinctoides (*?*) sp.

Fig. 5c

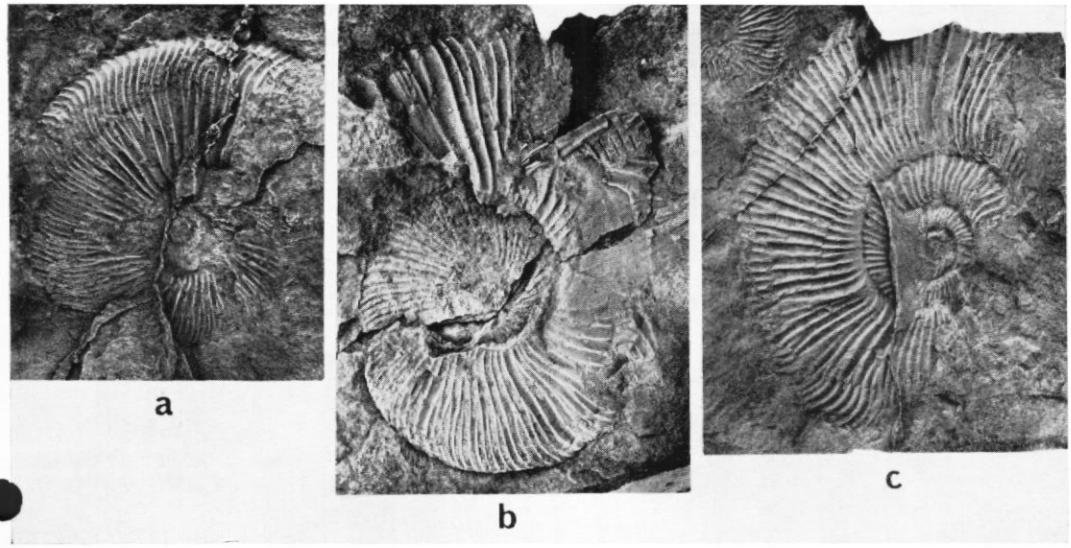

Fig. 5. a. *Kossmatia carsensis* sp. nov. var. (*?*); latex cast from an external mould; × 1, coated (KG.1258.106A).
b. *Kossmatia carsensis* sp. nov. var. (*?*); fragmentary internal mould showing a tendency towards late-stage wider spacing of the ribs; × 1, coated (KG.1258.102).
c. *Aulacosphinctoides* (*?*) sp.; latex cast from a fragmentary external mould; × 1, coated (KG.1258.108).

Material

One external mould of a crushed individual (KG.1258.108) and two moulds of juveniles (KG.1258.100 and 110) which may belong to the same species.

Description and remarks

One ammonite external mould in the collection from Carse Point (Fig. 5c) is readily distinguished from those of the more prolific *Kossmatia carsensis* by its straighter ribbing and the presence of a relatively deep constriction. Simple and intercalated ribs occur much more frequently on this specimen than on *K. carsensis* and its whorls appear to be more slowly expanding. Two juveniles (KG.1258.100 and 110) have similar characteristics. One of these is an obliquely crushed external mould which shows part of the venter; this is crossed by ribs which are bowed only slightly forwards and are not projected as in *Kossmatia*.

The specimens are too poorly preserved to identify with certainty but the features preserved suggest a relationship with the genus *Aulacosphinctoides*. Burckhardt (1919) described a number of finely ribbed species from the Lower Portlandian (? = Middle Tithonian) of the Sierra de Symon, central Mexico, under the name of *Aulacosphinctes* Uhlig. However, they lack the deep ventral groove of that genus and are perhaps more closely related to *Aulacosphinctoides* Spath. In particular, "*Aulacosphinctes*" *symonensis* (Burckhardt, 1919, p. 33, pl. XI, figs. 4–11) has ribbing of similar density and form to the present species. Verma and Westermann (1973, p. 184) have expressed the view that "*Aulacosphinctes*" *symonensis* and several other "*Aulacosphinctes*" of Burckhardt (1919) differ from *Aulacosphinctoides s.s.* by the possession of deep constrictions. They suggested that such forms should therefore be transferred to either *Torquatisphinctes* or *Dichotomosphinctes*.

Belemnoidea

Fig. 6a–e

The belemnites from the collection were passed to L. E. Willey for examination and he kindly contributed the following descriptions.

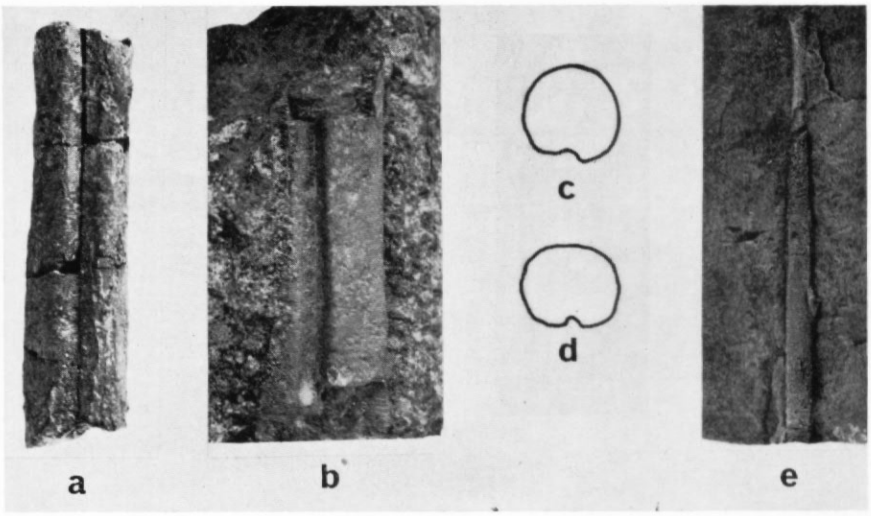

Fig. 6. a. *Belemnopsis* cf. *alfurica* (Boehm); ventral view of a guard fragment; × 1, coated (KG.1258.31b).
b. *Belemnopsis* cf. *keari* Stevens; ventral view of a guard fragment enclosing part of the alveolus; × 1, coated (KG.1258.51).
c. *B.* cf. *alfurica*; sketch cross-section to show the broad ventral groove; × 1 (KG.1258.31b).
d. *B.* cf. *keari*; sketch cross-section to show the deep, relatively narrow ventral groove; × 1 (KG.1258.51).
e. *Hibolithes* cf. *compressus* Stolley; latex cast from an external mould in mudstone; × 1, coated (KG.1258.45).

Although the belemnites from Carse Point are poorly preserved and consist of fragmentary guards and moulds, it has been possible to distinguish three species: *Belemnopsis* cf. *alfurica*, *Belemnopsis* cf. *keari* and *Hibolithes* cf. *compressus*. The *Belemnopsis* species occur both in the volcanic sequence and in the underlying mudstones, whereas *Hibolithes* is represented by only one specimen which came from the mudstones.

Fragments identified as *B.* cf. *alfurica* (KG.1258.31b, 44, 48, 53 and 60) are from guards characterized by a very broad and deep median ventral groove, compared with the respective sagittal and transverse diameters. In specimen KG.1258.31b (Fig. 6a) the groove is 5·5 mm. wide (where $dt = 12{\cdot}2$ mm.) and 1·0 mm. deep (where $ds = 12{\cdot}2$ mm.). The fragments indicate that the guard was relatively slender, elongate and slightly hastate. Cross-sections (Fig. 6c) from stem and apical fragments are circular or slightly depressed. Similar fragments from Ablation Point (Willey, 1973) were believed to represent guards comparable to several specimens of *B. alfurica* from Indonesia (Boehm, 1907*a*, p. 56–57, pl. VIII, figs. 4, 5 and 7–11, *non* text-figs. 16–18; 1907*b*, pl. X, fig. 8, *non* pl. X, fig. 7), and to a description of the lectotype for the nominal species *B. alfurica* (Boehm) (Stevens, 1963, p. 101–04, pl. 1, figs. 1–13).

Several fragments and moulds (KG.1258.31a, 42, 46, 47, 49–51, 55, 58 and 60) are from elongate hastate guards with a broad and deep median ventral groove. In specimen KG.1258.51 (Fig. 6b) the groove is 4·4 mm. wide (where $dt = 13{\cdot}6$ mm.) and 1·4 mm. (where $ds = 13{\cdot}8$ mm.). Cross-sections of the guards in apical and stem regions are depressed but anteriorly they become almost equidimensional, although not circular as the sides are flattened. These fragments differ from those of *B.* cf. *alfurica* (above) in having a comparatively deeper and narrower groove and in the depressed form of their cross-sections (Fig. 6d). They are considered to be similar to *B. keari* Stevens from the Heterian (Kimmeridgian) of New Zealand (Stevens, 1965, p. 74–77, pl. 2, figs. 6–17, pl. 3, figs. 1–12, pl. 4, figs. 1–4 and 8–15, pl. 5, figs. 1–9 and 13–15). A juvenile specimen of *B.* cf. *keari* has also been described from Ablation Point (Willey, 1973).

A unique external mould (Fig. 6e) in a dark pyritiferous mudstone is of an elongate slender guard whose length is about 20 times its maximum transverse diameter. Both outline and profile are hastate and appear to be symmetrical. The minimum transverse diameter is in the

region of the protoconch, whereas the maximum transverse diameter occurs approximately equidistant between the apices of the phragmocone and the guard. The alveolar and stem regions are markedly compressed in cross-section, but the apical region is only slightly compressed. A narrow, slit-like, median ventral groove extends from the alveolar region almost to the apex. This specimen is similar to *Hibolithes* cf. *compressus* described from Ablation Point (Willey, 1973), which in turn shows close similarities to the true *H. compressus* from the Lower Fajat Shale of Misol, Indonesia (Stolley, 1935, p. 58–60, pl. IV, figs. 1–5).

Age of the Fauna

The fauna as a whole has a late Jurassic aspect. *Inoceramus subhaasti* was originally believed to occur in strata of Oxfordian age in Misol (Wandel, 1936, p. 473) but, according to Stevens' (1965, p. 139, table 13) re-assessment of the Misol faunas, it appears that Indonesian occurrences of *I. subhaasti* are Middle Kimmeridgian in age. *Chlamys* (*?*) sp. resembles "*Aequipecten*" sp., also described from Indonesia in strata equivalent to those containing *I. subhaasti*; a closely similar species occurs in Upper Jurassic rocks near Ablation Point. *Grammatodon* sp. can be matched with a species found in the Upper Jurassic–earliest Cretaceous of Alexander Island. Among the belemnites, both *Belemnopsis keari* and *B. alfurica* are typically Kimmeridgian in age (Stevens, 1965). In Alexander Island, *B.* cf. *keari* and *B.* cf. *alfurica* have been found at Ablation Point and the latter species also at Belemnite Point (Willey, 1973). They occur in a thick zone of disturbed sediments which is probably largely Kimmeridgian in age. In Indonesia, *Hibolithes compressus* is Lower Tithonian in age (Stevens, 1965, p. 139, table 13), although a similar form from Alexander Island, *H.* cf. *compressus*, is known from the Lower Neocomian (? Berriasian) (Willey, 1973).

Most of the ammonites present belong to the genus *Kossmatia* and they are probably better preserved than the other fossils in the collection. According to Arkell (1957, p. *L*323), the genus ranges in age from Kimmeridgian to Upper Tithonian, but other authors (Roman, 1938, p. 326; Imlay, 1943, p. 538; Haas, 1960, p. 6) have also admitted the possibility of Berriasian occurrences. However, a recent review of *Kossmatia* by Verma and Westermann (1973, p. 202–11) suggests that the genus is restricted to the Middle and Upper Tithonian. They expressed doubt about the validity of reported occurrences of *Kossmatia* in New Zealand as early as the Kimmeridgian (Fleming and Kear, 1960). The author is indebted to G. R. Stevens (Geological Survey of New Zealand) for casts and photographs of some of the unillustrated New Zealand specimens of "*Kossmatia*" referred to in Fleming and Kear's paper. Whereas the lateral aspect of these species is *Kossmatia*-like, on those specimens where the venter is preserved, there is a smooth band along the mid line and the ribs are not projected forwards nearly as strongly as they are in typical species of *Kossmatia*. Thus there may be some grounds for separating those forms from *Kossmatia s.s. Kossmatia* sp. *C*, from the Tithonian Puti Siltstone (Fleming and Kear, 1960, p. 41), is readily distinguished from the Kimmeridgian "*Kossmatia*" spp. by its much finer and denser ribbing, but the venter of this specimen is apparently not preserved.

In view of the fragmentary and often corroded state of the belemnite guards, and the fact that similar belemnite genera and species in Alexander Island appear to extend beyond their normally accepted ranges, greatest age significance is attached to the ammonites in the Carse Point fauna. The fauna is undoubtedly late Jurassic and the presence of *Kossmatia* favours a Middle–Upper Tithonian age.

The thick (nearly 900 m.) volcanic sequence above the fossiliferous mudstones has been correlated with other volcanic successions in the Antarctic Peninsula (Skinner, 1973, p. 9) which are often loosely referred to as the Upper Jurassic Volcanic Group. The author agrees with Skinner that the late Jurassic age of the fossils beneath the volcanic rocks at Carse Point opens up the possibility that part of this volcanic sequence may range up into the Lower Cretaceous. A similar situation exists on Adelaide Island (Thomson, 1972), where Upper Jurassic fossils have been found in volcanic sediments at the base of a measured 3,000 m. volcanic sequence. The problem of the age of the Upper Jurassic Volcanic Group has been discussed more fully by Taylor and others (1974).

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