



## **Notostracan trackways and parataxonomy – a commentary**

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The recent paper review ‘Notostracan trackways and parataxonomy’ by Dzik (1996) of the article by Machalski & Machalska (1995) on the arthropod trackways ‘*Diplichnites*’ *triassicus* (Linck) from the Triassic of Central Poland raises several controversial and contentious issues that require commentary and clarification. Dzik (1996) takes issue with the nomenclatural philosophy of these authors and ichnologists in general and is clearly not a proponent of parataxonomy. He regards naming trace fossils as ‘biologically meaningless’, ‘that the parataxonomic approach to trace fossils is in fact destructive to [...] paleobiological studies’, that such nomenclatural procedures display ‘flawed logic’, and that ‘There is no need, however, to create a separate parataxonomy for trace fossils’ (Dzik 1996: p. 58). It is with statements such as these so vehemently expressed that we take issue and wish to provide the readership with alternative opinions.

Initially, we feel it important to reemphasize several of the basic tenets of ichnological research, as more fully discussed in Pickerill (1994) and Bromley (1996). It is well known that (i) the same (biological) individual or species can produce different ethological structures corresponding to different behavioral patterns; (ii) the same behavioral activity may be preserved differently depending upon the geotechnical properties of the substrate at the time of production and the diagenetic processes operative during its preservation; and (iii) different tracemakers or different species may produce identical structures when exhibiting similar behavior. Thus, to categorically and unequivocally assign a particular ichnotaxon to a specific organism or group of organisms is problematical without direct evidence of the tracemaker itself. In exceptional cases tracemakers are actually preserved in association with their ethological structures [e.g., the polychaete annelid *Trentonia shegiriana* Pickerill and Forbes preserved at the end of its trail (Pickerill & Forbes 1978), and the ophiuroid *Taeniaster bohemicus* Petr preserved within its cubichnion *Asteriacites lumbricalis* von Schlothheim (Mikuláš 1990)] but such examples are the exception rather than the rule. Instead, ichnologists are faced with much detective work in order to assess the potential tracemaker(s) of an ethological sedimentary structure. Nevertheless, the mere presence of such structures, potentially in rock sequences otherwise totally devoid of fossils, clearly indicates the former presence of organisms, irrespective of their zoological affinities. Dinosaur footprints are commonly preserved in terrestrial sequences, dinosaur bones less so (Lockley 1991); it is now becoming increasingly recognized that several dinosaur ichnotaxa, most of which were historically defined (e.g., Hitchcock

1858), can be equated with particular dinosaur groups. In contrast, meniscate burrows may be produced by arthropods, bivalve molluscs, or even vertebrates (Keighley & Pickerill 1994). That parataxonomy is 'destructive to [...] paleobiological studies' is therefore a subjective interpretation at best: the utility of trace fossils for paleobiological studies varies depending on the ethological structure that was produced.

Returning to the review in question, Dzik (1996) would prefer the trackways described by Machalski & Machalska (1995) to be referred to as 'notostracan trackway[s]' and expresses concern that the (producing) animal is not 'named in agreement with the spirit of zoological nomenclature'. These suggestions are flawed with respect to the ichnological principles outlined above, and for the following reasons.

First, Dzik confuses taxonomic nomenclature with taxonomy. Ichnologists operate with a dual nomenclatural system, as also recognized by the International Code of Zoological Nomenclature (Ride *et al.* 1985). Ethological structures produced by biological activity are named as ichnotaxa and the causative organisms, whenever recognizable, as biotaxa; the two do not compete for priority, in accordance with both the spirit and recommendations of the ICZN. It must be recalled that in any scientific endeavor names are adopted merely as conventional symbols or cyphers that serve as a means of reference and avoid the need for continuous and repetitive use of cumbersome descriptive phrases. This is true for all natural sciences, including all branches of earth science as well as biology and paleobiology, and use and construction of zoological names are governed by the ICZN. Typically, names of both zoological and botanical taxa, past and present, are Greek and Latin derivatives etymologically formulated to call to mind immediately and unequivocally the concepts intended by their transmitters. A species or ichnospecies should be named on distinguishing morphological features (hence the 'Principle of Name-bearing Types' to allow for 'the objective identification of names and for establishing synonymy' – ICZN 1985: p. xvi) rather than the 'organisms which produce them' (Dzik 1996). Although nomenclature should serve only as a handmaiden to the more substantive aspects of taxonomy (specifically Dzik's concern regarding the 'evolutionary relationships among taxa'), it is a separate and essential discipline; the labeling of ichnotaxa provides a necessary vocabulary for writing and conversing about trace fossils. Indeed, contrary to Dzik (1996), trace fossils require names in order that they may be studied objectively and systematically, that they are amenable to stabilization, synonymy, and survival, and that they establish conformity in usage. As Osgood (in Häntzschel & Krause 1972) has pointed out, unnamed ichnofossils usually are overlooked by paleontologists, are 'lost' in later literature, and must be named to survive.

Second, 'notostracan trackway' is a somewhat inappropriate and potentially confusing descriptor since notostracans have also been interpreted to have been responsible for trackways that are morphologically disparate structures to those described as *Diplichnites* (see Bromley and Asgaard 1979). Indeed, Gand (1994) also recently documented trackways morphologically dissimilar to *D. triassicus*, and named them *Isopodichnus furcosus*. However, he convincingly interpreted the trackways as having been produced by (unknown) notostracan branchiopods. Such variation is not surprising as notostracans are mobile omnivores that exhibit a variety of burrowing and locomotive activities (Tasch 1969). Thus, any descriptor such as 'notostracan trackway' does not accurately convey the morphology of the structure under consideration.

Third, in the absence of evidence of a definitive producer, a notostracan is only one of several potential arthropods responsible for the production of *D. triassicus*. In a nonmarine scenario it is of course tempting to equate such trackways with notostracan branchiopods but not exclusively so. The fact remains, however, that *Diplichnites* and morphologically similar trackways have been widely reported from marine environments and produced by marine arthropods, presumably not branchiopods. To name the (producing) animal 'in the spirit of zoological nomenclature' in the absence of definitive evidence of such is futile and should enter into no debate with respect to parataxonomy.

Unlike Dzik (1996), therefore, we maintain that there is a profound need to retain (and not 'create' – it already exists!) a 'separate parataxonomy for trace fossils'. Besides, as also noted by Bromley (1996), trace fossils are not parataxa in the classical sense of names applied to parts of an animal (e.g., scolecodonts, conodonts or for that matter almost all fossils) that ultimately can be zoologically assessed when its anatomy is more clearly defined. For example, in the absence of such a nomenclatural scheme the elegant Paleozoic ichnostratigraphic schemes utilized for essentially unfossiliferous sequences (e.g., Seilacher 1970, 1991) and based on the numerous and morphologically variable ichnospecies of *Cruziana* (or 'arthropod trails' as Dzik would prefer), would become meaningless. The basal Cambrian would, accepting Dzik's proposals, no longer be referred to as the *Phycodes* (*Trichophycus*) *pedum* Zone, but would have to be assigned some vernacular descriptor. These, as well as numerous other examples that could be discussed, demonstrate the usefulness and necessity of giving names to trace fossils. Their use may not necessarily always be paleobiological, but stratigraphical, paleoecological, sedimentological or strictly practical. In the latter cases, biological affinities can always be suggested within remarks accompanying systematic descriptions of ichnotaxa. It is our opinion, therefore, that the descriptor *Diplichnites triassicus*, as utilized by Machalski & Machalska (1995) and numerous other authors, will continue to survive, particularly with respect to bibliographic surveys. It is likely, however, that the descriptor 'notostracan trackway', as advocated by Dzik (1996), is potentially confusing and uninformative and we feel that such a descriptor would be quickly overlooked, eventually forgotten and certainly not entertained with respect to such surveys. In conclusion, we confidently predict that existing ichnotaxa will continue to be utilized nomenclaturally and, in agreement with Dzik, will indeed continue to be produced.

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