A second occurrence of the enigmatic *Kordesphecia* (?stem group Dasycladales) from the lower Cambrian of North Greenland (Laurentia)

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A second occurrence of *Kordesphecia nyeboensis* is reported from the Aftenstjernesø Formation (Cambrian Series 2) at the head of Nordenskiöld Fjord, North Greenland, providing significant new information concerning the morphology of an enigmatic microfossil first described from Nyeboe Land. A rhizoid (holdfast), a robust, plated stem and a crown with distinctive, radiating, rhombic cells are recognized in a relatively complete, sub-cylindrical juvenile specimen. The calcified thallus in larger examples is shown to have developed robust, trumpet-shaped branches or to have divided dichotomously. The new morphological details support the original suggestion that *Kordesphecia* may be a stem group dasycladalean green alga.

Keywords: Green algae, ?Dasycladales, Cambrian, Aftenstjernesø Formation, Greenland, Laurentia

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Kordesphecia was first described by Peel (2014) on the basis of three microscopic phosphatized specimens from the lower Cambrian Aftenstjernesø Formation of Nyeboe Land, North Greenland (Fig. 1). The subcylindrical form of the fragments, with rhombic cells radiating from a central cavity (Fig. 2), motivated inclusion within a small group of Cambrian genera involved in discussions concerning the earliest Dasycladalean algae (Riding 1991; 1992, 2001; Berger & Kaever 1992; LoDuca & Behringer 2009; Peel 2014; Jiang & Zhang 2022). Most of these genera were described by Russian palaeontologist Kira Borisovna Korde (1912–2001) on the basis of material from the former Soviet Union and include the lower Cambrian *Cambroporella* Korde, 1950, the middle Cambrian *Amgaella* Korde, 1957 and the late Cambrian *Seletonella* Korde, 1950. The affinity of other taxa of similar derivation, such as the lower Cambrian *Lenaella* Korde, 1959, is more problematic (Korde 1961; Rozanov & Zhuravlev 1992; Peel 2014; LoDuca *et al.* 2017).

Jiang & Zhang (2022) considered the oldest undoubted calcareous dasycladaleans to be the Ordovician *Vermiporella* Stolley, 1883 and *Kazakhstanelia* Korde, 1957 (Roux 1991). They proposed a new genus *Tarimoporella* Jiang & Zhang, 2022 (also inadvertently spelt as *Tarimporella*) from the lower Cambrian of Xinjiang, China as the earliest dasycladalean but the material is difficult to interpret from their illustrations. Yang *et al.* (2023) considered *Protomelission* Brock & Cooper, 1993 from the lower Cambrian of South Australia to be a dasycladean, but Song *et al.* (2026) reinterpreted it as a bryozoan.

This paper reports a new specimen of *Kordesphecia nyeboensis* Peel, 2014, the type and only known species of *Kordesphecia*, that preserves significant morphological features not seen in the original material from Nyeboe Land. Its description promotes revision of the diagnosis of *Kordesphecia* and supports its interpretation as a stem group dasycladalean (Peel 2014). As with the type material, the phosphatized new specimen was recovered by dissolution in 10 % acetic acid of carbonates from the basal Aftenstjernesø Formation, but from a locality at the head of Nordenskiöld Formation, 225 km to the east of the original locality for the species (Fig 1A).

Geological background

Cambrian strata crop out in three main areas of northern Greenland as part of the transarctic Franklin Basin (Higgins *et al.* 1991; Ineson & Peel 1997). In the westernmost areas, lower Cambrian siliciclastic sediments are followed by inner shelf carbonates (Poulsen 1927; Dawes 2004; Peel 2021a). In the

southern Freuchen Land–Peary Land area (Fig. 1A) siliciclastic sediments of the Buen Formation (Peel & Willman 2018) overlie an Ediacaran–lower Cambrian carbonate platform (Portfjeld Group; Willman *et al.* 2020; Ineson *et al.* 2024) that is followed by a well exposed complex of lower Cambrian–lower Ordovician, mainly shelf carbonates (Brønlund Fjord and Tavsens Iskappe groups; Fig. 1C) that progrades northward across the open shelf (Ineson & Peel 1997). Outer shelf and deepwater trough Cambrian strata emerge from beneath the overlying Ordovician–Silurian succession along the north coast, from Nyeboe Land (Fig. 1A, B) eastwards. The Aftenstjernesø Formation, which yielded all the material described herein, can be traced from its type locality alongside Henson Gletscher in southern outcrops to northern Nyeboe Land.

GGU sample 313072 was collected by A.K. Higgins and N.J. Soper on 22 July 1984 from 5 m above the base of the Aftenstjernesø Formation, lower Cambrian (Cambrian Series 2), on the west side of Hand Bugt, northern Nyeboe Land (82˚11′ N, 57˚12′ W), North Greenland (Fig. 1B; Peel 2014). Small shelly fossils from the Aftenstjernesø Formation in north-

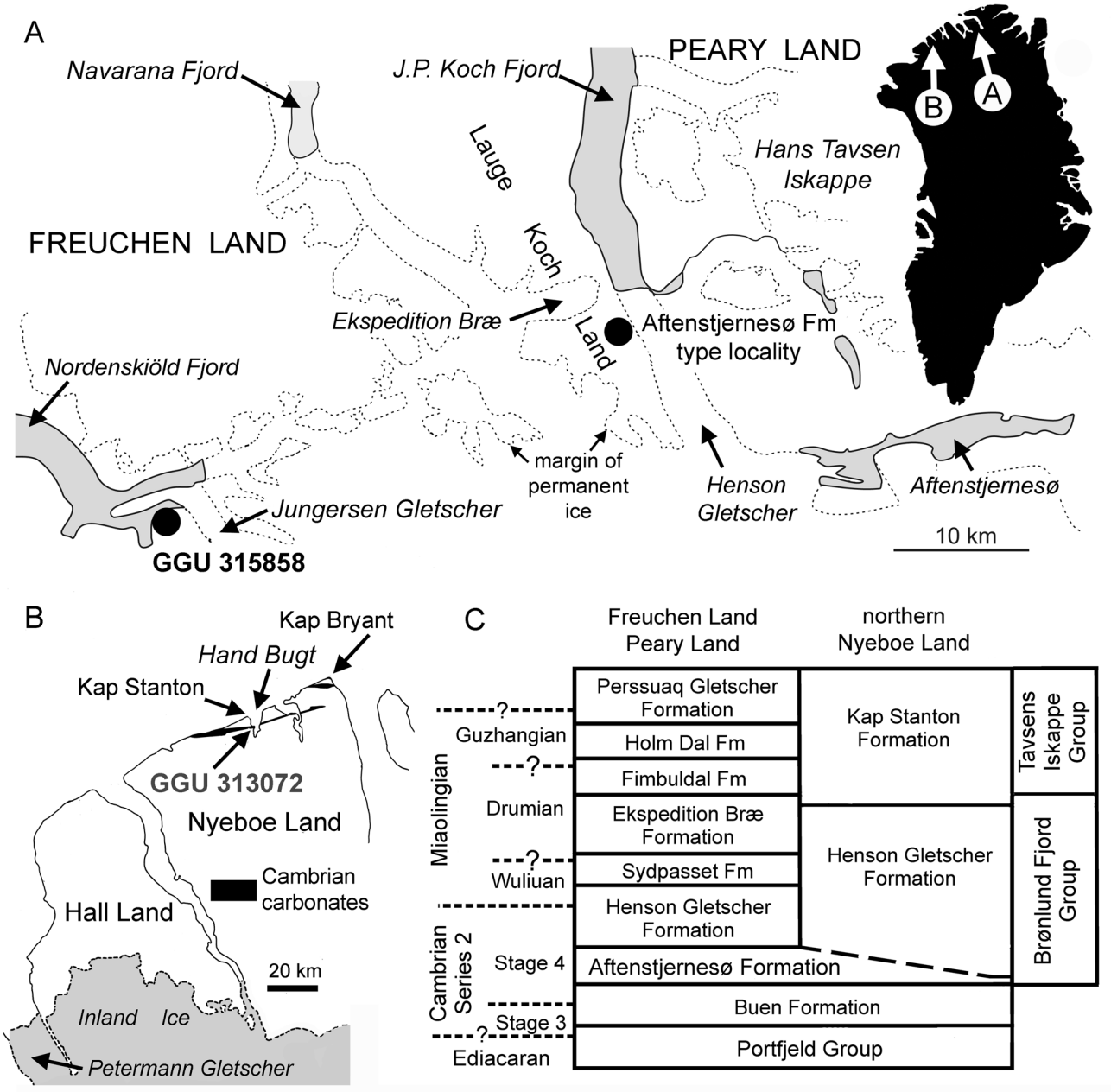


Fig. 1. Derivation of material. **A:** collection locality of GGU sample 315858 and location of type locality of the Aftenstjernesø Formation. Inset map of Greenland locates Fig. 1A, 1B. **B:** collection locality of GGU sample 313072, the type locality of *Kordesphecia nyeboensis* in northern Nyeboe Land. **C:** Cambrian stratigraphic nomenclature in North Greenland.

ern Nyeboe Land were illustrated by Peel & Skovsted (2021).

GGU sample 315858 was collected by Flemming Rolle in July 1984 from the Aftenstjernesø Formation, west of Jungersen Gletscher at the head of Nordenskiöld Fjord (82˚5′ N, 42˚50′ W), North Greenland (Fig. 1A). In addition to *Kordesphecia nyeboensis*, it yields a diverse fauna similar to that documented from the same formation in northern Lauge Koch Land by Peel (2021b), and by Oh *et al.* (2025, 2026) in the area around the type locality of the formation in southern Lauge Koch Land (Fig. 1A).

Institutional abbreviations. GGU prefix indicates a sample collected by Grønlands Geologiske Undersøgelse (GGU; Geological Survey of Greenland), now part of the Geological Survey of Denmark and Greenland (GEUS), Copenhagen, Denmark. MGUH: Natural History Museum of Denmark, Copenhagen. PMU: palaeontological type collection of the Muse-

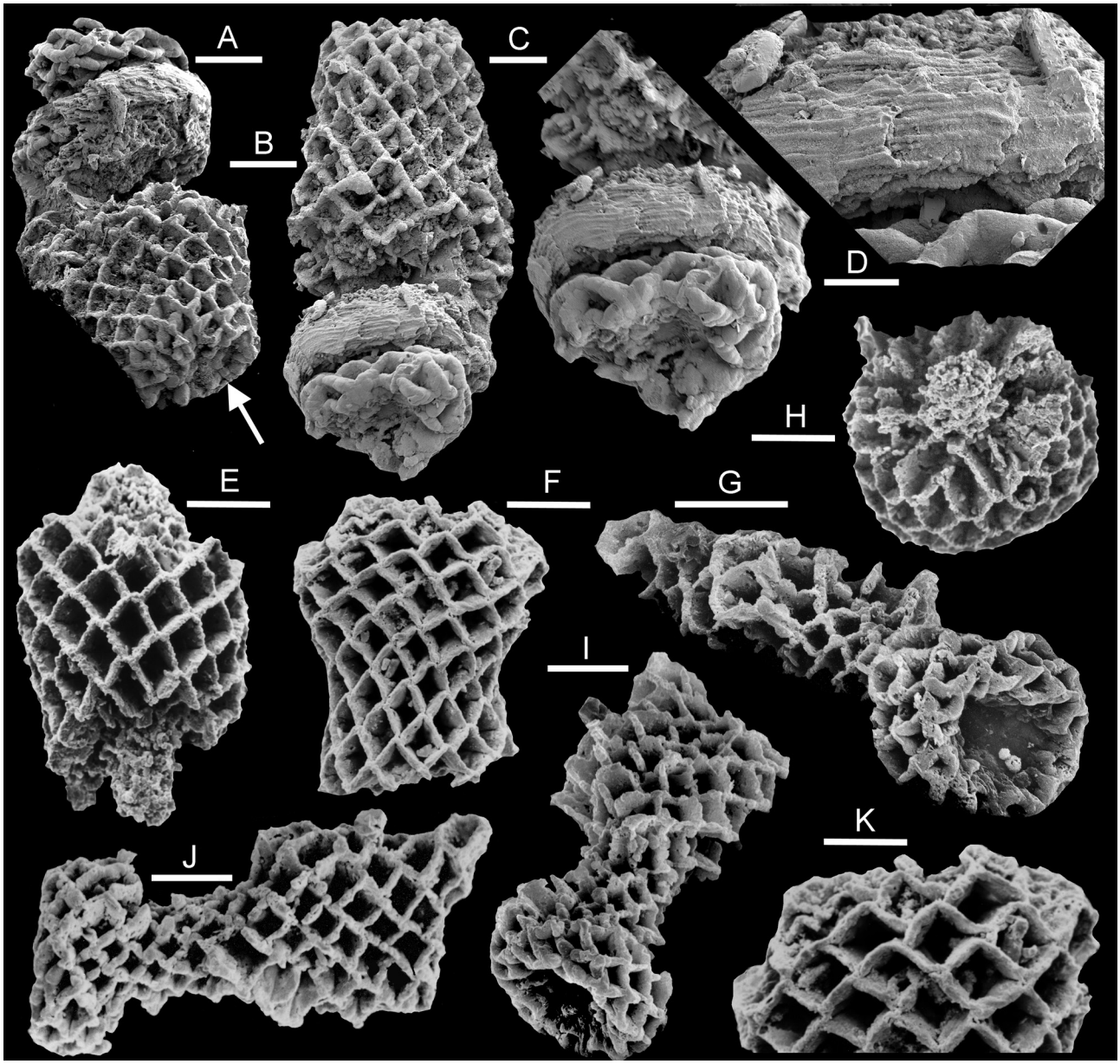


Fig. 2. *Kordesphecia nyeboensis* Peel, 2014, Aftenstjernesø Formation, Cambrian Series 2, North Greenland. **A–D:** PMU (33485) from GGU sample 315858. A, B, lateral views (apex arrowed in inverted specimen A). C, rhizoid (holdfast) and stem. D, stem showing transverse imbrication of plates. **E, H:** MGUH 30471 from GGU sample 313072, holotype, in lateral (E) and oblique axial (H) views, showing sediment infilled axial cavity. **F, K:** MGUH 30473 from GGU sample 313072, paratype, lateral view (F) with detail of microstructure (K). **G, I, J:** MGUH 30472 from GGU sample 313072, paratype, (G, I) oblique lateral views of branch with trumpet-shaped extremity. (J) lateral view, extremity of branch to left. Scale bars: 20 μm (D, K), 30 μm (C, E, F, H–J,), 40 μm (G), 50 μm (A, B).

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?Stem group Dasycladales Pascher, 1931

Genus *Kordesphecia* Peel, 2014

2014 *Kordesphecia* Peel, p. 368.

Type species. *Kordesphecia nyeboensis* Peel, 2014, from the lower Aftenstjernesø Formation, lower Cambrian (Cambrian Series 2) of North Greenland (Fig. 1).

Revised diagnosis. Erect, initially with a cluster of rhizoid (holdfast) threads passing via a short, plated stem (stalk, central axis) into a sub-cylindrical to claviform crown. Crown, in later growth stages, with robust branches or dichotomies with a trumpet-like termination, with rhombic lateral cells radiating from an axial cavity; seemingly with originally calcareous walls.

Discussion. The rhizoid and plated stem were not preserved in any of the original fragmentary specimens described by Peel (2014). Additionally, the supposed trumpet-like apex (Fig. 2G, I, J) is reinterpreted as a branch from the central axis of the crown.

Kordesphecia nyeboensis Peel, 2014

Figs 2, 3

2014 *Kordesphecia nyeboensis* Peel, p. 368–370, figs 2, 3.
2021 *Kordesphecia nyeboensis*, Peel & Skovsted, fig. 3A, B.

Holotype. MGUH 30471 from GGU collection 313072 from the lower Aftenstjernesø Formation, lower Cambrian (Cambrian Series 2), Hand Bugt, northern Nyeboe Land, North Greenland (Fig. 1B).

Figured material. MGUH 30472 and MGUH 30473 from the same collection as the holotype; PMU (33485) from GGU sample 315858 from the Aftenstjernesø Formation, lower Cambrian (Cambrian Series 2), at the head of Nordenskiöld Fjord, North Greenland (Fig. 1A).

Description. The sub-cylindrical new specimen of *Kordesphecia nyeboensis* from Nordenskiöld Fjord has a preserved length of about 350 μm and displays three morphological zones (Fig. 3). A basal zone interpreted as a rhizoid (holdfast) consists of anastomosing irregular threads about 8 μm in diameter. A zone of transversely ridged plates that form an imbricated series around the periphery (the stem; Fig. 2C, D) lies between the rhizoid and the distal crown (Fig. 3). The crown tapers uniformly towards its truncated apex, which is slightly impressed (Fig. 2A, arrow). Its surface is covered by a network of radiating, thickwalled rhombic cells that are arranged with their long axes parallel to the length of the crown (Fig. 2B), with the rhombs appearing to form rising spirals on the surface of the crown. The spiral rows are formed by contact between the sides of the rhombic cells and therefore are made up of cells of different ages. Individual proximal cells measure up to width 20 μm and length 25 μm, but decrease in size towards the apex and may become wider than long distally in other specimens (Fig. 2K).

The originally described specimens from Nyeboe Land are all fragments. The holotype displays sediment infilling the original axial canal (Fig. 2E, H) and the radiating structure of the cells (Fig. 2H). One paratype with concave lateral surfaces (Fig. 2F, K) shows the stacked shingles of the cell walls described in detail by Peel (2014, fig. 3). The second paratype is trumpet-shaped with an impressed apex (Fig. 2G, I). It was regarded by Peel (2014) as the apex of the crown but is reinterpreted here as a branch from the main axis of the crown (lateral view in Fig. 2J). The similarity in size of this fragment and the seemingly complete new specimen from Nordenskiöld Fjord, which lacks branches, indicates that the latter is likely a juvenile.

Discussion. In its general appearance, with radial lateral branches or cells arranged around a central cavity, *Kordesphecia* is similar to *Amgaella* as recon-

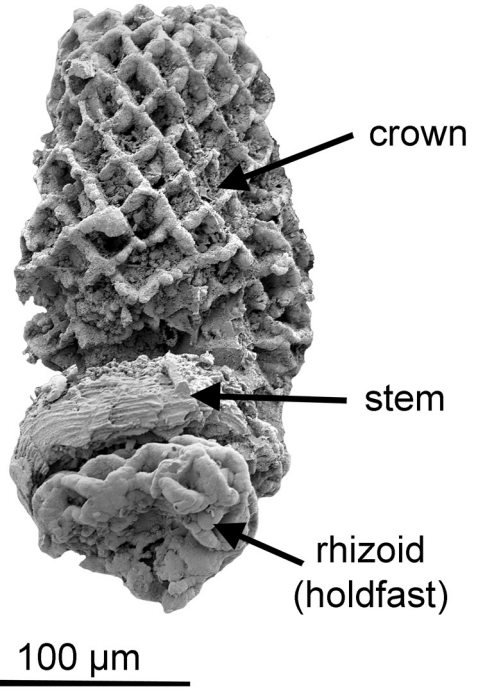


Fig. 3. Terminology of *Kordesphecia nyeboensis* Peel, 2014, PMU (33485) from GGU sample 315858. Aftenstjernesø Formation, Cambrian Series 2, North Greenland.

structed by Korde (1961), but Peel (2014) concluded that the resemblance between the rhombic cell patterns was superficial. As in *Amgaella*, the radiating fine branches of *Cambroporella* are delimited by an irregular, round to rhombic pattern (Korde 1950, fig. 1), but this appears to represent sediment infill between the original carbonate encrustation of the lateral branches, unlike the cell walls of *Kordesphecia*.

Lenaella Korde, 1959 from the lower Cambrian of the Lena River, Siberia, shares an outer wall composed of shingles with *Kordesphecia* and a central cavity. Korde (1961) considered *Lenaella* to be problematic, and it was omitted from the Russian treatise (Orlov 1963) and from Korde's (1973) second monograph of Cambrian algae. Rozanov & Zhuravlev (1992) made no assignment.

The stem of *Kordesphecia nyeboensis* is unique in its construction of robust, ridged plates, imbricated around the periphery (Fig. 2C, D). When present, the stem of dasycladaleans is usually only lightly calcified, even lacking in calcification, and often flexible.

Affinity of *Kordesphecia*

LoDuca *et al.* (2017) concluded that *Amgaella, Cambroporella* and *Lenaella* differ from [crown group] dasycladalean algae in one or more key features, and that *Kordesphecia* shows a different pattern of calcification, although this is to be expected if they are regarded as belonging to a stem group rather than the crown group. In particular, LoDuca *et al.* (2017) referred to the polygonal shape of the radiating cells, which may reflect shingling as in *Kordesphecia* and *Lenaella*. However, it may be a response to close packing of the carbonate encrustation around individual cylindrical lateral branches in crown group dasycladaleans (Génot 2009, pl. 2, fig. 5), as seen also in the branches of epiphytaceans, and in the contact between corallites in many tabulate corals.

Revision of *Kordesphecia* following the description of the new specimen, with recognition of a rhizoid, stem and crown increases the morphological similarity with many club-shaped dasycladaleans. While recognizing that these are simple adaptive features that might be expected in other groups, they provide additional support for the tentative interpretation of *Kordesphecia* as a stem-group dasycladalean by Peel (2014).

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