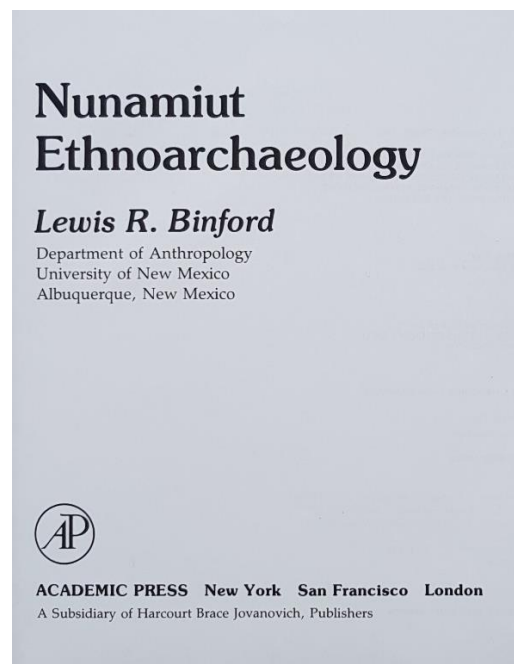
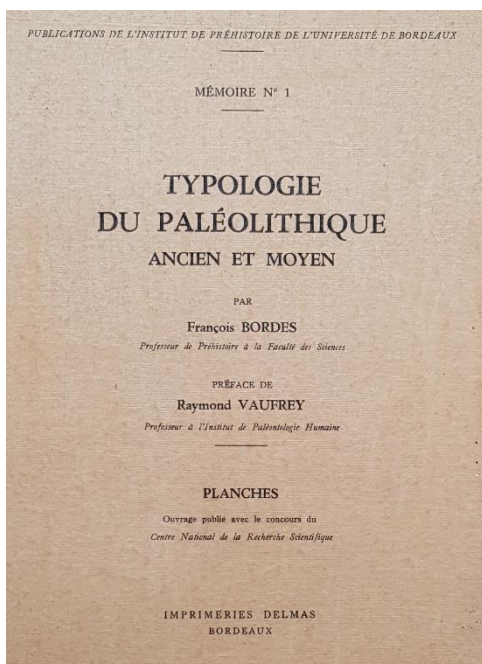


THE EXPLANATION OF MOUSTERIAN-INTERSITE VARIABILITY

an example of differing views on culture and the formation of the archaeological record



by

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INFORMATIVE ABSTRACT

This paper consists of two parts.

The first part traces in short the history of Mousterian research and discusses some of the elements of the discussion on inter-site variability. Main participants in the discussion are Bordes, who developed the method for describing Mousterian assemblages and 'discovered' the differences in the assemblages, and Binford who explained the differences in terms of different activities going on at different sites. The discussion is used to indicate a difference in the perception of culture among archaeologists.

The second part of the article describes a model for the fossilization of behavior into the archaeological record. Each of the phases is discussed in detail while references are made to some parts of the relevant literature. The general focus of this part is that each archaeologist should be familiar with all phases of the process all the way from the behavior of primitive societies down to the extraction of data during the excavation.

According to the author, the knowledge of the first part of this process could be much improved.

This article was written to bring to the attention of readers of "Archeologische Berichten" some concepts of the New Archeology. After a short history of Mousterian research some elements are discussed of the debate on Mousterian inter-site variability.

Furthermore it is argued that the way 'archeology' is fitted into the academic world has been instrumental in differential development of the science of archeology in Europe and America. The difference is probably most noticeable in the concept of culture and the way of scientific reasoning in both worlds.

In the second part of the article a model is discussed for the process of fossilization of behavior of living cultural systems into the archeological record and the recovery of data by the archeologist.

If the reader experiences the article as kind of 'sales-talk' on the work of Binford, I hope he or she will see that as an indication of the value of his work instead of a lack of value of this article. I am sure that a more extensive familiarization with his writings will convince most people of the vigor of his arguments.

Finishing this abstract we note that terms and expressions marked with* are explained in the glossary.

INTRODUCTION

Historical background

Ever since the unearthing of a skull part in the "Neanderthal" in Germany and the excavation of the rock shelter of "Le Moustier sur Vézère" in France in the 1860's European archaeologists have studied the material culture* of the Neanderthal-people. This material culture is referred to as Mousterian, and generally dated between 125,000 and 30,000 years ago.

The geographical distribution; of Mousterian artefacts* and Neanderthal physical remains is very extensive. In Europe it ranges from Portugal, Spain and Southern England in the west to the USSR in the east and from Holland, Germany and Poland in the north to Italy, Greece and Turkey in the south. Outside Europe it has been found in Africa north of the Sahara and in the Middle East. (Bordes 1968)

Until the Second world war the Mousterian culture* was mainly studied as a stratigraphic* unit in multi-layered sites*. Three different 'kinds' of Mousterian were distinguished: old Mousterian, with handaxes; middle or typical Mousterian and young Mousterian, with thick, so-called Quina-scrapers.

In the late forties and in the fifties the French archaeologist Francois Bordes extensively studied Mousterian bearing and other layers from sites in France. But of Bordes' intensive involvement grew a typological* system, a taxonomy *, for the middle and lower Paleolithic*. The typology is described in Bordes 1961.

The use of Bordes' taxonomy the analysis of the assemblages* that were found in France resulted in the recognition of five kinds of Mousterian assemblages, five facies* or industries*. The *Quina-Mousterian* is an industry with many Quina-type scrapers, as is the *Ferrassie-Mousterian*, but the latter has more tools made from a special type of flake or blade that are taken from a prepared Levallois core. The third facies is the *Mousterian of Acheulean Tradition* (MTA) characterized by the presence of handaxes. Next we find the *Denticulate Mousterian*. This industry contains a very high percentage of denticulate tools. The final facies is the *Typical Mousterian*, which takes a kind of intermediate position.

Interpretation of Mousterian facies

Bordes himself gives an explanation of the occurrence of several different facies of Mousterian in his 1972 book *A Tale of Two Caves*. He tends "to interpret these different industries as reflecting the cultural differences of human groups in possession of varied traditions." His "point of view is that during Mousterian times different cultures, with different traditions -of tool-making and tool-using, coexisted on the same territory, but influenced each other very little." Bordes continues to explain, that contemporary does in Mousterian times not always mean that the contemporary groups actually met. This is due to the very low population density at that time. Another aspect mentioned, is that acculturation through intermarrying probably did not occur. The in-marrying person might during her or his lifetime use the tools prescribed by his or her original group, their offspring would be more likely to make and use the tools as prescribed by the group they were born into. (Bordes 1972: 146, 147)

Based on the study of material she had dug up in the Middle East, Sally Binford together with her husband Lewis developed a theory that explains Mousterian inter-site variability as functional diversity within one culture. (Binford and Binford 1966, 1969; S. Binford 1968a, 1968b; L. Binford 1973) The Binfords state that an assemblage is something that only we, the archaeologists, see. The prehistoric people, on the other hand, used certain functional units or toolkits*. Each specific function or activity has its own kind of toolkit. As Mousterian tools are quite quickly worn out they are discarded in a more or less proportionate relation to the 'amount' of the activity performed. Complicating factors are that one tool might be used for different tasks and for one task more than one tool type might be used. Through this model, an assemblage is seen as the surviving accumulation of one or more different toolkits, used for one or more activities. From the theory we will now change to the real world, or in other words the test implications of the hypotheses must be tested against the data from the archaeological record*.

Using a slightly adapted version of Bordes typology the Binfords established artefact* counts for 17 assemblages (1 from France and 16 from Syria and Israel) and applied multivariate analysis to these counts. The obtained results indicated five groups of covarying artefacts, which on the basis of the main tool types represented in the groups, were preliminary assigned the following functions or activities: non-stone tool manufacturing; generalized killing and butchering; cutting and incising as part of food processing; shredding and cutting, possibly of plant materials and a specialized killing and butchering activity. (Binford and Binford 1966)

So far we have given an overview of the shifting of the focus of the study of Mousterian from excavation of multi layered sites through typological description of recovered assemblages to explanation of inter-site variability. In the next part we will describe some elements of the "culture versus function" debate, all to give rise to the formulation of a model for the formation of the archaeological record.

THE "CULTURE VERSUS FUNCTION" DEBATE

This part will not describe all arguments pro or contra one of the sides in this debate. A selection is made to set the stage for the main part of this paper. But first we will start by reviewing the theoretical framework of the two main participants, which can be equated in many instances with those of European and American archaeologists in general.

Different perspectives

In America the field of archaeology has for a long time been a part of anthropology. During its development relative 'primitive' societies could still be studied in the field. This might be called a blessing for archaeology since if it was not at least partly instrumental in the development of the "new archaeology", it certainly was in the development of ethnoarchaeology*.

Ethnoarchaeology is the use of ethnographic* studies for the purpose of explanation of archaeological phenomena. Not that the archaeologist searches the ethnographic literature to find an analogous example of the artefact or feature* he wants to explain. Ethnoarchaeology uses ethnographic research to build hypotheses. From these hypotheses that describe models for the behavior of the prehistoric people test-implications are derived and these are compared with the data recovered from the archaeological record. (Flannery 1967:105)

The "new archaeology" is a theoretical framework developed in the sixties in America. Besides looking for cultural 'laws', much like laws in other sciences, the "new archeology" uses systems theory and ethnoarchaeology to understand 'culture'. Culture is seen as "an extrasomatic* adaptive system that is employed in the integration of a society with its environment and with other sociocultural systems." (Binford 1965: 127) This approach is schematically represented in fig. 1.

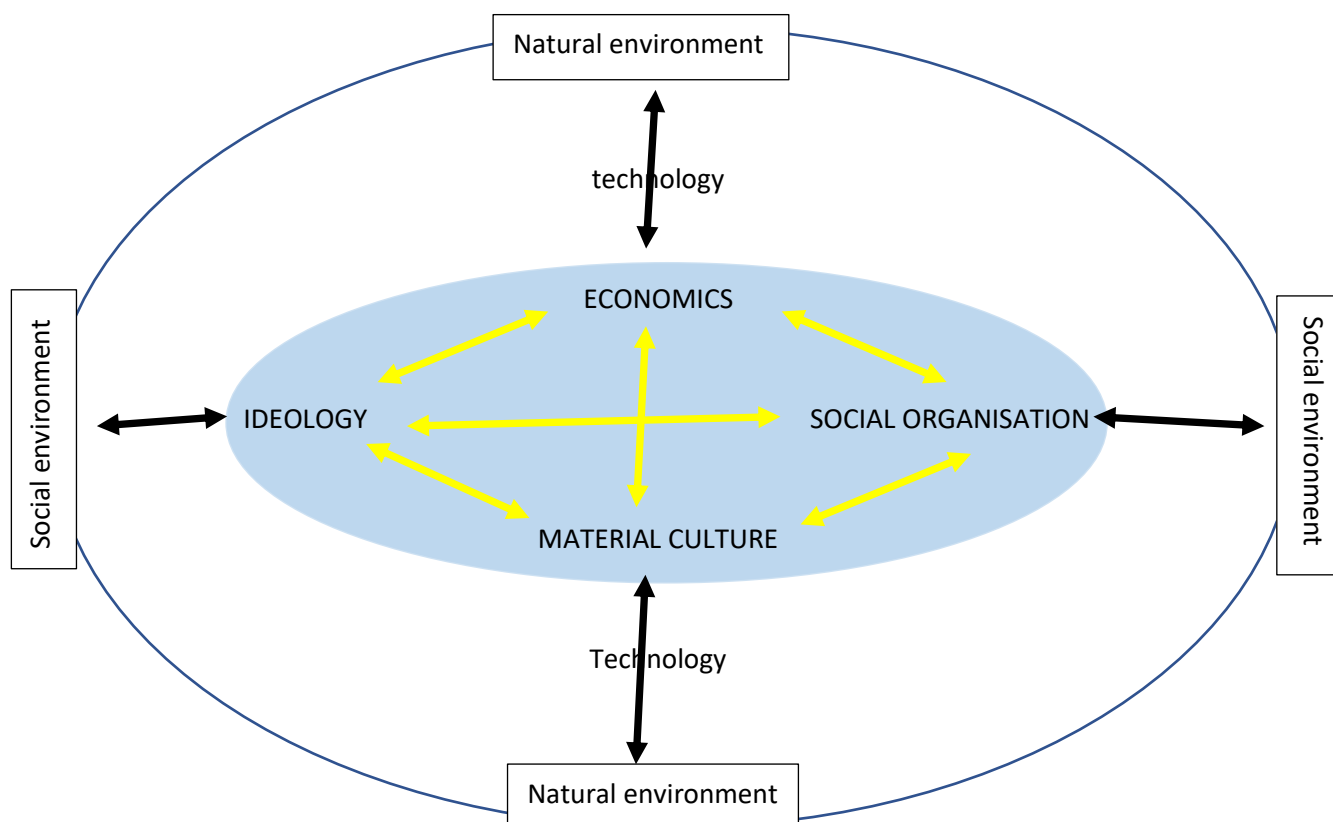


Fig. 1. A Systemic view of culture.

European archaeologists are only in minority most closely related to anthropology. More often they stem from geology, geography, art history etc. Another difference is that European archaeologists tend to rely on auxiliary sciences in another way. Both aspects have led to the use of scientific methods from other sciences in archaeology. Although very

useful it also helped to inhibit the development of ways of scientific reasoning for archaeology itself. (Binford 1983b: 16, 17)

The difference in affiliation of archaeology with other sciences can also be found in the definition of 'culture'. Binford considers the notion of culture central to the discussion on Mousterian inter-site variability, especially what he considers the "rather limited notions about culture itself and the manner in which it serves man as a clearly successful adaptive basis for the organization of behavior." (Binford 1973: 227) Stiles puts it in another way: "Paleolithic archaeologists have tended to stress definitions of archaeological "cultures" while neglecting discussion of *what these entities might represent in terms of living systems.*" (Stiles 1979: 3, italics added) Rolland tells us what the 'archaeological cultures' are: "...the material residues of activities by ancient hominid groups, their contents historically derived and socially transmitted." (Rolland 1931: 19)

It is the behavior of the living cultural systems, seen as expressing adaptation to their natural and social environment and seen in its most occurring forms as well as range of deviation therefrom, that sets the anthropological and archaeological definitions apart.

One final word on archaeology in the Old and New World. The difference in perspectives is noticeable in the comparison of some of the more outspoken people in the field. The New World also has many 'traditional' archaeologists and many Old World archaeologists start working from a New Archaeology perspective.

Elements of the discussion

Some of the arguments against the functional hypotheses can be found in Bordes and de Sonneville-Bordes (1970).

1. Killing sites

The Bordes' state that killing sites are unknown in France, at least not thoroughly excavated. This in our view does not necessarily mean that they do not exist in the archaeological record, it could very well be that they are generally not recognized as such. One has to bear in mind that most archaeological work in France is done in rock shelters and caves. Open-air sites are strongly underrepresented, in particular in regions where many sheltered sites are present. Although some butchering might have been done in the shelters, it is obvious that the killing and butchering of large animals must have taken place outside. The locations are more a function of the behavior of the hunted animals than of their hunters.

2. Procurement of raw material for stone tools

The Bordes' also state that workshops are nearly unknown in France because flint is readily available anywhere. This point seems a valid one and it implies that in many cases procurement of raw material for stone tools could have taken place on the site where the tools were needed. The recently started research off the natural occurrence of different kinds of natural flint in France will be very helpful to understand to what extent prehistoric people preferred certain raw materials over locally available raw materials. Application of the results of this research to Mousterian assemblages will show if people from that time also had such preferences or not. Even if flint extraction sites did not exist in Mousterian times, then it only implies, that one kind of special purpose site was not represented.

3. Identified tool functions

The interpretation of the tool types is another debated item. The Bordes' rightly remark that this interpretation is very tentative, something that the Binford's already said in their original paper. It is very unfortunate that no use-wear analysis has been done to see to what extent the preliminary assigned functions are the correct ones. Particularly fruitful research could be performed in this respect on assemblages that in Binford's sense consist of one single factor. Of course the use-wear analysis should be performed on the whole assemblage, not only the 'tools' in Bordes' sense, since unretouched flakes in experiments done by Walker (Walker 1973) proved to be more efficient in most butchering tasks than flakes with bifacial worked edges.

4. Intra-site variability

Finally we mention that the Bordes' agree with the existence of specialized toolkits, but then within a site. In the archaeological record this is visible as intra-site tool-type clustering. In connection with this point, we want to repeat a remark here made by Odell when he analyzed a Mesolithic settlement in the Netherlands: "... there is no reason that specific activity areas *have to* exist in the archaeological record, though they may often be observable." (Odell 1980: 410, italics added) Activity area here refers to intra-site clustering as well as inter-site patterning.

Other remarks in the culture versus function debate were made by Mellars (Mellars 1970) He points to some gaps in the present (=1970) data.

5. Part of diet consisting of Vegetable food

The collection and processing of vegetable food is something that we are totally ignorant about. As DeVore once remarked, the Kung Bushmen demonstrate that a society living of a 70% vegetable diet would be recognized by an archaeologist digging up their sites as a hunter and not as a hunter-gatherer society. (Binford S. and Binford 1968: 347) Binford himself found that the diet of the Nunamiut Eskimo's consists for 70 % of caribou meat and that most is stored before it is consumed. (Binford 1979: 256) These two examples are shown here to indicate large variability among hunter-gatherer food procurement behavior and to focus attention on the differential preservation in the archaeological record of direct information on food (food-rests or indicators as bones, nutshells pits etc.). This point bears also on Mellars remarks on the lack of understanding of the nature and importance of hunting activities in open-air sites and the relative importance of fishing in different sites.

6. Yearly animal migration pattern

Mellars also cites that we lack a clear understanding of the year around migration pattern of animals in the timeframe of study. We would like to stress at this point that a good understanding of the whole environment is necessary when one wants to study a human group as participating in an ecosystem. The area of interest can be quite large for such a study. Binford was told e.g. by one of his Nunamiut informers about the area in which he knew valuable resources. The Eskimo's indicated an area as large as 70% of France! (Binford 1979: 257, 272) Even if Mousterian people had interest in an area only 1/10 of that of the Nunamiut it would probably mean an enlargement of the field of View of many prehistorians.

7. Used typology

This section alone could fill a whole paper or more, as it often did. (Berle Clay 1976; Binford 1965; Meltzer 1981; Spaulding 1953, 1973; Stiles 1979; Wilmsen 1968)

Without looking at the intrinsic value of Bordes' classification system it must be recognized that without it the problem of Mousterian inter-site variability would not exist at all, that is not be recognized. Comparison of assemblages in America is for example hardly possible due to the lack of a widely applicable typology.

The Binfords used Bordes' typology in an only slightly modified form. Bordes' types are however "... based on a mixture of cultural (stylistic) and functional criteria." (Jelinek 1976 as cited in Stiles 1979: 2) Although widely applied in the past and in the present (as can be seen in Lumley 1976) this typology "tells us nothing about the people who made them." (Stiles 1979: 2) The 'normative'* type view, which certainly is widely present in Bordes typology, is something of relative little value. when we keep in mind Yeritsian' s (Yeritsian 1979) four main factors "in evaluating inter-assemblage variability: technology, stylistic meaning, functional meaning and sampling error" then the normative view is only applicable to the 'stylistic meaning'. But in working backwards from recovered assemblages the stylistic meaning can easily be misidentified from similarities due to technologic factors or pure chance. An example of a technological factor is given by Rolland. "The Rule of Limited Possibilities, inherent in dependence on percussion for manufacturing stone artefacts, makes independent recurrence of generalized flaking devices as in Levallois or bifacial techniques a process as likely as diffusion." (Holland 1981: 19)

Looking at the ethnographic record we see that "working-edge angle and overall size and thickness are the main determinants of how a stone tool will be used." (Stiles 1979: 3) This makes overall form totally irrelevant. Binford noticed that tools made to perform unexpected tasks vary with the tool demand and the resources at hand. (Binford 1979: 266) Again form is, at least partly, subordinate to other factors.

If we finally take into account the "Frison effect" that states "that each end product" (recovered artefact) "that we describe and classify may represent one stage in a sequence of distinct and perhaps highly varied implement forms" (Jelinek's comment in Stiles 1979: 13) than certain types of Bordes typology are placed in a very different light. As an example can be cited the Quins scraper seen as the end product of a series of rehappening's instead of a deliberate made tool according to the 'normative type' of the toolmaker.

The above made comments will suffice to show that using a certain typology is "risky business", if one does not take into account all factors that might have contributed to the final appearance in which an artefact is recovered from the archaeological record. We want to cite one final example before moving on to the next point of discussion. Odell studied the relations between types based on morphological criteria and functions determined by microwear analysis for artefacts recovered from the earlier mentioned site in the Netherlands. He found that certain form categories were nearly equivalent to functional categories, while other form categories combined artefacts from several very different functional categories. (Odell 1981)

8. Cultural boundaries

The tendency of ethnographers to study people that have not been studied before tends to create boundaries between cultures while reality is more like a continuum* of transition between cultures. (Wobst, 1973) Furthermore "...the distribution of stylistic elements of material culture may not be isomorphous with ethnic-group distribution." (Stiles 1979: 615) This point is brought up here to show that 'categories' created to help summarize the real world starts a life of its own. Sometimes it is necessary to look back at the real world in all its complexity, to see its simplicity.

The debate on the explanation of the inter-site variability of the Mousterian time period has been incorporated in this paper for two reasons. The alternatives are interesting in itself, not only for people studying Mousterian but for all stone age prehistorians. Far more important here however is its purpose of illustrating that an archaeologist can only study the things he has recovered well, when he is *familiar with all stages of the formation of the archaeological record*. which brings us to the next part of this paper.

THE FORMATION OF THE ARCHAEOLOGICAL RECORD

This section will describe a model for the formation of the archaeological record. The archaeological record is both contemporary and static. (Binford 1983: 100) The archaeologist who wants to make inferences about the dynamics of the behavior of the people of the past, has somehow to work back through the process of formation of the archaeological record. A broad overview is given in fig 2.



Fig 2. The process of formation of the archaeological record

The process extends from the behavior of the prehistoric people all the way down to the data the archaeologist recovers. It can be broken down in five major transitions. In each transition from one phase to the next, a part of the information contained in the previous phase is lost. The behavior fossilized in artefacts and features is just a part of all behavior. Not all artefacts and features are fossilized into the archaeological record, some are recycled, or otherwise destroyed. After being embedded in the archaeological record all kinds of agents act on the artefacts and features. Some agents change little of the information content, others change more, depending on the type of agent and the composition of the information carrier. Finally the excavation itself is a selective process. The chosen methods of excavation and registration define the selection that is made from all residual information still left in the soil before the excavation.

We will now look at some concepts developed by Schiffer. (Schiffer 1972, 1975) He distinguishes two contexts for artefacts, *systemic* and *archaeological*. when an object is in use in a cultural system, it is in systemic context. This can be active use or passive use. The latter refers to an object that is saved or cached for later use. An object is in archaeological context when it is no longer in use in a cultural system.

Schiffer distinguishes four transitions of context. The S-A process equals our fossilization of artefacts and features into the archaeological record. In the S-S process objects are reused for another purpose as the original one. The A-A process is the equivalent to our modification of the archaeological record. The last process than is the A-S process or

the reclamation of discarded and lost artefacts. We will deal in more detail with examples of these processes below when we describe transitions between the phases behavior and recovered data.

Each phase will be dealt with separately. If possible factors that are operable in each phase will be identified for illustration purposes. Complete coverage is certainly not claimed, the material is presented as a working model to which other factors can be added.

Behavior

Behavior is what anthropology is all about. Anthropological archaeology then should also focus on behavior more than on material culture. Material culture is only a carrier of information. The study of extant living primitive societies is the best source information on behavior. For those who study the lower and middle Paleolithic one word of caution from Stiles and Bower.

"One of the main assumptions to reexamine is that we can interpret all expressions of hominid behavior in the past in terms of our knowledge of Homo Sapiens Sapiens today." (Stiles 1979:2) In addition Bower remarks that like now extinct Pleistocene habitats, as arctic climates at relative low latitudes, some forms of social organization might have existed in the past that neither presently exist, nor have been observed by ethnographers in the recent past. The only way to overcome these problems is not to work backwards from the recovered data, but to follow the original process. That is formulate models, let the information destroying factors work on them and 'calculate' the final results by which the model can be identified in the recovered data. The biggest problem can be finding models that after reduction show enough difference in 'footprint' to make a meaningful comparison possible.

Some more general cautionary notes should be made at this time. Many ethnographic studies are limited in the size of the area observed. For patterns of behavior on the local level this poses no problems. If one looks at settlement systems in relation to social organization and subsistence behavior a large scope is necessary however. Another aspect often lacking in the ethnographic literature is a description of the fossilization of behavior into artefacts or in other words descriptions of the artefact production and use through the eyes of an archaeologists.

Hunter-gatherers have received a lot of attention in the 60's and 70's. Lee's work among the !Kung Bushmen in sub-Saharan Africa had probably a lot to do with that. The old idea of people struggling to make a living proved invalid, as did the idea that plant foods were an addition to lavish meat meals.

Many models have been developed to describe hunter-gatherer adaptations. Some are analyzed by Bettinger. (Bettinger 1980). Besides subsistence models, settlement location and population models are discussed.

We will describe one simple model not mentioned in Bettinger. It is a model for subsistence settlement systems derived by Binford from his firsthand experience among hunter-gatherers in Australia and Alaska supplemented by an extensive knowledge of ethnographic literature (Binford 1980).

Binford describes a bipolar continuum with as extremes *foragers* and *collectors*. Foragers practice a foraging strategy*, that is they return daily to their *residential base*. If the distance to the resources becomes too long they simply move their residential base. Collectors on the contrary are logistically oriented*. They send out parties to obtain certain resources from special purpose sites (kill sites, quarries, etc.). During their trips the parties also collect items that are not needed at that time, but might be of use in the future. If necessary the parties establish temporary field camps for maintenance activities of the group (shelter, eating, resting, gear repair). Collectors tend to accumulate useful items at their residential base, which makes a decision to move this base more costly. Outside basecamps useful and necessary goods, including food, is put in caches.

The elements of this model are not quite new, but it is worthwhile to look at the model as a continuum. Most hunter-gatherer societies will practice some mixture of foraging and collecting. Binford distinguishes one new element, the station. "Stations are sites where special purpose task groups are localized when engaged in information gathering, for instance the observation of game movement or other humans". We can sum up the model in Binford's words: "Foragers move consumers to goods with frequent residential moves, while collectors move goods to consumers with generally fewer residential moves."

Fossilization of behavior into artefacts and features

There are two methods to study this transition, ethnoarchaeology and experimental archaeology. We will start out with a model developed by Binford from his experience with the Nunamiut. (Binford 1979)

Binford distinguishes two types of technologies, *curated* and *noncurated*, objects part of the latter are discarded after use. Curated items can be divided in three different groups depending on their purpose. *Household gear* are artefacts for use in the base camp. *Personal gear* are artefacts either part of a kind of standard set or incidentally taken along for an expected task by an individual. *Site furnishings* are objects left or cached at a special purpose site for expected future use when the special purpose site will be used on a next occasion.

Binford would expect differences in patterns of tool design and tool use among household and personal gear on one hand and situational gear on the other. He would expect the first

"to exhibit both maximum design comparability relative to function, and minimum fit between the appropriate "quality" of the raw material and tool design. In addition there should be more design features related to hafting among items manufactured as household and personal gear, while in situational contexts items used for identical functions may exhibit at most only minimal and perhaps technically different, hafting features." (Binford 1979: 2&7)

For situational gear on the other hand the form of the artefacts would vary with the tool demand and the resources at hand, which could be naturally occurring resources, cached or scavenged items or recycled personal gear. (ibid)

"Planning or designing a tool to be incorporated in personal or household gear is very different, since it will be seen in the context of long-term usage and the requirement that it meet many different types of tool needs" (Binford 1979: 258, 269)

We want to close this section by reminding the earlier quote by Styles if one wants to apply the above model to Mousterian or older artefacts. Related to this Bordes already remarked that the Mousterian technology is largely noncurated (Bordes 1979: 269)

Experimental archaeology is another way to relate systemic behavior to artefacts and features. Coles gives an overview of some of the experiments done. Many of them, like the burning of reconstructed houses followed by excavation also look at the next two transitions, fossilization into the archaeological record and retrieving the data through excavation.

One has to keep in mind that establishing 'possibilities' of relations between techniques and their results, the artefacts and features, is not enough. After finding the 'possibilities' one must establish the 'probabilities' for each of the techniques, the probability that that technique was used to produce the object under study. (Callahan) Stone age replication studies can be found in Bordes 1969; Callahan 1979, Crabtree 1966, 1970, Flenniken 1978, Newcomer 1971 and Sheets 1973 on biface manufacturing in stages; Crabtree and Butler 1964 and Flenniken and Garrison 1975 on heat-treatment; Franssen and Wouters 1979 on Clacton artefacts, Newcomer and Sieveking 1980 on waste-flake distribution.

Finally we note Schiffer's S-S processes. He distinguishes four of them. *Recycling* occurs when a used item functions as raw material to make new objects. *Secondary use* is the reuse of nearly unaltered material for an other purpose. Schiffer defines *lateral cycling* the instances in which an object is handed to another user (second hand use) Finally he mentions *conservatory process*, what is what we do in museums. (Schiffer 1976: 37-40)

Again, it is important that while analyzing data the archaeologist reviews if one or more of these processes have been at work on his artefacts.

Fossilization of artefacts and features into the archaeological record

We want to start this section by referring to some points made above. The orientation of the living cultural system, foraging or logistical orientation, will strongly influence the way artefacts and features are distributed in the landscape. Foraging societies know only two kinds of sites, basecamps and special purpose sites where raw material or food is procured. Logistically oriented societies use besides this two also field camps and stations or observation sites. Binford found that the Nunamiut while waiting in these stations often partly processed artefacts, leaving these sites littered with production waste.

On site furniture Binford observed the following. It "enters the archaeological record only as a function of discontinued site use or natural processes which cover up or otherwise modify the site itself." (Binford 1979: 264). Larger items are more often drawn out of forming deposits when sites continue to be used than smaller items, which are easier lost.

Personal gear items when worn out are more often discarded in the basecamp while the owner checks and repairs his gear in anticipation of a coming trip rather than while away from the basecamp.

Schiffer made some important remarks in his 1972 article. He distinguishes *primary refuse* and *secondary refuse*. The first is thrown away at the location where the objects was used, the second is transported to another location. He observes further "...with increasing site population (or perhaps site size) and increasing intensity of occupation, there will be a decreasing correspondence between the use and discard locations for all elements used in activities and discarded at a site." (Schiffer 1972: 162)

Schiffer's S-A processes can be divided in normal and abandonment processes. The first group can be further divided in *discard*, throwing away after the usefulness has ended, *disposal of the dead* often accompanied by still useful goods, and *loss*.

Modification of the archaeological record

Many agents work on the archaeological record at any time. They may be of chemical, mechanical or biological nature. An article by Wood and Johnson gives an overview of some of them, in particular agents that disturb the soil and thus change the interrelationship and orientation of objects. (Wood and Johnson 1978) They cite nine processes of *pedoturbation*, the mixing of the soil.

Faunal turbation, the mixing caused by the action of animals. Beside mammals, insects and worms are active. "Like ants and termites, then, earthworms can also produce stone lines (and artefact lines?) at depth..." The writers refer to layers of stone at sometimes many meters depth that are the result of the upward movement of smaller soil particles by faunal turbation.

Animal action can also produce pseudo-tools. Miller describes some made by livestock trampling. (Miller 1982)

Floral turbation, the action by plants, is represented by two main effects. The roots of trees push the soil aside while growing, and later, after the tree has died the root channel is filled up, often with material from above. Falling trees also cause mixing of the soil. The soil is first moved upward with the roots. While the wood decays the soil falls back leaving a little mound behind. The same event causes horseshoe-shaped features in the podzol. (Kooi 1974)

Cryoturbation the action of alternate freezing and thawing of water in the soil. Again we see two effects. Larger objects, including artefacts can move upward in the soil. Sometimes the larger objects are not only brought to the surface, but they are also brought together in circular band patterns, or patterns of other geometrical form.

Graviturbation, the movement of the soil through its weight. The flowrates of frost-related movement is very slow (3 cm/year) but can operate on slopes of as little as 1 degree. Graviturbation can also occur unrelated to freezing, for example in saturated soils.

Argilliturbation, the expansion and contraction of clay through the absorption and emission of water. This action has a similar effect as cryoturbation. It brings larger objects to the surface, and sometimes creates stone pavements.

Aeroturbation, the action of air, in particular wind works primarily through the removal of smaller particles from the topsoil.

Aquaturbation, the action of artesian water. The artesian waters flowing to natural springs or the water caught under frozen soil can, through its pressure, mix soil.

Crystallurbation, the action of growing and wasting of crystals, can work similar to cryoturbation and argilloturbation in bringing up larger objects and sorting the soil material.

Seismiturbation, or earthquake action results in the development of cracks in the soil, often accompanied by lateral movement along the crack. Cracks generally are filled with material from higher layers.

"Cultural materials, then, may sink into the soil, may be concentrated into layers at depth, may be reoriented within the soil, may be thrust to the surface, or may be moved horizontally on a plane or downslope." (Wood and Johnson 1978: 593)

We want to mention three additional soil movers. First humans. Not only did the people whose dynamic behavior we are trying to reconstruct sometimes move their own cultural remains, people visiting the site between deposition and excavation also can have modified the archaeological record or selectively removed old artefacts. Many surface sites have lost a lot of their content through artefact collectors. As they make a selection of the whole population of artefacts the remaining assemblage often is skewed.

Modern construction and plowing are the more easily identifiable modifications of the archaeological record. Some recent research has shown that plowing does not necessarily destroy all spatial relationships.

Glacier action is also a mixing agent. In general the results of glacier action will be easily identifiable on a macro scale. Particular the relocation of whole deposits in moraines and alteration of artefacts due to movement under enormous pressure are effects an archaeologist can be confronted with while working on inter or pre-glacial assemblages.

The last mechanical action is stream action of rivers and creeks. Not only does stream action change the interrelationship and orientation of artefacts, the artefacts themselves are changed too, mainly by rounding of their extremities.

Chemicals form a separate group of modifiers of the archaeological record. Chemical combined with bacterial and molding action robs the archaeological record of most of its information. Only extreme circumstances of dryness, wetness or cold save perishable materials.

Again we have only given some causes for changes in the archaeological record over time. we think that archaeology is serious enough business to evaluate for each of these causes if and to what extend it has been operative on the assemblage under investigation.

Excavation of the archaeological record

The problem an archaeologist tries to resolve by excavating is the primary determinant of techniques used for excavation and data recording. I hope that it will be clear that a study of all the factors working on all the stages of the formation of the archaeological record should also contribute to the techniques chosen.

Binford found for example that in Bordes' excavations in France the exact three dimensional location of stone objects was recorded, but for faunal remains, which were plenty, only the layer. This made it impossible to relate stone objects and faunal remains in probable intra-site activity areas.

Hofman sites another example. He stresses that the longest axis of an artefact can be an indicator for "stream action" (Hofman 1981). Likewise Bordes sites granulometry as a source to recognize cold climates and cryoturbation in rock shelters. (Bordes 1972) Whatever the cue is for a certain process, one needs to identify the need for recording the necessary data before the excavation starts

Recovered data

Publications on analysis of recovered archaeological data are numerous. We want to name here just a few that are particularly promising as a means to infer behavior from artefacts.

Use-wear analysis has appeared to be a very powerful tool. (See for example Odell 1980, 1991) It was made applicable largely by Keely (Keely 1980) and tested by the Odell's. (Odell and Odell 1980) Briver found that working edges of tools often contain animal and plant residue. (Briver 1975) His discovery made him remark: "... archaeologists who religiously scrub their artefacts may be unwittingly destroying potential information bearing on the prehistoric function of the artefacts." Briver 1976: 483) In an experiment Brose found that "... a major factor inhibiting the creation of striations during butchering is the accumulation of fat along the working edge." In particular coarser materials seem to be susceptible to this. (Brose 1975: 93)

The refitting of chipped artefacts also proved to be a welcome addition to the existing analytical methods. (van Noten et al 1980) Not only can relations be made between activities at different places in one site, it can also be used to get an idea to what extent the archaeological record has been modified. (Villa 1982)

CONCLUSION

We have seen that the debate on the explanation of Mousterian inter-site variability illustrated how some of the participants had different views on culture. The old view perceived culture in a materialistic sense, that is it hardly went beyond the artefacts found in the archaeological record. The newer view sees culture more in a behavioral sense. Culture is seen as a system which parts relate to each other maintaining the existing situation, while on the other hand participating in other sociocultural and environmental systems.

In the second part we have looked at the formation of the archaeological record, all the way from the behavior of the people responsible for making the artefacts that are preserved in it to the data recovered from it by the archaeologist. Using only a small part of the literature some of the processes acting in each phase of the formation have been identified. Knowing much more processes were and are active, we feel that it is important that each person in our business, is aware of these processes and should try to contribute to completing the proposed model. In particular the study of ethnographic literature is a field that seems underdeveloped in Dutch archaeology.

"... in order to carry out the task of the archaeologist, we must have a sophisticated knowledge and understanding of the dynamics of cultural adaptation, for it is from such dynamics that the statics which we observe arise." (Binford 1980:4)

GLOSSARY OF TERMS

Acculturation	Change in one culture by 'learning' through contact with another culture.
Archaeological record	The soil containing archaeological information consisting of artefacts, features or the absence of these.
Artefact	Any object made, modified or used by man.
Assemblage	The total of artefacts recovered from an archaeological layer, e.g. the artefacts of layer 4 of Pech de l'Azé I.
Continuum	A classification in which an example is classified somewhere along a sliding scale. The scale is characterized by its extremes. Example: the plant-cultivating continuum with 'endpoints' "foraging" and "industrial production", somewhere in between is "slash-and-burn horticulture" and "pastoralism".
Culture	<p><u>Anthropological sense:</u> The way of life exhibited by a particular society; the integrated whole of artefacts, goods, technical processes, ideas, habits and values.</p> <p><u>Archaeological sense:</u> A recurring pattern of associated artefacts and/or features as buildings, art objects and burials. Often the term culture or a specific culture name is used to refer to the prehistoric people that used the artefacts.</p>
Culture-complex	A group of closely related cultures (in archaeological sense).
Curated technology	The technology used in toolmaking with the intention to save the tool after its first use. In other words made to be reused again and again. Non-curated tools are discarded after their first use.
Diffusion	Cultural diffusion is the spread of cultural items, such as ideas, styles, religions, technologies, languages, between individuals, whether within a single culture or from one culture to another. It is distinct from the diffusion of innovations within a specific culture.
Ethnic group	A group of individuals who share a set of beliefs and rules of behavior and who think that people not sharing those beliefs and rules do not belong to their community. (Stiles 1979b: 411)
Ethnoarchaeology	The use of ethnographic information in the building of hypotheses for prehistoric behavior.
Ethnography	The study and observation of non-western societies.
Extrasomatic	Without change in genetic makeup of the individuals or population.
Facies	A recurring type of assemblage, e.g. typical Mousterian, synonym for industry
Feature	An artefact that is so large or fragile, that it is in-transportable, or a combination of artefacts. Examples: monoliths, buildings, soil discoloration, stone hearths.
Foraging strategy	A resource procurement strategy in which the people return daily to the residential location (basecamp) See also 'logistically oriented strategy. (Binford 1979:270)
Hunting-gathering	A way of live where all food is procured by hunting animals and gathering wild plants, eggs,

small creatures, shellfish, etc.

Industry See facies.

Logistically oriented strategy In this system parties that are specifically organized to procure particular resources move to temporary camps. In these camps they execute maintenance activities for the party and from these camps they go to the places where they procure the resource. (e.g. hunting-camp) See also foraging strategy (Binford 1979: 270)

Normative type View Viewpoint in which the 'type' is seen as a mental template in the mind of the toolmaker.

Paleolithic Literally: paleo = old, lithic = made of stone. The prehistoric period starting at the beginning of prehistory to approx. 30,000 B.C.

Site Location where artefacts or features are found.

Stratigraphy Vertical relation of artefacts or features found within one site, often indicated by distinguishable layers.

Systems theory The interdisciplinary study of systems. A system is a cohesive conglomeration of interrelated and interdependent parts that is either natural or man-made.

Taxonomy Ranked typology, e.g. first subdivision on material (wood, stone, bone), second based on other elements.

Typology Subdivision of all items into certain classes based on particular criteria.

Toolkit A group of tools belonging together and normally used for a certain task, as an electrician's toolkit versus an auto-mechanics toolkit. The Binfords use this concept in an archaeological sense: a toolkit for scraping, a toolkit for hunting, etc.

Tradition In particular used by French archeologists, tradition refers to method of implement fabrication. Often the word is used in the sense of culture.

BIBLIOGRAPHY

Ammerman, A.J. and H.W. Feldman

1974. On the Making of an Assemblage of Stone Tools.
American Antiquity 39: 610-615.

Berle Clay, R.

1976. Typological Classification, Attribute Analysis, and Lithic Variability.
Journal of Field Archaeology 3: 303-311

Bettinger, Robert L.

1980. Explanatory/Predictive Models of Hunter-Gatherer Adaptation.
In: *Advances in Archaeological Method and Theory*. Vol 3, pp. 159-255.

Binford, Lewis R.

1965. Archaeological Systematics and the Study of Culture Process
American Antiquity 31: 203-210, as reprinted in Mark P. Leone {ed} 1972.
Contemporary Archaeology.
1973. Interassemblage Variability - the Mousterian and the "Functional Argument".
In: Renfrew 1973: 227-254.
1979. Organization and Formation Processes: Looking at Curated Technologies.
Journal of Anthropological Research 35: 255-273.
1980. Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation.
American Antiquity 45: 4-20.
1981. *Bones*. Academic Press, New York.
- 1983a. *Working at Archaeology*. Academic Press, New York.
- 1983b. *In Pursuit of the Past*. Thames and Hudson, New York.

Binford, Lewis R. and S.R. Binford.

1966. A Preliminary Analysis of Functional Variability in the Mousterian of Levallois Facies.
American Anthropologist, 1965, pp. 23B—295.
1969. Stone Tools and Human Behavior.
Scientific American, 1969 4, pp. 70-84.

Binford, Sally R.

- 1968a. Early Upper Pleistocene Adaptations in the Levant.
American Anthropologist, 1968, pp. 707-717.
- 1968b. Variability and Change in the Near Eastern Mousterian of Levallois Facies.
In: *New Perspectives in Archeology*, Sally R. Binford and L.R. Binford (eds) 1963, pp. 49-50.

Binford, Sally R. and L. R. Binford, eds.

1968. *New Perspectives in Archaeology*. Aldine, Chicago.

- Bordes, Francois H.
1961. *Typologie du Paléolithique Ancien et Moyen*.
Institut de Préhistoire de l'Université de Bordeaux, Mémoire No 1.
1968. *The Old Stone Age*. McGraw—Hill, New York.
1969. Reflections on Typology and Techniques in the Paleolithic.
Arctic Anthropology 6: 1-29.
1972. *A Tale of Two Caves*. Harper and Row, New York.
1973. On the Chronology and Contemporaneity of Different Paleolithic Cultures in France.
In: Renfrew 1973: 217-225.
1978. Typological Variability in the Mousterian Layers at Pech de l'Aze I, II and IV.
Journal of Anthropological Research 34: 181-193.
- Bordes, Francois H. and D. de Sonneville-Bordes.
1970. The Significance of Variability in Paleolithic Assemblages.
World Archaeology June 1970, pp. 61-73.
- Briuer, F.L.
1976. New Clues to Stone Tool Function: Plant and Animal Residues.
American Antiquity 41: 478-484.
- Brose, D.S.
1975. Functional Analysis of Stone Tools: a Cautionary Note on the Role of Animal Fats.
American Antiquity 40: 86-94.
- Callahan, Errett.
1979. The Basics of Biface Knapping in the Eastern Fluted Point Tradition. A Manual for Flintknappers and Lithic Analysts.
Archaeology of Eastern North America 7: 1-130.
- Coles, John.
1973. *Archaeology by Experiment*. Hutchinson and Co, London.
- Crabtree, Don E.
1956. A Stoneworker's Approach to Analyzing and Replicating the Lindenmeier Folsom.
Tebiwa 5: 3-39.
1970. Flaking Stone with wooden Implements.
Science 169: 146-153.
- Crabtree, Don E. and B.R. Butler.
1964. Notes on Experimental Flint Knapping: 1.
Tebiwa 7: 1-6.
- Dumont, J.
1982. Quantification of Microwear Traces: a New Use for interferometry.
World Archaeology 14: 206-217.
- Fish, P.R.
1981. Beyond Tools: Middle Paleolithic Debitage Analysis and Cultural Inference.
Journal of Anthropological Research 37: 374-386.

- Flannery, Kent V.
1957. Review of An Introduction to American Archaeology, vol 1: North and Middle America, by Gordon R. Willey. *Scientific American* 217: 199-122, as reprinted in Mark P. Leone (ed.) 1972. *Contemporary Archaeology*.
- Flenniken, J.J.
1973. Reevaluation of the Lindenmeier Folsom: a Replication Experiment in Lithic Technology. *American Antiquity* 43: 473-480.
- Flenniken J.J. and E.B. Garrison.
1975. Thermally Altered Novaculite and Stone Tool Manufacturing Techniques. *Journal of Field Archaeology* 2: 125-131.
- Franssen C.J. and A.M. Wouters.
1979. De in het Oud Acheuleen Toegepaste Technieken. *Archeologische Berichten* 5: 27-33.
- Hietala, H.J. and D.E. Stevens
1977. Spatial Analysis: Multiple Procedures in Pattern Recognition Studies (Mousterian). *American Antiquity* 42: 539-559.
- Hofman, Jack L.
1981. The Refitting of Chipped-Stone Artifacts as an Analytical and Interpretive Tool. *Current Anthropology* 22: 591-693.
- Keely, L.H.
1980. *Experimental Determination of Stone Tool Uses*.
The University of Chicago Press, Chicago.
1982. Hafting and Retooling: Effects on the Archaeological Record. *American Antiquity* 47: 739-809.
- Kooi, J.B.
1974. De Orkaan van 19 November 1972 en het Ontstaan van Hoefijzervormige Grondsporen. *Helinium* 14: 21-23.
- Leone, Mark P., ed.
1972. *Contemporary Archaeology*. Southern Illinois University Press, London and Amsterdam.
- Lumley, Henry de, ed.
1976. *La Préhistoire Française*. CNRS, Paris.
- Marshack, A.
1976. Some Implications of the Paleolithic Symbolic Evidence for the Origin of Language. *Current Anthropology* 17: 274-232.
- Mellars, Paul.
1970. Some Comments on the Notion of 'Functional Variability' in Stone-tool Assemblages. *World Archaeology* June 1979, pp. 74-88.
- Meltzer, David J.
1981. A Study of Style and Function in a Class of Tools. *Journal of Field Archaeology* 8: 313-326.

- Miller, Robert.
1982. Pseudo-Tools Created by Livestock from Halawa, Syria.
Journal of Field Archaeology 9: 281-283.
- Newcomer, M.H.
1971. Some Quantitative Experiments in Handaxe Manufacture.
World Archaeology 3: 85-94.
- Newcomer, M.H. and G. de G. Sieveking.
1980. Experimental Flake Scatter-Patterns: a New Interpretative Technique.
Journal of Field Archaeology 7: 345-352.
- Noten, F. van et al.
1980. A Paleolithic Campsite in Belgium.
Scientific American, April 1980.
- Odell, George H.
1980. Toward a More Behavioral Approach to Archaeological Lithic Concentrations.
American Antiquity 45: 404-431.
1981. The Morphological Express at Function Junction: Searching for Meaning in Lithic Tool types.
Journal of Anthropological Research 37: 319-342.
- Odell, George H. and F. Odell-Vereecken.
1980. Verifying the Reliability of lithic use-wear determinations by "blind test": the low-power approach.
Journal of Field Archaeology 7: 87-120.
- Rathje, William L.
1979. Modern Material Culture Studies.
In: *Advances in Archaeological Method and Theory*. Vol 2, pp. 1-37.
- Renfrew, Collin, ed.
1973. *The Explanation of Culture Change: Models in Prehistory*. Unwin, Surrey
- Rolland, N.
1981. Interpretation of Middle Paleolithic Variability.
Man 16: 15-42.
- Schiffer, Michael B., ed.
1972. Archaeological Context and Systemic Context.
American Antiquity 37: 156-1&5.
1976. *Behavioral Archeology*. Academic Press, New York.
1982. *Advances in Archaeological Method and Theory. Selections for Students from Volume 1 through 4*. Academic Press, New York.
- Sheets, Payson D.
1973. Edge Abrasion During Biface Manufacture.
American Antiquity 38: 215-218.

Spaulding, Albert C.

1953. Statistical Techniques for the Discovery of Artefact Types.

American Antiquity 18: 305-313.

1973. The Concept of Artefact Type in Archaeology.

Plateau 45: 149-163.

Stahle, David W. and James E. Dunn.

1982. An Analysis and Application of the size distribution of Waste Flakes from the Manufacture of Bifacial Stone Tools.

World Archaeology 14: B4-97.

Stiles, Daniel.

1979. Paleolithic Culture and Culture Change: Experiment in Theory and Method.

Current Anthropology 20: 1-3. Comments and replies to this article: 20: 8-21, 410-412, 613-615; 21:256, 409.

Villa, P.

1982. Conjoinable Pieces and Site Formation Processes.

American Antiquity 47: 276-290.

Walker, P.L.

1978. Butchering and Stone Tool Function.

American Antiquity 43: 710-715.

Wilmsen, Edwin N.

1968. Functional Analysis of Flaked Stone Tools.

American Antiquity 33: 156-161.

Wobst, H.N.

1978. The Archaeo-Ethnology of Hunter-Gatherers or the Tyranny of the Ethnographic Record in Archaeology.

American Antiquity 43: 303-309.

Wood, N.R. and D.L. Johnson.

1978. A Survey of Disturbance Processes in Archaeological Site Formation.

In: *Advances in Archaeological Method and Theory* 1: 315-381. Reprinted in: Schiffer 1982: 539-605.

Yeritsian, B.G.

1979. Comment on Stiles 1979.

Current Anthropology 20: 613-615.