

A Late Cretaceous gastropod homing scar (possibly ichnogenus *Lacrimichnus*) from southern Limburg, The Netherlands

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An isolated gastropod homing scar, etched into an arcscalpelline (cirripede) scutum, is recorded from the upper Nekum Member (Maastricht Formation, upper Maastrichtian) at the ENCI-HeidelbergCement Group quarry. This trace may be assignable to the ichnogenus *Lacrimichnus* Santos, Mayoral & Muñiz, that comprises etching scars produced by Neogene calyptraeid and/or capulid gastropods and ostreid bivalves from southern Spain and Portugal. However, it differs from both ichnospecies currently contained in that ichnogenus, *L. bonarensis* and *L. cacelensis*, in showing a relatively deep depression around the rim, irregularly distributed pit- and slit-like depressions, and an irregularly subcircular outline. Despite the wealth of available hard substrates (bivalves, coleoids, echinoids, etc.) and of hipponicid gastropods, such traces are exceedingly rare in the type area of the Maastrichtian Stage.

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Introduction

Only in recent years have trace fossil taxa from Upper Cretaceous (Campanian-Maastrichtian) strata in the type area of the Maastrichtian Stage (southeast Netherlands, northeast Belgium) been receiving due attention (Donovan & Jagt, 2002, 2004, 2005a, b; Jagt, 2003; Jagt & Dortangs, 2000, 2003; Bromley, Donovan & Jagt, research in progress). The 'tuffaceous chalk facies' of the Maastricht Formation, in particular, has now yielded numerous well-preserved sponge and bivalve borings, and etching traces of particular gastropods and bryozoans. Although the list of ichnogenera and ichnospecies is constantly growing (see, e.g., Jagt, 2003), it is puzzling to see that examples of well-known types of traces have still not been documented, despite the wealth of available hard substrates and of the agents that produce such traces. For instance, despite thorough examination both of outcrop and museum collections, the etching trace left by brachiopod pedicles, *Podichnus centrifugalis* Bromley & Surlyk, 1973, is still unknown from the area. This is in stark contrast to the abundance and high diversity of brachiopods there (see, e.g., Simon, 1998, 2003, 2004a, b, 2005). The same holds true for bryozoan etchings

(ichnogenus *Leptichnus* Taylor, Wilson & Bromley, 1999); although many hundreds of cheilostomate species are on record from the type Maastrichtian, only a few occurrences of this etching trace, on coleoids and ostreid bivalves, are known to date.

Other etching traces on hard (calcareous) substrates, that have been reported, are those produced by anomiid bivalves (*Centrichnus* Bromley & Martinell, 1991), vermetid gastropods (*Renichnus* Mayoral, 1987) and, possibly scalpellid cirripedes (*Flosculichnus* Donovan & Jagt, 2005a). Examples of these are also known from the Maastrichtian type area; see Jagt (2003) and Donovan & Jagt (2005a) for illustrations.

Another type of scar, referred to as 'homing scars' produced by hipponicid gastropods, has been reported from the Pliocene of Okinawa (southwest Japan) and is preserved on an olivid gastropod (Noda, 1991, fig. 7; see also Bromley & Heinberg, 2006). The present trace (Pl. 1), on the right scutum of an arcoscalpelline cirripede, *Arcoscalpellum gracile* (Bosquet, 1854), is comparable in structure and thus might have been produced by a juvenile hipponicid. The sole hipponicid known in the study area is *Hipponyx dunkerianus* Bosquet, 1848 (see Binkhorst van den Binkhorst, 1861; Kaunhøwen, 1898). This species ranges from the base of the Nekum Member to the top of the Meerssen Member and locally is commonly fixed to the walls of crustacean burrows (of the ichnogenus *Thalassinoides*) as well as occurring loosely, albeit abraded, in the various fossil hash levels characterising the latter unit. So far, it has not been seen on any other substrate except for hardground surfaces and burrow walls. Calyptraeids and/or capulids (see Santos *et al.*, 2003, 2004) may also be suggested as trace makers, but as far as I can tell these have not been recorded from the type Maastrichtian. Anomiid and ostreid bivalves, and vermetid gastropods leave etching traces having a different morphology; these should not be confused with the present specimen, as discussed below.

Specimens illustrated and/or referred to in the text are deposited in the collections of the Nationaal Natuurhistorisch Museum, Leiden (RGM) and the Natuurhistorisch Museum Maastricht (NHMM).

Systematic ichnology

Ichnogenus *Lacrimichnus* Santos, Mayoral & Muñiz, 2003

Type ichnospecies – *Lacrimichnus cacelensis* Santos, Mayoral & Muñiz, 2003, p. 184, pl. 1, figs. 1-5, by original designation.

Diagnosis – (After Santos *et al.*, 2003, p. 184.) 'Surface marks with oval to slightly ellipsoidal margin terminating on sharp end, with overall teardrop-shape. The margin clearly distinguished by colour of surrounding substrate, which is usually more heavily weathered or eroded, or by fairly deep, wide boring. Marks are smooth or exhibit light ornamentation consisting of discrete, shallow series of eccentric borings on interior.'

***Lacrimichnus*? isp.**

Pl. 1.

Material – A single specimen (RGM 211 422).

Locality and horizon – ENCI-HeidelbergCement Group quarry, St Pietersberg (Maastricht); Maastricht Formation, Nekum Member, top of subunit IVe-5 (see Felder & Bosch, 1998); upper Maastrichtian (*Belemnitella junior* Zone).

Description – The single trace is situated in the apical half of an average-sized right scutum, roughly wedged in between the occludent margin and apicobasal ridge (terminology following Withers, 1935) of the valve, and slightly oversteps the latter. Its shape is irregularly subcircular, with the greatest diameter being 3.4 mm. The outer rim comprises a relatively deep depression along its circumference, although there is marked variation in depth; an inner rim is sporadically distributed and consists of discontinuous pit- and slit-like depressions. A 'central field' shows minute corrugations (Pl. 1) which obliterate ornament features of the cirripede valve. Certain growth lines in the cirripede scutum have become accentuated, but are not part of the trace. The corrugated structures in the apical portion of this scutum (Pl. 1, fig. A) represent the remains of an adhering benthic foraminifer, *Planorbulinella cretae* (Marsson, 1878) (see Hofker, 1966).

Discussion

Santos *et al.* (2003) distinguished two ichnospecies, *L. cacelensis* and *L. bonarensis*. The former comprises oval to very elongate-ellipsoidal traces, round on one end and very sharp on the other, with a clear teardrop shape, and a margin defined by a relatively deep trace enclosing a slightly depressed inner zone which may either be smooth or possess a faint ornament of eccentric lines. The latter has a subcircular to suboval outline and consists of an extremely shallow furrow; bands or rings are usually not observed; the inside is smooth and lacks ornament, while one end is sharp and the other completely rounded.

Santos *et al.* (2003) compared *L. cacelensis* with attachment scars of the hipponicid gastropod, *Hipponyx conicus* (compare Cernohorsky, 1968; Radwański, 1977), now *Sabia conica* (see Vermeij, 1998). They noted that those marks are elliptical in shape and of similar size, but their margin showed a crenulate, highly irregular furrow (compare Vermeij, 1998, figs. 1, 2) which is well defined on the lower edge and poorly defined, or absent, on the frontal margin. The ornament of the inner zone comprises thin radial lines, but lacks concentric lines. The deepest zones in these traces lie on the lateral edges, in the centre and in the frontal margin, which corresponds to the apical portion of the shell. These show a relatively deep depression which is reminiscent of the roughly triangular depressed zone along the frontal edge in *L. cacelensis*.

Although the present trace (Pl. 1) does show pit- and slit-like depressions in places, it lacks the clearly developed crenulated margin and deeply excavated anterior pit, bounded by a wide rim (see Vermeij, 1998, figs. 1, 2), seen in traces left by the genus *Sabia*. Examples of the modern equivalent of the trace fossil *L. cacelensis* (NHMM JJ 13295a-d), produced by the calyptraeid *Crepidula fornicata* (Linné) on the pectinid bivalve *Pecten maximus* Linné, are much shallower, larger and do not display any ring at all, but these may be individual variations.

On account of the morphology, RGM 211 422 cannot be confused with traces produced by anomiid bivalves, vermetid gastropods or verrucid and/or balanid cirripedes.

The calcified byssus of anomiids leaves highly characteristic, tear-shaped attachment scars of sequentially enlarged arcuate depressions (see Bromley & Martinell, 1991; Bromley, 1999, 2004; Taddei Ruggiero, 1999; Jagt, 2003; Bromley & Heinberg, 2006), while vermetid scars consist of a deeply etched arcuate structure, as illustrated by Mayoral (1987, fig. 3; pl. 2, fig. 13), Taddei Ruggiero (1999, fig. 10, P), Jagt (2003, pl. 2, fig. 3), Donovan (2004, figs. 1-3) and Bromley & Heinberg (2006, fig. 13). Verrucid barnacles, of which two species occur in the type Maastrichtian (balanids being unknown until later in the Paleogene; see Taylor & Wilson, 2003), have so far only been found attached to burrow walls in hardground, often associated with bryozoans and serpulids, and on calcareous sponges (pers. obs.). It may be expected that such cirripedes produced traces on calcareous substrates, of the type described as *Centrichnus concentricus* by Bromley & Martinell (1991, p. 249, fig. 7; see also Martinell & Domènech, 1982, pl. 2, figs. 5, 8, 9). Homing scars, with radular traces, produced by patellid gastropods (see Voigt, 1977, pl. 3d) also differ in structure and cannot be confused with RGM 211 422.

In conclusion, it appears that both RGM 211 422 and examples of gastropod homing scars described and illustrated by Noda (1991) may be assignable to *Lacrimichnus*, but more material is needed to determine their specific ichnotaxonomic status.

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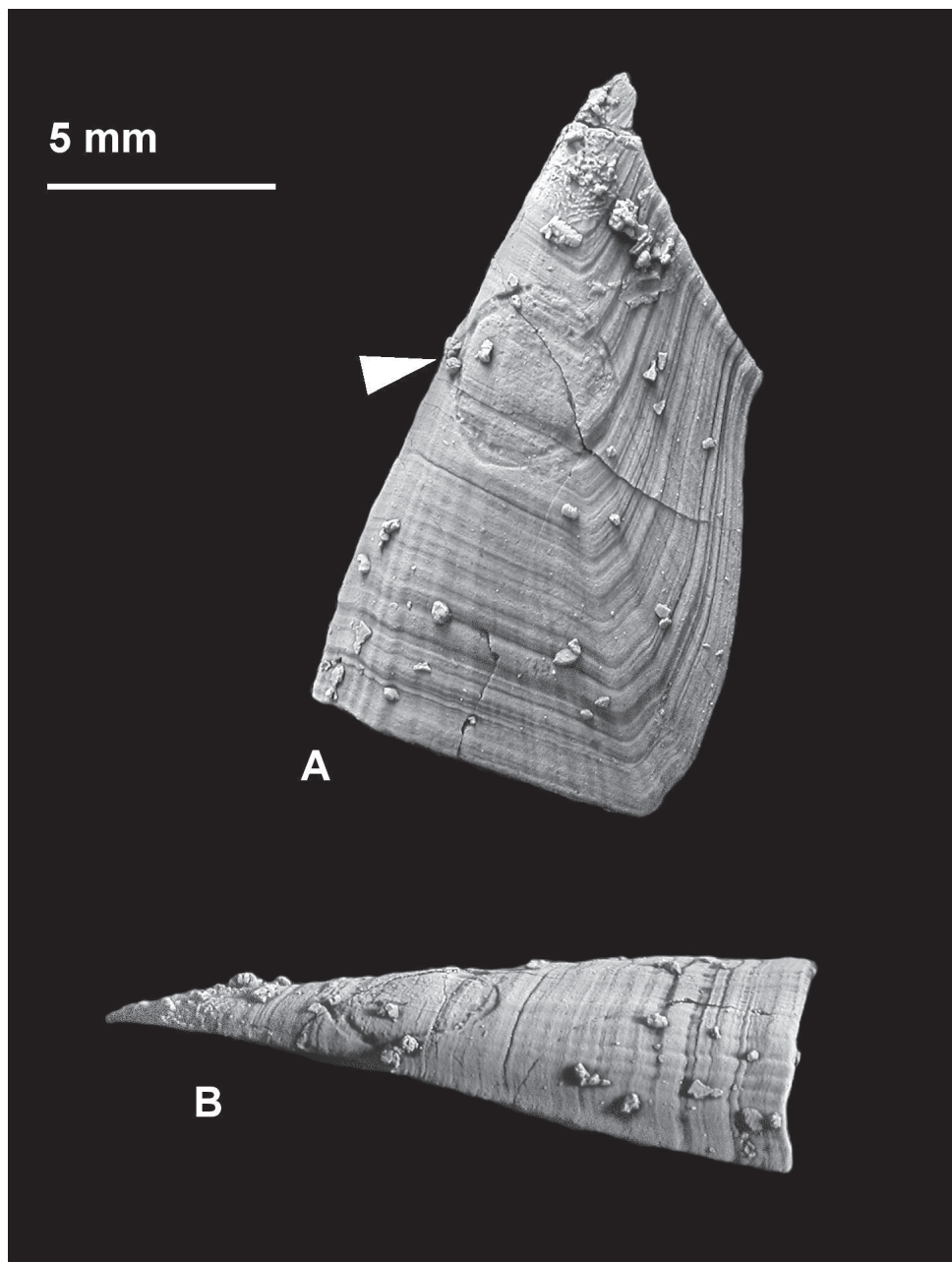


Plate 1.

Lacrimichnus? isp., gastropod homing trace [arrowed] on arcoscappellic cirripede scutum (RGM 211 422); ENCI-HeidelbergCement Group quarry, Maastricht; Maastricht Formation, upper Nekum Member (upper Maastrichtian, *Belemnitella junior* Zone). A, plan view; B, lateral view (of occludent and basal margins and rostral angle); near the apex of the cirripede valve (A) occur the remains of an adhering benthic foraminifer, *Planorbulinella cretae* (Marsson, 1878).

