A CRITIQUE OF MIDDLE-RANGE THEORY IN ARCHAEOLOGY

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For the past decade, several archaeologists have advocated the development of middle-range theory as a way to give objective meaning to the archaeological record (e.g., Bettinger 1987; Binford 1977, 1983b; Thomas 1983, 1989; Torrence 1986). They argue that we must translate the static archaeological record into behaviorally dynamic terms by documenting causal linkages between relevant behaviors and their static material by-products. This is accomplished, they argue, by making observations today that establish signature patterns allowing the unambiguous recognition of particular dynamics from their static by-products, and inferring past dynamics from identification of signature patterns in the archaeological record. Further, it has been emphasized that the operations and products of middle-range theory must remain logically independent of the general theory we use to explain the past to avoid automatically confirming our ideas about the past through a tautology. This approach to middle-range research is flawed in two major respects. First, the justification of inferences relies on the establishment of universal behavioral laws and unambiguous signature patterns to validate the use of uniformitarian assumptions, neither of which can be accomplished in the manner proposed. Second, the tautological relationship between description and explanation is not only an unavoidable, but also a necessary aspect of science. Solutions to these problems lie in using the physical characteristics of the archaeological record itself as our source of knowledge about the past rather than translating the record into untestable behavioral reconstructions.

Shortly after Western scholars accepted the potential for great human antiquity in 1859, a series of Tertiary age deposits were found to contain crudely chipped stones or eoliths. These chipped stones were initially argued to be the earliest stone tools produced by people. However, the simplicity and exceedingly great antiquity of these objects led many to question the interpretation of these eoliths as artifacts of human manufacture. Thus, the young discipline of prehistoric archaeology became embroiled in its first debate over the meaning attributed to objects thought to be part of the archaeological record (Grayson 1986). Given that archaeologists are interested in learning about the human past by observing the archaeological record as it exists today, the issue of how we give meaning to observations of this record has been a recurring theme. Most recently, discourse over the methods of inference in archaeology has focused on the role of middle-range theory.

In 1977, Lewis Binford introduced the term "middle-range theory" into the published archaeological literature in a volume on theory building in archaeology. Binford (1977, 1983b: 10) argues that theory building is needed on two levels -- middle-range and general. To Binford, general theory includes ideas concerning the causes of change in the organization of living systems while middle-range theory addresses the inferential link between the unobservable past organizational dynamics treated in general theory and the static material patterns formed by those dynamics and observable in the archaeological record.

In this scheme, general or explanatory theory determines the relevance of knowledge of dynamics generated by the application of middle-range theory. For this reason, Binford argued in 1977 that development of general and middle-range theory must proceed together so that time is not wasted building irrelevant middle-range theory. However, since that time, Binford has stressed the view that general and middle-range theory must be logically independent if we are to objectively evaluate our ideas about the past (Binford 1981b: 29, 1982b). In other words, we must

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acquire objective knowledge of what the past was like based on different theory than we use to explain the past. As a result, Binford's work over the last ten years has been almost exclusively concerned with the methodology of inference in the form of middle-range research.

Although other archaeologists have employed a concept of middle-range theory, sometimes in the same sense as Binford (Bettinger 1987; Thomas 1983, 1989; Torrence 1986) and sometimes not (Goodyear, Raab and Klinger 1978; Raab and Goodyear 1984; Schiffer 1988), it is Lewis Binford who has contributed the most to middle-range theory's development and been its most outspoken advocate. Therefore, this review focuses on the structure and logical consequences of Binford's view of middle-range theory in archaeology.

Binford's Structure for Middle-Range Theory

Middle-range theory can be seen as consisting of four components: 1) documentation of causal relations between relevant dynamics and observable statics; 2) recognition of signature patterns in static remains; 3) inference of past dynamics from observation of signature patterns in archaeological record; and, 4) evaluation of these inferences. Figure 1 depicts the relations among these four components and their relations to general theory. The arrows represent an idealized sequence of operations within this structure.

Dynamics and Statics

Binford (1981b; 1982b) argues that while the archaeological record is composed only of static arrangements of matter, we are interested in studying the dynamic characteristics of past cultural systems. Recently, Binford (1983b: 222, 1987) has made it quite clear that by dynamics he means

the organizational arrangements of behavior and not discrete behaviors per se. As a first step in the investigation of the organizational properties of past cultural systems, a link must be established between these organizational dynamics and their static material by-products. Because it is only in the present where both dynamics and statics are available for observation, these linkages must be established through what Binford (1981b: 27) calls actualistic research. This is research carried out in the present using ethnographic, experimental or historical sources of information to document the relations between relevant dynamics and observable statics.
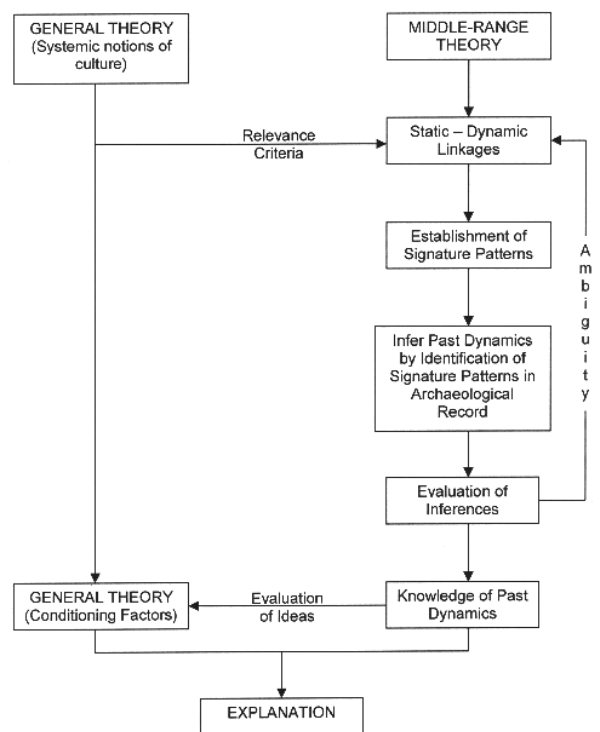

Figure 1. A conceptual model of Binford's middle-range theory.

A critical aspect of these dynamics-statics linkages is that they must be causal. For Binford (1981b: 26; 1983b: 223), cause must be demonstrated on two levels. First, the energy of the organizational dynamics must be shown to cause in a mechanical sense the static material by-products observed during actualistic research. This eliminates the

possibility that the linkage is coincidental and leads to the development of signature patterns discussed in the next section. Cause must also be demonstrated in a functional sense. The organizational dynamics that produce the statics must be explainable in functional, systemic terms. This forms a central part of the evaluation process discussed below.

Signature Patterns

The utility for archaeologists of linkages established between dynamics and statics is dependent on the identification of criteria for recognizing material traces of the dynamics likely to be preserved in the archaeological record. Binford (1981b: 26) refers to these traces as "signature patterns" and he argues that to be diagnostic of particular dynamics, they must be redundant and unambiguous. As Grayson (1982) has pointed out, the establishment of signature criteria takes the form of "if and only if" statements. Much of Binford's recent empirical work (e.g., 1978, 1981b, 1983a, 1983b, 1989) has been devoted to constructing and recognizing signature patterns.

Inference of Past Dynamics

Once signature patterns have been established, inferences can be made. In middle-range theory, inference is the procedure by which we give dynamic meaning to the static arrangements of matter in the archaeological record. It involves a translation process in which observations of matter in the archaeological record are converted into statements or concepts regarding the dynamic conditions that brought them into being (Binford 1981b: 26-28, 1982b:30-31). These inferences require the recognition of established signature patterns in the archaeological record and the assumption that the static-dynamic link identified by the signature patterns existed in the past as well as in the present. In other words, a uniformitarian assumption is required.

Evaluation of Inferences

Because the inferences are reconstructions of past dynamics that are no longer observable, the evaluation of the validity of these inferences rests entirely on the validity of the methods used to generate them. No empirical tests are possible because there are no empirical products. This has led Binford (1981b, 1982a, 1982b, 1983b: 12-17) to stress that it is the methods of inference that must be tested and not the results of those methods.

Binford (1981b: 27) contends that two related aspects of middle-range theory must be true for the inferences to be valid. First, cause and effect relations between statics and dynamics must be firmly established and second, the uniformitarian assumptions must be justified. As I stated earlier, cause and effect must be both mechanical (result of interaction of energy and matter) and functional (explainable in terms of its relations to other parts of the system). These causal relations cannot be tested through observations of the archaeological record or through ethnographic research alone (Binford 1987), but must involve actualistic middle-range research.

In 1977, Binford recognized that the validity of uniformitarian assumptions is limited when considering human behavior over the vast span of archaeological time. However, he also suggested that there are at least three domains or classes of data available to archaeologists for which uniformitarian assumptions may be justified. These are the use of space by people and the resulting spatial structure of material by-products, and the ecology and anatomy of still extant animals with which people interacted. Binford (1977, 1981b:44, 238) warrants his use of these domains by reference to the existence of apparent functional limitations or constraints

and the extreme regularity of patterns observed in the present. In other words, Binford (1973, 1987) appeals to the existence of laws or law-like propositions to justify his uniformitarian assumptions.

Recently, Binford (1987) has proposed the recognition of ambiguity as another approach to the evaluation of inferences. Ambiguities between the inferred meanings of different classes of data (i.e., site structure and anatomical part frequencies) can lead to the recognition of unknown organizational strategies or isolate areas of inadequate knowledge. This form of evaluation is depicted in Figure 1 as the line moving from the evaluation step back to the establishment of static - dynamic linkages.

An example of Binford's linking and evaluation process is in order. While conducting ethnoarchaeological investigations among the Nunamiut of Alaska, Binford (1978) observed that kill sites and hunting camps are dominated by distal limb elements (phalanges and metapodials). Binford explained this pattern by reference to the economic utility of different anatomical parts and their likelihood of being transported away from procurement locations in a logistically organized system. The pattern observed at hunting sites had been created by the differential transport of anatomical parts based on economic decisions that balanced transport costs with the utility of different anatomical parts. A functionally causal link is established between economic utility of particular anatomical parts and their likelihood of transport from logistic hunting sites to residential sites, and a signature pattern is established in the form of differential faunal element frequencies.

Since Binford's Nunamiut experiences, similar studies in Australia yielded different results (Binford 1987). An Aboriginal residential site was found to contain similar anatomical part frequencies to the Nunamiut hunting sites. Binford explained these differences by arguing that the same behavior, the treatment of low utility anatomical parts, is integrated differently into the logistic Nunamiut system and the foraging strategy of the Aborigines. Thus for Binford, the apparent ambiguity in these two cases led to new knowledge of static-dynamic linkages when the signature patterns were employed as a frame of reference rather than as ethnographic analogs.

Relations between General and Middle-Range Theory

In Binford's scheme then, middle-range research produces objective descriptions of past organizational dynamics that are warranted by the validity of uniformitarian assumptions and by their independence of general theory or our ideas about the factors that condition those dynamics. Binford believes the intellectual separation of general and middle-range theory is necessary to avoid a tautological relationship between our alleged knowledge of the past and our explanations of the past. He (Binford 1983b: 223, 1987) argues that only after we have successfully diagnosed the nature of past systems through middle-range research is it possible to evaluate our general theoretical ideas and begin to seek explanations for inferred differences and similarities.

It is here in the relations between general and middle-range theory that the logic of Binford's arguments is best displayed. Since for Binford, general theory involves the explanation of the functioning and organization of cultural systems, our descriptive or observational language must measure these variables. However, the archaeological record, our only access to prehistoric cultural systems, consists only of arrangements of matter. Binford's solution to the dilemma is the development of middle-range theory as the method of translating the static facts of the archaeological record into

the dynamic systemic terms addressed by general theory. Because the products of middle-range theory cannot be evaluated empirically, Binford argues for the logical independence of general and middle-range theory to avoid committing the fallacy of confirming the consequent (Binford 1981b: 29).

Other Forms of Middle-Range Theory

At this point it is worthwhile to briefly compare Binford's middle-range theory to forms of middle-range theory discussed by other archaeologists. Mark Raab and Albert Goodyear (1984) have argued for the adoption of the concept of middle-range theory as developed by the sociologist Robert Merton (1949). Merton perceived a gap between empirical products of sociological research and highly abstract sociological theories and proposed middle-range theories as a way to link these two domains. This mini-theory approach has not received much attention by archaeologists and has recently been criticized by Schiffer (1988) for its reliance on a single hierarchy. Raab and Goodyear (1984) recognize that their approach bears little resemblance to Binford's.

Schiffer's Behavioral Archaeology with its emphasis on behavioral correlates and formation processes shares much in common with Binford's middle-range theory despite arguments to the contrary (Binford 1981a; Schiffer 1985a, 1985b). Like Binford, Schiffer (1976, 1987) believes that we must first reconstruct past behavior in a valid and unambiguous fashion before reasonable explanatory theories can be offered. However, they apparently disagree on the form the reconstruction is to take and the relation of general theory to the middle-range or transformation theory employed in inference. More recently, Schiffer (1988) offers a view of middle-range theory that may diverge considerably form Binford's. Schiffer suggests that middle-range theory refers to lower level theories that are subsumed under higher-level theories in a system of hierarchically related archaeological principles. I believe this hierarchical rather than independent concept of middle-range theory has much to offer, but a thorough analysis is beyond the scope of this paper.

Critique of Binford's Middle-Range Theory

In this critique of Binford's middle-range theory, I examine two issues ó how inferences are evaluated, and the role of general theory. The validity of inferences made in middle-range research rests primarily on the appropriateness of the assumption that the static - dynamic relations observed today necessarily existed in the past and that these relationships are recognizable unambiguously through signature patterns. That is, the arguments used to connect the statics and dynamics must be laws that are true at any time or place (i.e. theoretical laws). Because Binford is interested in differences and similarities in the organization of behavior in past systems, these laws must pertain to human behavior.

To what extent, then, do Binford's functional explanations of static - dynamic linkages observed in the present constitute universal theoretical laws? To be universally true, Binford's laws must state definitionally true relations between invariant classes. However, Binford's statements are actually empirical relations based on specific observations for which an economic rationale has been provided. Although these relations may occur with great regularity, they are not necessary or true by definition nor are the classes invariant since this would preclude the kind of change, the development of new forms, of interest to archaeologists. Therefore, Binford's relational statements are not universal laws, but empirical generalizations regarding the kind of static archaeological

record produced by particular sets of behavior. In middle-range theory, these generalizations function as interpretive algorithms for translating static facts of the archaeological record into relevant statements of past dynamics.

When seen in this light, Binford's middle-range theory suffers from two serious flaws. First, because the inferences of past dynamics are based on empirical generalizations rather than universal laws, the validity of uniformitarian assumptions is questionable. It is doubtful that empirical generalizations will ever yield unambiguous signature patterns because other dynamics that have not yet been observed may result in the same static record (see Lyman 1985 and Grayson 1988 for examples of such a situation). In this context, it appears that the best that can be hoped for is the establishment of equifinality.

The second and perhaps most serious flaw involves the tautological relation that exits between the functional systemic notions of organized behavior which appear to compose Binford's general theory and the inferences or translations produced by middle-range theory. Although Binford argues for the independence of general and middle-range theories, the tautology is clearly shown by the role that economic functionalism plays in determining both the validity and relevance of middle-range translations (Binford 1981b:145-147; Binford, Mill and Stone 1988). However, this tautological relationship is not debilitating in and of itself. The problem lies in that middle-range theory as proposed by Binford does not yield an empirically testable product. In science, the necessary tautology between explanation and description, that the rules for both come from the same body of theory, is made harmless by the requirement of empirical testability within a framework of falsification (Dunnell and Simek 1984).

The lack of universal behavioral or cultural laws and empirical verification of knowledge claims gives an accommodative, *post hoc* character to the inferences derived from middle-range theory. Although the middle-range interpretations may appear more plausible, they actually have no more secure claim for validity than the interpretations of archaeologist employing traditional approaches. Binford (1983:75) occasionally recognizes this deficiency in his approach to middle-range theory, but he seems to believe that relevant laws of human behavior will eventually develop out of actualistic research (Binford 1987). However, because universal laws are part of the theoretical realm and the units or nouns of those laws cannot change, it is impossible for empirical generalizations of behavior to yield universal laws.

This last point leads us directly to a consideration of the role of general theory. Binford argues strongly for the intellectual separation of general and middle-range theory. This belies a notion of an objective archaeological past that can be reconstructed independent of our interest in it -- a position Binford (1986) has argued strongly against and, as we have seen, has not attained it in his own work. However, concern with the fallacy of confirming the consequent which led Binford to his position on general theory is something to be taken seriously. In archaeology and other social sciences as well, what passes for general theory consists of a set of assertions about how people behave which are usually based at least in part on empirical generalizations and common sense (Dunnell 1982; Willer and Willer 1974). If the theory is robust, for example optimal foraging theory, it provides certain expectations about how people behave under given circumstances. If the theory is employed in a context where behavior can be observed, it can yield powerful results. However, if it is used as part of an interpretive algorithm for giving behavioral meaning to material remains, we commit the very fallacy Binford tried to avoid.

The reason Binford's solution fails is that his identification of the problem is misplaced.

The circular connections between theory and description, which Binford finds so appalling, are, in fact, unavoidable (Lewontin 1974:8). Description involves classification and classification requires *a priori* input in defining the field of interest and the relevant descriptive attributes (Dunnell 1971). Despite Binford's (1981b:290) beliefs to contrary, this is how all science proceeds although the *a priori* input may be implicit and non-theoretical as is often the case in archaeology. The problem arises when there are no empirical phenomena against which to test our expectations. Because Binford's middle-range theory does not solve this problem, he ends up committing the same error as most traditional approaches to giving meaning to the archaeological record.

We may ask whether it is possible to solve this problem in archaeology or must we be content with plausible reconstructions. I think it is solvable, and the solution includes many of the arguments and proposals made by Binford and others. That we study a contemporary material record that is devoid of inherent meaning relevant to the past is incontrovertible. Because our interests are in the past, we must give meaning to the record. That the process by which we give meaning to the record involves uniformitarian assumptions, I believe is also beyond dispute. However, for these assumptions to be justified, they must be based on universal theoretical laws. Such laws can only pertain to the physical world since change in organic systems excludes the possibility of invariant classes required in universal laws. Binford is fond of citing radiocarbon dating as an example of the linking process involved in middle-range theory. He argues that radiocarbon dating works for archaeology because its theoretical basis is independent of theories we may be testing by acquiring information on elapsed time (Binford 1981b:290-291, 1982b:134-135). Although this reasoning is superficially appealing, it is wrong. The utility of radiocarbon dating stems from its basis in universal physical laws that allow the estimation of the time since a discrete event (isolation of an organism from the carbon reservoir) with a specifiable certainty. A basis in theoretical laws is, in fact, the strength of all archaeometry. That these laws are independent of anthropological or archaeological theories is largely irrelevant. When seen in this light, it is clear that the physical characteristics of the archaeological record itself can give us access to the past. No translation of the static record into untestable behavioral dynamics is necessary. This solution makes empirical testing and falsification possible and trivializes Binford's tautology problem. At the same time, we are forced to look more closely at the role of general theory. For the development of scientific archaeology to proceed, we need robust and explicit general theory to help structure our observations and expectations of the empirical archaeological record. In science, it is general theory that provides the terms in which both description and explanation are accomplished.

Conclusions

At the beginning of this paper, I mentioned the eolith debate as the first time scholars working on human prehistory confronted the problem of giving meaning to the archaeological record. Grayson (1986) has pointed out that the methods developed to address the eolith problem are essentially the same as those recently proposed by Binford. It is informative to recognize that the eolith debate was not resolved by these methods. All that could be said based on the actualistic research conducted on flint fracture was that there are several agents that can produce chipped stones. This is demonstrated by the debate, which continues today, over the chipped stones at the Calico Site in southern California.

The resolution of the European eolith debate in the 1930s stemmed from improvements in our knowledge of hominid paleontology and a change in the way archaeologists gave meaning to the record. The growth of culture history in the 1920s and 1930s brought about a shift away from the analogical use of ethnographic and experimental information in favor of formal comparisons of archaeological assemblages to one another. The goal was to give chronological and homologous or ethnic meaning to differences and similarities observed in the archaeological record (Binford 1968; Dunnell 1986a, 1986b).

The recent return of concern with middle-range kinds of issues grew out of the New Archaeology's interests in giving analogous or functional meaning in anthropological terms to patterns of similarity and difference in the archaeological record. These goals required that better methods be developed for unambiguously reconstructing past behavioral dynamics. I have tried to demonstrate that Binford's middle-range theory approach will be no more successful at this task than the methods devised to distinguish naturally from artificially chipped stones over 100 years ago.

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