Maximum Middle Jurassic transgression in East Greenland: evidence from new ammonite finds, Bjørnedal, Traill Ø

Peter Alsen and Finn Surlyk

With an appendix by John H. Callomon: Description of a new species of ammonite, *Kepplerites tenuifasciculatus* n. sp., from the Middle Jurassic, Lower Callovian of East Greenland

A Middle – lower Upper Jurassic sandstone-dominated succession, more than 550 m thick, with mudstone intercalations in the middle part is exposed in Bjørnedal on Traill Ø, North-East Greenland. A number of ammonite assemblages have been found, mainly in the mudstones. They indicate the presence of the Lower Callovian *Cadoceras apertum* and *C. nordenskjoeldi* Chronozones. The mudstones represent northern wedges of the Fossilbjerget Formation hitherto known only from Jameson Land to the south. In Bjørnedal they interfinger with sandstones of the Pelion and Olympen Formations. The presence of the Fossilbjerget Formation in this region indicates complete drowning of the Middle Jurassic sandstone-dominated Pelion Formation during maximum Middle Jurassic transgression.

A new species, *Kepplerites tenuifasciculatus*, is described in the appendix by J.H. Callomon. The holotype and paratype are from Jameson Land, East Greenland, but the species is also found in Bjørnedal, Traill Ø, North-East Greenland.

Keywords: ammonites, Fossilbjerget Formation, Middle Jurassic, *Kepplerites tenuifasciculatus* Callomon, Pelion Formation

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The Mesozoic deposits of the Traill Ø area in North-East Greenland were studied by Donovan (1953) during Lauge Koch's East Greenland expeditions (Fig. 1). Middle Jurassic exposures are few and scattered and fossils are scarce, allowing only a few tie-points to the biostratigraphically well-dated succession in Jameson Land to the south (Callomon 1993). A succession of dark micaceous, silty mudstones in an otherwise sandstone-dominated succession in the Bjørnedal valley, south-east Traill Ø was described by Donovan (1953; Fig. 2). Only a few poorly preserved and unidentifiable ammonite fragments were recovered. Hence the exact stratigraphic position and age of the mudstones were unknown and have remained as such until re-examination of the locality and intensive search for ammonites was carried out during fieldwork in the Traill Ø area in 1996 (Alsen 1998). New finds of ammonites indicate an Early Callovian age (*Cadoceras apertum* Chronozone) of the mudstones (Fig. 3), which are referred to the Fossilbjerget Formation, previously known only from Jameson Land (Surlyk *et al.* 1973). This paper presents the new finds of ammonites in the Bjørnedal area and the implications of these for the sequence stratigraphic interpretation of the basin.

The Traill Ø area forms the northwards continuation of the Jurassic Jameson Land Basin within the East Greenland rift basin. Huge amounts of sand-dominated sediments were introduced into the basin mainly from the north in Middle Jurassic times and were transported southwards by marine currents along the basin axis. A

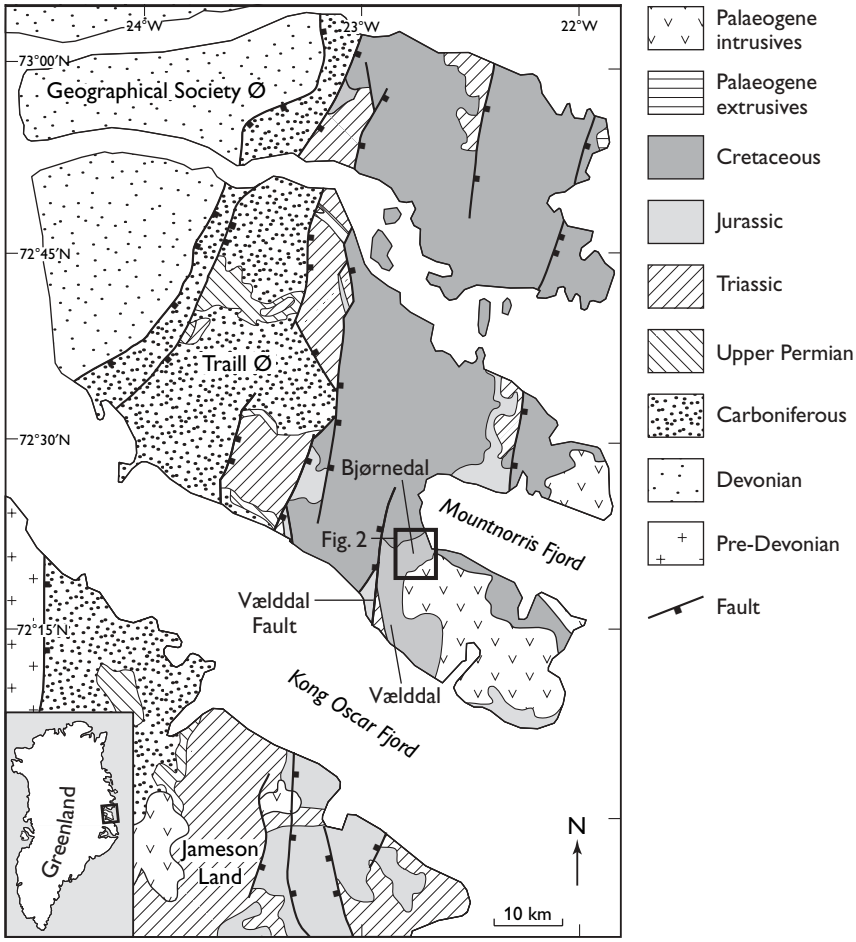


Fig. 1. Simplified geological map of the Traill Ø area. Location of study area (Fig. 2) is indicated.

thick succession of Middle Jurassic marine sediments, mainly sandstones, was deposited in northern Jameson Land and progressively thins distally towards the south. The proximal areas in Traill Ø acted as a bypass area for much of late Middle Jurassic time and the succession is generally thinner compared with the more distal areas in Jameson Land (Surlyk 2003).

The south-easternmost part of Traill Ø constituted an eastwards-tilted fault block, in contrast to other Jurassic fault blocks in East Greenland which are tilted westwards (Donovan 1953; Carr 1998; Surlyk 2003). A detailed analysis of the Middle Jurassic succession in the Vælddal area close to the crest of the eastwards-tilted block was recently undertaken by Carr (1998; Fig. 1). He demonstrated that as a result of synsedimentary movements of the Vælddal Fault during Middle Jurassic time the sedimentary evolution of the Bjørnedal area differed somewhat from that of other parts of the region. The Middle Jurassic succession in this block shows palaeocurrent directions to the east in contrast to the axial, southwards-oriented palaeocurrent directions seen elsewhere. The sandstone/mudstone ratio also decreases and the succession shows proximal to distal facies changes in the same direction (Vosgerau *et al.* 2004, this volume).

Stratigraphy

The lithostratigraphical scheme for the Jurassic of East Greenland was erected by Surlyk *et al.* (1973), Surlyk (1977, 1978) and Birkelund *et al.* (1984). The scheme is under revision and many units have been raised in rank (see Surlyk 2003, fig. 5). In the Traill Ø area, the Middle – lower Upper Jurassic succession now includes the Bristol Elv, Pelion, Fossilbjerget and Olympen Formations in ascending order (Fig. 4). The Bristol Elv Formation is probably not exposed in Bjørnedal. It is of pre-Late Bajocian but probably still Middle Jurassic age and includes fluvial pebbly sandstones and thin coaly shales (Therkelsen & Surlyk 2004, this volume). The Pelion Formation consists of shallow-marine sand-

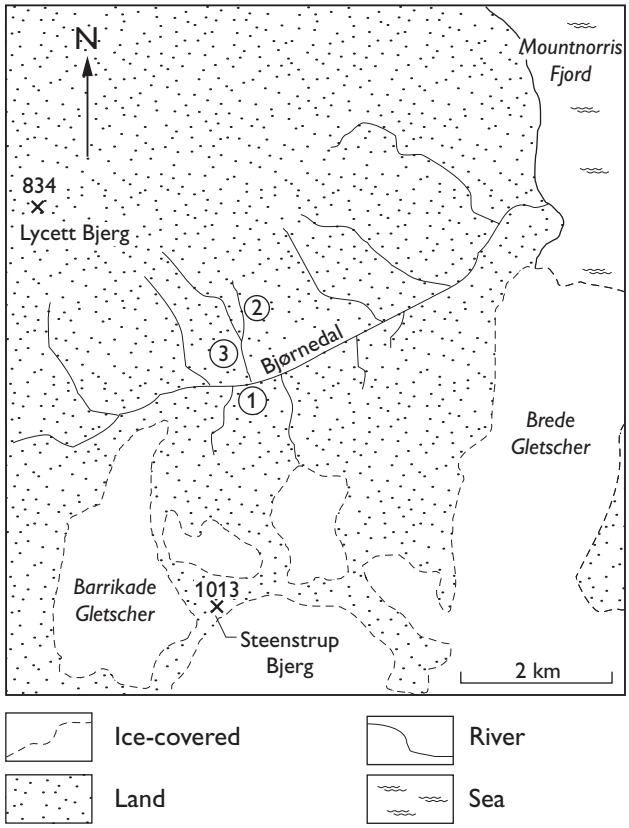
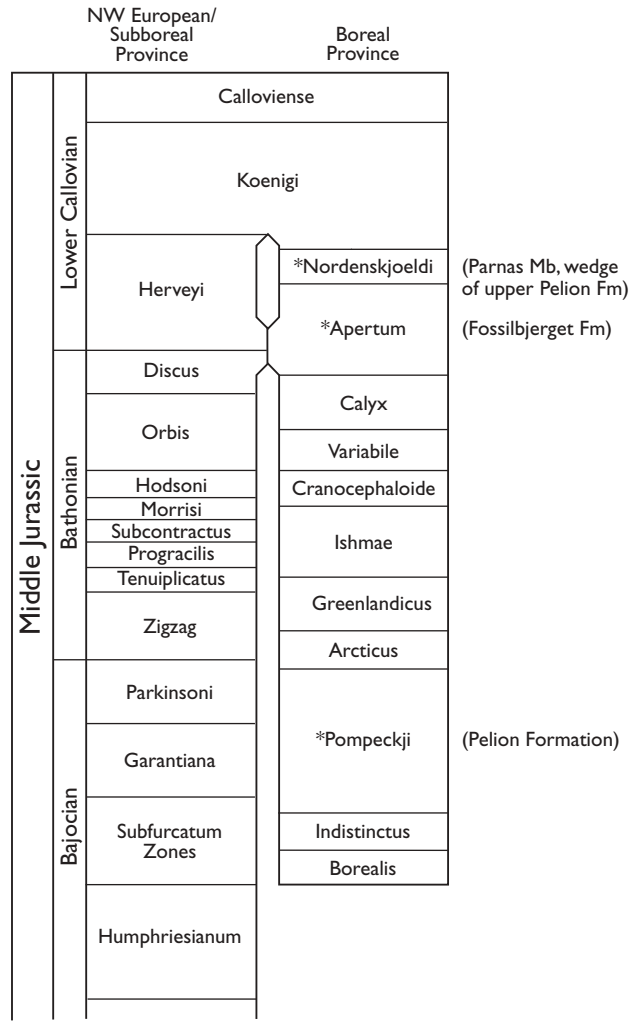


Fig. 2. Map of the Bjørnedal area, Traill Ø showing locations of sections and ammonite localities. **1**, Locality 1 with section JTH-15/96; **2**, Locality 2 with section JTH-14/96; **3**, Locality 3. Altitude of mountains in metres.

stones with bivalves, belemnites, ammonites and plant fragments. The formation rests on Triassic strata or on the Bristol Elv Formation. It is overlain by, or interfingers at the top with, offshore, dark, micaceous, silty mudstones of the Fossilbjerget Formation. A regressive wedge in the top part of the Pelion Formation interrupts the overall backstepping Pelion–Fossilbjerget couplet, and belongs to the Parnas Member of the Pelion Formation (Surlyk 2003). The Fossilbjerget Formation is overlain by the lower Upper Jurassic Olympen Formation, which also consists of shallow marine sandstones themselves quite similar to the sandstones of the Pelion Formation below, making recognition of the Olympen Formation difficult.

The Middle Jurassic succession in the Bjørnedal area is poorly exposed. The area described here corresponds to the 'northern part of Bjørnedal' of Donovan (1953). An intensive search for ammonites was made in dark, silty, micaceous mudstones exposed in small sections along the Bjørnedal river, Locality 1, and in a small section in a gully at Locality 2 (Figs 2, 5). Three ammonite assemblages were recovered; two ammonite species have been identified, one of them previously known from Jameson Land but hitherto undescribed.

The description of the Middle Jurassic succession in Bjørnedal is based mainly on Donovan (1953), since fieldwork was focused solely on the mudstones in its middle part. The succession is subdivided into five lithological units, A–E in ascending order (Figs 4, 5). Unit A belongs to the Pelion Formation and consists of about 200 m of sandstones containing *Cranocephalites*, which suggests correlation with the Upper Bajocian *C. pompeckji* Chronozone (Fig. 3) and indetermi-



* Zones identified in the Bjørnedal area

Fig. 3. Scheme of standard ammonite zones in the Upper Bajocian – Lower Callovian, Middle Jurassic. Due to faunal provincialism close correlation between zones in East Greenland (right column) and the NW European/Subboreal Province (left column) is not possible. The East Greenland ammonite zonation represents a secondary standard chronostratigraphical scheme for the Boreal Province. Modified from Callomon (2003).

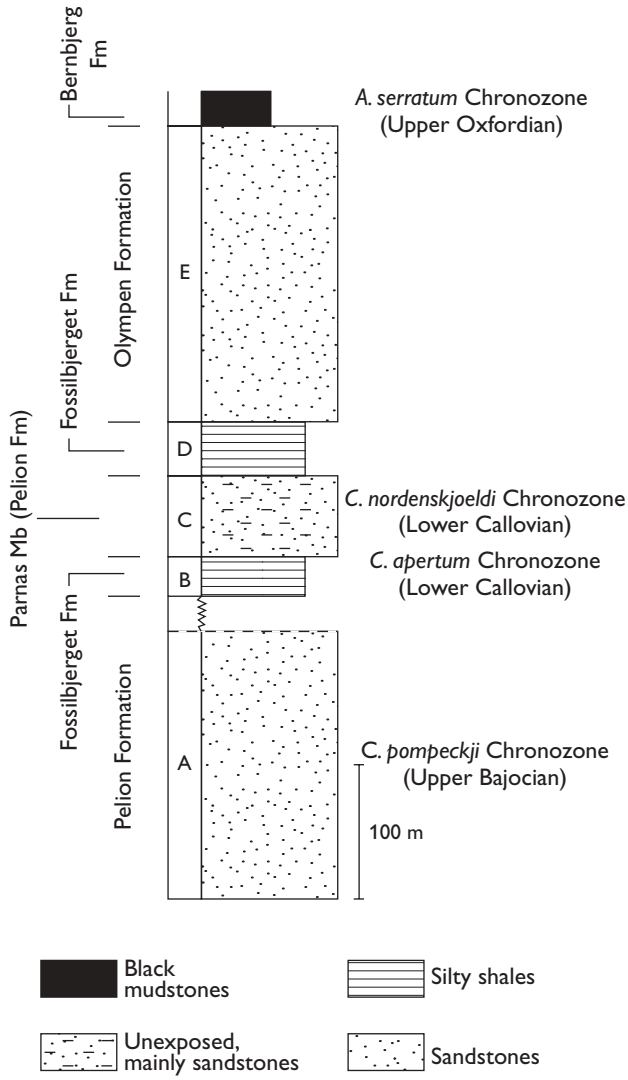


Fig. 4. Schematic section of the Middle Jurassic succession in Bjørnedal, based on Donovan (1953) and new data.

nate plant remains (Donovan 1953). The unit is exposed north-west of the mouth of the valley on the north-eastern slope of mount Lycett Bjerg facing Mountnorris Fjord (Fig. 2). The strata dip towards the south-east and disappear beneath the succession exposed in Bjørnedal. The base of the unit is not exposed. Unit B belongs to the Fossilbjerget Formation and consists of 25–30 m of soft, black, micaceous, silty mudstones with pyritic concretions and indeterminate plant impressions. The species of *Kepplerites* found indicates an Early Callovian age (*Cardioceras apertum* Chron; Fig. 3). Unit C is a mainly scree-covered interval, about 60 m thick, probably consisting mostly of sandstones. Finds of *Cadoceras* sp. in loose blocks in the scree indicate an Early Callovian age (*Cardoceras nordenskjoeldi* Chron; Fig. 3). The unit belongs to the Parnas Member, representing the last regressive tongue of the overall backstepping Pelion Formation. Unit D consists of about 40–50 m of black, silty mudstones with intercalated sandstones and indeterminable ammonites. It belongs to the upper part of the Fossilbjerget Formation. A 50 m core (GGU 303124) drilled at Locality 2 (Fig. 2) through most of this unit records a development from offshore black mudstones with occasional storm sandstone beds, 5–10 cm thick, into offshore transition zone mudstones with an upwards increasing content of fine-grained sandstone (Fig. 6). At the top, a syenite sill, *c.* 3 m thick, occurs between the mudstones and the base of the sandstones of the overlying lower Upper Jurassic Olympen Formation (Unit E). This formation consists of about 220 m of apparently massive sandstones interbedded with irregular beds of dark micaceous mudstones with traces of plants (Donovan 1953). It is overlain by Upper Jurassic black mudstones of the Bernbjerg Formation containing Late Oxfordian ammonites (*Amoeboceras serratum* Sowerby 1813; Price & Whitham 1997).

Discussion

The sequence stratigraphical development of the Middle Jurassic succession of Jameson Land was interpreted by Surlyk (1990, 1991), Surlyk *et al.* (1993) and in more detail by Engkilde & Surlyk (2003). It is difficult to trace or correlate key surfaces from Jameson Land across Kong Oscar Fjord to the Traill Ø area, in part because of the rather limited and generally poor outcrops on Traill Ø. In Jameson Land, the base of the Pelion Formation appears to be almost isochronous everywhere and of early Late Bajocian age (*Cadoceras borealis* Chron; Fig. 3). The formation is overlain by the Fossilbjerget Formation, with a strongly diachronous boundary younging sourcewards towards the north. This reflects the overall backstepping of the sandy Pelion system caused by a combination of increasing rifting and eustatic sea-level rise. During maximum transgression in the Early–Middle Callovian, deposition of offshore Fossilbjerget mudstones reached its northernmost extent. The presence of the Fossilbjerget Formation in Bjørnedal, Traill Ø, extends the known distributional area of the formation northwards by about 100 km. This reflects drowning of the marine sand-dominated depositional systems of the Pelion Formation during the Middle Jurassic at maximum transgression. A sandstone wedge of the Parnas Member (Pelion Formation) is intercalated in the Fossilbjerget Forma-

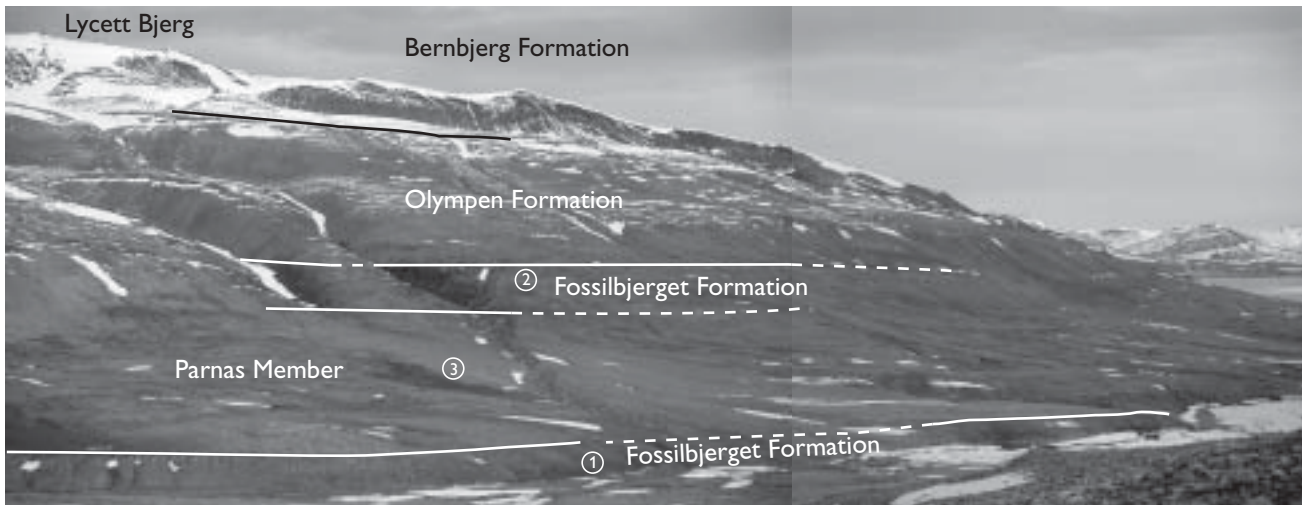


Fig. 5. View of Bjørnedal towards the north-west. The succession exposed on the southern flank of Lycett Bjerg is subdivided into lithostratigraphical units. **1–3**, indicate localities (Fig. 2). The Fossilbjerget Formation section in the centre of the photograph is 40–50 m thick. (Photo: S. Piasecki).

tion and represents the last, Early Callovian, regressive tongue of the overall backstepping Pelion Formation. The Fossilbjerget Formation is overlain by the prograding sandstones of the Olympen Formation.

Systematic palaeontology

Specimens with MGUH numbers are stored at the Geological Museum, University of Copenhagen, Denmark.

Superfamily Stephanocerataceae Neumayr 1875
Family Kosmoceratidae Haug 1887

Genus *Kepplerites* Neumayr & Uhlig 1892

***Kepplerites* cf. *tenuifasciculatus* Callomon 2004**
Plate 1, fig. 1

Material. One fragmented specimen (MGUH 25762 from GGU 429773).

Horizon. The specimen was found loose in unit B at Locality 1 (Figs 2, 4, 5).

Description. Only two-fifths of the last whorl is preserved, as an imprint in silty mudstone. The fragment, a macroconch, comprises most of the body chamber of an adult specimen with an estimated maximum diameter of 130 mm. Its umbilical seam is uncoiling and the ribs near the aperture are strongly projected forward. Primary ribs are coarse and strongly curved. Each primary rib gives rise to four secondary ribs, which persist to the venter. Secondary ribbing is very fine and dense. Secondary ribs are almost straight but seem to curve slightly backwards near the venter giving an overall sinuous appearance of the primary and secondary ribs.

Comparison. The species is consistently more densely, finely ribbed than any other species of *Kepplerites* from East Greenland, with little, if any, modification of the primary ribbing in the adult stage.

Age and distribution. *K. tenuifasciculatus* occurs in central Jameson Land and on Traill Ø. In central Jameson Land it is found at a level above *K. traillensis* (faunas 24–26 of Callomon 1993). *K. traillensis* is thought to correlate closely with the horizon of *K. keppleri* in Europe, which defines the base of the Callovian. *K. tenuifasciculatus* is thus of Early Callovian age (*C. apertum* Chron; Fig. 3).

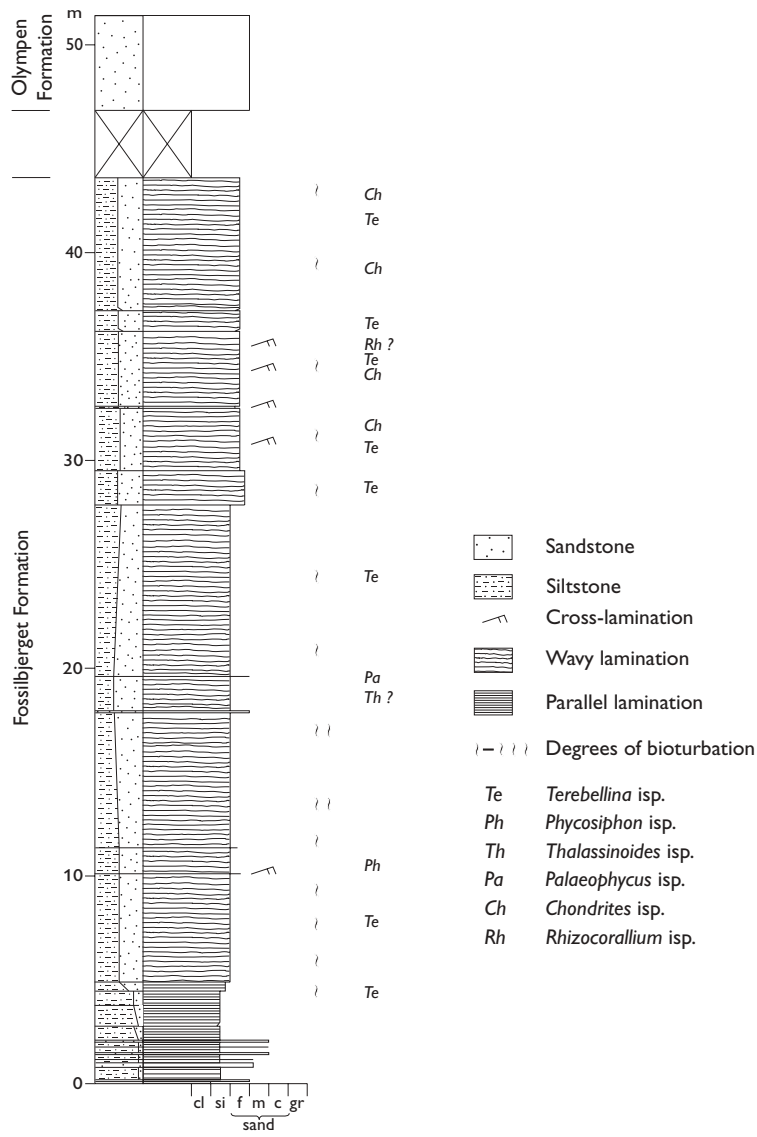


Fig. 6. Sedimentological log of core GGU 303124, measured by J. Therkelsen and P. Alsen. For location, see Figs 2, 5.

Family Cardioceratidae von Siemiradzky 1891

Genus *Cadoceras* Fischer 1882

***Cadoceras* sp.**
Plate 1, figs 2A–C, 3

Material. Several fragments preserved as imprints in black shale (MGUH 25763–766 from GGU 429771; GGU 429772). The assemblage includes well-preserved small specimens of microconchs, some of which are almost complete (Plate 1, figs 2A–C).

Horizon. The assemblage was collected at a small exposure in the streambed of the Bjørnedal River in Bjørnedal, Traill Ø. The succession was not measured, but belongs to unit B (Fig. 4).

Description. The fragments seem to be those of macroconchs. They are densely ribbed with relatively coarse, strong primaries and secondaries. Size cannot be estimated. The microconchs are small and evolute with dense, very fine ribbing. Ribbing becomes somewhat coarser near the final peristome. The maximum diameter is on average about 16 mm.

Age. The specimens are early *Cadoceras* (J.H. Callomon, personal communication 1997) probably from the *C. apertum* or *C. nordenskjoeldi* Chronozones (Fig. 3; faunas 27–30 of Callomon 1993). The assemblage thus indicates an Early Callovian age.

***Cadoceras* cf. *nordenskjoeldi* Callomon & Birkelund 1985**
Plate 1, fig. 4A–C

1904 *Olcostephanus* Neumayr (?*Simbirskites* Pavlow & Lamplugh) nov. sp. – Madsen, p. 195, plate 10, fig. 2.
cf. 1985 *Cadoceras nordenskjoeldi* n. sp. Callomon & Birkelund, p. 84, pl. 1, fig. 4; pl. 4, figs 1–6.

Material. Several fragments (MGUH 25767–769 from GGU 429768). The fragments are small and crushed macroconchs and are poorly preserved in hard, reddish sandstone. Complete specimens and microconchs have not been identified.

Horizon. The assemblage was found loose in unit C at Locality 3 between the mudstones exposed at Localities 1 and 2 (Figs 2, 4, 5).

Description. The inner whorls are finely and densely ribbed and seem to be evolute. The outer whorls are evolute, with very coarse and blunt primary and secondary ribbing. The whole assemblage seems to consist of fairly slim variants.

Comparisons. The specimens are referred to as *C.* cf. *nordenskjoeldi*, which has the above-mentioned characteristic style of ribbing. This is supported by their stratigraphical position above *K. tenuifasciculatus*.

Age and distribution. This is the first find of the species outside the Fossilbjerget and Olympen areas in central Jameson Land. *C.* cf. *nordenskjoeldi* indicates an Early Callovian age (*C. nordenskjoeldi* Chron; Fig. 3).

***Cadoceras* sp. indet.**
Plate 1, fig. 5

Material. Two specimens and fragments (MGUH 25770 from GGU 429767; GGU 429769–770). One specimen is a poorly preserved macroconch (Plate 1, fig. 5); the other is a poorly preserved microconch. Both are imprints in mudstones.

Horizon. The ammonites were collected at Locality 2 from level 29–30.6 m in section JT-14 (Fig. 2) in mudstones of unit D (Figs 2, 4, 5).

Description. The macroconch is medium-sized and evolute, and comprises most of a whorl of the body-chamber. Ribbing is dense and relatively strong up to the aperture. Primaries divide into secondaries on the middle of the flank. The specimen shows no adult modification and could be a juvenile. Maximum diameter measures 61.5 mm. The other specimen, probably a microconch, is small and relatively evolute. Ribbing is dense and sharp with primaries and secondaries. Maximum diameter is 30 mm.

Age. The assemblage is too poorly preserved for determination to specific level. The specimens are possibly early *Cadoceras* of Early Callovian age (J.H. Callomon, personal communication 1997; Fig. 3).

Acknowledgements

We acknowledge generous support by the Danish Research Councils (Project: 'Resources of the sedimentary basins of North and East Greenland') and thank Jette Halskov for drafting, Jens Therkelsen, who provided the measured sections, John H. Callomon and Lars Stemmerik for reading the manuscript critically, and Walter K. Christiansen and G. Bloos for useful reviews.

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Plate 1

Plate 1

All specimens are figured natural size.

Fig. 1. *Kepplerites* cf. *tenuifasciculatus* Callomon.
Adult macroconch.
MGUH 25762 from GGU 429773.

Fig. 2. *Cadoceras* sp.
A: MGUH 25763 from GGU 429772b.
B: MGUH 25764 from GGU 429772a.
C: MGUH 25765 from GGU 429772c.

Fig. 3. *Cadoceras* sp.
MGUH 25766 from GGU 429772e.

Fig. 4. *Cadoceras* cf. *nordenskjoeldi* Callomon & Birkelund
A: MGUH 25767 from GGU 429768a.
B: MGUH 25768 from GGU 429768c.
C: MGUH 25769 from GGU 429768b.

Fig. 5. *Cadoceras* sp. indet.
MGUH 25770 from GGU 429767.

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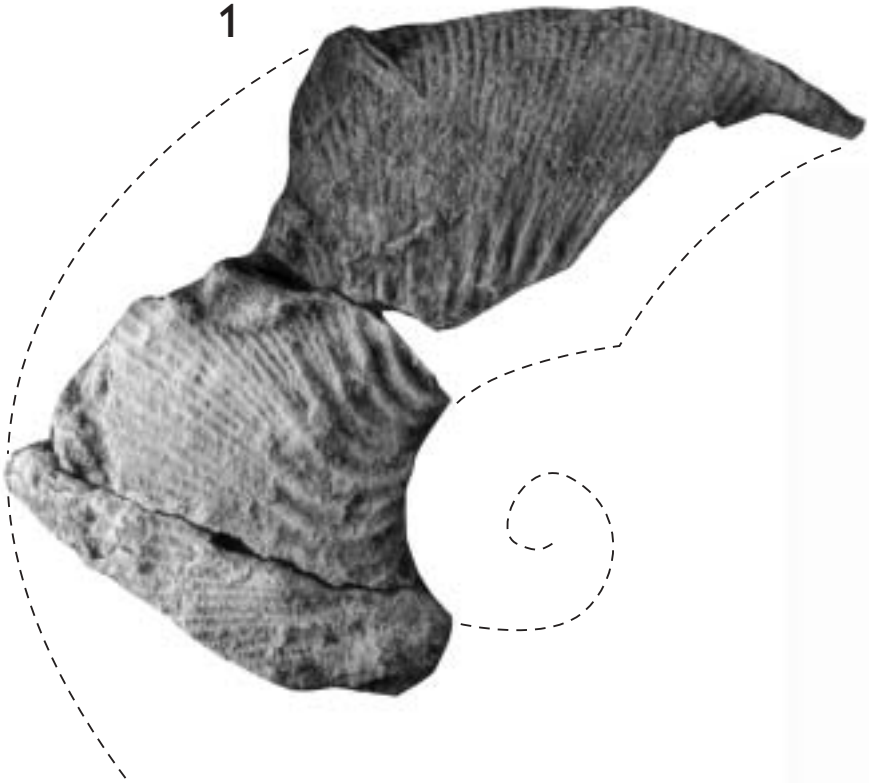

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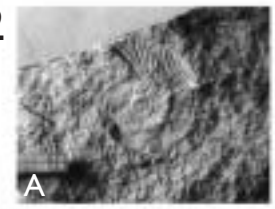

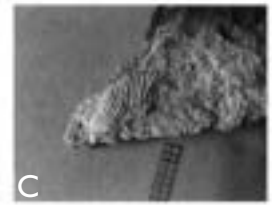

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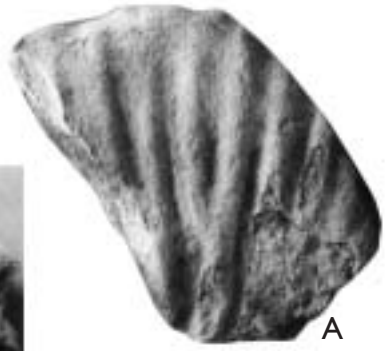

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Appendix

Description of a new species of ammonite, *Kepplerites tenuifasciculatus* n. sp., from the Middle Jurassic, Lower Callovian of East Greenland

John H. Callomon

A new species of ammonite, *Kepplerites tenuifasciculatus* n. sp., is described. Its type locality is at Fossilbjerget in central Jameson Land, East Greenland and its type horizon lies in the Apertum Zone, the lowest zone in the Lower Callovian Stage of the Middle Jurassic. It has a narrow stratigraphical range and hence makes a good guide-fossil for stratigraphical time correlation.

Keywords: ammonite, East Greenland, Fossilbjerget, Jameson Land, *Kepplerites tenuifasciculatus* n. sp., Middle Jurassic

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The revision of the biostratigraphy and biochronology of the ammonite faunas of the Middle Jurassic of East Greenland has revealed a number of hitherto unknown species that characterize very narrow chronostratigraphic intervals and hence make excellent guide-fossils for time correlations (Callomon 1993). One of these is now described. It represents a transient – chronospecies of some authors – in the evolution of one of the two evolutionary lineages, the Kosmoceratidae, whose members inhabited East Greenland during the Late Bathonian and Callovian, the other being the much longer-ranging Cardioceratidae.

Superfamily Stephanocerataceae Neumayr 1875
Family Kosmoceratidae Haug 1887

Genus *Kepplerites* Neumayr & Uhlig 1892

Type species. Amm. keppleri Oppel 1862.

***Kepplerites tenuifasciculatus* n. sp.**
Plate 1, figs 1–2

1993 *Kepplerites* sp. nov. J [*tenuifasciculatus* MS] Callomon, p. 103.

Holotype. Plate 1, fig. 1, MGUH 25310 from GGU 185614a (T. Birkelund and C. Heinberg collection 1974) Jameson Land, Fossilbjerget, section 43, bed 14, horizon J27 (Figs 1, 2).

Other material. Paratypes I, II, MGUH 25311–312 from GGU 185614b, c; paratype III, MGUH 25313 from JHC 4475 (Plate 1, fig. 2; T. Birkelund and J.H. Callomon collection 1971), same locality and bed; JHC 4469–4471, section 42, bed 18 (see Fig. 2); GGU 144191–192 from south slopes of mount Mikael Bjerg, section 31 (Birkelund coll. 1971; Fig. 1). Numerous other specimens seen *in situ* were too poorly preserved to be worth collecting.

Stratigraphical horizon. The southern slopes of Fossilbjerget are marked by three ridges, running southwards, on which sections have been recorded, numbered 41–43 from east to west (Callomon 1993, fig. 1).

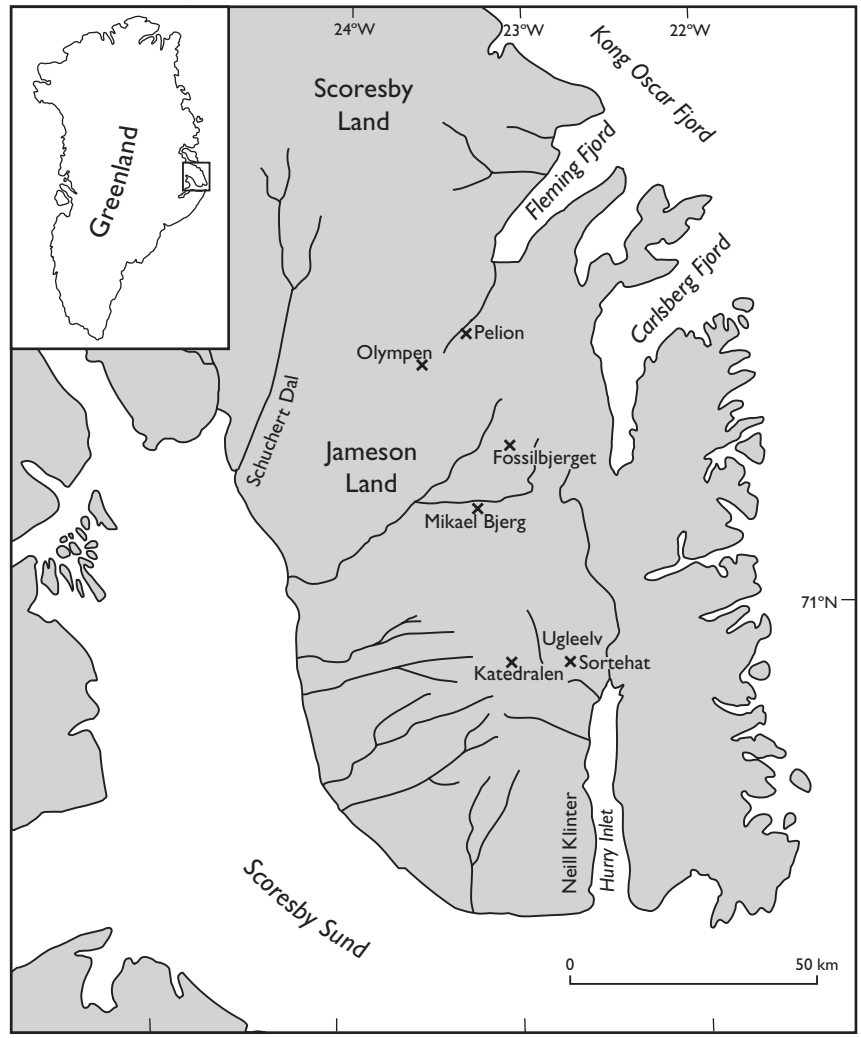


Fig. 1. Sketch-map of the Jameson Land area with place names mentioned in the text.

The sections span the shaly Fossilbjerget Formation underlain by the sandy Pelion Formation and capped by the sandstones and shales of the Olympen Formation (Surlyk *et al.* 1973; Larsen & Surlyk 2003). The three sections differ only in detail. Section 43 is shown in weathering-profile in Figure 2. It was previously shown in outline by Surlyk *et al.* (1973, fig. 23). Lithologically, the sediments consist predominantly of shaly siltstones or very fine-grained sandstones, barely consolidated except in concretionary layers that punctuate the succession as markers or in scattered calcitic or phosphatic concretions. Some of the beds are highly glauconitic, indicating condensed, sediment-starved intervals and comparison with adjacent areas, *e.g.* at the mountains Olympen and Mikael Bjerg (Fig. 1), shows that the succession incorporates numerous hiatuses of variable durations. The age-diagnostic ammonites can be recovered only from the hard beds. Their biostratigraphy in terms of faunal horizons, however, is with only few exceptions as close to complete as present knowledge allows (Callomon 1993, fig. 4). The only horizon in the interval under discussion not so far recognized in the Fossilbjerget–Olympen area is J23, that of *Kepplerites vardekloeftensis*. It may have been lost in a hiatus, marked by a sharp lithological break, under the glauconitic ironstones of beds 9–13 (Fig. 2, Section 43). The type-horizon of *Kepplerites tenuifasciculatus*, J27, is bed 14, an indurated, shaly, non-glauconitic, light brown fine-grained sandstone, 0.2 m thick, lying with sharp contact on the hard, ferruginous and highly glauconitic sandstone marker of bed 13 below (Fig. 2, Section 43). The contact probably marks another hiatus that would account for the considerable break, both in composition and morphologies, between the faunas of beds 13 and 14. The fauna of bed 13 consists predominantly of *Cadoceras* (*apertum*), with only minor *Kepplerites* (cf. *traillensis*). That of bed 14 is dominated by monospecific

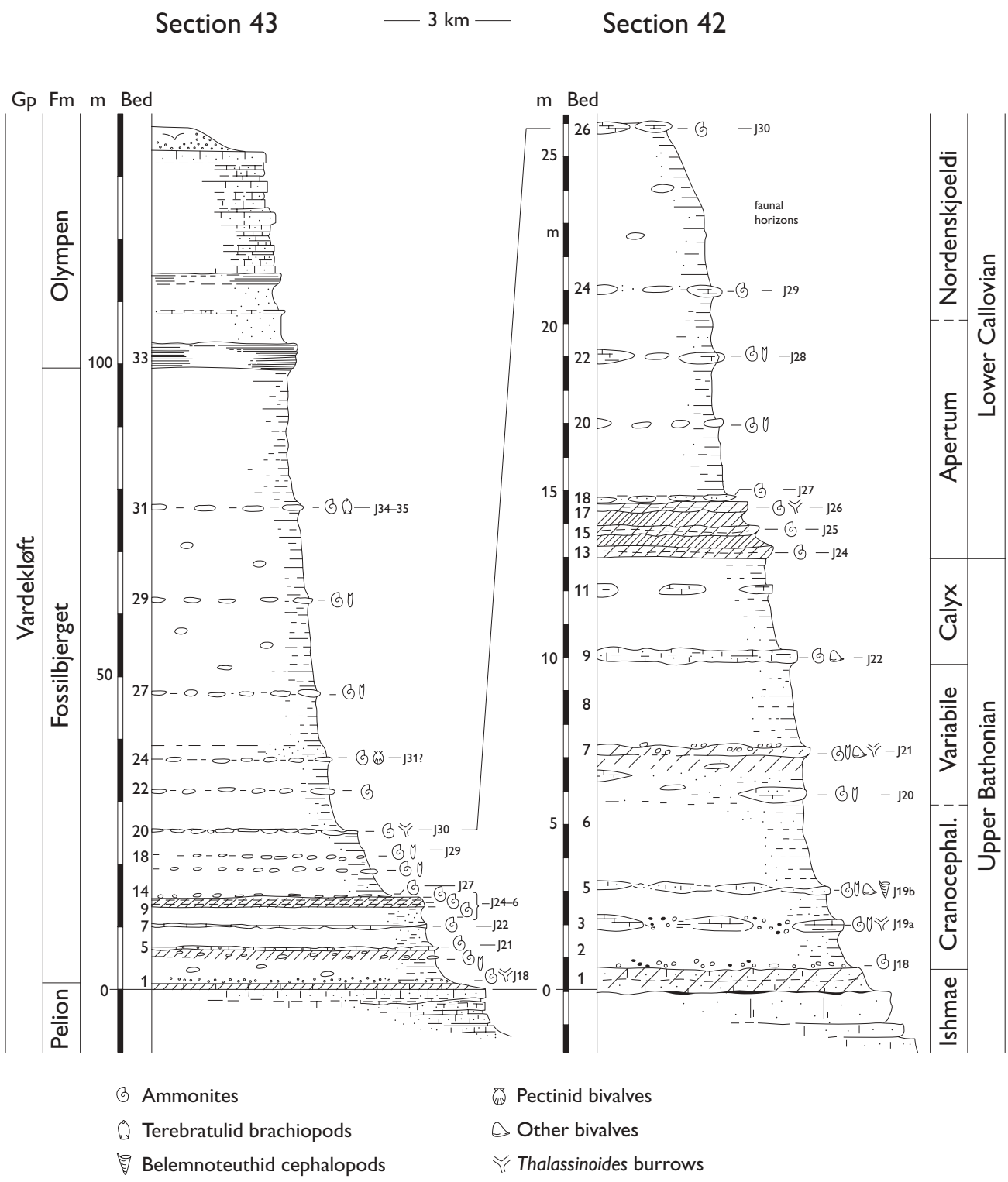


Fig. 2. Diagrammatic sections in weathering profile through the Fossilbjerget Formation at its type locality on the southern slopes of Fossilbjerget, central Jameson Land; section 43 is located 3 km west of section 42. Note that the beds in the two sections are numbered independently – discussion of bed numbers in the text refers to those in Section 43. Lithostratigraphy at left, standard chronostratigraphy – substages and zones – at right. Diagonal hatching: glauconitic. Numbers J18–J35: the ammonite faunal horizons recognized in Jameson Land (see Callomon 1993). The horizon of *Kepplerites tenuifasciculatus* is J27. **Cranocephal.**, Cranocephaloide.

Table 1. Measurement of dimensions

	Holotype	Paratype III
Maximum diameter	137 mm	140 mm
Septate to	*c.* 100 mm	*c.* 90 mm
Length of bodychamber, whorl	0.70	0.75
Fractional umbilical width at last septum	0.23	0.22
Fractional umbilical width at aperture	*c.* 0.34	*c.* 0.33
Primary ribs per whorl		
– at diameter 125–130 mm	51	57
– at diameter 85–95 mm	40	46
Ratio of secondaries:primaries around last septum	3.8	3.4

Kepplerites (*tenuifasciculatus*) with only occasional crushed, indeterminate *Cadoceras*.

Description. All the available material consists of crushed internal moulds and measurements of dimensions (Table 1) are of limited value. The figured specimens are typical; both are complete adult macroconchs with strongly uncoiling seams on the last whorl. The microconchs remain unknown. The ribbing is characteristically dense and fine, the primaries rising retroradially on the umbilical wall, then swinging in a strongly forwards-directed curve on the umbilical shoulder into accentuated prorsiradiate ribbing on the whorlside, dividing into fasciculate sheaves (tenuifasciculate) of secondaries at about a third flank-height, rising uncurved to the venter, persisting with little or no loss of strength to the simple, somewhat sinuous peristome. There is no evidence of the lateral accentuation of the primaries into tubercles seen in other species of *Kepplerites*, especially in the younger ones and subsequently in the descendant, *Kosmoceras*. Inner whorls are not seen, so whether the earliest stages already have tabulate venters is not known.

Comparisons. The evolution of major morphological characters in the genus *Kepplerites*, leading to *Kosmoceras* in the Middle Callovian, was very gradual. Differentiation of successive transients relies on relatively minor variations of size and ribbing, often perceptible only by the trained eye in assemblages of more than a single specimen in which the range of intraspecific variability can be assessed. Changes were not continuously orthogenetic: characters could 'progress' and 'regress' with time largely independently, leading to frequent partial homoeomorphies.

In descending order:

1. *Kepplerites traillensis* Donovan 1953 (plate 17, figs 1a, b, holotype; plate 18, figs 1a, b), faunal horizons 24–26, is similar in size, coiling and style of ribbing but significantly less densely ribbed, with only *c.* 31 primaries per whorl (before the onset of the modifications on the final stage of the adult bodychamber found in all the Kosmoceratidae). The type material came from mount Morris Bjerg on Traill Ø, about 5 km north-east of the coast of Kong Oscar Fjord to the south-west. It was found in isolation, both stratigraphically and faunistically, so the position of its faunal horizon in the general succession has to be deduced by correlation with the more continuous successions in Jameson Land. The closest resemblance is to the forms found also on the southern slopes of Fossilbjerget, sections 42 and 43, horizons 24–26, as minor components in faunas dominated by *Cadoceras apertum* (Callomon & Birkelund 1985).

   K. traillensis is also, among all the known faunas of Greenland, the one closest to the type-species *K. keppleri* (Oppel): cf. Buckman (1922, plate 289A, B, lectotype, evolute inflated variant with slightly tabulate venter); Quenstedt (1886, plate 77, figs 1–5, S. Germany); Page (1989, fig. 5.1a, b, England). The resemblance is close but may not be exact, so that both specific names are retained for the time being. It indicates, however, a close time correlation and provides the basis for the assignment of the Apertum Zone already to the Lower Callovian.

2. *Kepplerites vardekloeftensis* Callomon 1993 (p. 102), faunal horizon 23. The holotype (Spath 1932, plate 25, figs 2a, b, complete adult) and paratype (Spath 1932, plate 25, figs 1a, b, complete adult phragmocone) came from the calyx limestone, a prominent concretionary marker-bed in the Fossilbjerget Formation along the length of the outcrops above Neill Klinter, the line of cliffs on the west side of Hurry Inlet and traceable inland as far as Katedralen on Ugleelv (Fig. 1); level 560 m in sections of Rosenkrantz reproduced by Spath (1932, p. 126, fig. 10). The species resembles *K. tenuifasciculatus* in coiling, size and density of primary ribbing but the secondary ribbing is coarser and fades on the

bodychamber. The two species are closely homoeomorphic but stratigraphically separated by the transients described above, which differ appreciably.

3. *Kepplerites svalbardensis* Sokolov & Bodylevsky (1931, p. 79, plate 5, figs 1, 2) resembles *K. tenuifasciculatus* in coiling and finesse of ribbing, but is smaller: adult size 105 mm, septate to 70 mm. The ribbing (45 primaries per whorl) differs, however, on the whorl-side in that, after the initial forwards twist at the umbilical margin, it curves backwards again, the secondaries reaching the venter rectiradially.

   The species occurs in Greenland as a minor component in fauna 22, the dominant element of which is *K. peramplus* Spath. The latter is so distinctive, characterised by its great size (adult diameters 200 mm or more), involute and compressed inner whorls (see also Dietl & Callomon 1988, figs 4, 5), that there seems little doubt about the separate biospecific identities of the two taxa. They are not linked by intermediates and represent one of the rare cases in which the specific diversity at one horizon of an evolving generic clade rises above the monospecific. The faunal horizon can be followed from southern Hurry Inlet (types of *K. peramplus*) as far as the mountains Mikael Bjerg and Fossilbjerget, sections 42 and 43 (see above; Fig. 1).

   Upwards, the record of *Kepplerites* in Greenland becomes tenuous. Occasional specimens have been found in the Nordenskjoeldi Zone, horizons 28–29, but the preservation is too poor to be able to say much of interest other than that they are still of the general appearance and size of *K. traillensis* or *K. tenuifasciculatus*. The next horizon to yield keppleritids is horizon 32. The forms at this horizon are, however, quite distinct: small, evolute and round-whorled, typical of the chronosubgenus *Gowericeras* that makes an abrupt appearance in much of northern Europe and thereby characterizes the Koenigi Zone.

Age and distribution. Lower Callovian, Apertum Zone, faunal horizon 27. Central Jameson Land, southern slopes of Fossilbjerget, sections 42–43, and around Mikael Bjerg (Fig. 1), sections 31, 33.

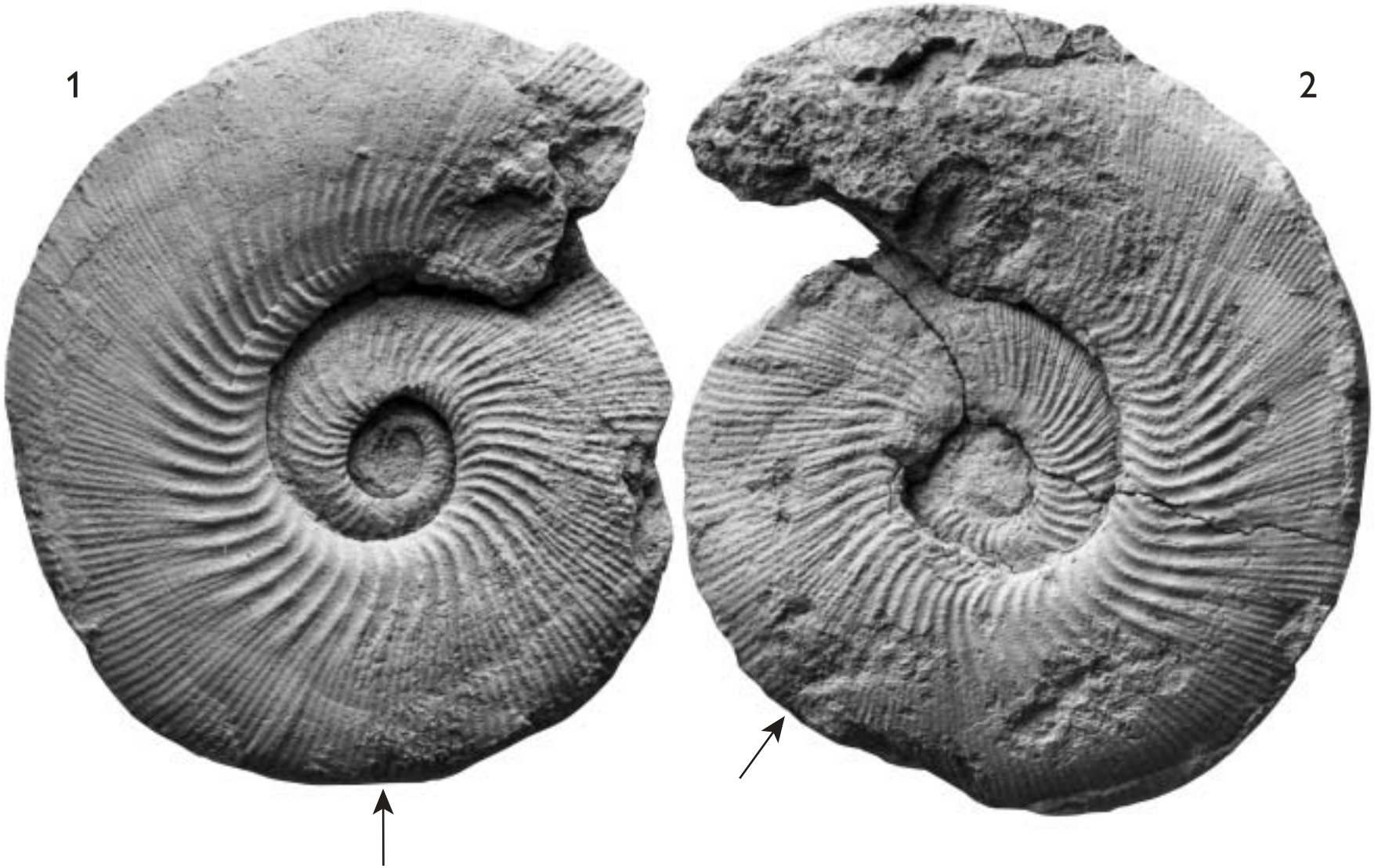
Plate 1

Plate 1

Complete adults, natural size; arrows mark the position of the last septum at the onset of the adult bodychamber.

Fig. 1. *Kepplerites tenuifasciculatus* n. sp.
Holotype, MGUH 25310 from GGU 185614a.
Fossilbjerget, section 43, bed 14, faunal horizon J27.
Lower Callovian, Apertum Zone.

Fig. 2. *Kepplerites tenuifasciculatus* n. sp.
Paratype III, MGUH 25313 from JHC 4475.
Section, bed and faunal horizon as above.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