

New *Taenidium* (trace fossil) in the Upper Cretaceous chalk of northwestern Europe



Bromley, R. G., Ekdale, A. A. & Richter, B. 1999–12–20: New *Taenidium* (trace fossil) in the Upper Cretaceous chalk of northwestern Europe. *Bulletin of the Geological Society of Denmark*, Vol. 46, pp. 47–51. Copenhagen. <https://doi.org/10.37570/bgsd-1999-46-05>

A meniscate backfilled trace fossil that is common in Upper Cretaceous chalk of Denmark, Germany and England is described as the new ichnospecies, *Taenidium crassum*. This ichnotaxon is differentiated from other ichnospecies of the ichnogenus on the basis of the irregular, asymmetrical menisci in the backfill.

Key words: *Taenidium*, chalk, flint, Upper Cretaceous, new ichnospecies *T. crassum*, ichnotaxonomy.

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The Upper Cretaceous chalk of northwestern Europe contains abundant and diverse trace fossils. One particularly common trace fossil has a meniscate backfill and no mantle or lining. Based on these characteristics, the trace fossil clearly belongs in the ichnogenus *Taenidium* Heer 1877. Three ichnospecies of *Taenidium* were considered valid by D'Alessandro & Bromley (1987), and four by Keighley & Pickerill (1994), but the morphology of the meniscate trace fossil in the European chalk does not correspond to any of these. Therefore a new ichnospecies (*T. crassum*) is established here.

The trace fossil is commonly preserved within flint concretions in the chalk (Fig. 1; see also Bromley & Ekdale 1984, fig. 4A-C) or on the surface of flints (Fig. 2; see also Bromley & Ekdale 1984, fig. 3B). As revealed by the technique of oiling smoothed vertical or horizontal surfaces of chalk (Bromley 1981), the trace fossil is a prominent element of the chalk ichnofabrics (Fig. 3; see also Ekdale & Bromley 1991, fig. 7B; Bromley & Richter 1999, fig. 1).

Ichnotaxonomy

Ichnogenus *Taenidium* Heer 1877

Emended ichnogeneric diagnosis: Unlined or very

thinly lined, unbranched, straight or sinuous cylindrical trace fossils containing a segmented fill articulated by meniscus-shaped partings (D'Alessandro & Bromley 1987).

Remarks: *Taenidium* is a meniscate backfill structure, usually considered to be produced by an animal progressing axially through the sediment and depositing alternating packets of differently constituted sediment behind it as it moves forward. Locklair & Savrda (1998) envisaged a more complicated means of production in order to explain the colour variation of individual packets in the meniscate fill of *Taenidium* in the Demopolis chalk of Alabama.

Keighley & Pickerill (1994) distinguished between “segments” and “packets” for the units comprising a meniscate fill. However, owing to the irregular structure of *T. crassum*, both types occur, apparently randomly, within the fill, so the sediment increments are all referred to here as packets.

Taenidium crassum new ichnospecies

Ichnospecific diagnosis: *Taenidium* having variable, parabolic or chevron-shaped sediment packets that are generally asymmetrical, with the apex of the parabola or chevron offset from the midline of the fill.

Description and occurrence: The offset of successive

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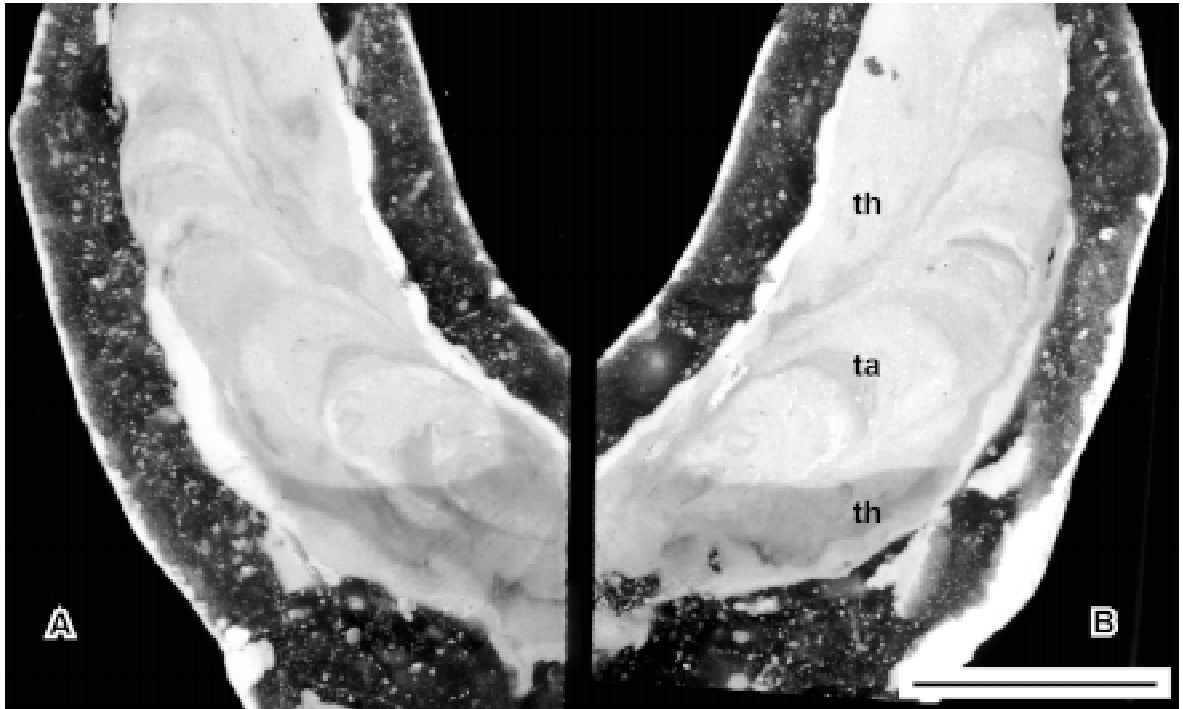


Fig. 1. Part and counterpart of a *Thalassinoides* flint sawn longitudinally and polished. Marginally the flint is black, and internally it is pale. The original boundary of the *Thalassinoides* lies within the black zone. The fill of the *Thalassinoides* has been reworked and contains a *Taenidium crassum*. A. An axial section of the holotype. The asymmetrical arrangement of the paraboloid menisci is clearly visible. B. Off-centre section of the holotype, indicating the *Thalassinoides* (th) and the *Taenidium crassum* (ta) inside it. Note the three shades of grey in the *Taenidium crassum*: pale, medium and dark. Scale bar equals 2 cm.

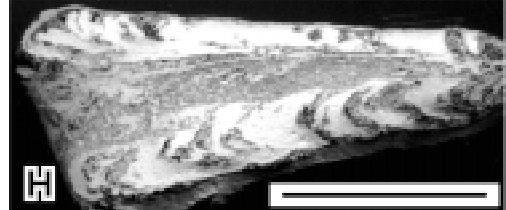
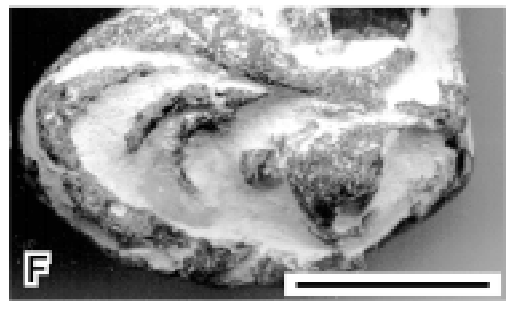
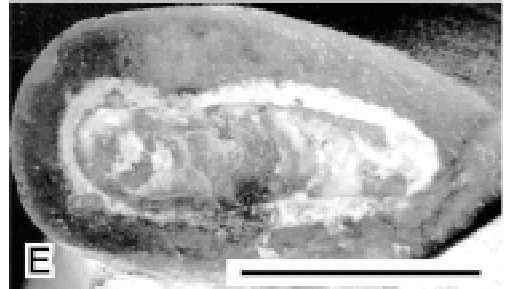
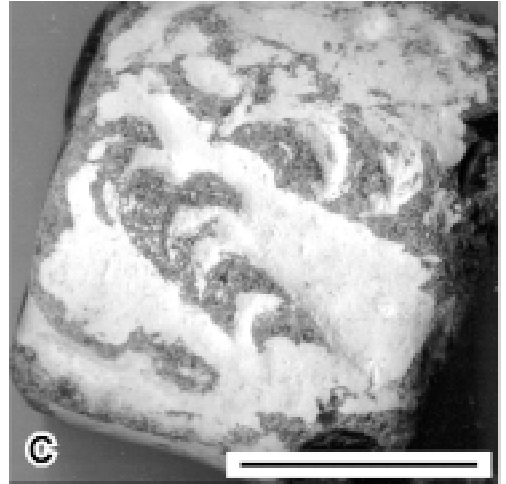
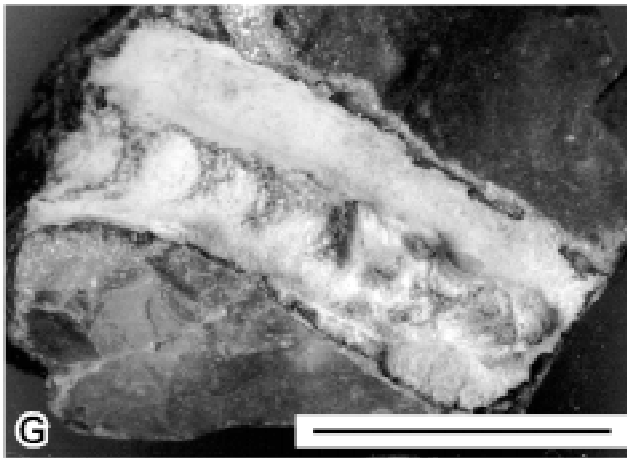
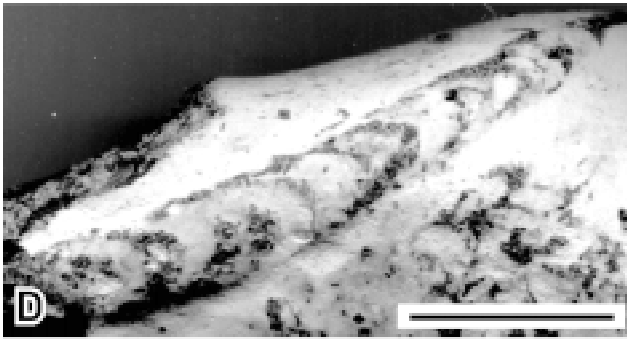
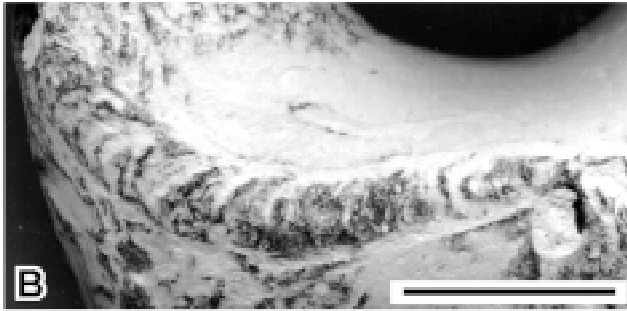
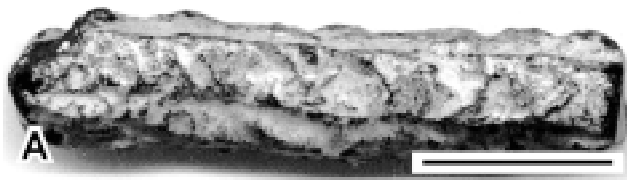
menisci is irregularly developed and commonly alternates from side to side. In specimens that are preserved on the flint-chalk boundary at the surface of flint concretions, the trace fossil is usually clearly visible, and the meniscate packets are alternately dark and light in colour, although the sediment texture appears to be uniform throughout. In specimens that are preserved within flint or that are seen with contrast-enhancing techniques (Bromley 1981, Richter & Bromley in press) in the unsilicified chalk, the colour-contrast is more subtle. In such cases, three colours of sediment may be present (Figs 1, 3).

T. crassum occurs both freely within the chalk and

inside the fill or spreite of other trace fossils. In particular, it commonly occurs within the fill of *Thalassinoides* and within the spreite of *Zoophycos* (Ekdale & Bromley 1991, Bromley & Richter 1999).

Remarks: *T. crassum* differs from other ichnospecies of *Taenidium* in the form of its menisci. *T. crassum* has relatively deep, paraboloid or chevron-shaped menisci, which are similar to those of *T. cameronensis*, but are placed asymmetrically. The triple colour scheme (pale, medium and dark grey) of the sediment packets of the backfill is unique among *Taenidium* ichnospecies.

Fig. 2. *Taenidium crassum* expressed on the surface of flint concretions. This is the most commonly observed occurrence of this trace fossil, because its visibility in unsilicified chalk is poor unless visibility-enhancing techniques are employed. Scale bars equal 2 cm. A. *T. crassum* running along the boundary of a straight burrow-fill, possibly a small *Thalassinoides*. Loose flint from Møns Klint, Denmark; Maastrichtian. MGUH 25305. B. Loose flint from Stevns Klint, Denmark; Upper Maastrichtian. MGUH 25301. C. Loose flint from Skærbæk, Mors, Denmark; Maastrichtian. MGUH 25302. D. Loose flint from Stevns Klint; Upper Maastrichtian. MGUH 25306. E. *In situ* flint from Shoreham Cement Works, Shoreham, Sussex, England; 1 m below Lewes Marl, Lewes Flint Series, Coniacian. MGUH 25304. F, G. Loose flints from Skærbæk; Maastrichtian. MGUH 25307–8. H. Loose flint from Møns Klint; Maastrichtian. MGUH 25309. I. Loose flint from the Jasmund Peninsula, Rügen, Germany; Maastrichtian. The backfill appears to be cross-cut by an even deeper-tier trace fossil. MGUH 25303.



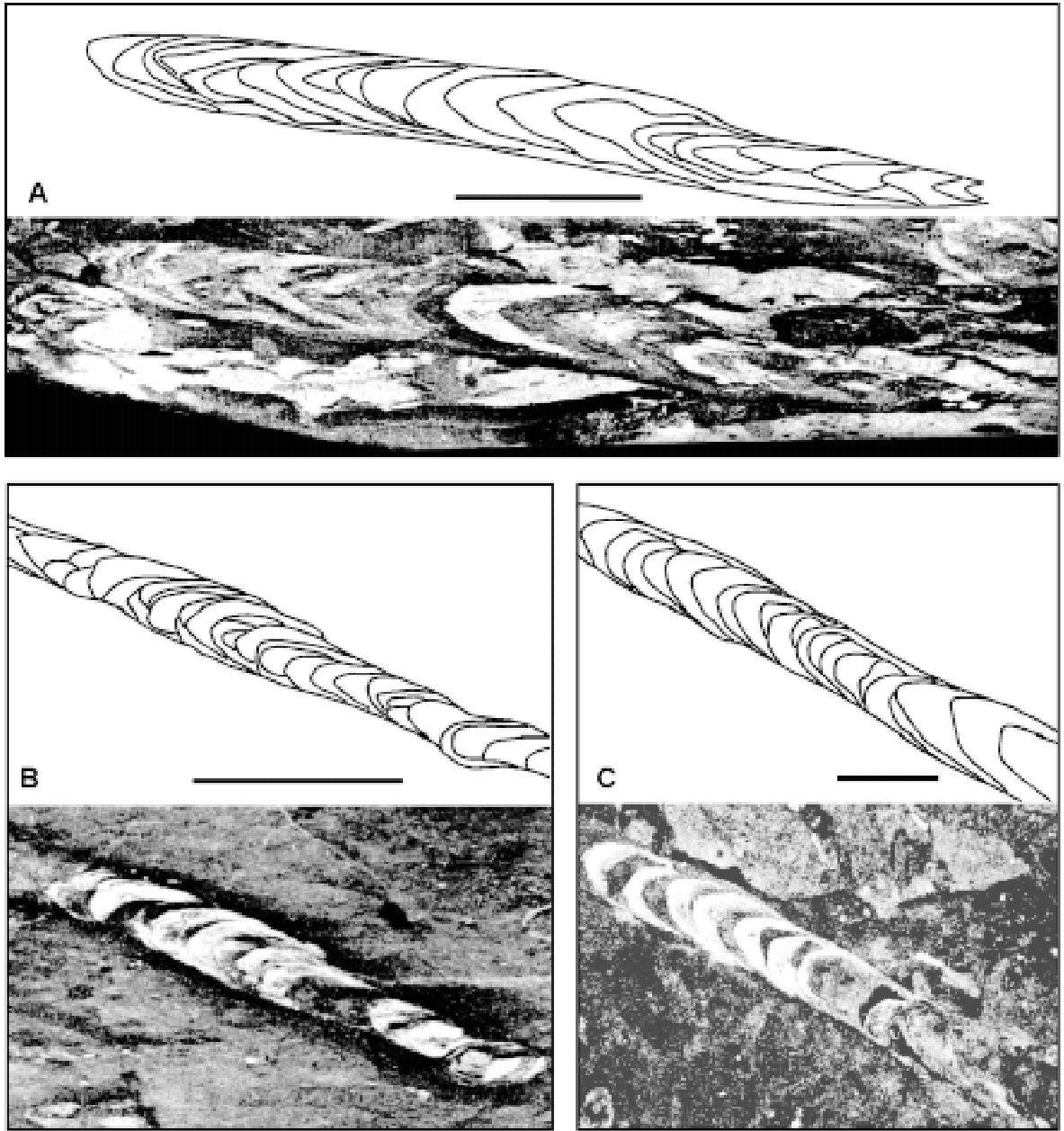


Fig. 3. *Taenidium crassum* seen in vertical and horizontal section in Danish chalk. Contrast has been increased by means of oil application (Bromley 1981) and computer-aided image enhancement (Richter & Bromley in press). The irregular, offset menisci are clearly visible, as also are the pale, medium and dark grey colours of the sediment packages. The outlines of the individual meniscate packets are depicted in the line-drawings. Samples are from the M 14 marly chalk horizon (Håkansson & Hansen 1979, fig. 13), about 17 m below top of Maastrichtian. Dania Quarry, south of Mariager Fjord, Jylland, Denmark. Details of the meniscus fill have been outlined manually using an extreme enlargement on a computer. Scale bars equal 1 cm. A. Vertical section. B. Vertical section. C. Horizontal section.

A somewhat similar, unnamed form of *Taenidium* occurs in the Demopolis chalk of Alabama (Locklair & Savrda 1998). This has similar irregularity of the backfill menisci but apparently to a lesser degree than in *T. crassum*. Also, the meniscate packets of sediment are reported to display only two colours. Closer study is required to ascertain if this Alabama form is comparable to *T. crassum*.

Interpretation: *T. crassum* cross-cuts the spreiten of *Zoophycos* and thus belongs to a deeper tier than *Zoophycos*. Indeed, even the deep-tier *Chondrites* is seen to transect *T. crassum* only rarely. Its strong visibility (in contrast-enhanced samples) and its sharp boundaries render it an “elite trace fossil” (Bromley 1990, 1996) in the assemblage, and this is consistent with its location in the deepest tier.

The wide shafts of *Zoophycos* commonly contain relatively narrow meniscus backfill elements that resemble *T. crassum* (Ekdale & Bromley 1991). This fact, taken together with the frequency of its occurrence inside the spreiten of *Zoophycos*, might be taken to suggest that the two structures were produced by the same tracemaker (Bromley et al. 1999).

Type material: The holotype (Fig. 1), MGUH 25300, is preserved within a flint that represents the silicified sediment fill of a *Thalassinoides* burrow which was reburrowed by the *Taenidium* maker. Paratypes (Fig. 2) are preserved in flints and include the following: MGUH 25301 from Upper Maastrichtian chalk, Stevns Klint, Sjælland, Denmark; MGUH 25302 from Upper Maastrichtian chalk, north shore of Mors, Jylland, Denmark; MGUH 25303 from the Lower Maastrichtian chalk, Rügen, Germany; MGUH 25304 from the Lewes Flint Series (Coniacian), Shoreham, England.

Type locality and stratum: The holotype was collected from Upper Maastrichtian chalk by H. J. Hansen at a level 110 cm beneath the Maastrichtian-Danian boundary at Nye Kløv, Jylland, Denmark.

Geographical and stratigraphical range: Specimens are known in Coniacian to Maastrichtian chalk throughout western Europe, including especially Denmark, Germany and England.

Dansk sammendrag

Et sporfossil med leddelt indfyld, som er almindeligt i øvre kridt skrivekridt i Danmark, England og Tyskland, er beskrevet som en ny ichnospecies, *Taenidium crassum*. Dette sporfossil afviger fra andre arter af *Taenidium* på basis af strukturen af indfyldningen, som er uregelmæssig og variabel.

Acknowledgements

Lots of good friends, especially Ulla Asgaard, helped us collect and study the material. Hans Jørgen Hansen, University of Copenhagen, collected the holotype. A. A. Ekdale's participation in this investigation was funded in part by the National Science Foundation. We thank P. Orr and C. Heinberg for constructive and helpful refereeing.

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