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Trace Fossils, Process, and Documents

Robert D. Montoya
Indiana University, Bloomington, montoya@indiana.edu

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Introduction

This paper examines fossils as documents. Fossils are informative in the documentary world because they represent the skeletal structures of once-living organisms—therefore, they are the documentary remnants of something that, previously, was a fully-complete organism or documentary entity. Fossils can also be studied to better understand what David Sepkoski (Spekoski, 2017, p. 55) called "paleontology's ur-archive," in that they represent the archival record of the earth's organisms. But more specifically, this paper examines trace fossils, which are entities once-removed from the above notion of body fossils (Bromley, 1990). Trace fossils are the fossilized "structures produced in rocks, sediments and grains by the life processes of organisms" (Bromley, 1990, p. 1). Therefore, trace fossils are forms of evidence that help us better understand and construct the *activities* of organisms that are not contemporary with our investigations. Trace fossils, then, are not to be seen as static representations, but rather a blip in on the radar of much larger processes that came to a rather arbitrary end. On the one hand, this is obvious; on the other, what implications can this perspective have on how we understand the production and preservation of all documents?

The production of trace fossils can be a useful conceptual model to help us better understand the processual quality of documentary entities. Trace fossils, given how they are produced through the activities of organisms, are fundamentally altered or always-partial representations of past organic entities and events. They illustrate how we can potentially conceive of *all* documents as partial and part of an unfolding process of articulation—documents are *never* complete and, thus, we should not treat their content as if they were. All documentary interpretation involves an inherent process of re-creation of documentary conditions to understand and critique. The past, and our ideas of the past, are mediated through the evolution and unfolding of this documentary information.

Trace fossils

Typical trace fossils are animal burrows (i.e. bivalve—oysters, scallops--and lobster burrows in the sea floor), footprints, coprolite, plant root canals, and borings (general indentations made on hard surfaces by living animals). Paleoichnology is the formalized study of these fossilized traces ("Palaeoichnology | paleoichnology, n.," 2019). Another concept I will describe more later is taphonomy, which is the study of the processes for fossilization and how "information" (broadly construed) is lost during that process. (Of course, you gain certain other elements—for example, the substrate that ultimately hardens, but we'll set this issue aside and keep our attention on the degradation of the original entity.)

Trace fossils inform us about the activity and processes associated with organisms. The traces left behind by an individual sea urchin for example, will present with trace 'fingerprints' unique to its species. Andrew Smith and Peter

Crimes (1983, p. 83), for example, describe the traces left by the heart (sea) urchins (genus *Scolicia*), which include "bilaterally symmetrical, convex, meandering ridges 1–5 cm broad." These traces are often complex and not easily identifiable. The trace composition between one sea urchin and a closely-related urchin species will exhibit only nuanced differences, so a great deal of scientific interpretation connects a trace with a species.

The forms of trace fossils change over time as they encounter various environmental conditions. In essence, there can be no fossil or trace fossil without an inherent *loss* of information—they are defined by loss, and paleoichnology and taphony arose to make logical sense of how this loss can inform the movements and life processes of organisms. This is a significant way of understanding and reconceptualizing how more-traditional documents (i.e. books, documents, and data) are re-mediated through new and multiple modes of representation forms.

Paraonis *fulgens*

Before proceeding, let's present the case of the trace fossils typically left by *Paraonis fulgens,* an annelid species originally described by G.M.R. Levinson in 1884 (World Register of Marine Species, 2019), and discussed by Richard Bromley in his text, *Trace Fossils: Biology and Taphonomy* (1990, pp. 90–93). *Paraonis fulgens* is a very small worm—in fact, smaller than its burrow diameter which ranges from around 0.2 to 0.4 mm. It lives in tidal flat areas of sandy beaches. Its distribution is fairly wide, extant in coastal areas of the Gulf of Mexico, Caribbean, the Western Mediterranean, and Northern Atlantic—inclusive of the Toulon area of France. It has been thriving in these areas for some time and still plays a small, albeit significant, role in their sedimentary ecosystems.

Paraonis fulgens likes to keep itself busy by constantly constructing what Richard Bromley refers to as spiral traps (1990). These spirals constitute *Paraonis fulgens*' burrow system and are constructed like cascading waterfalls: lateral spirals in the sand that progressively go deeper into the ground, each connected by "steeply inclined or vertical shafts" (1990, p. 90). These spirals are then connected to a final, vertical burrow which branches off into many directions. The spirals sometimes extend to a full diameter of 8 cm, with each successive layer of the spiral about 3mm away from each other (comprising a beautifully symmetrical and intricate space resembling the spiraling tail of "The Monkey" Nazca line in Peru). The annelids produce a kind of mucous that line the spirals to help them keep their shape in the damp sand. The preservation potential of these burrows is particularly high—especially, for example, in the Minas Basin of the Bay of Fundy, Canada, where conditions facilitate longevity (Risk & Tunnicliffe, 1978).

The process for creating these burrows is as follows: the annelid moves into the upward area of the sand and constructs these spirals. "At low tide, when the water table sinks to below the level of the spirals, the worm seeks refuge within the

lower passages… the water table begins to rise again, the worms gradually ascend" (Bromley, 1990, p. 92). The current of the water, of course, often ruins these spirals, which are immediately reconstructed. But why this kind of activity—for what ultimate purpose? Their particular use was baffling to some because, of course, full burrows are nearly impossible to observe, especially at high tide (1990, p. 92). In terms of the documentation of this process, these fossilized spiral traps constitute the most useful evidence to answer this question, though this evidence must be weighed with other forms of evidence that bring to light the full context of its creation and function.

Examination of the gut of the annelids shed light on this conundrum: it was found that, in low tide, they primarily feasted on benthic diatoms—single celled algae that live near the seafloor. These diatoms are also mobile with the ebb and flow of the ocean at low and high tides. So, just like the worm (though more passively), they move downward at low tide and, as the high tide comes in, they redistribute upward as the water comes in to access sunlight. In this process, the algae become entangled in slime spirals that were left by the annelids, and are thus eaten.

Process

Paraonis fulgens trace fossils are not full representations of an organism's activity, but rather are part of a broad series of events that must be formulated together to form a coherent understanding of the organism's movement within an ecology. In order to truly decipher a trace fossil's significance is to understand the *full* context of creation and preservation.

Further, initial traces are not created in a vacuum. All traces are also *messy* and vastly influenced by their contemporary ecology. Trace fossils rarely present themselves as self-evident to anyone but the most experienced paleontologist. Taphonomy is the scientific study of "the processes that lead to the loss of information as sediments pass from the active benthic boundary layer"—the active, liminal space between the sediment and water surface—"into the geological record" (Bromley, 1990, p. 127). As impressions are made into a surface (the moment of document creation), emergent spatiotemporal conditions impact how an animal's activities are documented, and ultimately, fossilized for future scientific examination. For example, if an animal burrows into an area previously burrowed-into by a former species, the two burrow imprints will comingle, making the trace fossil complex and multi-layered.

More often than not trace documents exist within assemblages, intersect with one another, and are produced in "communities" (Bromley, 1990, Chapter 6) of similar or different kinds of organisms. As such, in addition to the problems associated with understanding processes for *one* species, scientists must disambiguate a network of traces that intersect with the trace of concern. The

existence of these communities also points to the intersectional qualities of documentation—their interpretation is defined by, and mediated through, environmental relationships (Wetzel, 1991) that simultaneously hinder their indexical usefulness while also amplifying their fragmentary and unbounded qualities.

Given this, Trace documents are also inherently palimpsestic: they are fragments upon fragments of processes that must be differentiated from one another to be properly defined as *informative* in any scientific sense. Johanna Drucker (Drucker, 2013, p. 58) describes a document as "an illusion of an area created at the intersection of overlapping frames"—parsing apart these frames and deciding what is, or is not, the document in question is a large part of identifying and explicating a given entity, trace fossils or otherwise. So, on the one hand, trace fossils *do* represent a given organism's activity, but on the other another, perhaps more integral way, these traces also represent *many* processes, and how we differentiate one process from another defines our ultimate assessment about a document's meaning and associations. And these associations are ultimately contingent. Kiersten Latham's (2016) notion of "floating fixity" comes to mind in this domain as well—the idea that an authentic environment for a document is based, in part, on how you define and bound a document's 'origin' point.

With the story of *Paraonis fulgens* in mind, and reconsidering trace fossils as documents, we can begin to see how an essential quality of these documents is their processual nature: they are but one piece of a much larger narrative and tell us only the slightest bit about the organism in question.

In this way, the production of trace fossils can be a significant conceptual model to help us better understand 'documents' broadly conceived given that they are defined by their incompleteness and understood to be inherently partial in their conveyance of a narrative. Interestingly, however, the process of alteration and loss (due to environmental conditions, community trace fossil effects, etc.) is an essential component in how we interpret them, which is usually not the case when you encounter what we might call traditional documents (texts, works, etc.) that present themselves as whole material entities. The domain of analytical bibliography, as one example, has long acknowledged the importance of understanding documents as primary and secondary evidence of their production conditions (Abbott, 2009, Chapter 2). Analytical bibliography focuses on the material objects—the texts themselves—to discover the conditions within which they were produced.

We must shift our thinking from document-as-entity to document-as-event.

Nature & Document as Event

Didier Debaise's (2017) publication, *Nature as Event*, is a useful text in reorienting ourselves to an event-based documentary mind frame. In this book, Debaise posits

a new way to understand our relationship to nature that is based on value, morals, and multi-positionality. His thinking stems from Alfred Whitehead's (1920) critique of "the bifurcation of nature" in *The Concept of Nature*. Debaise pushes against the scientific materialism still very prevalent in the sciences, rooted in Descarte's notion of secondary and primary qualities (and while the latter is antiquated to a certain extent, he argues its roots are still very apparent in scientific thinking). Instead, Debaise advocates for a "philosophy that in its very form, its ambition and its manners of relating to things, can grant due importance to the deeply plural experience of nature" (Debaise, 2017, p. 77). Debaise then outlines a phenomenologically-infused notion of nature as an 'event' experienced through the subjective "position of the body" (28–29), as well as an understanding that nature is *in time*, always passing, changing, and reinterpreted. The passage of nature is an event and the way we experience it is as well. *Paraonis fulgens* is inherently a process, as are the traces that it leaves behind for us to later interpret—setting artificial boundaries on evidence and documentation is antithetical to the essential processual mode of the natural world.

Debaise provides the example of Cleopatra's needle (a document in its own right)—the obelisk in New York City—as an event. And while we don't usually think of a static monument-as-event, Debaise shows that, "If we place ourselves in the right timeframe, the persistence of the obelisk becomes more ephemeral than it initially appeared" (2017, p. 32). If one imagines the monument through the lens of a broad temporal timeframe, it is, indeed, mobile, and indicative a whole host of ongoing positionalities. Debaise continues, "when looked at in terms of a general overview, it is true that the obelisk seems not to change, but when we look more closely … we realize that beneath its apparent simplicity there is a multiplicity of modifications, variations, and interactions with its natural environment" (2017, p. 32). Even red granite cannot escape the processes of nature. Documents are always-already in the process of changing in a material sense. As stated by Whitehead,

> For example, in a museum some specimen is locked securely in a glass case. It stays there for years: it loses its colour and perhaps falls to pieces. But it is the same specimen and the same chemical elements and the same quantity of those elements are present within the case at the end as were present at the beginning (Whitehead, 1920, pp. 24–25).

All documents become traces of their former conditions. And more, all of our interactions with documents involve the same process of interpolation as seen with *Paraonis fulgens*—we are constantly piecing together communities of documents to understand the complex context of its documentary significance.

The crux here is that we should reorder our understanding of documents to embrace that they are not, and never were, an accurate, full, or comprehensive

representation of an organism, intention, idea, or any other entity. Similar to the process of trace fossilization, we must understand the presentation of documents in whatever form, as not copies of, or even literal re-presentations of, their production conditions, but as objects that have undergone similar types of evolution through time—including the loss or alteration of informative content through spatiotemporally bound material, environmental, or contextual conditions.

Documents are Operative

The process of understanding the ontological or epistemological position of a trace fossil document is thus an attempt to do *at least* two things: (a) understand that a crucial aspect of any document is that its existence is primarily defined by *loss* and *change*, not information (insofar as we understand *information* to be representing the *conditions* of its creation). Over time, a document loses more information than it will eventually represent; and, (b) make ourselves more aware of the frames we impose upon a fossil (or any other document) within contemporary discourses, and that such framing constitutes what we consider to be informative. The meanings we ascribe to fossils, the structures and contexts we provide them are more a product of our own moment than the historical moment that produced it as an instance within a stream of events (and I emphasize: events in plural, for there are many communities of traces to contend with). We should reframe ourselves to better understand that *loss* is equally as vital as that which we can decipher.

In essence, looking to trace fossils can help us more clearly formulate a process for document creation—how they are merely impressions or fragments of knowledge that are formed in specific, plural conditions. We should not reify documents as primarily representations of information or knowledge, but state, rather, that they primarily represent the things we lose in this process of creation, and that that our individual processes are struggling to recreate them to best of our abilities. Documents are, at their core, *operative* in nature.

References

Abbott, C. S. (2009). *An Introduction to Bibliographical and Textual Studies* (4 edition). New York: Modern Language Association.

British Geological Survey. (2019a, March). Fossil specimen: NMW 73.28G.3 a-c – Holotype. Retrieved March 15, 2019, from GB3D Type Fossils | High resolution photographs and digital models of British type fossils website: http://www.3d-fossils.ac.uk/scanView.cfm?typSampleId=10000135&filePath=docs/OBJ/NMW/73_28G_3a/73_28G_3a.obj

British Geological Survey. (2019b, March). Fossil specimen: NOTNH FS12398 [GB3D Type Fossils | High resolution photographs and digital models of

British type fossils]. Retrieved March 15, 2019, from http://www.3d-fossils.ac.uk/fossilType.cfm?typSampleId=25000060

Bromley, R. G. (1990). *Trace fossils: Biology and taphonomy*. London; Boston: Unwin Hyman.

Debaise, D. (2017). *Nature as event: The lure of the possible*. Durham: Duke University Press.

Drucker, J. (2013). *What is?: Nine epistemological essays* (1st ed.). Victoria, Texas: Cuneiform Press.

Latham, K. F. (2016). The curious case of floating fixity (and its relationship to authenticity). *Proceedings from the Document Academy*, *3*(2). https://doi.org/10.35492/docam/3/2/2

Palaeoichnology | paleoichnology, n. (2019). In *OED Online*. Retrieved from http://www.oed.com/view/Entry/234353

Risk, M. J., & Tunnicliffe, V. J. (1978). Intertidal spiral burrows; Paraonis fulgens and Spiophanes wigleyi in the Minas Basin, Bay of Fundy. *Journal of Sedimentary Research*, *48*(4), 1287–1292. https://doi.org/10.1306/212F7662-2B24-11D7-8648000102C1865D

Smith, A. B., & Crimes, T. P. (1983). Trace fossils formed by heart urchins—A study of Scolicia and related traces. *Lethaia*, *16*(1), 79–92. https://doi.org/10.1111/j.1502-3931.1983.tb02001.x

Spekoski, D. (2017). The earth as archive: Contingency, narrative, and the listory of life. In L. Daston (Ed.), *Science in the archives: Pasts, presents, futures*. Chicago ; London: The University of Chicago Press.

Wetzel, A. (1991). Ecologic interpretation of deep-sea trace fossil communities. *Palaeogeography, Palaeoclimatology, Palaeoecology*, *85*(1), 47–69. https://doi.org/10.1016/0031-0182(91)90025-M

Whitehead, A. N. (1920). *The concept of nature*. Retrieved from http://archive.org/details/cu31924012068593

World Register of Marime Species. (2019). Paraonis fulgens (Levinsen, 1884). WoRMS – World Register of Marine Species. Retrieved September 3, 2019, from. http://www.marinespecies.org/aphia.php?p=taxdetails&id=146932