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Solving Meno's Puzzle, Defeating Merlin's Subterfuge: Bodies of Reference Knowledge and Archaeological Inference

LuAnn Wandsnider

University of Nebraska-Lincoln, lwandsnider1@unl.edu

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PROCESSUAL ARCHAEOLOGY

*Exploring Analytical Strategies,
Frames of Reference,
and Culture Process*

Edited by

AMBER L. JOHNSON

PRAEGER

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Solving Meno's Puzzle, Defeating Merlin's Subterfuge: Bodies of Reference Knowledge and Archaeological Inference

LUANN WANDSNIDER

THE MIND OF Lewis Binford is nimble and constantly evolving. In part, one can map Binford's prodigious intellectual growth by looking at the research trajectories of his students, who often continue on paths they began under his tutelage. In my case, certainly, this is very true. When I arrived at the University of New Mexico in the late 1970s and early 1980s, Binford was exploring the nature of the archaeological record: how to understand past human organization at a supra-ethnographic scale, what we might learn from bones and site structure, and how to reliably give meaning to the archaeological record. This chapter, harking back to the early 1980s, focuses on the latter and attempts to organize some of the many thoughts that have been offered on the notion initially known as middle-range theory.

Fundamental questions in archaeology are: What is it? How old is it? Why did people make it? Why did they stop making it? What do these patterns in artifacts, structures, and so forth mean at a deeper level? When students of archaeology ask and answer these questions, they are confronted with Meno's Puzzle and Merlin's subterfuge.

Meno was the imaginary debater with whom Plato puzzled over the detection of Virtue (Evans 1995). If we knew how to recognize Virtue in a person, then we could and would do so. But, if Virtue's distinguishing characteristics are a mystery to us, how will we recognize a virtuous individual when one appears? Mark Twain's Merlin, the resident magician in King Arthur's court, was capable of discerning activities happening at great

distances, even 10,000 miles away. Shockingly, however, Merlin could not reckon the contents of the Connecticut Yankee's pocket, though both were located in the same room (Dunnell 1992; Gould 1978; Twain 1917).

Meno's Puzzle and Merlin's subterfuge have, in various guises, been visited by archaeologists (Ascher 1961; Binford 1967, 1968, 1977b, 1980, 1981, 1987a; Butler 1965; Clarke 1978; Dunnell 1982; Gould 1978; Gould and Watson 1982; Lowther 1962; Shott 1998; Sullivan 1978; Trigger 1995; Tschauner 1996; Wylie 1982, 1985, 1989a, 1989b, 1992a, 1992b, 1996) and others (Gould 1965) with some frequency over the last several decades, for they engage the heart of the matter of validly learning something about a past that had virtues perhaps very different from those familiar to us. In the archaeological literature, Meno's Puzzle appears as the methodological paradox (Binford 1977b:3; Ramenofsky and Steffen 1998:3), while Merlin's subterfuge is concerned with the validity of knowledge claims about a past "10,000 miles" distant.

In archaeology, three related problems surface. First, without traveling back in time, how can we really know what the past was like? Second, can we learn about the past without imposing the present on the past (Wobst 1978)? That is, can the past somehow speak for itself and tell us something different than we think we already know? Finally, assuming that we can learn about the past, how do we know those knowledge claims are secure?

Lewis Binford (1962) answered the first question in 1962 by noting that the archaeological record is a contemporary phenomenon and that from it we derive inferences about what the past was like. Middle-range theory was part of the solution to both Meno's Puzzle and Merlin's subterfuge and the answer to the final two questions offered by Binford (1977b; 1981) in the late 1970s. As initially articulated by Binford, middle-range theory had several necessary attributes. First, it defined an unambiguous relationship between enduring, material archaeological phenomenon and a generating condition or process. Second, this relationship had to be uniformitarian in nature, that is, occurring in the past, which we hope to learn about, as well in the present, where it could be understood and documented. Moreover, it had to be warrantable as such. And it had to be independent of ideas about the past one hoped to evaluate, and thus could be used in an instrumental fashion to infer the occurrence of past processes from observations on patterned contemporary archaeological phenomena. Binford described middle-range theory as the Rosetta Stone to the archaeological record and as a means for linking the bear footprint of a physical record and the bear in the dynamic systemic realm. In this way it offered a robust, independent observational language with which to describe the archaeological record and interpret it in terms of past conditions (Binford 1981:25).

Since its introduction, the concept of middle-range theory has been ignored, maligned, critiqued, and revised (Shott 1998). While Shott finds middle-range theory to be paid short shrift in archaeology today, it is clear

that both past (Grayson 1986) and present archaeological practice necessarily depends on a construct that, in the inferential process, behaves like Binford's middle-range theory, whether it is labeled as such or not. Indeed, recent researchers (e.g., (Hodder 1999; Tilley 1994; Trigger 1995; Tschauner 1996) from diverse archaeological schools have come to acknowledge the critical role that such instruments have for constructing defensible archaeological interpretation, even using the term "middle-range theory" to describe this inferential tool. The middle-range theory actually used by many researchers, however, strays rather far from the ideal laid out by Binford in the late 1970s, as discussed below.

More recently, Binford (2001a, 2001b) has retreated somewhat from aspects of middle-range theory as described in the 1970s, but also moved beyond it. While not naming middle-range theory per se, he has decried the application of simple "diagnostic conventions" to complex archaeological interpretation. Binford (1987b, 2001a, 2001b) has introduced the term "frames of reference" to describe a learning process that organizes current, pertinent knowledge against which archaeological observations can be arrayed to further explication of archaeological variation. As elaborated upon especially in his volume, *Constructing Frames of Reference: An Analytical Method for Archaeological Theory Building Using Ethnographic and Environmental Data Sets*, such a learning strategy is essential for approaching the analysis and interpretation of second- and third-order archaeological units constructed from primary units of archaeological observation.

In this chapter I revisit Meno's Puzzle and Merlin's subterfuge. I introduce the term "bodies of reference knowledge" to describe the crucial element in the archaeological interpretative enterprise, a hermeneutic enterprise that also recognizes the archaeological record, the archaeological document (observations made on the record), ideas about the past we propose to evaluate archaeologically or which inform the construction of inferential tools, and interpretations of the past yielded by archaeological investigation and analysis. Bodies of reference knowledge may be usefully characterized along several different dimensions, as described below. Following from this dimensionalization are observations on how bodies of reference knowledge are applied. Elaboration of the archaeological interpretative enterprise in this way allows us to approach a solution to Meno's Puzzle and defeat Merlin's subterfuge.

BACKGROUND

Shott (1998) has offered a comprehensive history of the notion of middle-range theory in archaeology, especially focusing on the difference between Binfordian and Mertonian middle-range theory, which was also reflected

upon earlier by Raab and Goodyear (1984). But it is useful to situate Shott's history in the larger context of determining relevant archaeological observations and assigning secure meaning to those observations.

In archaeology, there has been for some time an explicit concern for archaeological versions of Merlin's subterfuge and, later, Meno's Puzzle. Robert Ascher (1961) discoursed on the defensible use of ethnographic analogy to undergird archaeological interpretation, an issue later revisited by Gould and Watson (1982) and others (Murray and Walker 1988; Wylie 1982). Lowther (1962) offered insights on what constitutes an archaeological fact and how the truth of such facts might be assessed, pointing to a conservative strategy that assessed new archaeological knowledge on the basis of its congruence with established knowledge. And Butler (1965) noted the role that prior knowledge, whether explicitly acknowledged or not, played in data collection and analysis.

While archaeologists in the 1960s and 1970s consulted philosophers of science to find an escape from Merlin's conundrum (Fritz and Plog 1970; Kelley and Hanen 1988; Watson et al. 1971, 1984), they soon realized the uniqueness of their situation (Wylie 1989b). Binford (1983:66–67) offers a graphic account of his recognition of the chasm between observations on archaeological materials, in his case from Combe Grenal, and interpretations of the Mousterian past. His 1970s solution to the problem, middle-range theory, emerged over a decade and was presented in rationale and also operationally in *Nunamiut Ethnoarchaeology* (Binford 1978b), *Bones: Ancient Men and Modern Myths* (Binford 1981), and *Faunal Remains from Klasies River Mouth* (Binford 1984), as well as elsewhere (Binford 1978a, 1980).

Grayson (1986) points out that something like middle-range theory or middle-range research has long been part of archaeology, citing examples from the French Paleolithic and Great Basin discussion of eoliths. The 1980s expansions in the development of middle-range interpretive tools he credits to an expansion in the recognition of interpretative ambiguities. More important than this, I think, is the seemingly simple act of labeling this aspect of the archaeological enterprise, which Binford and others (e.g., Watson's [1979] source- and subject-side knowledge) did, exposing archaeologists to this crucial—indeed, inescapable—step in constructing knowledge about the past. That is, Binford (and others, but especially Binford) made the implicit explicit, thereby making it something the discipline could discuss, digest, and move on programmatically.

Wylie (1989b, 1992b, 1996) has highlighted another aspect of middle-range theory that was raised in the early days of the conjoined processual/postprocessual soliloquies, on objective versus relative observation. She cogently describes middle-range theory as the middle course steered between the shoals of a false objectivism and the reefs of a not very useful relativism. Archaeologists today, explicitly or not, use a middle-range-like

construct to sustain inferences and, in so doing, display what Wylie calls mitigated objectivism: Observations made on archaeological deposits are not only recognized as theory-laden (a point of challenge offered by relativists to processual archaeology), but in fact they are, it is to be hoped (Chippendale 2000), deliberately laden with theory that is both relevant yet analytically independent of the ideas of the past under investigation.

Middle-range theory as a term was first used by sociologist Robert Merton (1968) to describe linkages between primary sociological observations (made in what archaeologists understand as the systemic context) and higher-level grand theory (Raab and Goodyear 1984). As noted by Raab and Goodyear (1984), Shott (1998), and Binford (1983:18–19), this usage of the term is very different from the methodological sense of 1970s Binfordian middle-range theory, which links up the material archaeological record and interpretations of those materials. Raab and Goodyear (1984) argue for terminological precision and suggest renaming Binford's middle-range theory as "archaeological theory." Shott offers a similar argument, suggesting "formational theory," since in his eyes Binfordian middle-range theory seems to pertain most to how archaeological deposits were formed. Both advocate retaining the Mertonian sense of middle-range theory for linking between reconstructed primary observation units (derived from the application of archaeological or formational theory) and general theory.

RECENT INNOVATIONS

Over the last 10 years, archaeologists from widely divergent theoretical stances have offered several different ways to both solve Meno's Puzzle and subvert Merlin's subterfuge. In structure, all of these routes appear very similar, as demonstrated by Wylie's analyses of the evolutionary archaeology (Wylie 1995) and feminist archaeology (Wylie 1996) programs, Tshauner's (1996) comparison of behavioral and postprocessual archaeology, and the admissions of Tilley (1994) and Trigger (1995). This single, widely employed escape consists of an inferential pyramid (Schiffer 1987, 1988; Trigger 1989:20) in which upper-level abductions are situated in what Dunnell (1971; 1992) terms the ideational realm and are derived from many lower-level, independently grounded inferences based in the material realm. These latter primary inferences consist of both deductions and abductions and also rely on less secure inductions, generalizations, and conventions, all based in some sort of middle-range construct.

The middle-range offerings of both Trigger (1995) and Tilley (1994) are significant because they represent some of the first attempts by those concerned with ideology and mentalist issues to acknowledge the critical role played by a middle-range construct in sustaining inferences about the past. Trigger seeks to extend a symbolic analogue into the past:

The study of these correlations requires a different kind of middle-range theory and different bridging arguments. This middle-range theory takes the form of demonstrations that certain kinds of beliefs and symbolism correspond significantly with specific types of societies. Hence, where these types of societies can be shown to have existed, the presence of specific beliefs or symbolism can be postulated with varying degrees of confidence. The strongest bridging arguments take the form of evidence from written documents, oral traditions and ethnographic data which indicate that these beliefs were in fact present in the individual societies being considered [Trigger 1995:425].

Meanwhile, Tilley (1994) is interested in sustaining interpretations about the role of the landscape in the lives of past peoples. He surveys several ethnographically known cultures that had different degrees of economic and ideological complexity and generalizes from these few.

To be expected of these pioneering efforts, they also represent some of the more naive examples of middle-range applications, relying as they do on simplistic ethnographic analogies that do not engage the full complexity of the matter at hand. Binford (1967) early on acknowledged the role of analogy in pointing out areas where middle-range research is required. That is, where Trigger and Tilley end their discussion of middle-range research, Binford might begin it. Following Cowgill's (1993) recommendations, fuller treatments would look beneath the surface of the offered generalizations, perhaps to the contextual psychology of humans with respect to portable and landscape symbols.

More recently, Hodder (1999) has offered an analysis of the archaeological interpretive process based on what archaeologists do as opposed to prescriptions about what they should do. He describes this process as a hermeneutic spiral; the reasoning process is recursive and iterative and constantly works between "the parts" and "the whole" at a variety of levels of abstraction. (The hermeneutic nature of archaeological interpretation is similarly evident in Wylie's discussions and in Binford's [1977b:7] early discussions of middle-range theory as well as O'Connell's (1995) critique of ethnoarchaeology.). Archaeological inference in this process has several characteristics (Table 11.1) and depends very much on the pre-understandings of the researcher, which I understand as the various aspects of the paradigm (Kuhn 1970; Masterman 1970; Wilk 1985) within which a researcher works. Hodder argues that in fact archaeologists do not "test hypotheses," as early positivist New Archaeologists prescribed, but rather they constantly evaluate the degree of fit between data and interpretation. These best-fit interpretations (Kelley and Hanen 1988:360–368) I understand to be what is meant by abductions (Blackburn 1994).

The hermeneutic nature of archaeological reasoning lies in how archaeological observation proceeds. "[T]he definition of [archaeological] objects [such as artifacts and features] depends on interpretations of contexts

Table 11.1 Characteristics of Archaeological Inference (Hodder 1999: 33–65)

1.	Depends on the integration of parts into wholes, with all strands of evidence supporting the coherent whole
2.	Works by analogy and comparison (example, ethnographic analogy)
3.	Depends on pre-understandings, including the initial definition of object of study, criteria to identify which facts are significant; goal of inquiry and notions about what will count as an answer; tools; methods and skills; social structure of research team; wider social, political, and funding context
4.	Is data-led in that discovery is a crapshoot and may deny previously held pre-understandings
5.	Method is interpretation dependent with different kinds of archaeological deposits approached in different ways
6.	Depends on anticipated narratives
7.	Is multiple and diverse depending on pre-understandings of the archaeologist and the disciplines (natural science, social science, and humanities) that archaeology straddles
8.	Lack of coherent whole produces tensions, leading to further research
9.	The fit of data to interpretation is made at several levels, by the researcher and by the community to which researcher reports

and definition of contexts depends on interpretation of objects” (Hodder 1999:86, Figure 5.2). And, after Kosso (1991:625), Hodder (1999:27–28) describes middle-range theory as a hermeneutic tool.

Theories...in general are confirmed by appeal to observations, and observations in general are understood and verified with the support of theories. Observations are theoretically influenced claims about specific situations. Theories are claims which go beyond particular perceptions of observations. Individual observations are interpreted by appeal to theories which are themselves put together and supported by observations.

Downplayed in this presentation is the notion that middle-range constructs, while subjectively recruited to meet a particular task, are nevertheless employed in an analytically independent manner (Binford 1981; Lucas 2001:183–187; Wylie 1996). Data collected and interpreted with them may, in the parlance of some, resist particular interpretations. Moreover, as discussed below, some middle-range constructs are more than analogs (contra Hodder’s Characteristic 2) and yield inferences that are more robust than those produced through induction. Given these observations, it would

seem useful to modify Hodder's Figure 5.2 to reflect that data are constituted and interpreted using these analytically independent hermeneutic tools presented as bodies of reference knowledge (discussed below) in Figure 11.1.

While others have finally admitted the essential role of a middle-range-like construct for making knowledge claims about the past, Binford (2001a, 2001b) has characteristically moved on to offer another important distinction. He retains in the toolbox of the archaeological enterprise something akin to what he early on discussed as middle-range theory:

The challenge facing archaeological researchers is to decide which properties of our observational events can be linked most securely to events that occurred in the past. Since all arguments about what the past was like are based on circumstantial evidence, they must be judged by how well they link observations in the present to dynamic events inferred from such evidence. Only strong arguments of causal necessity are acceptable [Binford 2001a:46].

To this Binford adds another critical interpretive tool, however, which is how knowledge claims can begin to be made for that myriad of situations wherein multiple contingent factors come into play in determining human behavior and also the consequent material record. It is this complexity that has caused other researchers to either continue with flawed but rich ethnographic analogical reasoning, often ignoring interesting variation. Binford's most recent offering is a strategy for generating interpretative homologues tied to very particular conditions through inductive inspection

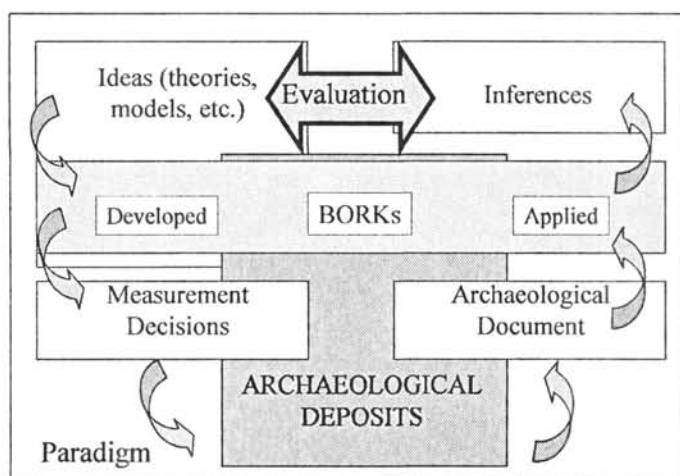


FIGURE 11.1 Archaeological hermeneutic enterprise.

of multiple cases arrayed against better understood dimensions of potential variation. It is a strategy for transiting from the complex known into the complex unknown. He illustrates this strategy by arraying ethnographically documented hunter-gatherer cases against various well-understood dimensions of climatic variation. As the volume *Constructing Frames* demonstrates, for this work to proceed requires an incredible investment in recruiting and organizing prior knowledge about climate and about ethnographically known hunter-gatherers.

While Binford's current work especially concerns interpretation of second- and third-order archaeological patterning, earlier work applied the same strategy to assist interpretation of first-order archaeological patterning in bone distributions informed by knowledge of how carcasses are differentially utilized and transported (Binford 1987a). Another example illustrates: Stone can be knapped in a limited number of ways, all described by fracture mechanics (seated in Newtonian physics). Knapping, however, may take different trajectories depending on various conditions. Thus the character of chipped stone assemblages reflects the degree to which technology is curated or expedient (Binford 1977a), with maintained or reliable tools kits (Bleed 1986), designed to manage time or material constraints (Torrence 1983), with close or distant raw material sources (Nelson 1991), and accumulating over years or centuries (Holdaway and Fanning 2003). Current chipped stone analysis employs Binford's frame of reference strategy, attempting to monitor assemblage variation with respect to each of these potential sources of variation. Actual measurements made on debitage and tools (i.e., first-order observations on archaeological materials) feed this constrained and contextualized multidimensional analysis.

Binford gave a label—middle-range theory—to an inescapable step in archaeological interpretation that has long been employed by archaeologists. His most recent emphasis on frames of reference similarly gives a label to an analytic strategy that until now has been unnamed but is used by those researchers working with archaeological variation. The importance of the analytic strategy detailed by Binford cannot be overemphasized. Thus the development and application of uncontextualized middle-range constructs is insufficient, especially for approaching the complex and contingent human past. The inductive strategy outlined by Binford, informed by prior knowledge and particular contexts, appears to be the best solution for how to proceed.

Hodder (1999) notes the importance of pre-understandings in archaeological interpretation but uses the one term as an umbrella for all aspects of pre-understanding and prejudgment that inform archaeological work, from inception to final interpretation. Binford's important contribution here, in his emphasis on prior knowledge and frames of references, is that there are some pre-understandings that can and should be usefully cultivated by the researcher. We cannot control the social milieu in which a researcher is

raised, although she can be made aware of it. We can, however, fashion particular hermeneutic tools that are sensitive to the issue at hand.

Except for confusing students, the discipline has gotten along just fine using a surfeit of terms—archaeological theory, archaeological correlates, middle-range theory, middle-range research, source-side knowledge, mid-level theory, formation theory, and potentially, frames of reference—to describe a critical portion of the archaeological interpretive enterprise. Nevertheless, in what follows, I introduce and attempt to justify the utility of yet another term, body of reference knowledge, which offers various merits over current terms. I detail the dimensional nature of such bodies and the modes of argument that involve the application of bodies of reference knowledge of different kinds.

BODIES OF REFERENCE KNOWLEDGE AND THEIR DIMENSIONS

By “body of reference knowledge,” I refer to a more or less coherent corpus of knowledge, sometimes developed in other disciplines, recruited by archaeologists to address particular archaeological problems. The proposed addition to the archaeological lexicon offers several advantages. For one, the term body of reference knowledge (BORK) allows us to admit that some of the bodies of reference knowledge on which we commonly rely are not always theoretically secure, contra the terms “archaeological theory,” “middle-range theory,” and “formational theory.” For example, Shott (1996, 1998) admits that the documented relationship between size and use life of ceramic vessels at this point is correlative rather than theoretically supported (meaning, we know when and under what circumstances a particular relationship holds). Nevertheless, he feels confident that it can be used in an instrumental capacity to support inferences about ceramic assemblage composition. Similarly, as noted above, while Trigger (1995) has proposed expanding “middle-range theory” to deal with iconographic phenomenon, the middle-range theory he proposes is really an analogical application of an empirical generalization and at present lacks theoretical undergirding. The theoretical content of a body of reference knowledge is critical for it speaks to the security of inference; it is but one property to be considered here.

Second, the term “bodies of reference knowledge” gives a name to a critical element in the archaeological enterprise so that we can dimensionalize it (see below), and discuss and debate it. In his extended discussion of middle-range theory, Lucas (2001:186–187) uses the term “middle-range research” in this capacity. Yet, other authors (e.g., Grayson 1986) use this same term with other senses. Thus, in pursuit of a vocabulary that is ever more precise, I suggest referring to this entity as a body of reference knowledge.

Third, "body of reference knowledge" avoids the issue of Mertonian precedence in use of the term middle-range theory as raised by Raab and Goodyear (1984) and Shott (1998). Fourth, while Shott sees such tools as being useful in understanding the formation of the archaeological record—hence his term "formational theory"—Clarke (1973), Sullivan (1978), and Schiffer (1988) recognize a more expanded domain of application, with which I concur. The important point here is that this source-side knowledge, both archaeological and nonarchaeological, exists and that we archaeologists organize and apply it to enable interpretation.

Bodies of reference knowledge are used in establishing primary units of archaeological observation as well as secondary and tertiary units of analysis in inferring that particular processes have occurred or that particular conditions have obtained (Figure 11.1). Their development and use takes into account: the nature of a specific archaeological record (e.g., comprised of chipped stone? architecture? both? other?); the ideas, inchoate or not (Ramenofsky and Steffen 1998), to be examined archaeologically; and the kinds of secondary and tertiary units that will be utilized to engage those ideas (using a comparative analytic strategy and employing other bodies of reference knowledge).

Dimensions

Not all bodies of reference knowledge are equal, and consequently the inferential process (that is, how they are used by archaeologists) varies depending on the nature of the developed and applied BORK. BORKs can be mapped along several general dimensions (Table 11.2).

RELATIONSHIP BETWEEN CONDITION/PROCESS AND PATTERN. The first dimension, with three aspects, focuses on the relationship between the condition or process we ultimately hope to infer and archaeologically observable material patterns. First, regarding whether the process-pattern relationship is "instantaneous" or emergent, consider the irrigation network constructed in Uruk, Mesopotamia (Adams 1981). Its presence suggests that multiple families are in simultaneous residence, that seasonal water shortages are likely that limited the productivity of some preferred crops, and that some modest or even highly developed degree of communal organization is in place to coordinate its construction and regulate its use. The presence of an irrigation system on the Euphrates River at 4600 B.C., then, indicates the presence of the above-described conditions, at least at the instant in time of the canal's construction.

At the other end of the continuum are patterns that result from processes operating or conditions obtaining over a span of time. The development of size-sorted assemblages by water occurs after some passage of time (Wood and Johnson 1978), albeit, archaeologically speaking, brief.

Table 11.2 Dimensions of Bodies of Reference Knowledge

1. Relationship between condition/process and pattern
a. instantaneous/emergent pattern
b. uniquely determined/ambiguous
c. single vs. multiple factors
2. Understanding of relationship
a. theoretical vs. empirical
b. comprehensiveness
3. Application
a. breadth (universal/contextual)
b. warrantability (uniformitarianistic warrant, assumption)
c. mode (identification, deductive, inductive inference)

Similarly, the development of assemblages differentially rich in bifaces or cores develops as a result of the history of occupation responsible for those assemblages (Bamforth and Becker 2000), perhaps over centuries.

To some extent, whether the process-pattern relationship is instantaneous or emergent is a matter of scale of observation. In fact, an irrigation system cannot be built in an instant and is likely something that emerges over years or decades, although for it to have functioned at all, much of it must have existed simultaneously. The simple point here is that, as expounded upon by Bailey (Bailey 1981, 1983, 1987), different processes have different temporalities, and our ability to see them archaeologically is thus affected by how much time has indeed passed as assemblages develop. This issue requires its own treatment and will not be elaborated upon further here (Wandsnider 2004a, 2004b).

Second, is the condition/process-pattern relationship a necessary, determined one, with one unique process giving rise to one unique pattern? Or, may a particular process have, contextually, several different well-determined archaeological outcomes? Similarly, is the pattern an equifinal one, for which many different processes may be responsible?

The relationship between radiocarbon decay (a process) and the resulting pattern, distinctive amounts of ^{14}C and ^{12}C , is perhaps the clearest example of an unambiguous, necessary relationship between process and pattern (Taylor 1997). As we understand it, radioactive forms of carbon are unstable, and the probability that they emit gamma particles within a certain time frame is described by a probability distribution. At least in this universe and given the atmospheric conditions present on the earth's

surface today, radioactive carbon must behave this way. Even this relationship, however, is subject to various contingencies, with different patterns resulting. For example, whether the sample is carbonized wood versus bone versus shell; whether it is derived from the Northern or Southern Hemisphere; whether the calibration curve is complex for a particular radiocarbon time range, and so on, do not affect the form of the relationship but do affect the application of the BORK to interpret particular samples.

Thus, inferences about sample age are often well determined—we have good information about when radioactive carbon was no longer emplaced in the sample. However, multiple inferences may follow, and the associated error terms may be either large or small.

On the other hand, Binford (1987a), Kneebone (1990), and Schiffer (1988) have argued that the degree of spatial structure in archaeological deposits is tied to the amount of energy being expended in that space. That is, with more people, more activities, more enduring items, less space, etc., more nonrandom structure should be seen (Wandsnider 1996). Binford (1978a, 1987a) notes, however, that the relationship between energy density and spatial structure is highly contextual. That is, how a single nuclear family structures its space and activities within that space may be qualitatively different from how an extended family, several cooperating families, or a same-sex task group might organize exactly the same activities in exactly the same amount of space. Thus, we should expect no simple relationship between archaeologically observed structure and group size, activity kind, and so forth. Again, we have what is likely a well-determined relationship that is expressed slightly differently depending on various contingencies that are perhaps difficult to establish.

RELATIONSHIP UNDERSTANDING. A second dimension deals with what we in the systemic world know about the BORK process-pattern relationship. Two aspects are relevant here: the degree to which the relationship is theoretically or empirically understood, and the comprehensiveness of the understanding.

With a rich theoretical understanding of the relationship, we can explain how and why a particular relationship holds and, equally important, the conditions under which it does not hold. Newtonian physics explains the behavior of unstable isotopes at the earth's surface in our post-Big Bang world and allows us to relate patterns in specific isotope frequencies to the process of radioactive decay. In turn, this body of reference knowledge has been recruited for use as a dating tool by archaeologists, to learn when the ^{14}C isotope was last emplaced by an organism.

In contrast, a pattern-process relationship may be empirically well established but not well understood. Trigger's (1995) observations on symbols employed within complex societies stands as a provocative empirical relationship that can even now be used in an instrumental capacity. But

since we are unsure of why and when the relationship holds, we risk the possibility of making interpretative errors. Byers's (1999) symbolic pragmatics offers a body of theory within which Trigger's very strong pattern may become explainable, as may the body of theory currently under development by biologists and others to explain the contexts within which wasteful advertising (Neiman 1997) or costly signaling occurs.

Completeness or comprehensiveness of the understanding of the pattern-process relationship is also critical. Part of Cyrus Thomas's (1985: 627–631) evaluation of the evidence for the authorship of prehistoric North American mounds depended on a botanical body of reference knowledge and observations of trees with 800 rings growing on mounds. He finds the botanical BORK that equates one tree ring with one year of growth to be not well substantiated and thus questions the maximum age of the mounds (800 years) determined using this BORK.

Similarly, selectionist archaeologists have relied on incompletely specified pattern-process relationships to infer that particular evolutionary processes have occurred. Assuming for the moment that one can establish that material forms comprise a lineage in which heritable traits are passed to subsequent generations—no small matter—then trait frequencies through time are the pattern to be interpreted. For example, Beck (1998) finds distinctive patterns in projectile point attributes frequencies through time, which she argues reflect either selection or drift. But other processes may also be at work, and to date a case has not been made that a particular pattern necessarily refers to either selection or drift exclusively.

INFERENCES, APPLYING BORKS. A third dimension is the application of a particular BORK to a particular set of archaeological observations. In discussing the scope of application, the concern is with how narrow or wide that scope is (both theoretically and technically), the degree to which we can warrant that a particular BORK is relevant to a set of archaeological observations, and how inference is actually sustained.

The scope of application may be either very broad or very narrow. The body of Newtonian physical theory that describes the behavior of fissionable carbon isotopes has a very wide, almost universal scope of application. We assume that this body of theory describes carbon isotope decay rates both today and in the distant past, indeed, even as far back as until just after the Big Bang. Technically, the scope of application is more narrow than that, since some of the values of the parameters describing that theory have been impacted since the 1940s by nuclear testing. Moreover, the half-life of radioactive carbon is small enough that this BORK is only useful on carbon samples emplaced within last 100,000 years. And, there is also evidence that suggests that parameter values within this body of theory may be different for the Southern and Northern Hemispheres, as the circulation of carbon within each hemisphere is slightly different.

Establishing the relevancy of this BORK to archaeological situations depends on establishing several parameters: (a) that it comes from a non-contaminated pre-1940s archaeological context, (b) that some ^{14}C is still present, and (c) the hemisphere from which the sample comes. If the sample satisfies these conditions, the carbon isotope BORK is considered relevant and applicable and may be used to infer the age at death of the organism from which the sample is derived.

Other BORKs are decidedly more narrow in their scope of application or specify a series of narrow situations in which a particular relationship holds. For example, in *From Bones to Behavior* (Hudson 1993), authors discuss the various conditions under which rational humans transport bones from kill sites. Similarly, dietary breadth and other optimal foraging models describe well particular choices for particular configurations of currencies, time frame, species, and so forth. As different circumstances or conditions obtain, then so do different decisions and choices. Archaeologically, the challenge is several-fold. The archaeological signatures of several processes may be equifinal, or may require establishing that particular circumstances in fact occurred, which may be difficult or impossible. As well, archaeological assemblages are time-averaged, meaning that the pattern we find is likely owed to several distinctive but unresolvable processes.

Inference is the process of moving from acceptance of some propositions to acceptance of others (Blackburn 1994). In archaeological reasoning, four modes of inference or BORK application are evident depending on the nature of the BORK. Identification (Binford 1981) refers to inference by simple pattern-matching of essential characteristics between modern and past samples. If a pollen grain has two large air bladders, it meets the morphological criteria to be identified as a *Pinus* species pollen grain. For a bone specimen to be identified as a deer humerus, it must meet other morphological criteria. Through experience, BORKs of entities and their essential characteristics have been developed. Identification proceeds with barely a hiccup when natural entities (plant and animal species, minerals) that have essential properties are involved, although see instances when evolved species are discussed, as for the behavior of *Bison antiquus*. Identification as a kind of formal analogy also occurs when identifying artifacts and features that have characteristics essential to a particular function, such as smelting (Kelley and Hanen 1988:360–368).

Deduction refers to inferences that follow from a set of premises. In archaeology, deductions are possible when a pattern-process BORK describes an unambiguous (or nearly so) and theoretically understood relationship. The age of a charcoal sample can be deduced because the half-life of radioactive carbon is known, as is the theory that explains the process of radioactive decay and the factors that condition it. Hence, technical matters relating to age determination are also known, and we have developed the technology to measure even small quantities of ^{14}C . The age of a sample, if

no contamination can be argued, is necessarily determined. Deductive inferences are very robust but also very limited. As emphasized by archaeologists specializing in chronometrics, a radiocarbon (or dendrochronology or obsidian hydration, etc.) date specifies the age of the sample and the event that produced that sample, which may or may not be the event of interest.

BORKs that have very narrow scopes of application may also be applied deductively if the context can be established. Rogers (2000) discusses how the agents responsible for attrition in a bone assemblage can be diagnosed using a probability model based in experience.

Induction, or reasoning by analogy, refers to reasoning to empirical conclusions from empirical premises through extension or projection rather than necessary entailment. In general, BORKs that deal with human behavior are applied inductively rather than deductively because human behavior is highly contextual and situational, and it is difficult or impossible to establish that context archaeologically for individual cases. For example, Watson and Kennedy (1991) infer that in eastern North America, women were proximately responsible for domesticating plants. This inference is based on a body of reference knowledge derived from ethnographic accounts of the labor; in general, women in ethnographically known societies assume primary responsibility for plant harvesting and manipulation. Why this strong pattern is the case and why exceptions occur likely have to do with societal gender dynamics and the division of labor and knowledge, but as far as I am aware, this body of reference knowledge has not so far been developed in this direction. Were a theoretical BORK describing the division of labor and knowledge to be developed, it might be possible to make more secure deductions about past manipulators of plants. Because of the possibility that a contemporary empirical pattern, specified in a BORK, has been incorrectly imposed to interpret an archaeological deposit, inductive inferences are generally considered suspect.

Finally, abduction refers to reasoning to the best interpretation with the data at hand. As described by Hodder (1999), data coherence and correspondence, embedded as they are in BORKs that are conventional, empirical, or theoretical, is important, as is parsimony. Typically, many strands of evidence (Wylie 1989a), supported by many different BORKs, are employed.

CONCLUSION

Bodies of reference knowledge are hermeneutic tools deliberately built and used by archaeologists in escaping Meno's Puzzle and in exposing Merlin's subterfuge. They are inescapable for establishing primary, secondary, and tertiary units of archaeological observation as well as in inferring that particular processes have occurred. Their development and use takes into account the nature of a specific archaeological record, the ideas to be examined

archaeologically, and the kinds of secondary and tertiary units that will be utilized to engage those ideas (using a comparative, frames of reference, analytic strategy and employing other bodies of reference knowledge).

One of the many contributions of Lewis Binford to archaeology is the isolation of the concepts of middle-range theory and frames of reference, thereby making these elements of the archaeological enterprise researchable. I suggest here that it is useful to consider both middle-range theory and frames of reference as different kinds of bodies of reference knowledge. More generally, such bodies can be usefully mapped along a number of independent dimensions, including the process-pattern relationship itself, our knowledge of the process-pattern relationship, and BORK application.

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