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A plea not to ignore ichnotaxonomy: recognizing and recording *Oichnus* Bromley

Stephen K. Donovan[1,2]

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Abstract Many palaeontologists and sources of palaeontological data refer to 'drill holes' or 'small round holes' in shells, produced by invertebrate borers and sources of palaeoecological data. But such terminology may eventually be overlooked or forgotten; it is better that the authors also resort to ichnotaxonomy and refer these structures to their ichnogenus, *Oichnus* Bromley. This will support stabilization of the ichnotaxonomic record and improve communication. Ichnologists already follow this terminology; palaeobiologists (and some archaeologists) now need to develop a similar habit.

Keywords Drill holes · Small round holes · Ichnology · Archaeology · Palaeoecology

Introduction

This note is an argument to stabilize terminology by removing a fence—not a very high fence—between palaeontologists/palaeobiologists and some archaeologists on one side, and ichnologists on the other. What one side of the fence refers to, loosely, as 'small round boreholes' or suchlike, the other names it *Oichnus* Bromley (1981). This paper argues that the latter should be the universal nomenclature for such structures.

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✉ Stephen K. Donovan
Steve.Donovan@naturalis.nl

[1] Taxonomy and Systematics Group, Naturalis Biodiversity Center, Postbus 9517, 2300 RA Leiden, The Netherlands

[2] Department of Earth Sciences, University of New Brunswick, Fredericton, NB E3B 5A3, Canada

Once upon a time, my feet were planted firmly on the palaeontological side of the fence. For example, Donovan and Littlewood (1989, p. 185) noted that a Late Pleistocene scaphopod from Jamaica was "… bored on the left lateral surface, about 3 mm below the apex, by a predatory gastropod." Further, Donovan (1991, p. 2) observed that a pit in a Mississippian crinoid cup had a perforation that "… is circular with a rounded margin. The cavity is a conical, flat-bottomed pit …" Both reports were accurate, but both were doomed to sink from view in the abstracting and indexing literature because neither of the small round holes received a name. Now, with the zeal of a true convert, I encourage you to apply the correct ichnotaxonomic name(s) to your small round holes to improve communication and raise the profile of your publications, and to encourage interactions with other palaeontologists and ichnologists.

This note is the 'child of' an earlier paper that included similar imprecations (Donovan and Pickerill 2004) and has been engendered, at least in part (but also by my simmering impatience spread over too many years), by the recent archaeological paper of Kubicka et al. (2017), a notable contribution to the burgeoning study of small round holes in shells. In particular, these authors have clarified the criteria for the determination of the provenance of such holes in samples—either by boring invertebrates or drilling humans—which is appreciated as a timely aid to the taphonomic analysis of archaeological objects. However, the paper is flawed, as is unfortunately rather common in the palaeoecological literature (Table 1), in choosing not to embrace the concepts of ichnotaxonomy for these structures.

In writing this comment, my intention is not criticism of Kubicka et al. (2017) or, indeed, any other paper. Heard (2016, p. 144) recently defined ""Comment" papers [as a] critique or attempt to rebut recently published primary-results papers", but I recognize a third sort of contribution

Table 1 A selection of papers from the library of the author that discuss small round holes, but that are not named *Oichnus* therein

	Publication	Substrate/age	Identification
1	Kitchell et al. (1986)	Benthic molluscs/Recent	*O. paraboloides*
2	Donovan and Littlewood (1989)	Scaphopod/Late Pleistocene	*O. paraboloides*
3	Donovan (1991)	Crinoid cup/Mississippian	*O. paraboloides*
4	Rohr (1991)	Gastropod/Ordovician	*O. paraboloides*
5	Baumiller and Macurda (1995)	Blastoids/Devonian and Mississippian	*O. simplex*
6	Bittner (1996)	Brachiopods/Eocene	*O. paraboloides*
7	Hoffmeister and Kowalewski (2001)	Brachiopods/Miocene	*Oichnus* ispp.
8	Ceranka and Złotnik (2003)	Echinoids/Miocene	*O. simplex*[b]
9	Kelley et al. (2003)	Various[a]	*Oichnus* ispp.
10	Amano (2003)	Bivalves/Miocene	*O. paraboloides*
11	Hua et al. (2003)	*Cloudina*/Neoproterozoic	*O. simplex*
12	Delance and Emig (2004)	Brachiopods/Recent	*O. paraboloides*
13	Ishikawa and Kase (2007)	Bivalves/Pliocene	*O. paraboloides*
14	Meadows et al. (2015)	Echinoids/Oligocene	*O. simplex*
15	Leonard-Pringel and Jackson (2016)	Benthic molluscs/Neogene	*Oichnus* ispp.
16	Kubicka et al. (2017)	Archaeological shell samples/Quaternary	*Oichnus* isp.

[a] Papers in Kelley et al. (2003) adhere closely to a palaeobiological interpretation. At least seven papers therein refer to 'small round holes' in one form or another, perforating diverse (mainly Cretaceous and Cenozoic) taxa, yet only one paper, Brett (2003, p. 409), refers to *Oichnus*. The list is far from comprehensive, but does provide some idea of the range of taxa bearing 'small round' holes that have not been correctly named *Oichnus* or, indeed, were not placed in any ichnotaxon. Nominal ichnospecies listed include *Oichnus simplex* Bromley (1981), and *Oichnus paraboloides* Bromley (1981)

[b] Donovan and Pickerill (2004)

that provides extra supporting data to the original argument (Donovan 2017, pp. 31–34). This I shall do by reference to a large published source that was inadequately sampled by Kubicka et al. (2017), namely that concerning the fossil record.

Recognizing *Oichnus* Bromley (1981)

Multiple aspects of small round holes in shells have been studied by palaeontologists, particularly in (ichno)systematics, palaeoecology and taphonomy. These holes are among the most simple of morphologies of trace fossils and also the most common, and it is difficult to imagine how naming them, at least to ichnogenus, would be in any way burdensome to any author. Small round holes in shells, most commonly produced by invertebrates, are placed in the ichnogenus *Oichnus* Bromley (1981). It should be borne in mind that ichnotaxonomic names, while superficially similar to Linnaean binomens, represent a parallel scheme of classification for what are biologically generated sedimentary structures; for a discussion of the nineteenth century origins of this system, see Osgood (1975). But, in consequence, applying any ichnotaxonomic name is not to identify the producing organism, but it does introduce stability to the nomenclature of these biologically constructed sedimentary structures.

Recent discussion has sought to clarify the relationships of *Oichnus* with its synonyms (Bromley 2004, pp. 466–467; Zonneveld and Gingras 2014; Wisshak et al. 2015; Donovan and Pickerill 2017). I recognize that other authors may consider one (or more) of these other names to be more valid, but I regard all such structures as *Oichnus* (Pickerill and Donovan 1998; Donovan and Pickerill 2002, 2004, 2017).

Small round holes of the form discussed by Kubicka et al. (2017) are commonly the spoor of particular families of gastropods, although members of other invertebrate groups, such as cephalopods or annelids, may produce essentially identical structures (Bromley 2004). Cylindrical small round holes are commonly produced by predatory muricid gastropods and are referred to as *Oichnus simplex* Bromley (1981). Carnivorous naticid gastropods drill conical holes that are called *Oichnus paraboloides* Bromley (1981) (Table 1). Assignment to each or either of these ichnospecies should be possible for many or most of the small round holes described in the literature, although the figures presented by Kubicka et al. (2017, figs. 1, 3) lack adequate detail to permit such differentiation.

But why should we bother to name small round holes at all? Donovan and Pickerill (2004, p. 483) made cogent arguments:

> "We … consider that these "drill holes" can be named with relative ease rather than retaining them in

rather vague and open nomenclature … We emphasize this because in any scientific endeavour, names, be they biotaxonomic or ichnotaxonomic, should be adopted as conventional symbols or ciphers that serve as a means of reference, thereby avoiding the need for continuous and repetitive use of cumbersome and generalised descriptive phrases. The descriptor "drill holes" is potentially confusing and uninformative, and we feel that it could be quickly overlooked, eventually forgotten and certainly not entertained in any form of ichnotaxonomic surveys … Trace fossils require names so that they are amenable to stabilization, synonymy and survival, and that they establish conformity in usage".

Further to the determination of site selectivity by producers in archaeological objects by Kubicka et al. (2017), reference to the fossil record provides ample evidence that prehistoric boring organisms showed site specificity on invertebrate prey with mineralized shells (see many discussions in Kelley et al. 2003) long before any species of man could have been involved. The illustrated examples (Fig. 1) are reproduced from a broader survey of the diversity and occurrence of *Oichnus* borings in shells from the Late Pliocene Bowden shell beds of south-east Jamaica. Site selectivity is easily recognized in the figured examples of *O. paraboloides*; *Homo sapiens* reached Jamaica over three million years later, in 600 AD (Atkinson 2006, p. 3), and could not have generated them. The presence of these

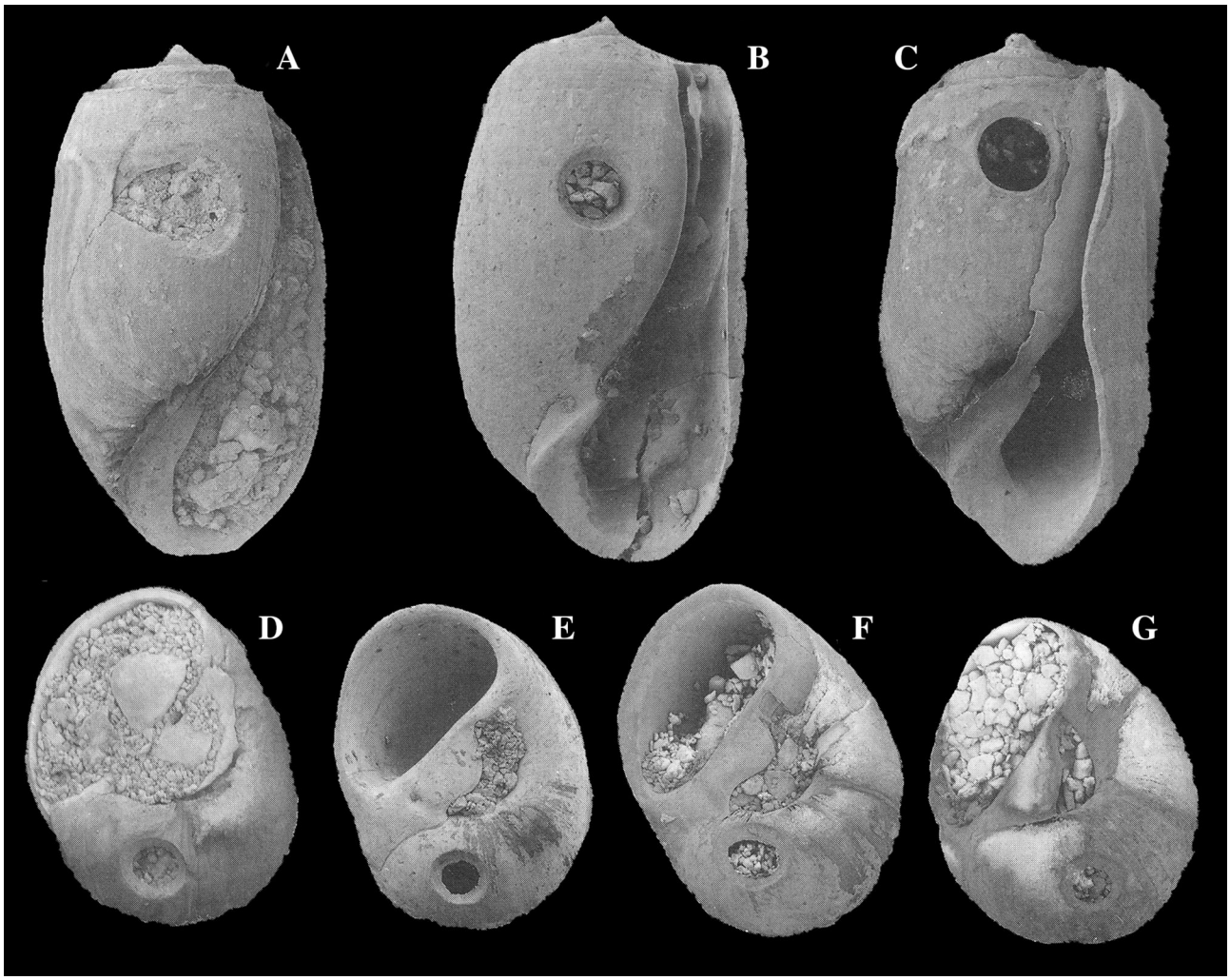

Fig. 1 Scanning electron micrographs of examples of site specificity of *O. paraboloides* Bromley in the gastropods *Acteocina lepta* Woodring 1928 (**a–c**), and *Natica castrenoides* Woodring 1928 (**d–g**), from the Bowden shell beds, Bowden Formation, south-east Jamaica (after Pickerill and Donovan 1998, pl. 3). (**a–c**) *Oichnus paraboloides* in *Acteocina lepta*. (**a**) ×25; (**b**) ×22; (**c**) ×19. Note shell fracturing and resultant breakage immediately to the left of *O. paraboloides* in (**a**). (**d–g**) *Oichnus paraboloides* in *Natica castrenoides*. (**d**) ×9; (**e**) ×7; (**f**) ×9; (**g**) ×8. Note that other examples of *O. paraboloides* in *A. lepta* ($n = 9$) (see also Woodring 1928, pl. 2, Fig. 5) and *N. castrenoides* ($n = 6$) are located at almost identical sites. All specimens coated with 60% gold–palladium. Specimens deposited in the Museum of the Department of Earth Sciences, University of New Brunswick, Fredericton, Canada

structures in *Natica castrenoides* Woodring (1928) suggests not just predation, but cannibalism.

Conclusions

I applaud all the publications mentioned in Table 1 for their informative, well-considered and data-rich contributions, and congratulate the authors of this suite of well-written papers. In future, they and other authors who have hitherto referred to 'drill holes', 'small round holes' and the like are encouraged to refer to them as *Oichnus*. This simple procedure will propagate ichnotaxonomic stabilization of their contributions in the relevant literature. Indeed, my target audience for this paper is not the ichnologist, who does not need such instruction and justification, but the palaeontologists/palaeobiologists (and some specialized archaeologists), who embrace the ecological and palaeoecological (Table 1) more enthusiastically than the ichnotaxonomic, with rare exceptions (see, for example, Leighton 2003, p. 228).

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Compliance with ethical standards

Conflict of interest None.

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