

What Taphonomy Is, What it Isn't, and Why Taphonomists Should Care about the Difference

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The term “taphonomy” was originally defined by paleontologist I.A. Efremov in 1940 as “the study of the transition (in all its details) of animal remains from the biosphere into the lithosphere”. The term evolved to include plant remains because Efremov also indicated that taphonomy concerned the “transition from the biosphere to the lithosphere”. The concept and the term were both adopted by zooarchaeologists who were interested in whether modified bones represented prehistoric tools or were concerned about the fidelity of the paleoecological signal of a collection of faunal remains. Until the middle 1970s, the term still meant what Efremov originally intended. When some archaeologists adopted the term to signify the formation and disturbance of the archaeological record and natural modification of artifacts, they caused the term to take on meanings different than those originally specified by Efremov. Taphonomy concerns once living material whereas archaeological formation processes concern both once living and never living material; taphonomy concerns the transition from living to non-living and geological, so includes both natural and cultural formation processes as either biasing or information laden and of research interest whereas archaeological formation concerns the transition from a living system to a non-living geological one but natural processes are biasing whereas cultural formation processes are of research interest. Taphonomists should quietly inform archaeologists who misuse the term that in so doing they exacerbate confusion and misunderstanding.

Keywords: ARCHAEOLOGY, DEFINITIONS, EFREMOV, PALEONTOLOGY, TERMINOLOGY

Introduction

Every form of inquiry about a kind of phenomena -literature, organisms, celestial bodies, chemical elements, geological deposits,

whatever- includes more or less unique terminology about the subject phenomena. The purpose of the terms is to provide shorthand labels for unique properties of the subject phenomena so that they might be

distinguished from other phenomena and to enhance communication efficiency during the course of research and teaching (e.g., Pushkin, 1997; Slisko & Dykstra, 1997). But terms are words we choose as labels, and they have meanings that we assign to them rather than having some inherent meaning that originates in the phonemes and morphemes of which they are made. The critical issue therefore is that we must agree on what terms mean else we are merely jabbering at one another rather than communicating. If we do not agree on the meanings of terms, then we may think two individuals are talking about the same thing when they say “cup” when in fact they are not, or we may think two individuals are talking about different things when one says “spoon” and the other says “ladle” when in fact they are not. The implications of obscure terminology or terms without agreed upon and generally understood meaning should be clear. The clarity and explicitness of scientific terminology are particularly important given that the sciences depend on replicability (repeatability) and independent empirical confirmation of knowledge claims.

In this paper, I briefly review the origin and history of the term “taphonomy” in its parental discipline of paleontology. This history establishes what the term was originally intended to mean and how that meaning evolved to keep pace with the evolution of paleobiology from paleontology (Sepkoski & Crane, 1985). Then a sketch of the history of the use of the term in North American archaeology is presented to illustrate how the term was sometimes adopted by that discipline without clear understanding of what the term was originally intended to mean, and how other times the term was adopted by archaeologists to label a related but different sort of phenomena than that

originally intended. Use of the term by archaeologists has occasionally provided a unique way to view the history of the formation of the archaeological record, and that is good; however, taphonomy has also been used as a label for phenomena that are arguably not what the term actually signifies. The latter can hinder communication, reduce understanding, and exacerbate confusion. Given the history of terminological confusion in archaeology (e.g., Lyman *et al.*, 1998) and zooarchaeology (e.g., Lyman, 1994a) and the misunderstanding and confusion that has resulted, it behooves taphonomists to educate their colleagues in archaeology as to proper (and improper) use of the term that delineates a very particular subject matter. This paper is meant to be a warrant for that educational endeavor. The history indicates that misuse of the term was likely initiated and perpetuated with good intentions, and that such misuse is growing in pervasiveness. The history also indicates that the misuse was unnecessary and can be discontinued with minimal effort on the part of taphonomists.

What “taphonomy” is

Russian paleontologist I.A. Efremov (1940:85) coined the term “taphonomy” as a label for the science of the laws of embedding, or “the study of the transition (in all its details) of animal remains from the biosphere into the lithosphere”. First, note that as originally defined, only animal remains were included; I return to this point later. Second, note that the etymology of the term resides in the Greek words *taphos* for burial and *nomos* for laws (Cadée, 1991); Efremov (1940:85) denoted this “new branch of paleontology” as all those efforts focusing on “analyzing the processes of embedding”. Taphonomy as

a term designating a particular field of research originated and evolved in paleontology where it originally was conceived as involving two stages, the first occurring between an organism's death and its final burial (recognizing that it could be buried, exposed, and reburied more than once), or biostratinomy, and the second stage occurring from final burial to recovery by the paleontologist, or diagenesis. The distinction was made in order to distinguish and keep separate those largely preburial and mostly biological (biostratinomic) processes that influenced remains and those mostly postburial geological and chemical (diagenetic) processes that influenced remains (Lawrence, 1979a, 1979b, 1979c).

Taphonomy had become a household word by the middle 1980s when paleobiologists Anna Behrensmeyer and Susan Kidwell (1985:105) indicated that taphonomic research involved "the study of processes of preservation and how they affect information in the fossil record". They underscored how historically the research focus of taphonomists had been on bias in, and information loss from, the fossil record, but that it was increasingly understood that taphonomic processes not only removed information they also added information, such as gnawing marks on bones suggesting predator identity. Efremov (1958:85), for example, noted that a "significant regularity of taphonomy is the absence in geological chronicle of any remains of land animals conserved in their life conditions". Historically early taphonomic research therefore focused on "stripping away the taphonomic overprint" (Lawrence, 1968:1316, 1971:593); the historically later phase had the additional focus of deciphering the paleoecological significance of taphonomic attributes displayed by the remains of organisms (Wilson, 1988). Taphonomic processes did not just remove potential data by altering (perhaps to the point of destruction)

the paleontological record, they also added potentially important information such as predation marks (e.g., predatory bore holes in mollusks).

More recently, Behrensmeyer *et al.* (2000:103) indicated that taphonomy "seeks to understand processes [that have influenced organic remains] so that data from the fossil record can be evaluated correctly and applied to paleobiological and paleoecological questions". Other commentators at this time agreed (e.g., Martin, 1999), reflecting a growing sophistication in conception of precisely what taphonomy is all about. The consensus likely marks a natural evolution of the term from denoting only processes that somehow bias a collection of remains of organisms, to acknowledging that some of those processes may be of interest in their own right. The consensus does not change the connotation or denotation of the term's original definition because the term had always concerned what happened to the remains of organisms after death and prior to recovery - it is about the *transition of organic remains from the biosphere to the lithosphere*, not just the *loss* of those remains. In short, other than the obvious difference between a live organism and dead one, since its inception taphonomy has always concerned the differences between the carcass of an organism that simply is dead and its mortal remains some centuries or millennia after it died. Why were the latter (often, but not always) an incomplete representation of the former? Why were the latter articulated or not, scattered or not, fossilized or not, broken or not? And on and on. That the term was, in the early days, often taken to mean information loss reflects the narrow view of the time that the fossil record was typically not complete relative to some seldom specified biological unit, whether

an organism, population, community, or some other unit (e.g., Olson, 1980). The term was, after all, coined by someone with deep interests in the paleoecological meaning of fossil remains (e.g., Efremov, 1958; see also Cadée 1991; Lawrence, 1968, 1971; Martin, 1999).

Most recent discussions authored by paleobiologists reflect the evolved definition of taphonomy (e.g., Rogers *et al.*, 2007). That is, taphonomy is now typically conceived as the processes that convert one or more organisms into phenomena of interest to paleobiologists. Those phenomena can be micro- and macro-scopic remains of plants or animals, their condition with respect to a plethora of variables, and their locations, orientations, distributions and associations. In short, taphonomists ask particularistic versions of the question: Are the remains different than when they were part of a live organism, and if so, how are they different, and what do the similarities and differences indicate about paleobiology, paleoecology, and the like?

From paleontology to archaeology

Multidisciplinary research that was associated with understanding early hominid evolution was the door through which taphonomy first entered archaeological research in an explicit way (e.g., Behrensmeyer, 1975; Hill, 1976). The introduction was facilitated by increasing archaeological questions about distinctions between naturally modified bones and those modified by hominids (e.g., Shipman & Phillips, 1976; Shipman & Phillips-Conroy, 1977). This general question was an old one that had been around since the beginning of archaeology as a distinct field of inquiry about the human past (e.g., Wyman, 1868), but it

reached something of a peak of interest as more deeply penetrating questions were asked about the possible proto-cultural behaviors of early hominid ancestors (e.g., Brain, 1967; Dart, 1949) and also about human behaviors as reflected by the archaeological record in general (e.g., Reid *et al.*, 1974, 1975). During the 1970s, the general interest among archaeologists concerned the formation processes that had created the archaeological record (e.g., Schiffer, 1972, 1975), soon to be referred to as middle range research (Binford, 1977). Because they were asking slightly different questions, paleobiologists not only did actualistic paleontology (Warne & Häntzschel, 1979) but soon came to refer to at least some of their efforts as “fidelity studies” (Kidwell & Flessa, 1995); the latter were concerned with how accurate a reflection a fossil collection was of one or more properties of a biocoenose.

As noted above, the early taphonomic focus of paleontologists with paleoecological and evolutionary interests was on the many kinds of information loss and biases (information distortion) in the fossil record (Martin, 1999). This same focus on information loss and bias also attended early concerns over the archaeological record (e.g., Ascher, 1968; Schiffer, 1972, 1975). In both cases, the comparative standard was the living record - for paleontology, a biological population or community of organisms (Olson, 1980); for archaeology, an ethnographic culture (Schiffer, 1972). Paleontologists and archaeologists alike were the unfortunate distant relatives of the parent theory-rich and information-rich disciplines of biology and anthropology, respectively (Lyman, 2007; Sepkoski, 2005). One could say that archaeologists were *preadapted* to thinking taphonomically (from the perspective of a biased and incomplete archaeological record) given

their interests in culture and human behavior, things that only exist among living people.

Archaeologists had been told for years by their ethnologist colleagues that the archaeological record was a fragmented and incomplete ethnographic record, to the point that they believed it and repeated it (references in Lyman, 2007), just as paleontologists had been told their materials were a fragmented and incomplete biological record (Sepkoski, 2005; see Simpson [1944] for an early effort to fight back). Thus it is not surprising that, like in paleontology (e.g., Clark & Kietzke, 1967; Lawrence, 1968), an early focus in archaeology geared toward answering cultural questions was on information loss, bias and distortion (e.g., Ascher, 1968; Isaac, 1967; Schiffer, 1972); the archaeological record was conceived to be a fragmented and incomplete cultural or human-behavioral record. Paleontologists did actualistic or neotaphonomic research virtually from the start in an effort to make that portion of the earth-history record they studied into something recognizable to a biologist (e.g., Richter, 1928; Weigelt, 1927); archaeologists did the same (e.g., Ascher, 1961; Atkinson, 1957; Hayden, 1945; Kleindienst & Watson, 1956; Semenov, 1957) in their parallel effort to put the few remaining fragments of cultural systems back together and to get at the prehistoric human behaviors that resulted in the artifacts of the culture they had found.

Some of the parallels between paleobiological taphonomy and the processes that form the archaeological record are found in a discussion by Warren DeBoer. DeBoer (1983:20-21) borrowed the term “taphonomy” and modified a schematic illustration of taphonomic history (Figure 1a) from Clark & Kietzke (1967:117) (DeBoer credited the illustration to derivative sources)

to fit an assemblage of artifacts (Figure 1b). In borrowing a model of information loss, DeBoer not only provided a very useful heuristic device for understanding some aspects of the formation of the archaeological record, he sharpened the focus on formation processes that create and modify the archaeological record as somehow biasing and information removing rather than potentially of interest in their own right.

Despite the parallels between paleobiological taphonomy and archaeological formation processes, there is a critically important distinct difference between the two fields when it comes to the reconstruction enterprise, by which I mean inferring properties of the biocoenose from which a collection of biological remains originated, or inferring properties of the culture from which a collection of artifacts derived. Unlike an archaeologist, a paleobiologist knows what a particular seed or leaf or bone or tooth or shell looked like when the organism was alive. This makes this first, reconstruction step of taphonomic analysis relatively straightforward; the comparative baseline -the size and form of the living organism- is known. Does the prehistoric specimen of concern display any attributes that make it unlike a normal (modern) specimen of the same kind? Is it distorted, broken, scarred, discolored, burned, mineralized, disarticulated? If so, why? Is the difference representative of a pathology that was caused when the organism was alive, or is the difference postmortem and thus taphonomic (e.g., Bartosiewicz, 2008)? Having a more or less well known model of what the contributing organism(s) looked like is a major advantage in paleobiology; archaeologists do not have that advantage and must infer very fundamental properties of the artifacts they study, such as whether a projectile point is an arrowhead, the tip of an atlatl dart, a

spear head, or a knife. After that, they really don't have any way to determine what the, say, arrow shaft (e.g., fletched, unfletched) and bow (e.g., sinew backed, or not) looked like. But a femur demands a tibia, and the femur of a bear (Ursidae) demands a particular kind of tibia whereas a femur of a squirrel (Sciuridae) demands a rather different kind of tibia. Knowing those anatomical necessities, in conjunction with what a "normal" skeleton looks like, provides a significant comparative framework for detecting taphonomic attributes of skeletal remains. (Plants are a bit more complex; how many apple seeds are represented by a single leaf from an apple tree?).

Another notable similarity between paleobiological taphonomy and archaeological formation process or middle-range studies involves the conception of time averaging in the former (e.g., Johnson, 1960; Peterson, 1977; Schindel, 1980) and palimpsest or coarse-grained assemblages in the latter (Binford, 1980; Brooks, 1982). Both have been pursued with some vigor in their respective disciplines (e.g., Kowalewski & Bambach [2003] for paleobiology; Bailey [2007] for archaeology). The amount of cross-pollination between the two disciplines has, unfortunately, been minimal (see Lyman [2003] for an example of the effects of time averaging on results of a zooarchaeological analysis). It is perhaps because of the lack of cross-disciplinary communication and sharing of ideas and methods that the basic concept of taphonomy has been misunderstood in archaeology.

In archaeology

It would be impractical if not simply impossible to list the numerous examples of misuse of the concept of taphonomy by archaeologists.

It would also add little to establishing the central point of this paper, which is to demonstrate that the concept has indeed been misused by archaeologists. I therefore merely discuss several examples of misuse of the concept. I do not intend to imply either that the authors I cite display particularly or even exemplary faulty reasoning or that these authors represent the majority of archaeologists. The items I cite happen to be ones that I was aware of, they were on my bookshelf, or I found them during the course of research for this paper. In short, the individuals I cite are merely those whose thoughts were readily accessible to me.

In an early use of the term in the archaeological literature, White (1979:211) provides a relatively lengthy description of what he means by taphonomy: Archaeological sites are subject to a series of taphonomic processes that take place between the time that the artifact or object is deposited and the present. Referred to as *non-cultural formation process concepts* or *n-transforms*, these concepts allow the archaeologist to explain and/or predict the interactions through time between a culturally deposited assemblage (or anything less than an assemblage) and the specific environmental conditions in which it was deposited. Differences between what was laid down in the behavioral past -the systemic context- and what the archaeologist recovers in the present -the archaeological context- are at least partially explained by these transforms.

White misuses the term and concept of taphonomy in a way that becomes pernicious in archaeology: Taphonomy concerns only natural or non-cultural processes. This is not at all what Efremov, a paleontologist and paleoecologist, had in mind, nor is it an accurate use of the concept as involving the transition from the biosphere to the

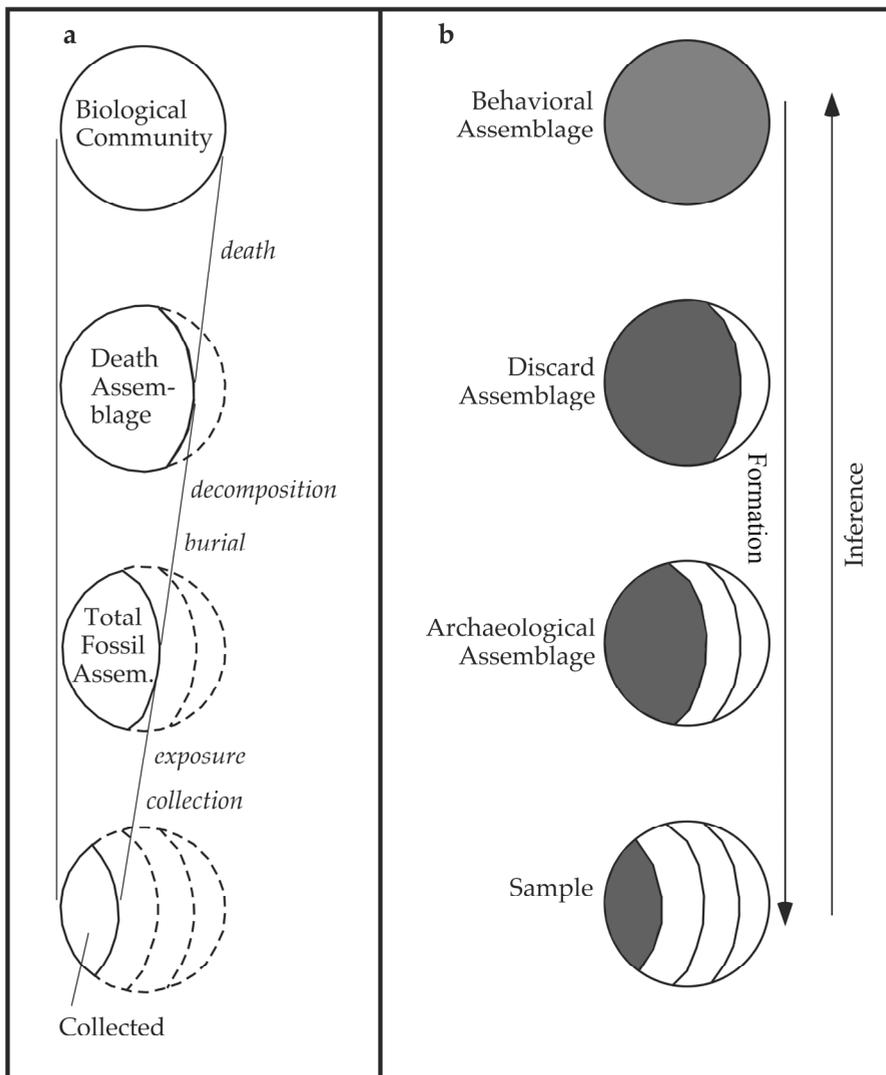


Figure 1. Models of (a) paleontological taphonomy (after Clark & Kietzke, 1967) and (b) archaeological taphonomy (after DeBoer, 1983).

lithosphere. And while it is unclear as to why White uses the term, let alone why he uses it the way that he does, it is not difficult to speculate that saying “taphonomy” is a lot easier than saying “non-cultural formation processes that influence the archaeological record”.

Whitlam (1982:146) argues that “taphonomy, strictly defined, refers to the laws of burial and embedding” and is an “earth science”, and on those bases he suggests that “archaeological taphonomy focuses on the study of the transition (in all its details) of artifacts from abandonment by the subject population until their archaeological recovery”. This conception focuses on “alterations of the formal and spatial characteristics of artifacts by natural processes following abandonment by the subject population” (Whitlam, 1982:147). Confusion immediately arises because this natural-process focus precludes alterations of artifacts by human activities, such as excavating cache pits and in so doing breaking or moving artifacts. Taphonomy as originally conceived and defined with respect to organic remains includes no such confusion, which is not to say that some paleobiologists don’t err in categorizing, say, butchering marks as non-taphonomic attributes of bones (examples in Lyman, 1994b). Rather, my point is that Whitlam’s characterization doesn’t explicitly distinguish the biostratigraphic and diagenetic stages. Further, it does not note that the important point of taphonomy is to distinguish “postmortem” alterations from those that reflect paleoecology when the artifact was “alive”. This is the same distinction that Schiffer (1972) made between the archaeological context and systemic context many years ago, a fact Whitlam (1982) recognizes. The reason that Whitlam suggests that we use the concept of

archaeological taphonomy is unclear, although he seems to think it will assist with writing research questions that are answerable if formation and recovery processes that influenced a collection are explicitly considered.

Dibble *et al.* (1997:630) note that archaeology “is in need of a term to refer to [non-human] distortions of the archaeological record” and so “for want of a better term”, they use taphonomy (see also Hiscock, 1985). By this term they mean to denote a wide range “of natural processes that distort the whole of the archaeological assemblage, including lithics and fauna, both during and subsequent to its deposition” (Dibble *et al.*, 1997:630). In using the term in this fashion, Dibble and colleagues misuse it in two ways. First, and as should by now be anticipated, the term was originally meant to signify the transition of organic remains from the biosphere to the lithosphere, not the transition of, say, lithic artifacts from the systemic context to the archaeological context. Second, and perhaps less obviously, the term was not meant to denote “distortion” but rather the transition, whether distorting or not. By defining taphonomy the way that they do, Dibble *et al.* (1997) make the term take on only a fraction of what it was originally meant to denote. Their definition of the term, despite its greater efficiency than *natural processes of formation of the archaeological record*, ignores those human behaviors such as carcass butchery and skeletal part accumulation, fragmentation, and deposition that are, by the original definition, just as much a part of taphonomy as any carnivore behavior that accumulates or modifies bones. Dibble and colleagues (2006) have continued to misuse the term in both ways.

Some, such as Kluskens (1995:241), have expanded Efremov’s (1940) seminal definition “to include cultural remains as

well as animal remains”. A similar expansion is suggested by Rapp & Hill (1998:50) who indicate that “artifact taphonomy... is an interpretational perspective based on the study of formational processes that affect the final spatial pattern and compositional character of the archaeological record”. They note that taphonomy concerns “processes that can transform the original [human] behavioral signal” of the archaeological record and the “principles of artifact taphonomy provide a framework for evaluating the events and processes that affect objects as they travel from the dynamic contexts associated with human behavior through the transforming events after they become part of the geological context to the point at which they form the patterns that become the archaeological record” (p. 50). While noting that the concept of taphonomy had been “originally applied to physical biotic remains [making up] the fossil record”, they suggest that the “usefulness of a parallel application of the taphonomic approach to the archaeological record should be clear” (p. 50). Of course Klaskens (1995) and Rapp & Hill (1998; see also Rapp & Hill, 2006) are correct that knowing about the processes that create the archaeological record is “useful”, but is that expansion conceptually and intellectually harmless? I outline why I think such expansion is potentially harmful below.

In a book that has been used as a text for upper-division classes in archaeology, Johnson (1999:56) writes that “taphonomy is the study of how the archaeological record is created from ‘cultural’ and ‘natural’ behavior”. He follows with examples of carnivore destruction of bones in archaeological and ethnoarchaeological contexts, likely because he finds taphonomy “most strongly developed in areas like botanical and faunal remains and animal behavior” (Johnson 1999:58).

But his definition, like that of Klusken (1995) and Rapp & Hill (1998, 2006), although a seemingly simply and innocent expansion of the original, produces an incorrect definition that could lead to eventual confusion.

In their textbook meant to be an introduction to archaeological method and theory, Renfrew & Bahn (2004:56) state that “in recent years archaeologists have become increasingly aware that a whole series of *formation processes* may have affected both the way in which finds came to be buried and what happened to them after they were buried -i.e. their taphonomy”. It should be clear that this statement is inaccurate; Renfrew & Bahn (2004:290-291) provide a much more accurate description of exactly what taphonomy is later in the same volume, though they focus on animal remains and ignore plant remains. Interestingly, Bahn (1992:489) had earlier defined taphonomy as “the study of the transformation of materials into the archaeological record. Originally the term was limited to the examination of these processes for living organisms... the focus of taphonomic studies is the understanding of the processes resulting in the archaeological record *per se*”. This definition -and that is surely what it is because it is in a dictionary- is misleading in several ways; taphonomy is not “the study of transformations” but instead it is the transformations and processes themselves. The definition also does not specify materials, so it could include faunal remains, lithic and ceramic artifacts, sediments, and whatever else one considers to be parts of the archaeological record.

Along similar lines, taphonomy has been used to denote the effects of natural processes on all sorts of archaeological phenomena. Bednarik (1994:68) specifically referred to the “distorting effect of taphonomic

processes [on prehistoric] symbolic production [and art]”. Niknami (2007:101) stated that “landscape taphonomy... deals with the processes by which elements of the landscape become selectively removed or transformed by both natural and cultural processes”. Barton *et al.* (2002:166, 167) refer to “artifact taphonomy” as the study of “accumulating agents, differential element loss, and morphological alteration” of artifacts making up a collection in order “not simply to identify gaps or distortions in the archaeological record but to match inferences to the appropriate resolution for the available data and to use an understanding of formation processes to gain additional information about past human behavior”. Rick *et al.* (2006) seem to largely use the term taphonomy as a synonym for archaeological record formation processes, but their discussion occasionally suggests that formational processes create the archaeological record whereas taphonomic processes disturb, alter, and destroy the human behavioral signal of the archaeological record.

Other (mis)conceptions

There are two additional points that warrant identification in the context of this paper. One concerns so-called *bias*; the other concerns another common misrepresentation of the concept of taphonomy. In the following I first briefly consider each of these in turn. I then turn to a final aspect of the definition of taphonomy.

In archaeology, the old connotation of taphonomy as concerning only those processes that produce a fragmented and incomplete record still predominates despite more than two decades of an expanded conception in paleobiology. Thus we read

that “taphonomic factors would have ensured the survival of skeletal remains of only a few of [hundreds or thousands of individual mammals]” (Fiedel, 2009:24). This notion has been acknowledged for more than a century. Archaeologist Oscar Montelius (1888:5) remarked that “Only a small part of what once existed was buried in the ground; only a part of what was buried has escaped the destroying hand of time; of this part all has not yet come to light again”. And paleontologist Adolph Seilacher (1992:109) pointed out that “taphonomy is a science about the unlikely: the survival of organic materials and forms in spite of their general drive towards recycling by biological, physical, and chemical degradation”. What is important is *if* that incompleteness creates a bias, and recognizing that *bias* is relative to a variable that must be measured in order to answer a research question. An assemblage that has undergone carnivore ravaging will be lacking those skeletal parts that were destroyed and/or consumed by the carnivores and thus be biased relative to the variable of skeletal part frequencies as reflections of differential transport. That same assemblage may not be biased with respect to the list of species whose remains were accumulated by site occupants.

The second point to be made is that the view that cultural processes, or human behaviors, are not taphonomic is pervasive among archaeologists as well as zooarchaeologists. For example, consider the statements by Dibble *et al.* (1997) quoted earlier. They are not alone in their misrepresentation of the concept. Schiffer (1987:260), for one, says that the “branch of science that studies the natural transformations of living animals (and plants) to the paleontological record is known as taphonomy”. Some zooarchaeologists also hold the view that human behavioral

processes (such as butchering) that influence bones are not taphonomic processes. A wonderful example of this is Speth's (1991:37) comment that "taphonomic rather than hominid agencies are responsible for [a bone] assemblage". I have suggested elsewhere that this conception of taphonomy is discipline-centric because human behaviors are the major subject of interest to archaeologists whereas anything that might obscure or destroy indications of human behavior must be taphonomic because taphonomic processes are (mis)conceived as biasing (Lyman, 1994b:33). Obviously such a conception of taphonomy fails to grasp what Efremov originally meant by the transition from the biosphere to the lithosphere.

Taphonomy was proposed as a distinct field of study because of the disconnect between a biotic community and its organic fossil traces, and the potentially muddled paleoecological signal of the latter with respect to the former (Efremov, 1940, 1958). That it was originally defined so as to concern only animal remains but quickly came to be applied also to plant remains is not unexpected given that paleontology, paleobiology, and paleoecology concern remains of both, and also because of Efremov's phrase "transition from the *biosphere* to the lithosphere" (emphasis added). Both plants and animals are part of the biosphere, and thus such an expansion of Efremov's definition of the term he coined does little violence to the original concept.

Discussion

Taphonomy as a term and concept served a useful purpose in paleontology when coined by Efremov (1940). It implied a particular kind of very general question had to be answered if paleontologists were to determine the

evolutionary or paleoecological significance (the usual questions) of a prehistoric animal or collection thereof: Why do these faunal remains appear the way that they do? The ability to answer this question ensured that efforts to answer questions about evolutionary histories and paleoecology -the ones traditionally asked by paleontologists- were not misguided. In the preceding discussion of the history of the concept, I have touched on reasons why I think the concept and term have been misused by archaeologists. Here I summarize that earlier discussion and highlight the similarities and differences between taphonomy as originally conceived and formation processes of the archaeological record. The discussion that follows is summarized in Table 1.

Taphonomy concerns the transition of living organisms into a geological mode of occurrence; archaeology concerns the use of non-living material such as stone and clay as well as originally living tissue such as sticks, bones, and hide as tool material and the human modification and transition of that material to a geological mode of occurrence, as well as its modification after it initially has a geological mode of occurrence. Thus taphonomy is but a small part of the formation processes that create the archaeological record - the formation processes that involve animal and plant tissue. This is one of what I take to be three critical distinctions between taphonomy and the formation of the archaeological record. In short, this first distinction means that living tissue has a different mode of natural occurrence than lithics or clay or metal, and this in turn means the two kinds of material have a different starting point in their respective histories with regards to formation of the archaeological record. In particular, as noted above, a mammal skeleton provides a natural

Table 1. Comparison of taphonomy and formation of the archaeological record.

Topic	Taphonomy	Formation of the Archaeological Record
Material	Living*; a model of standard skeleton, seed, leaf, etc., is known for every taxon (taphonomic starting point)	Living* and Non-Living; a model of a standard specimen of raw non-living material is unknown
Similarities	Modified from natural state by natural and/or cultural processes	Modified from natural state by natural and/or cultural processes
Differences	Can be merely dead (unmodified from natural state)	Must have at least one attribute created by human activity to be “archaeological”
Formation processes	<ul style="list-style-type: none"> •Natural - of potential interest (e.g., trace fossils of predators such as gnawing damage) •Cultural - of potential interest 	<ul style="list-style-type: none"> •Natural - usually only of interest as potentially biasing or destructive •Cultural - of central interest (e.g., technology, use-wear)

*same

model to which a prehistoric bone can be compared. There is no similar natural model for a lithic or clay specimen that is an artifact.

The second critical distinction between the two is this: By definition, an object must display at least one attribute created by human behavior for that object to be considered of archaeological significance, that is, to be considered an artifact (which is not to say that archaeologists have no interest in natural objects). Bones and seeds and shells and leaves need not have an artificial attribute to have research significance for an archaeologist. Sometimes termed *ecofacts*, non-artificially modified biological specimens indeed have ecological research significance, but they may also have other sorts of significance as well. Some faunal remains in a site deposit may have little to do with human occupation of the site, and thus while they might reflect something of the ecology of the site setting, they have little to do directly with human ecology.

The third and final critical distinction concerns the fact that formation processes influencing the biological record and those influencing the cultural record can both be

categorized generally as natural or cultural (Table 1). But otherwise, depending on the research question asked, natural formation processes tend to be of research interest in and off themselves with respect to biotic remains (gnawing marks indicating predation and perhaps predator identity) but are typically conceived as noise or biasing with respect to cultural remains (Schiffer, 1987). This subtle ontological difference is perhaps *the* most fundamental difference between taphonomy as originally conceived and archaeological record formation processes. Failure to recognize this distinction is why archaeologists often consider human behaviors such as butchering and fracture of bones for marrow extraction to be non-taphonomic whereas carnivore gnawing of bones to extract marrow is considered to be taphonomic. Thus, carnivore gnawing is not a source of ecological information to an archaeologist whereas it is to a paleobiologist. To escape this ontological morass, archaeologists must recognize that taphonomy concerns both natural and cultural processes and agents that influence the biotic record. Sometimes, depending on the research question asked, those natural

processes are indeed biasing or troublesome; other times, they might well be the topic of greatest interest because they reflect directly on the research question being asked.

Conclusion

One might wonder if we should be concerned with how the term labeling our discipline is used. I think we should be concerned because those of us who write for *Journal of Taphonomy* and read its contents know what the term meant to Efremov, but a disconcertingly large number of our colleagues in archaeology do not know what it means, or have chosen to change its original definition to fulfill a need they perceive. One might quibble about how important this change is; I suggest it is critically important because as philosopher of archaeological science Merrilee Salmon (1982:148) noted some years ago, does the term (signifying a concept) help us get some analytical work done by having a particular definition? I suggest it does because it specifies a very particular field of inquiry, materials constituting that field, and attendant analytical methods. My experiences with terms that have obscure or diffuse meanings has resulted in struggles to comprehend what a researcher is doing analytically and why (e.g., Lyman, 1994a; Lyman *et al.*, 1998).

The role and proper use of scientific terminology in both teaching and research has undergone some scrutiny in other disciplines (e.g., Pushkin, 1997; Slisko & Dykstra, 1997). In short, in so far as the meaning of a term is agreed upon, understanding and comprehension are increased and communication efficiency is greater. I have shown some of the terminological pitfalls -the means by which misunderstanding is exacerbated- that attend using the term taphonomy to signify the

formation (including distortion, fragmentation, modification, and destruction) of the archaeological record of artifacts, features, landscapes, and the like. I suggest that if we wish to maintain what taphonomists do as something distinct within paleobiology and archaeology, then we need to quietly correct those who use the term to signify something that is not what Efremov had in mind.

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