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THE USE OF THE TERMS TRACE, MARK AND STRUCTURE

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Abstract: *Mark, trace* and *structure* have been inconsistently used in ichnology for many years; we wish to clarify the origins and to prescribe correct usage of these terms. The origins of the words are ancient and complex; in the twentieth century they were given clear definitions as ichnologic terms. Seilacher (1953) defined a *mark* (German *Marke*) as a physical (abiogenic) sedimentary structure, as in the common terms *sole mark, flute mark,* but not *bite mark* or *scratch mark*. *Trace* has been defined many times; we recommend the consensus definition of Bertling *et al.* (2006) as "a morphologically recurrent structure resulting from the life activity of an individual organism (or homotypic organisms) modifying the substrate"; this includes *dwelling trace, feeding trace, bite trace*. *Structure*, as implied in another consensus paper (Frey, 1973), is a neutral term for geologic patterns resulting from either biogenic or abiogenic processes. Use of the three terms in a clear consistent manner will aid communication both among ichnologists and between ichnologists and their colleagues in other fields.

Key words: Ichnology, terminology, mark, trace, sedimentary structure.

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A few of us ichnologists had a bantering discussion on the "Ichnology" Facebook group at the beginning of 2014. Unfortunately, this re*mark*able discussion with its nested commentary was un*trace*ably deleted due to re*structur*ing of the group's page. Still, we feel it is important to make this discussion available to a broader audience because we have noticed a trend toward misuse of the well-defined terms *mark, trace* and *structure* in some recent publications. In particular, the incorrect phrases *bite marks* and *scratch marks* seem to be all too popular in vertebrate- and invertebrate-related ichnologic publications. As pointed out by Ekdale *et al.* (1984), the structures described in these articles were clearly produced by living organisms, and therefore should be called *bite* (or *biting*) *traces* and *scratch(ing) traces*. Similarly, striae made on the walls of burrows can be called *bioglyphs* (= individual sculptural elements; Bromley *et al.*, 1984), or collectively as *bioprint* (= the sum of all information that can lead to the identification of a tracemaker; Rindsberg and Kopaska-Merkel, 2005), or *scratch ornament*. It seems that neither authors nor reviewers are aware of the correct use of terms.

Ichnological terminology, in fact, developed over a period of decades and in more than one language. Adolf Seilacher (1953) is credited, and rightfully so, for establishing the scientific paradigm in which we work, but he did not work in a vacuum. German palaeontologists already had a long history of working on trace fossils; one of them, Krejci-Graf (1932), endeavoured to standardize the terms used for ichnology and Seilacher adopted several of these terms and concepts. Their acceptance among French- and English-speakers was accelerated by correspondence between Seilacher and Lessertisseur (1956), and by the enthusiastic acceptance of Seilacher's work by English researchers such as Simpson (1957). But the first edition of the trace fossil section of the *Treatise on Invertebrate Paleontology* (Häntzschel, 1962) contained little discussion of terms.

A crucial step was taken when the young Robert W. Frey (1971) ambitiously attempted – in a field trip guidebook! – to standardize ichnologic terms and concepts in the English language. This trial was followed by a period of international correspondence – by "snail-mail"! – in which he developed a list of equivalent English, French, and German terms, aided by Hans-Erich Reineck, Günther Hertweck, and Jacques Lessertisseur. The manuscript of "Concepts in the Study of Biogenic Sedimentary Structures" was circulated among 33 researchers in 12 countries for comments before publication. Reviewers included Krejci-Graf. Previously, the terminology of ichnology had developed partially and independently in different languages, but this would never be the case again. Häntzschel (1975, table 1) repeated Frey's (1973) terminology with minor modifications, and most of these terms remain standard.

Still, Frey (1973) missed an important concept. With his emphasis on biogenic sedimentary structures, he neglected to give a brief, general term for sedimentary structures that were *not* made by organisms, which he called *physical sedimentary structures*. But the common German term *Marke* (pl. *Marken*) had already served well for this purpose for several decades (Krejci-Graf, 1932), including *Runzelmarken,* which is still used for describing wrinkle marks. Krejci-Graf was consistent in his usage of *Marke,* but unfor-

tunately not of *Spur,* "trace," which included physical sedimentary structures made by moving objects, e.g., rainprints and gas-escape structures. *Marke* or English *mark* in the strict sense as it is used today, was defined by Seilacher (1953: p. 423) in his ground-breaking work "Studien zur Palichnologie" and reinforced by Richter (1954: p. 103).

According to the seminal definitions by Krejci-Graf (1932), reinforced by Richter (1935), Reineck and Singh (1973), Ekdale *et al.* (1984: p. 309) and the consensus reached by a majority of ichnologists during the first two Workshops on Ichnotaxonomy, summarized by Bertling *et al.* (2006), the terms *trace, mark* and *structure* are defined as follows:

Trace: "A morphologically recurrent structure resulting from the life activity of an individual organism (or homotypic organisms) modifying the substrate" (Bertling *et al.,* 2006: p. 266). The word has been used more or less in this meaning in English since about 1400 AD (Barnhart, 1988: p. 1156). It could also refer to a dirt path. Before that, *tracen* meant "to traverse, pass over, tread," as borrowed from Old French *tracier* or *trasser,* ultimately from Latin *tractus,* "a track or course." The original meaning from which *tractus* is derived would have been "to draw," i.e. as a horse draws a carriage. *Track, trail, train* seem to be distant relatives of *trace* that took different etymological paths into English.

Mark: "Non-biogenic structure produced by physical means, as in ripplemarks or death marks (thus, for example, it is incorrect to refer to bite traces as 'toothmarks'" (Ekdale *et al.*, 1984: p. 309). Krejci-Graf (1932) derived the German term *Marke* from mediaeval German *merken = kennzeichnen,* which may be translated into English as "to mark, to indicate" or even "to stamp (something) on," and in the figurative sense also "to remember" ("Mark my words!"). However, a trip to a couple of etymological dictionaries (Partridge, 1963: pp. 381–382; Barnhart, 1988: p. 634) shows that the meanings and origins of the word *mark* are complex in both English and German. *Mark* can be a limit or boundary, with the Latin cognate *margo* meaning much the same, and resulting in English *margin*. Related words include *march,* as in "the Welsh Marches" or borderlands and *marquis* or *margrave* (the noble in charge of a march). The Indo-European root may mean something like "cut" or "divide." In the long run, *mark* (the limit) becomes *mark* (the sign indicating a limit), and finally *mark* (the sign itself). But there is also another Germanic word, **mark*, meaning a "pledge," that has come to mean a "sign" in several languages. (The asterisk, *, indicates a form that is not attested in writing, but has been reconstructed from later forms.) In English, we have a privateer's *letter of marque,* the document that allows a pirate to seize the vessels of a rival state. Two words have collapsed into one.

Structure: The word is derived from *structus* as past participle of the Latin *struere,* meaning "to pile, place together, build, assemble, heap up, arrange," etc. In ichnology *structure* is used as a neutral term for patterns in geologic materials, in case one does not want to pronounce whether something has been produced by living activity or by purely physical forces. To avoid repetition in a text, additional words can be used, e.g. *biogenic structure* as a synonym for trace fossil, or *erosional structure* as a general term including flute marks and other sole marks (cf. Frey, 1973).

As ichnologists we, like any other group of scientists, need clearly defined terms in order to communicate. The terms *trace, mark* and *structure* are clearly demarcated terms and we have to use them accordingly. We therefore hope with this article to raise awareness of the correct use of ichnological terms.

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