

# The arthropod trail *Multipodichnus* from the upper Middle Cambrian (Holm Dal Formation) of central North Greenland.

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A *Cruziana*-like trace fossil is described from the uppermost beds of the Holm Dal Formation in its type locality in western Peary Land. Lower stratigraphic levels within the same formation yield rich faunas of late Middle Cambrian age. The trace has its closest known counterparts in freshwater deposits from the Permian and Triassic.

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The trace fossil described here was collected from the upper levels of the Holm Dal Formation in its type section in western Peary Land, central North Greenland (Fig. 1). The upper Middle Cambrian Holm Dal Formation is a constituent formation of the Tavsens Iskappe Group and forms part of the carbonate-dominated marine shelf sequence of the Early Palaeozoic Franklinian basin which extends from Arctic Canada eastward across North Greenland. Discussion of the regional setting and the stratigraphy of the Holm Dal Formation is given by Ineson (this volume) while papers by Robison, Hood & Robison, Zell & Rowell and Peel (all this volume) describe the fauna.

The Holm Dal Formation is 155 m thick in its type section and is dominated by subtidal argillaceous lime mudstones of deep, outer-shelf aspect. It forms the lower part of a large-scale regressive cycle and is succeeded by platform-edge, shallow water carbonate and siliciclastic sediments of the Perssuaq Gletscher Formation (Fig. 1). This upward-shallowing trend is reflected in the Holm Dal Formation itself by the appearance of winnowed peloidal grainstones and packstones, and flaggy siliciclastic sandstones in the upper levels of the formation.

The trace fossils described below occur within the interval of pale yellow-brown weathering sandstones near the top of the formation (Fig. 1). The sandstones are very fine-grained to fine-grained, moderately to well sorted and typically bioturbated, although locally displaying current ripple cross-lamination. Further discussion of this facies is given by Ineson (this volume). The environment of deposition is broadly interpreted as the proximal zone of the outer shelf.

The precise age of the trace fossils is not established.

Lower levels within the Holm Dal Formation have yielded a diverse fauna within which trilobites are conspicuous (Robison, this volume). Robison notes that the dominant polymeroids belong to species and genera characteristic of the lower and middle *Cedaria* Zone of North American usage. However, accompanying agnostoid species are characteristic of the *Lejopyge laevigata* Interval-zone indicating a late Middle Cambrian age in terms of the Swedish standard for north-western Europe. A similar age is assumed for the specimens of *Multipodichnus*.

*Multipodichnus* Walter, 1984

*Multipodichnus holmi* n. ichnosp.

Figs 2–6

Name. – In reference to the type locality in Gustav Holm Dal.

Material. – One slab with 8 clearly distinguishable trackways collected by J. R. Ineson in 1979 from the Holm Dal Formation in Gustav Holm Dal, western Peary Land, central North Greenland. The slab is preserved in the Geological Museum, Copenhagen; figured specimens are numbered MGUH 18.668–18.670 from GGU sample 218655.

Definition. – Species of *Multipodichnus* in which the main bend of the individual track is more distally placed

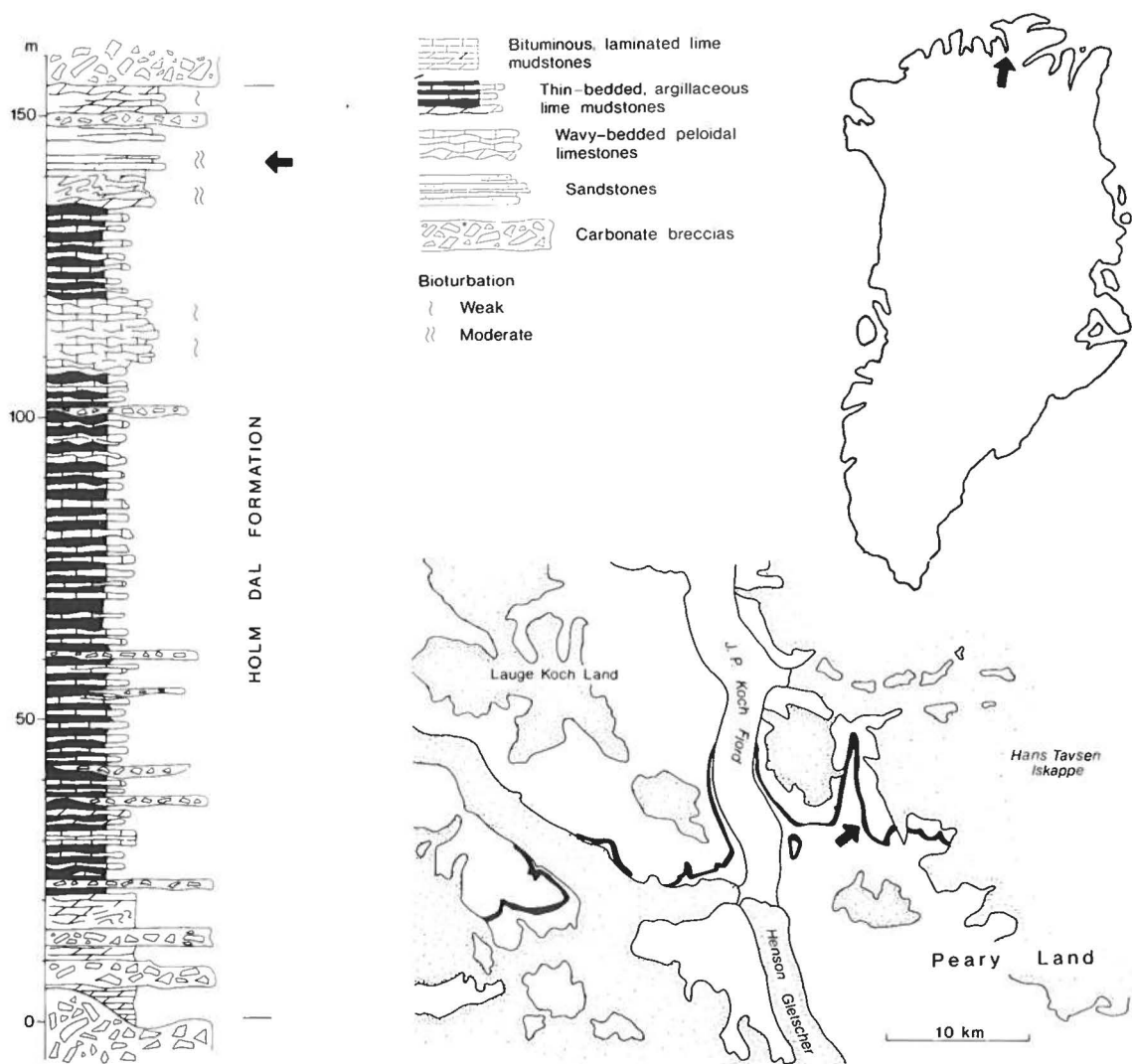


Fig.1. Location and stratigraphy of the Holm Dal Formation in central North Greenland. Arrows mark the horizon yielding *Multipodichnus holmi* n. sp. in the type section of the formation, and the location of the type section.

than in the type species *M. reptatus*; well preserved specimens show traces of short setae or spines.

**Description.** – The upper surface of the thin slab of very fine-grained sandstone has a number of 3–16 mm wide and slightly curving trails. These are preserved in epirelief. Each trail consists of paired imprints of a curved limb outline, with the convexity directed posteriorly. The sediment is pushed up at the posterior extremity, while an evenly sloping concavity is formed in front. In a few cases this concavity exhibits setal imprints, numbering up to at least five in one track. The setal scratches from both sides converge backwards, the angle of the V being about 40–45 degrees. The limbs therefore were swung around an axis which differed some 20 degrees from the transverse line.

One point of variation is the depth of impression. In one large trail the limbs were so deeply impressed that their outline is shown to the midline of the trail (Figs 4, 5). In most trails, however, there are only tracks showing the more distal parts of the limbs (Figs 2, 3, 6). Individual trails show a straighter outline of the limb tracks, probably because the limbs were held at a greater angle to the sediment surface when the tracks were made. There is a gradation between the extremes showing that they belong together.

In a few cases there is some indication that the track pairs were arranged in V-shaped series consisting possibly of some 6–7 pairs (Fig. 6).

**Discussion.** – This trace fossil is reminiscent of traces referred to *Cruziana* and *Diplichnites*. However, it can



Fig. 2. *Multipodichnus holmi* n. sp., trackway with imprints of setae in the individual tracks. Holotype, MGUH 18.668 from GGU 218655, Holm Dal Formation, Gustav Holm Dal, Peary Land, central North Greenland, X 3.

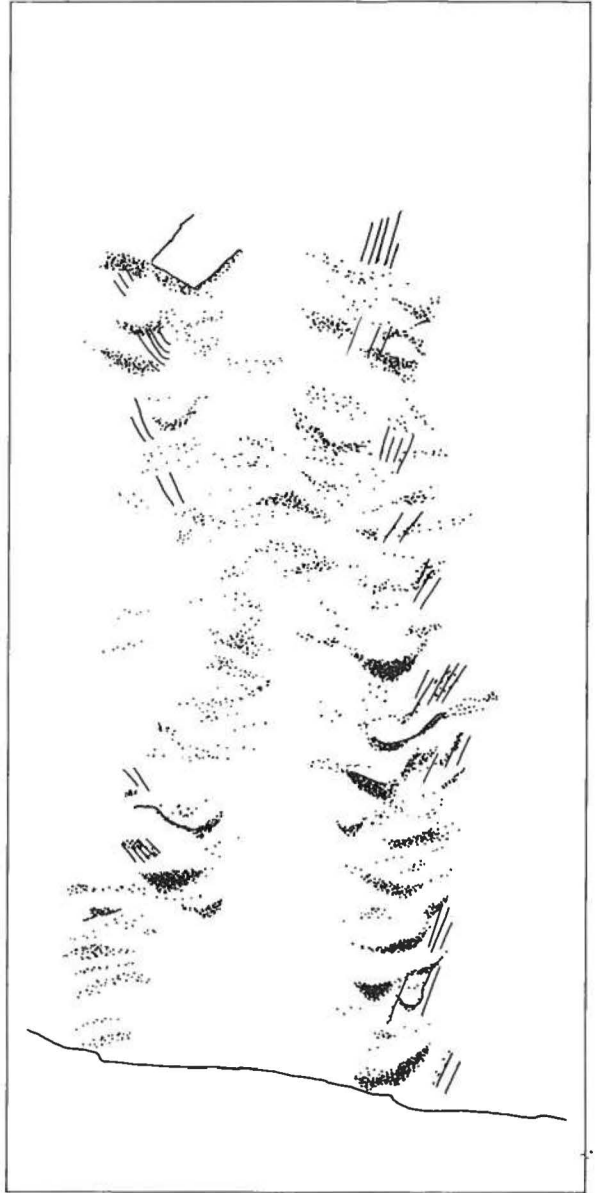


Fig. 3. *Multipodichnus holmi* n. sp., sketch of the holotype (Fig. 2) showing trackway with imprints of setae in the individual tracks.

not be referred to these genera because the individual tracks were formed by a foliaceous kind of limb provided with short terminal setae. In *Cruziana* and *Diplichnites* the tracks were instead formed by a pediform endopod and/or by a rake-shaped exopod. The most similar track described in the literature is *Multipodichnus reptatus*, described by Walter (1983) from the Rotliegendes (Lower Permian) of the German Democratic Republic and the trace described herein is at least provisionally referred to the same genus. However, there is a

great time discrepancy between the two occurrences, and the Permian trace was made in a non-marine environment. It is not suggested that *M. reptatus* and *M. holmi* were produced by phylogenetically related animals.

Another trace that is similar to *Multipodichnus holmi* was described as *Cruziana* sp. B by Bromley & Asgaard (1979: fig. 19) from Triassic freshwater strata at Carlsberg Fjord, East Greenland. Like *M. holmi*, this trace consists of serially repeated lobes which show an over-



Fig. 4. *Multipodichnus holmi* n. sp., trackway with outlines of track-producing foliaceous appendages. MGUH 18.669 from GGU sample 218655, Holm Dal Formation, Gustav Holm Dal, Peary Land, central North Greenland, X 3.

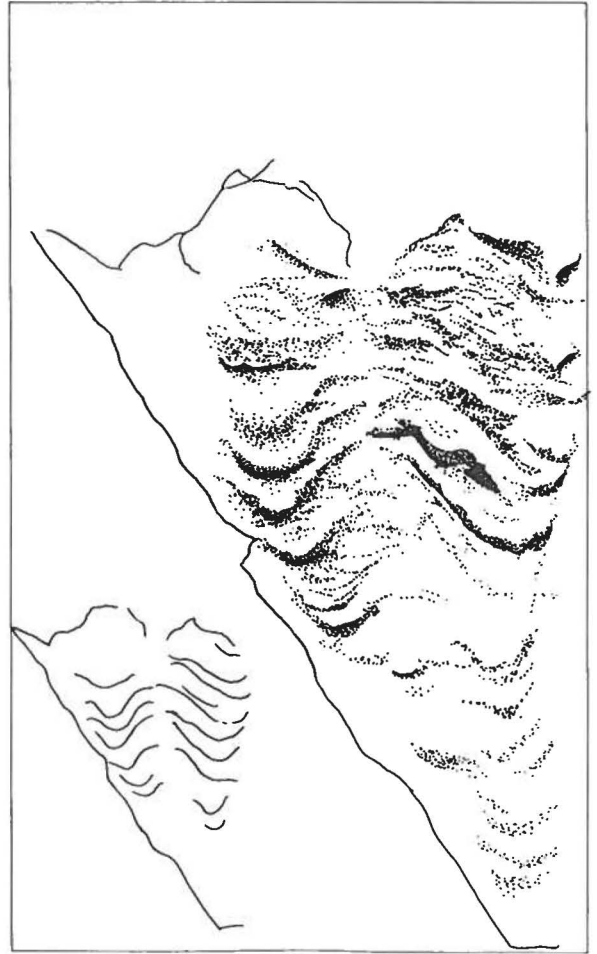


Fig. 5. *Multipodichnus holmi* n. sp., sketch of the specimen illustrated in Fig. 4 showing trackway with outlines of track-producing foliaceous appendages; small figure showing the crests of the individual tracks, X 2.

lapping, imbricated relationship in places, and commonly have an arcuate form. Weak striae are seen locally. The trails vary considerably in shape and Bromley & Asgaard believe that they are probably endogene variants of the associated *Cruziana problematica* or *Diplichnites triassicus*. A similar interpretation may apply for *M. holmi*, although there are no preserved trail types with which it can be associated.

The limb in the animal responsible for making the trace assigned to *M. holmi* was moved backwards-inwards in the track-making stroke. This direction of movement is commonly seen in *Cruziana* and *Rusophycus*, trace fossil genera generally held to have been produced by trilobitormorph arthropods. In phyllopods with foliaceous limbs, on the other hand, the limbs presumably would have moved straight backwards. In principle, the limb of notostracan phyllopods can produce tracks of the general type found in *M. holmi*

(Trusheim 1931; Bromley & Asgaard 1972). The Middle Cambrian *Branchiocaris* from the Burgess Shale has foliaceous limbs with an outline that would seem to fit the trace-maker (Bergström, unpublished observation), but again the basal hinge of the limb appears to be strictly transverse, which makes the backwards-inwards movement impossible.

There is a variety of marine Cambrian arthropods other than trilobitormorphs known for instance from the Burgess Shale, but as a rule the limbs are too poorly known to allow a serious discussion of those arthropods as possible trace-makers. The conclusion regarding the systematic position of the trace-maker is therefore that it was an arthropod of unknown affinities.

#### Acknowledgements

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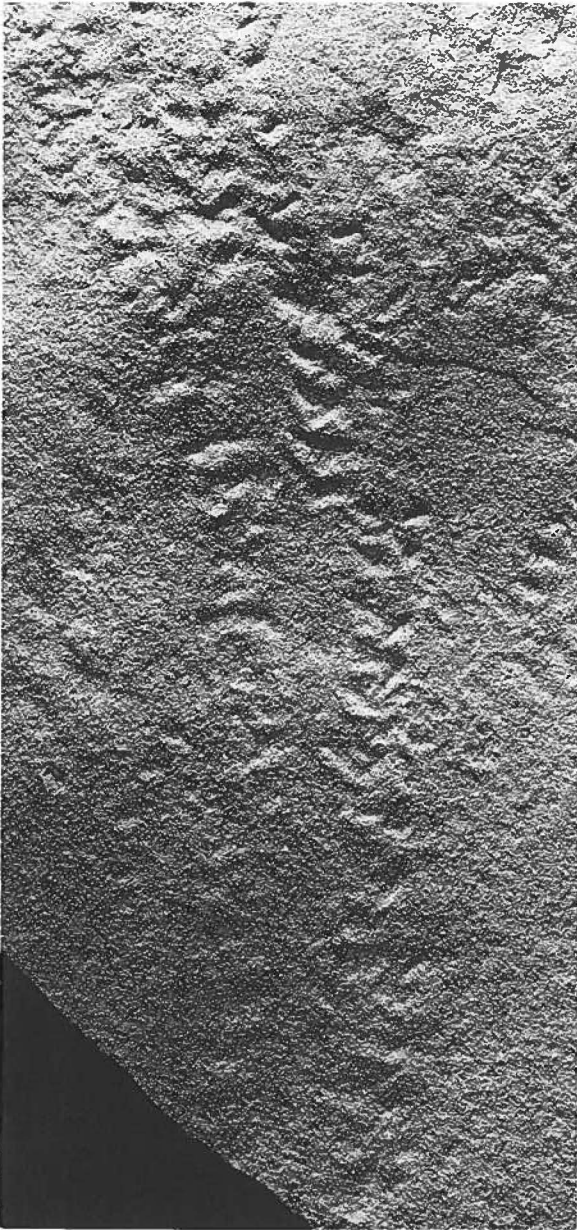


Fig. 6. *Multipodichnus holmi* n. sp., trackway with indication of V-shaped pattern. MGUH 18.670 from GGU sample 218655, Holm Dal Formation, Gustav Holm Dal, Peary Land, central North Greenland, X 3.

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