Volume 2 Spring 1983

HALIKSA'I *

U.N.M. CONTRIBUTIONS IN ANTHROPOLOGY

* Hopi introduction to a narrative

A Publication of the

University of New Mexico Anthropology Society

UNIVERSITY OF NEW MEXICO PRESS

Albuquerque 1983

SITE STRUCTURE: A METHODOLOGICAL APPROACH TO ANALYSIS

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Analysis of site structure has the potential to be a soundly based methodology for making inferences about the past. A procedure of analysis is proposed, and is applied to the Magdalenian site of Pincevent 36, and substantive results are discussed. An evaluation is made of the methodological basis for this and other applications.

Introduction

Site structure, the analysis of the spatial arrangement of archaeological materials, has become an important focus of archaeological inquiry in recent years. It can be seen as a part of the New Archaeology, a shift in focus away from purely chronological, and cultural/typological questions that were seen as the primary responsibility of archaeology toward questions that are more functionally oriented (Willey and Sabloff 1974). The application of radiocarbon dating solved many of the major questions that had been asked by archaeologists, and they began to seek other questions to explore in the late 1950s. Archaeologists could then investigate different questions through inspection of the archaeological record. Whereas patterns had been identified in the record previously, they had been used as identifiers of "cultural" entities that were to be ordered in time and space; now questions were asked about what the patterns meant and how they had come about. Willey's (1953) settlement pattern study of the Viru Valley was the inception of investigation into the spatial organization of cultural systems. Instead of merely chronicling the succession of past history, archaeologists now viewed sites as parts of adaptive systems, and the evolution of cultural systems as adaptive change.

In the 1980s the New Archaeology has entered another phase. No longer are imaginative interpretations and reconstructions of the archaeological record sufficient. Since all observations on the archaeological record are actually contemporary, any statement about the past is necessarily an inference. The critical problem has become the justification of the inferences used to make those interpretations and reconstructions. The problem is how to justify the linkage between the contemporary statics of the archaeological record and the inferred dynamics of past human behavior.

What are the static derivatives of dynamics, and how can we demonstrate a necessary, causal linkage between them? We cannot do that by studying the archaeological record, we must look at the dynamics of operating systems. The archaeologist needs to be able to isolate the necessary consequences of dynamics that would be observable as statics in the archaeological record.

A Methodology for Site Structure Analysis: Archaeological Dynamics

The problem is how to build a methodology which provides a robust justification for inferring human behavioral dynamics from patterns of spatial distribution in the archaeological record. This justification must not be culturally dependent, that is, valid only within a given cultural group, but must be applicable to a dimension of human behavior that is universal to *Homo sapiens*. It is suggested that examination of pattern-

ing in the spatial distribution of various classes of artifactual debris can yield significant information about the spatial organization of human behavior. This patterning can be inspected by means of constructing isopleth or contour maps of artifact density, as suggested by Camilli (1979), following Hagget (1966).

A number of underlying assumptions direct the process of method building for this analysis. First is the proposition that sites are locations in which activities take place, but that the space use of activities will be organized with reference to the existence of permanent facilities, such as hearths or shelters (Graham et al. 1982). The surfaces produced by the deposition of items can be analyzed for organizational properties of activities. Second, not all activities will be organized the same way with reference to the features; they may be overlapping or they may be spatially differentiated.

Third, not all activities will result in final deposition at the location of the activity (Schiffer 1972). There are a number of discard modes that may come into effect (Binford 1983); additionally, the space use requirements for overlapping activities may result in periodic maintenance of the site area. This is particularly true for space inside of a shelter or structure. Fourth, areas which are devoid of material remains can be behaviorally significant. This category includes space for sleeping and working (Leroi-Gourhan and Brezillon 1966, 1972; Binford 1983).

Principles of the mechanics of the human body will result in organized patterns of deposition. Activities which take place from a seated position will be organized differently from those which take place from a standing position (Newcomer and Sieveking 1980). The latter are more likely to be much more extensive in space use, and may be more likely to take place away from permanent facilities. Activities which take place next to facilities may represent more intensive space use and be structured to provide a place to sit, with an arc of work debris around it. Within constrained space, such as inside a shelter, scheduling of different activities in the same space may necessitate the maintenance or periodic cleaning of that space (Anderson 1982).

Application to Pincevent: Archaeological Statics

An example of the application of this methodology is a structural analysis of several classes of data from the site of Pincevent, Section 36, a Magdalenian site excavated and reported by Andre Leroi-Gourhan and Michel Brezillon (1972). This site was chosen because it is a modern, well-controlled excavation, in which there was a well-preserved distribution of artifactual material on a single occupational surface, rather than a deeply stratified deposit. Because the excavators were interested in an ethnographic reconstruction, as though the site was a "little Pompeii" (Binford 1981b), horizontal provenience was well controlled for all material remains. Lithic debitage, bone fragments, tools, and features were piece-plotted, and the distributions of all these items were published and made available in a format suitable for this analysis.

The large scale maps were used to derive counts of bone, retouched tools, and small flakes for each one-meter-square grid unit. These values were then used to construct a contour map of densities of artifact classes to be superimposed over the locations of the hearth features. Because the range of frequencies per unit was extremely wide (1 to 189), an exponential scale was used for contour intervals. The first interval was 3 items per square meter, the second was 7 items per square meter, the third was 20 items per square meter,

the fourth was 55 items per square meter, the fifth was 90 items per square meter, and the sixth was 148 items per square meter. This scale allows a visual display of the distribution of low frequency items, and a display of the shape and location of high frequency concentrations. Figures 1, 2, and 3 represent artifact densities for bones and bone fragments, retouched tools, and small flakes (less than 1 cm long), respectively.

Modes of disposal that refer to seated work space adjacent to a hearth can be differentiated. The particular classes of data from Pincevent were selected because they may best reflect several of these modes. Item size appears to be a critical determinant of discard. Items that are extremely small may be dropped directly at the location of the activity responsible for their production. Flakes less than 1 cm in maximum dimension were selected as possibly resulting from that mode of deposition. The pattern in the archaeological record that results from this behavior is referred to as the drop zone (Binford 1978b). Larger items that are generated in high frequency may be disposed of individually by tossing them away. The interaction of the activity location and the facility location will determine the location of the toss zone. Bone debris from food preparation and consumption was selected to represent the tossing mode of disposal. Items that are utensils or tools with long use life will not be tossed or lost, but will be placed somewhere convenient in anticipation of further use, though the future use may not be at the location of placement. Retouched lithic tools were selected to represent the placement mode of disposal. Another mode of disposal is dumping. Dumping is a maintenance activity, organized by the need to keep activity areas free of debris. Thus, dumping modes may involve the same class of items as do tossing modes, in this case, bones. Further, the presence of structures such as shelters or houses will determine whether certain areas will be systematically maintained, or cleared of debris.

The patterns of deposition of each class of artifacts are shown in Figures 1, 2, and 3. For each, there are several areas of concentration. Each of the three large enclosed hearths served as a central focus for the organization of the disposal modes. For convenience in presenting the model, I shall label them Hearth A (V-105), Hearth B (T-112), and Hearth C (L-115).

The patterning of deposition among the three hearth and material complexes appears highly redundant. First, the retouched tools and small flakes are located on the opposite side of the hearths from the bone debris. They can be distinguished in terms of distance and direction. The retouched tools are located adjacent to the hearths, averaging 0.55 m from the hearth centers. The concentrations of bone debris are oriented with a 155° difference in bearing from the tools (measured from the hearth center). The bone concentrations average 1.42 m in distance from the hearth centers. The closest concentrations of small flakes are located on a vector averaging 22.5° difference from the retouched tools, but always within the angle between the tool and bone vectors. The small flakes average 1.05 m from the hearth centers.

A number of tool use or maintenance areas occur at a greater distance from the hearth centers, indicated by concentrations of flakes unaccompanied by bone debris (Figure 3). They average 3.76 m from the hearth centers. They are also frequently distributed in arcs around empty spaces (e.g. W-103, H-115), implying seated work space away from the overlapping cooking and tool use space adjacent to the hearths.

For Pincevent 36, a model can be constructed to show the structural

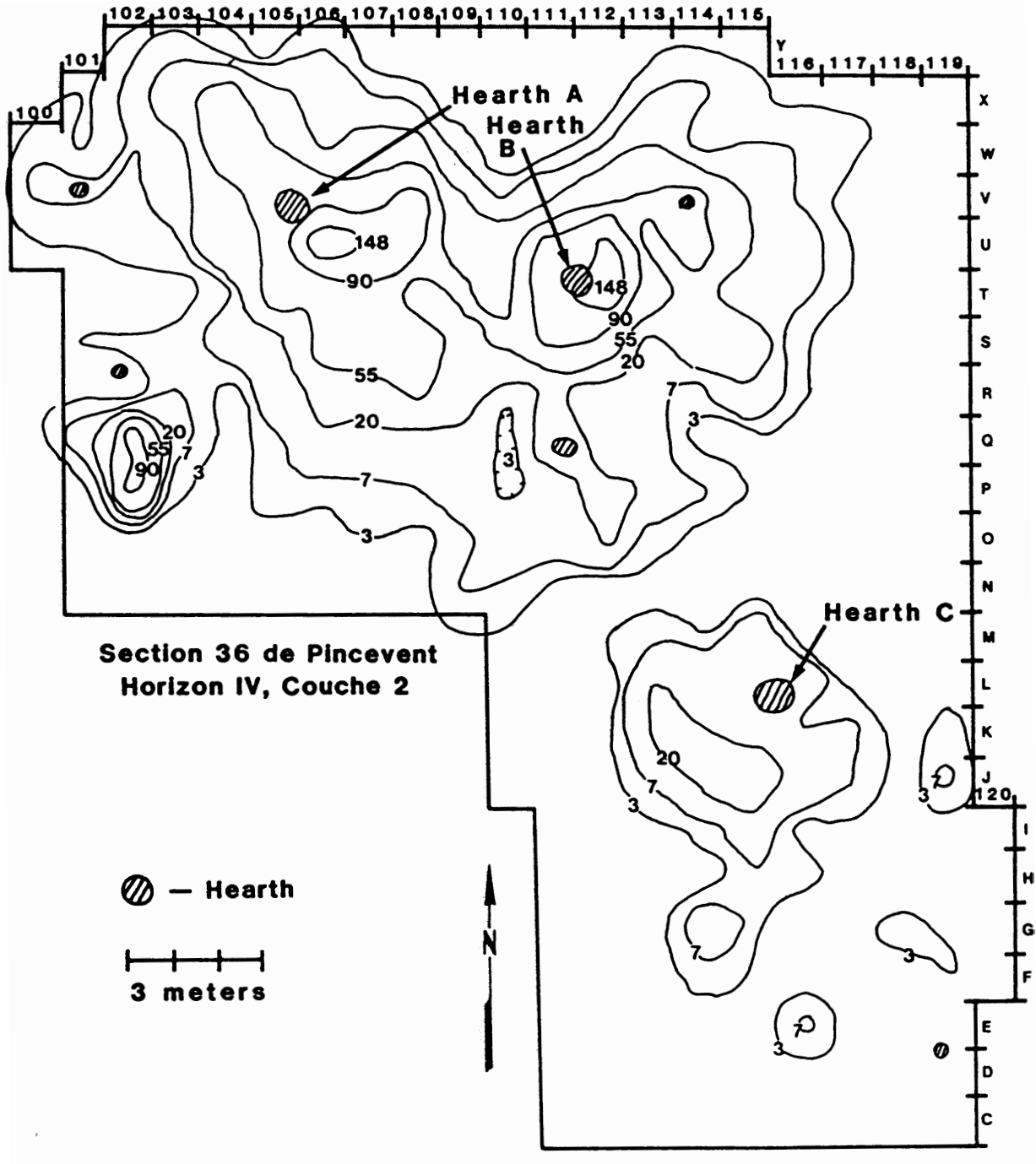

Figure 1. Distribution of bones and bone fragments.

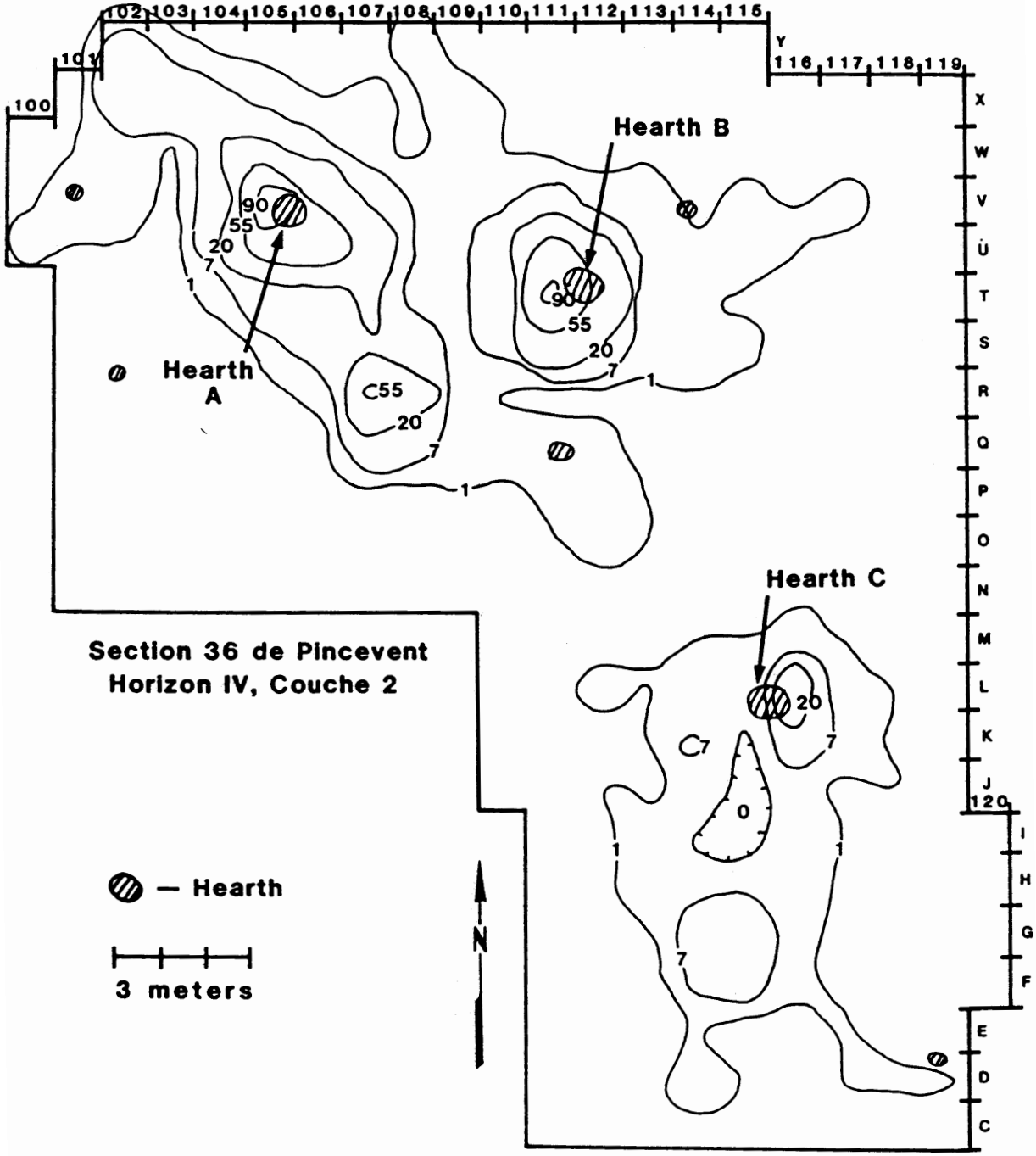

Figure 2. Distribution of retouched tools.

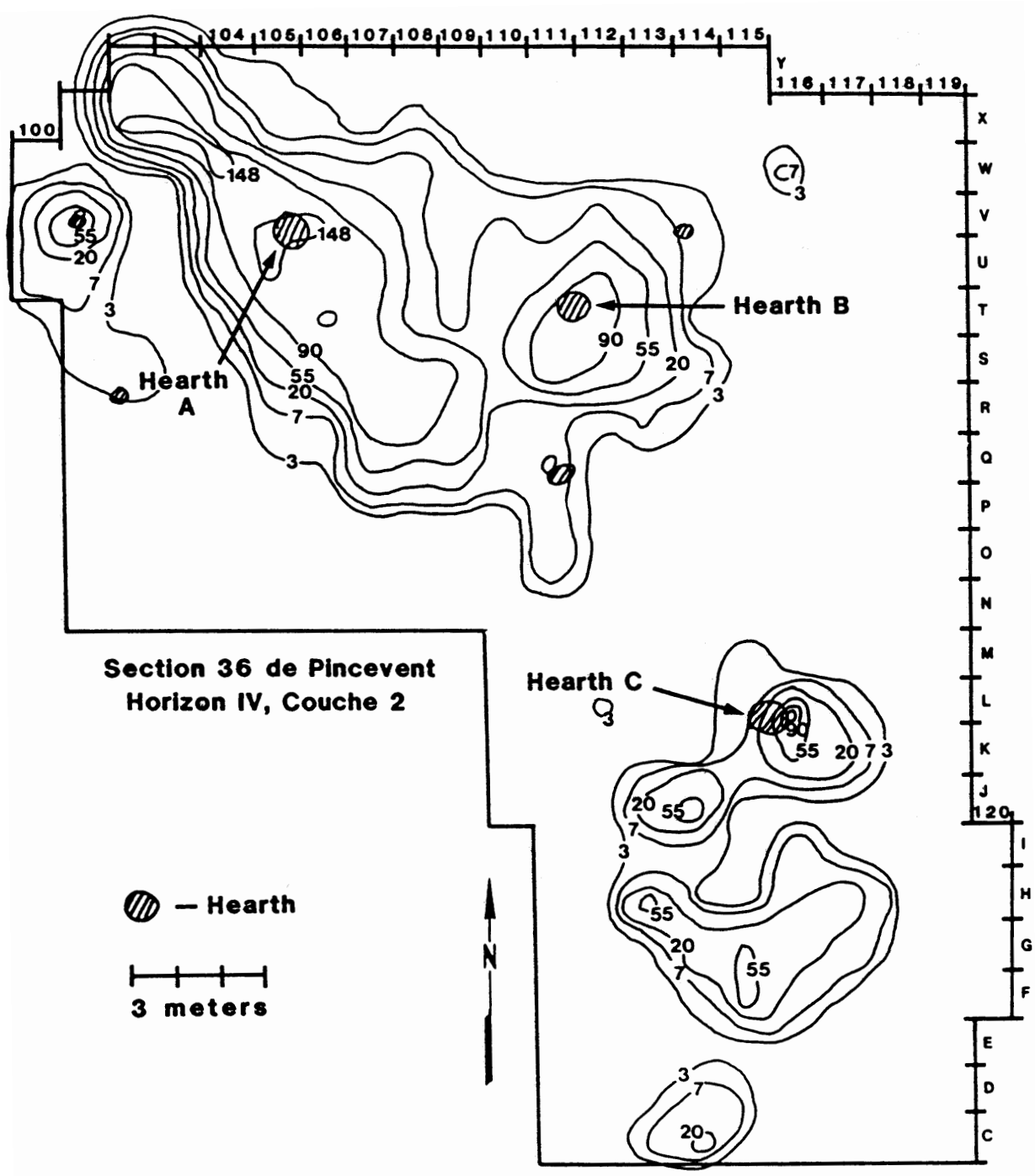

Figure 3. Distribution of small flakes.

relationship between the different modes of deposition. Vectors were constructed which show the distance and direction to the highest concentration of each material class nearest each respective hearth (see Figure 4). Thus, a general site model implies close spatial association in the deposition of tools and small flakes. Both are located close to the hearth, but not in overlapping identical patterns. If the small flakes do represent a drop mode close to the seated working space, they are structurally associated with regard to the location of retouched tools, implying that they are functionally related to the use and maintenance of those tools. The tool concentrations are located closest to the hearths, implying curation adjacent to the focus of activity. This represents the placement mode of disposal.

The bone debris is located on the opposite side of the hearths from the suggested tool use and curation areas. The greater distance of bone debris from the hearths implies a toss mode of disposal rather than a dropping mode. Some locations have concentrations of bone and small flakes, but are devoid of retouched tools. Whereas the distribution of unassociated flakes are arcs, the configurations of these locations of flakes and bones are small piles. These are present in the southern portion of the site near Hearth C (e.g., K-114, S-114). They may be the result of a dumping mode of disposal, suggesting that perhaps some space maintenance has occurred.

Discussion

Leroi-Gourhan and Brezillon (1972) conducted an analysis to determine the location of residential structures on this site. They suggested that shelters were located adjacent to each of the major hearths, that tool use activities occurred inside the structures, and that trash was thrown out the door. Behind the work space would have been an empty space for sleeping.

The spatial analysis presented here suggests one should not assume a structure will be present at every site. When one views all classes of artifactual material, they exhibit structural organization in their spatial distribution. Organization in a distribution does not, however, necessitate the presence of a physical shelter (see Binford 1983 for a discussion of this problem at Pincevent 1). Certain organizational properties in this case suggest these hearths were the foci of an open camp. The area of debris around each hearth averages 53 square meters (see figures 1, 2 and 3). For Hearths A and B all classes of items are distributed in a large concentric pattern that focusses on the hearth. Access to the hearth appears unimpeded on every side. The orientation of the different classes may be attributed to factors other than the presence of a shelter. One such factor controlling the orientation could be wind direction, as at the Mask Site (Binford 1978b).

There are some structural or organizational differences between Hearths A and B and Hearth C. As noted, the areas around Hearths A and B exhibit large concentric depositional patterns with significant quantities of all debris classes. For Hearth C, however, most of the material from all classes of debris is located to the southwest of the hearth. Moreover, some of this material is concentrated in multiple epicenters of deposition, particularly the bone and small flake debris. The presence of multiple dumps, rather than a general concentric deposition, may imply maintenance of cleared space, which in turn suggests the possibility of a shelter. If an area was maintained for sleeping or cleared of debris from other activities, then it might be located to the northeast of Hearth C.

How might one account for the difference in structural organization

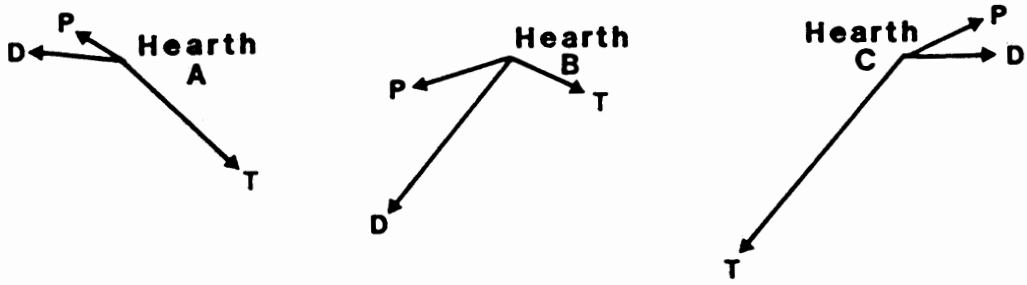

Figure 4: Vector model for the structure of deposition around Hearths A, B, and C.

between Hearths A and B and Hearth C? The presence of a shelter at the latter location is one possibility. What conditions would require a difference in the organization implied by the presence of a shelter? Hearths A and B are organized differently from Hearth C with respect to the hearth focus, and there is a major difference in the orientation of the vectors for placement, drop, and toss deposition (see figure 4). A major axis was constructed to represent the direction from the seated work space across the toss zone. For Hearths A and B, these axes were 130° and 95°, or generally to the southeast. For Hearth C, the major axis was 245°, or to the southwest. There is additional evidence for similarity between the two northern hearths; although refitments of end scrapers and burin spalls show conjoins only within each hearth area (Leroi-Gourhan and Brezillon 1972:138-139, 126-128), a number of backed bladelets, mandibles and long bone fragments indicate conjoins between Hearths A and B, but not between either of them and Hearth C (Leroi-Gourhan and Brezillon 1972:134-136, 148-150, 152-153). These observations raise the question of contemporaneity between the hearth features. Most of the evidence suggests that Hearth A and B were occupied at the same time. The structural redundancy suggests that they were occupied by groups of similar size and organization. The orientation of their major axes can be interpreted as indicating that they were both oriented to the same environmental condition, perhaps predominant seasonal wind direction. In contrast, Hearth C's major axis is oriented in the opposite direction, and has depositional patterns that suggest dumping disposal and maintained space, and thus, a shelter. A plausible alternative hypothesis or "just-so story" infers a seasonal differentation for the occupation of the two parts of the site. One means of

testing a possible seasonal difference in occupation is with a cementum analysis of sectioned reindeer teeth associated with each hearth and debris complex (cf. Gordon 1982, Spiess 1979, Bourque et al. 1980).

Site Structure: Building a Research Strategy from the Pincevent 36 Case

The Pincevent 36 distributions provide an example of how site structure studies may be used for a specific site with specific questions. Some specific interpretations of the site's use were made possible by using general propositions about the disposal modes of different sizes and kinds of items, those propositions are derived from ethnoarchaeology. Many interpretations depend upon the observed ethnoarchaeological distributions of perishable material (e.g., Hayden 1979). However, many sites do not have preserved faunal material, but only stone tools.

What other dimensions can give us information about the organization of human behavior? As suggested above one can study the distribution patterns of cultural items and features: site structure. Many studies of site structure have attempted overly specific reconstructions of the archaeological record, by generalizing from specific ethnographic observations. For instance, Yellen (1977) mapped the distribution of items on Bushman camps, for which he knew the number of occupants and the length of occupation, to derive a generalization linking properties of the archaeological record with organizational aspects of behavioral dynamics. Yellen's ring model attempts to account for the total area of artifactual debris by using a single model of clustered huts and special activities.

The primary failure of Yellen's model is that it accounts for the distribution of debris in a unidimensional fashion, dictating that all debris is related to either the inner or outer ring. It does not differentiate between the organizational variability of each separate class of data. Nor does it account for variability in the structural input of any one class of data; for instance, large and small game may be consumed differently, and the discard pattern variability should reflect differences in preparation and consumption.

Moreover, the methodological shortcoming is the failure to provide an argument of necessity linking patterns of artifactual distribution to patterns of behavior. Yellen enumerated empirical cases as the basis for generalization, a post hoc accommodation to a correlation. But this is not an explanation of the organization of space use, nor is it a sound methodology for obtaining information on intensity or duration of site occupation. Yellen offers no necessary explanation of why the pattern should be interpreted as he suggests, except for an assertion that it is a result of cultural identity or ethnicity (although he does not test the assertion by comparing site structure of Herero camps to Bushmen camps). If the methodology is only good for use within a known ethnic group, what good is it for archaeological applications to other places and times?

The study of site structure need not be so limited. It is a line of inquiry that can be studied ethnoarchaeologically in a fruitful manner: linking dynamic behavior to static patterns. It is a dimension of inquiry that can be used with durable items that are likely to be preserved in the archaeological record, such as lithic tools and debris.

Most important, the archaeological spatial distribution of items is a class of information for which one can develop arguments of necessity that are not culturally determined. The mechanics of the human body provide a regularity

to certain dimensions of space use and organization. This regularity allows the use of uniformitarian assumptions which allow for reliable interpretations of spatial patterning in many contexts. One can relate resultant patterns of spatial distributions to principles of biomechanics. The organization of space use provides a frame of reference to view other kinds of variability. Thus the discovery of spatial patterning is not an end in itself, but a means of reliably understanding one dimension of organization as a tool for making inferences about other dimensions.

We might begin to use site structure as one of a host of different lines of inquiry into the archaeological record. Certainly, our ability to identify linkages depends upon the use of various kinds of cross-cutting information linking archaeological remains with the cultural dynamics we wish to study. The linkages may not always be as readily discernable as the Pincevent 36 example above, where a few general propositions about how items are disposed of are almost directly visible archaeologically. This kind of case could be further evaluated as a "control" for studies of other domains of archaeological observations. Then the development, and testing, of many different linkages would be possible.

The need for such a linkage is the basis for much of the recent ethnoarchaeological and experimental research (cf. Donnan and Clewlow 1974, Yellen 1977, Gould 1978, Binford 1978a, Hayden 1979, Kramer 1979). Oswalt (1974) used the direct historical approach to identify items from relatively recent sites. But this method obviously has extremely limited applicability. The arbitrary assignment of function to types of artifacts on the basis of gross morphology does not solve the problem of inference. In many cases the function of artifacts or the functional role of sites is not directly knowable from the contents of the site. One needs to look at other dimensions of the archaeological record to understand the organization of the behavioral system that was responsible for its deposition. Because of the lack of a robust methodology for understanding the meaning of variability in lithic assemblages, Binford (1978a, 1981) has examined faunal material as another approach for understanding the organization of cultural systems. Once an understanding of the organization in one class of data (fauna) was achieved, it could be linked to stone tool variability.

Site structure analysis done within a framework of justifiable linkages could be another methodologically robust lines of inquiry, one which could shed light on the meaning of variability in other classes of data.

Conclusions

Site structure has been used to make an inference about the residential status of Pincevent 36. It has raised other questions about the organization of the site which will require different methodological approaches. This kind of analysis was possible because Pincevent 36 was a high resolution site with excellent preservation, which was excavated appropriately. All items were piece-plotted, which is a necessity for this kind of analysis. We do not yet have a fully developed methodology for site structure. There needs to be much more research for pattern recognition, both in the archaeological and ethnoarchaeological realms, which can help us to make stronger inferences about past dynamics from static observations of the archaeological record. Even a well developed methodology of site structure analysis would not be a panacea. It is but one of numerous lines of inquiry that must be developed to answer our questions about past human behavior. It can be soundly based on principles that are not culturally dependent.

Other proposed methodologies must meet this criterion for epistemologically sound inference. The job of archaeologists is to develop those methodologies.

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