

TESTING THE REALITY OF A "LIVING FLOOR" WITH ARCHAEOLOGICAL DATA

Harold L. Dibble, Philip G. Chase, Shannon P. McPherron, and Alain Tuffreau

No matter how "pristine" an archaeological assemblage may appear, archaeologists should always be concerned with documenting the degree and nature of possible postdepositional disturbances. This paper outlines a number of tests that can be applied to archaeological, vs. geological, data to assess these effects, and their use is illustrated in an excavation of a Lower Paleolithic site in France. Although this site was originally thought to contain a possible "living floor" reflecting relatively little postdepositional disturbance, the tests applied here clearly show that both the lithic and faunal components in large part reflect secondary deposits and most probably are only coincidentally associated. From a methodological perspective, this study clearly demonstrates the power of these tests for assessing the taphonomic history of any site containing lithic and faunal remains, and the use of this particular example illustrates the need for these kinds of tests to be applied at the time of excavation.

No importa cuán intacto un conjunto arqueológico pueda aparecer, los arqueólogos siempre deben documentar el grado y la naturaleza de posibles perturbaciones post-deposicionales. Este artículo delinea varias pruebas que pueden ser aplicadas a datos arqueológicos versus geológicos para determinar estos efectos e ilustra su uso con la excavación de un sitio del Paleolítico Inferior en Francia. Aunque se pensó originalmente que este sitio contenía un posible "piso de habitación," reflejando relativamente poca perturbación post-deposicional, las pruebas aquí aplicadas demuestran claramente que tanto los componentes líticos como los faunísticos reflejan en gran parte depósitos secundarios y que probablemente están asociados en forma coincidental. Desde una perspectiva metodológica, este estudio revela el poder de estas pruebas para determinar la historia tafonómica de cualquier sitio que contenga restos líticos y faunísticos, y el uso de este ejemplo en particular ilustra la necesidad de aplicar estas pruebas durante la excavación.

Fundamental to the interpretation of any archaeological site is an understanding of the processes under which it formed. While our goal is to interpret a site in terms of the particular activities carried out by particular groups of people, it is essential to bear in mind that many other natural agents can alter both the position and morphology of the artifacts as well as the composition of the overall assemblage. It is for this reason that studying processes underlying the formation of archaeological sites (Schiffer 1972) has become a major concern of archaeologists. The problem is to separate the behavioral component underlying site formation from other natural agencies; many such agencies, if not recognized, can be mistakenly interpreted as reflecting human behavior alone. In its most general sense, this is

the concern of taphonomy. This term was originally coined to refer to the transition of paleontological material from the biosphere to the lithosphere (Efremov 1940), and, strictly speaking, anything that happens between the death of an animal and the arrival of its bones in the laboratory is the subject of taphonomy (Lyman 1994:3–5, 12–40). However, among zooarchaeologists, it has informally come to refer to the study of factors that, by distorting the faunal record, interfere with the use of faunal data to infer prehistoric behavior—factors such as differential preservation of various bones of the skeleton, destruction of or addition to faunal assemblages by carnivores, and so on (Brain 1981; Gifford 1981; Gifford and Behrensmeyer 1977; Isaac 1984; Sterud et al. 1980). However, archaeology as a whole, not just

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zooarchaeology, is in need of a term to refer to such distortions of the archaeological record. Thus, for want of a better term, taphonomy is used here to cover an even wider range of natural processes that distort the whole of an archaeological assemblage, including lithics and fauna, both during and subsequent to its deposition (Binford 1985; Bonnichsen 1988, 1989; Bordes 1975; Brain 1981; Dibble 1995; Kluskens 1995; Nash and Petraglia 1987; Nielson 1991; Schick 1986).

This paper presents a taphonomic study of lithic and faunal material from the Acheulian site of Cagny-l'Épinette. The study is designed to test the possibility that one of the levels, II, represents a living floor. Although the term "living floor" is used quite often in the literature, it is not well defined. It is often taken to mean a discrete and undisturbed occupation surface, in which the composition and spatial distribution of the artifacts, fauna, and features reflect primarily or exclusively the behaviors of the past inhabitants over a relatively restricted period of time. Such a situation would be important for archaeological interpretation simply because it would present the most accurate reflection of a set of human activities that took place at a site. Unfortunately, the problem is how to verify that such is the case. Here we present an integrated taphonomic approach that focuses on several aspects of the archaeological materials recovered from the site. What is of most interest in this study is that although level II appeared initially to represent such a living floor, the application of several different kinds of tests clearly and unanimously shows that such is not the case. The simultaneous application of these methods at the time of excavation serves as an example of both the power and importance of archaeological data to the question of site formation and postdepositional disturbance. It also illustrates the very real need to carry out studies focusing on taphonomic questions regardless of how "pristine" a site may appear. For this reason, the overall methodology has relevance to New World as well as Old World archaeologists since the integrity of archaeological assemblages and their spatial distribution is a concern for excavations in any period or geographic area.

Background to the Study of Paleolithic Living Floors

In the archaeology of Upper Paleolithic and later

hunter-gatherers, the study of presumed living floors has been a common procedure, at least since the analysis of the Mesolithic site of Star Carr in northeast Britain (Clark 1954, 1972). It is coming to play a major role in the ways archaeologists look at the Upper Paleolithic, especially, perhaps, in the North European Plain. The best known (out of many) such sites include Etiolles (Olive 1988; Pigeot 1987; Taborin et al. 1979), Pincevent (Leroi-Gourhan and Brézillon 1966), Plateau Parraïn (Bordes and Gausson 1970; Koetje 1987), Les Tartarets (Schmider 1975), Verberie (Audouze et al. 1981; Perlès 1976), Gönnersdorf (Bosinski 1979), Meer (Cahen et al. 1979), Gruebgraben (Montet-White 1991), Dolní Vestonice (Klima 1963), Spadzista Street (Kozłowski 1974), Kostenki (Boriskovskij 1958), Mezhirich (Jelinek and Hanzalek 1987), and Mezin (Boriskovskij 1958).

Even in the Middle Paleolithic, claims of living floors are fairly common, for example at Biache-Saint-Vaast (Tuffreau and Sommé 1988), Epouville (Fosse and Lechevalier 1979), Hortus (de Lumley 1972), Seclin (Tuffreau et al. 1985), Ripiceni-Izvor (Paunescu 1965), Molodova V (Chernysh 1961; Ivanova and Chernysh 1965), Vaufray (Rigaud and Geneste 1989), and the sites of Grainfollet, Mont-Dol, Karreg-ar-Yellan, and Kervouster in Brittany (Monnier 1986, 1988). For the Lower Paleolithic such claims have been made in Europe for Bilzingsleben (Mania and Weber 1986), Boxgrove (Bergman and Roberts 1988; Roberts 1986), Swanscombe (Newcomer 1971a; Waechter et al. 1971), Torralba (Freeman 1975, 1978; Freeman and Butzer 1966; Howell 1989), Terra Amata (de Lumley 1966, 1967, 1969a), Lazaret (de Lumley 1969b), the Caune de l'Arago (de Lumley and Boone 1976), the Grotte d'Aldene (Barral and Simone 1972), Mas des Caves (Bonifay 1976), and Baume Bonne (de Lumley and Bottet 1962); in the Near East at Latamne (Clark 1967, 1968) and 'Ubeidiya (Bar-Yosef and Goren-Inbar 1993; Stekelis 1966; Stekelis et al. 1969); and in Africa at Kalambo Falls (Clark 1969, 1974), Koobi Fora (Bunn et al. 1980; Kroll and Isaac 1984), Melka Kunturé (Chavaillon et al. 1979), and Olduvai (Leakey 1971).

Many of these claims for the presence of living floors have been challenged, however, with reference to a large number of factors that potentially

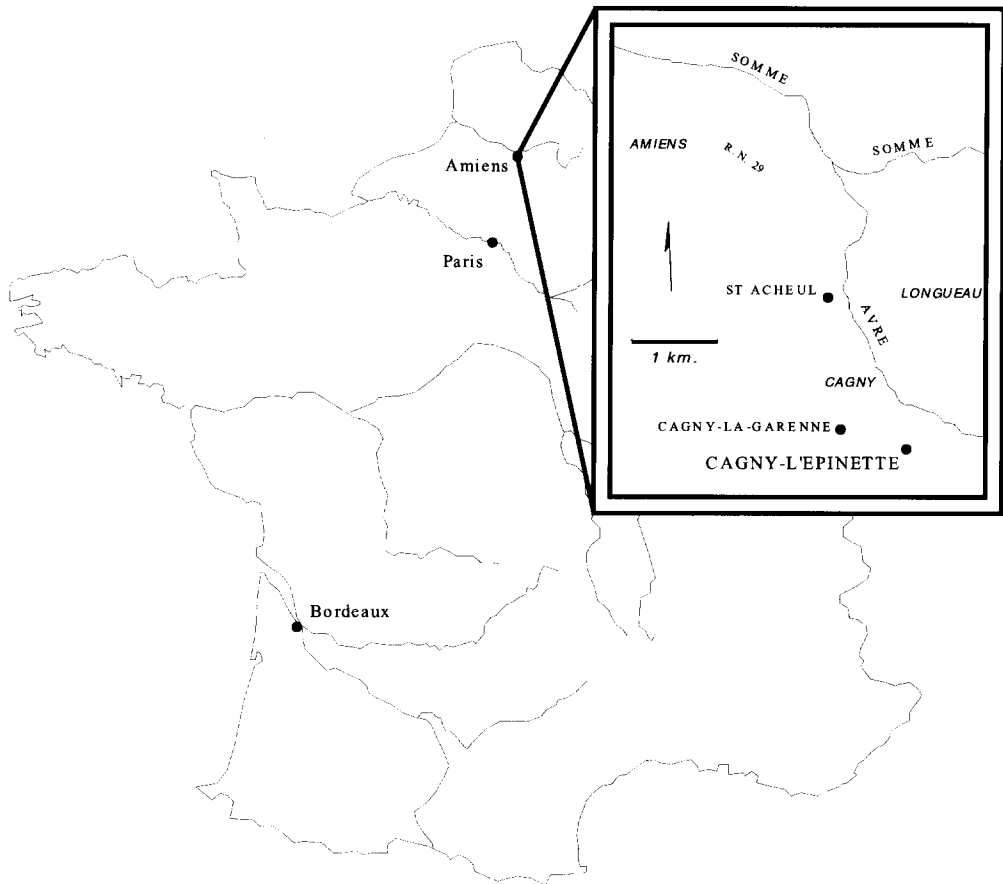


Figure 1. Map showing location of the site of Cagny-l'Épinette.

play significant roles in the formation of an archaeological assemblage. Most commonly, attention is focused on the geological aspects of the surrounding matrix, noting the kind of processes involved in the original deposition of the sediments (aeolian, alluvial, or slope, for example) and the kinds of postdepositional processes that may have later affected them, primarily mass movement and erosion (Butzer 1971; Waters 1992). It is becoming increasingly apparent, however, that the assemblage itself also provides important taphonomic evidence since many of the same postdepositional processes that affect the surrounding geological matrix will also leave identifiable signatures on the assemblages. Thus, among the challenges to claimed Paleolithic living floors, a number have arisen not only from the geological study of the sediments, but also from taphonomically oriented archaeological studies of

the assemblages themselves. Some examples include recognition of a less than tightly restricted vertical distribution of artifacts; evidence for stream deposition, or at least disturbance, based on damage, orientation, and composition of the artifacts; evidence that carnivores rather than hominids were responsible for the accumulation of bones; absence of refits, or refits between apparently separate levels; random distributions of artifacts; evidence of partial mixing of what may have been discrete occupations; evidence from bone weathering that occupation may have been extended or repetitious; natural explanations of what appear to be artificial patterns; and lack of demonstration that all material on a surface belongs to the same occupation (see Binford 1981, 1987a, 1987b; Binford et al. 1988; Boeuf 1976; Bordes 1980a, 1980b; Dibble 1995; Klein 1987; Kluskens 1995; Potts 1984, 1986; Shipman 1986;

Todd 1987; Villa 1977, 1982, 1983). In fact, it is quite difficult to rule out, or even identify and isolate, the effects of all of the various agents that can and do affect the integrity of an archaeological assemblage (see, for example, Chase et al. 1994).

What emerges from this brief review of proposed Paleolithic living floors is that while particular sites are asserted to represent such a context, most claims are almost immediately followed by a counterclaim that the site may have suffered some degree of disturbance. What this suggests is that archaeologists generally do not, at the time of excavation, collect enough of the kinds of data, including archaeological data, that would adequately address the taphonomic history of the sites. At Cagny-l'Épinette, however, where the initial excavations strongly suggested that a living floor was also present, attempts were made to collect suitable data to support the premise.

Cagny-l'Épinette

The open-air site of Cagny-l'Épinette is located in the Department of the Somme, France. It is linked stratigraphically and industrially to the classic Lower Paleolithic sites of northern France (see Figure 1) that have been studied since the turn of the century (Bordes 1952, 1953b, 1956; Bordes and Fitte 1953; Bourdier 1961; Commont 1908, 1909, 1910, 1911, 1912, 1913). Situated in a terrace of the Avre River (a tributary of the Somme), it is only some 500 m from the Acheulian site of Cagny-la-Garenne and not much farther from the eponymous site of St. Acheul. Cagny-l'Épinette has been under excavation by Tuffreau since 1980, and the senior authors of this paper participated in the project from 1991 to 1994. All of the combined data have been utilized in this paper.

The total depth of quaternary deposits at Cagny-l'Épinette is just over 3 m. The lowest deposits (levels H, I, and J, which contain the level II that is the main focus of this article), are stream-laid sediments resting directly on the underlying chalk bedrock. Overlying these is a loess cover. Just over 75 m² of level II was exposed through the 1994 season, though what proportion of the original site this represents is unknown. Based primarily on terrace stratigraphy (Antoine 1990; Biquand 1974), the site has been thought to date to the beginning of oxygen-isotope stage 9, although aspects of the microfauna from the site are more consistent with

stage 7 (Tuffreau et al. 1995; see also Moigne 1989). A more detailed description of the site and the work done through the 1993 season can be found in Tuffreau et al. 1995 (see also Léopold 1993; Tuffreau 1988; Tuffreau et al. 1986).

A number of reasons led researchers to suspect that layer II might represent a single occupation surface, or living, floor. First, the surrounding matrix was initially characterized as fine fluvial (*fluviale fin*) sediments, which appeared to have been deposited in a very low energy environment. Second, Tuffreau's previous excavations suggested that the artifacts occurred in a dense and relatively thin horizontal concentration, implying that they were left on a stable surface. Third, certain concentrations of archaeological material appeared to reflect activity areas of the site.

Beginning in 1991 a number of changes to the excavation and analytical techniques used at the site were introduced in order to collect archaeological data more relevant to actually demonstrate whether or not such an interpretation was valid. These new techniques were designed to focus on several distinct kinds of questions that have been raised in other studies of Paleolithic living floors, namely (1) the degree of disturbance by natural agencies, including transport and winnowing of the material through stream action and the action of carnivores, (2) the degree of disturbance by human actions, either by the removal of blanks and tools due to hominid transport or by the mixing of discrete occupations, and (3) the association between the faunal and lithic components.

Results

In this section various data are presented that touch both on the features of the site that originally led to the hypothesis that a living floor was present and on new observations that are especially relevant to this question. As will be seen below, there is in fact an important gravel component to the sediments, including rather large, unworked flint nodules, which suggests in itself a higher energy of deposition. Also, examination of the horizontal and vertical distributions of different classes of lithic and faunal remains shows no clustering or separation that could be attributed to behavioral causes, and they do not reveal a thin layer of material that could represent a discrete occupation. In fact, the analyses that follow all

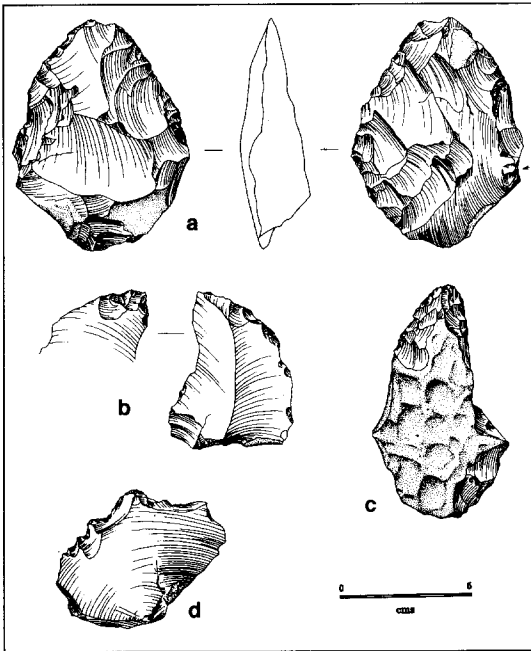


Figure 2. Artifacts from level II: biface (a); flake with interior retouch and exterior edge damage (b); retouched gelifract (c); denticulate (d).

lead to essentially the same conclusion, that the bulk of the lithic material appears to have been at the very least disturbed by stream action and quite possibly redeposited from upstream. It is even possible that a considerable portion of the apparent retouch is the result of stream damage. Most of the fauna apparently were not butchered and probably had nothing to do with any human occupation. Faunal remains, too, were at the very least disturbed by stream action and quite possibly redeposited from upstream, although the distance traveled was not great. In addition, the orientations and imbrications of the lithics and fauna and virtually identical weight distributions of worked flint and unworked gravel imply heavy disturbance by stream action.

Lithic Artifacts

The lithic assemblage from level II is composed of 480 artifacts, plus a number of other unworked flint objects (including naturally broken flint and raw flint nodules). Among the artifacts (see Figure 2 and Figure 3) are a large number of unretouched flakes (226 complete or proximal portions), 51 complete or proximal tools, 24 tool fragments, 19 bifaces, and the rest flake fragments and debris. There are also 16 cores, although most of these are

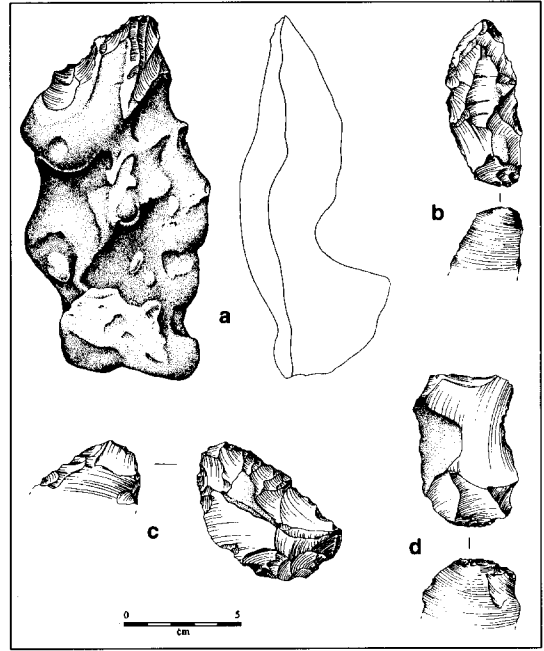


Figure 3. Artifacts from level II: retouched gelifract (a); biface thinning flake (b); bifacially retouched flake (c); biface thinning flake with exterior and interior edge damage (d).

very lightly worked and in most cases exhibit only one or two flake removals.

Technologically, the industry is rather nondescript. There are very few demonstrable biface thinning flakes and virtually no Levallois products. The general lack of biface thinning flakes argues against biface manufacture taking place at the time of occupation. Most of the observable platforms are either plain or cortical, and there are only 15 faceted platforms and 5 dihedral ones. There are no true blades in the assemblage. By and large the industry is fairly cortical, with only about a quarter of the flakes exhibiting no cortex. This would suggest that a very limited degree of core reduction was taking place, although the number of blanks per core is relatively high (17.3 complete/proximal blanks per core).

The same nondescript aspect of this assemblage carries over to the retouched component. There are a total of 260 pieces in the real count, but well over 100 of these are abrupt and alternating pieces (types 46–49 in Bordes [1961] typological system). There are some scrapers (mostly simple types) and a much higher proportion of notches and denticulates. There are also some "Upper Paleolithic" types, including end-scrapers,

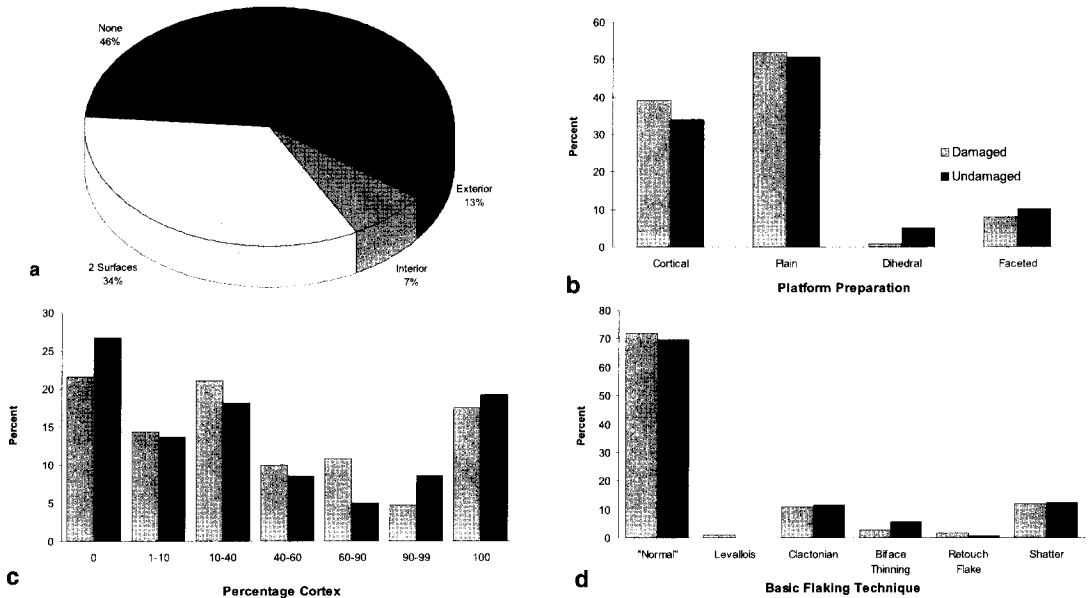


Figure 4. Breakdown of lithic assemblage by character of edge damage (a). Comparison of damaged vs. undamaged series by kind of platform preparation (b), percent of cortex (c); and basic flaking technique (d).

burins, and backed knives, and one truncated-faceted piece. By and large, and except for the bifaces, the tools are not well made and are not at all standardized. In addition, a fairly high proportion of the retouched tools, including one partial biface, are made on natural frost-fractured "gelifracts," which are flint spalls that popped off of nodules during rigorous climatic conditions.

In spite of the abundance of raw material at the site, it is clear that the main behavior was not directed at exploiting it. Most primary exploitation sites are noted for an abundance of cores and large cortical flakes, but generally with a low blank-to-core ratio (Bryan 1950; Butler and May 1984; Dibble 1995; Fowler and Birmingham 1976; Munday 1976; Rehrer 1991; see also Montet-White and Holen 1991). As noted above, however, Cagny-l'EpINETTE does have a number of cortical flakes, but there are very few cores (thus giving it a very high blank to core ratio), and the cores that are present exhibit a minimum of flake removals.

The bifaces from level II fit with the overall character of the lithic industry in that they are highly variable in terms of size, morphology, and technology. They range in maximum size from over 160 mm to under 80 mm and in shape from limande and cordiform through to elongated lanceolates. Lastly, as regards technology, most of the bifaces appear to be made on readily available

flint nodules, although one biface is clearly made on a flake blank and another on a gelifract. The highly variable nature of the biface industry may suggest a degree of mixing or multiple occupations, or that factors such as size, morphology and technology were less important than simply achieving a bifacial edge. On the other hand, it may also reflect a mixture of tools due to geological redeposition.

There is no question that a sizable proportion of the lithic assemblage is of hominid manufacture—there are several clear bifaces and many flakes—though it is not clear that this is true of the entire industry. In fact, there are many lines of evidence that suggest that several significant aspects of the industry are simply due to natural agencies, specifically the transport of objects by stream action.

The first indication of transport is the edge damage that is exhibited on a large number of the pieces. As shown in Figure 4a, over half the objects (including both retouched and unretouched blanks) do exhibit macroscopic edge damage. While some of this may have resulted through use or manufacture, damage of this sort, in both its frequency and intensity, often reflects postdepositional transport. Significantly, on most of these pieces the damage is located on both surfaces, which is more consistent with its being the result of movement such as stream rolling than to

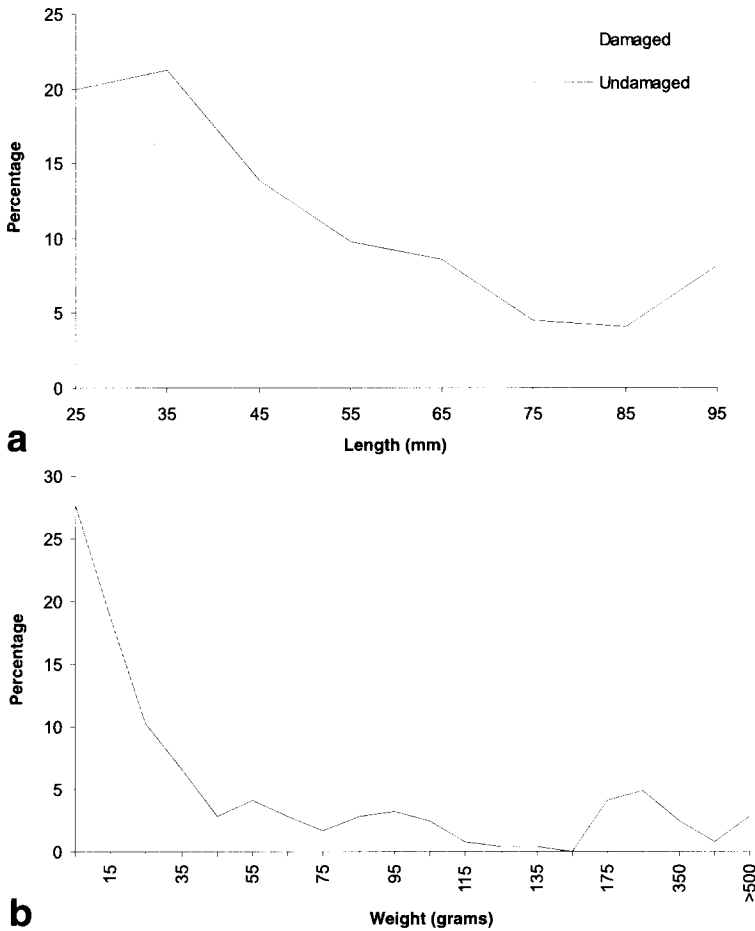


Figure 5. Comparison of damaged vs. undamaged lithic series by length and weight.

trampling or other disturbances that might have taken place in situ.

On the other hand, not all of the pieces are damaged. While the damaged component may have been subjected to transport mechanisms, it does not automatically follow that the rest of the assemblage—the undamaged component—was transported in as well. In other words, it could be that some lithic material was washed in while other artifacts were deposited in situ. However, as shown in Figure 4b–d, the damaged and undamaged components are virtually identical in their morphology, and they also exhibit the same size distribution (Figure 5). It would seem unlikely that two unrelated assemblages, one derived and one deposited in situ, would be so similar in composition. Thus, if some pieces were damaged as a result of stream transport, it would suggest that the whole assemblage was transported.

However, it is not always easy with this assemblage to determine whether the retouch observed on the pieces is the result of intentional modification or was itself just a reflection of transport. It is generally acknowledged (Bordes 1953a, 1961:46; Bordes and Bourgon 1951:17; Dibble and Holdaway 1993; Verjux 1988) that postdepositional artifact damage can significantly alter an assemblage in ways that resemble behavioral modifications. For example, edge damage such as that described here can be difficult to differentiate from macroscopic use wear, and it can also be easily mistaken for retouch. This is especially true in the case of notched and denticulated types. Trampling studies (Bordes and Bourgon 1951:17; Flenniken and Haggerty 1979; Nielson 1991) have shown that these types in particular can occur as a result of postdepositional processes. In fact, some Paleolithic industries that exhibit a high frequency

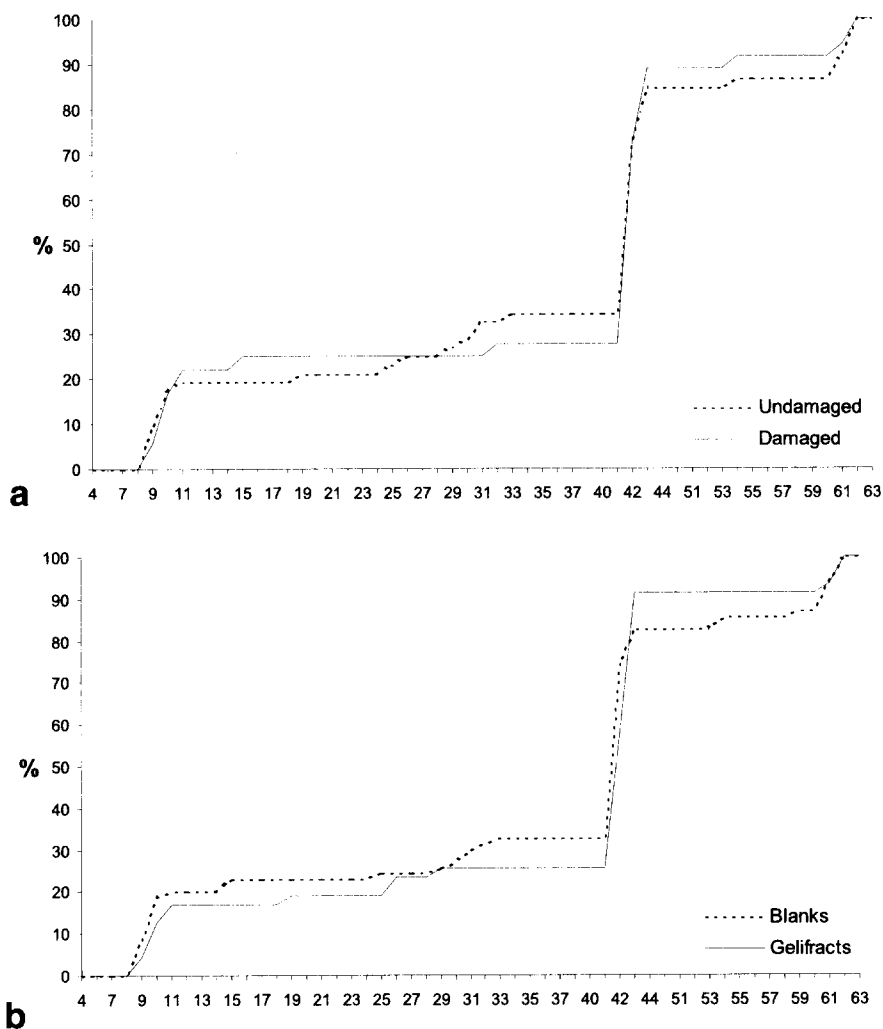


Figure 6. Essential cumulative graphs showing typological breakdown of Cagny-l'EpINETTE retouched tools. Comparisons of damaged vs. undamaged series (a) and retouched flake blanks to retouched gelifracTs (b).

of such types, notably many examples of "Tayacian," are often associated with disturbed geological contexts (Bordes 1953a). Unfortunately, these are the dominant types in the Cagny-l'EpINETTE flake tool assemblage.

As mentioned above, there are a large number of "tools" made not on flakes but on naturally occurring gelifracTs. These can be quite large and in some cases difficult to distinguish from actual flakes. To make it more difficult, many show extensive edge damage and surface abrasion clearly due to rolling.¹ For the most part these were considered to be unworked and not included in the type counts, except when a piece exhibited double patina or if the retouch appeared to be rel-

atively fresh and/or deliberate. What is disturbing is that the typological composition of the gelifracT tools (Figure 6b) almost exactly matches the typological composition for the flake tools—those that were made on flakes. Now, there is no reason why the retouch on these former pieces could not have been put there intentionally (in fact, there is one clear biface fashioned from a piece of frost-fractured flint). But it is also clear that many of the gelifracTs were transported into the site through stream action. Again, if the retouch on them, or what must be counted as retouch, is primarily due to that transport, then it suggests the same for the retouch occurring on the real flakes.

Another way to approach the question of

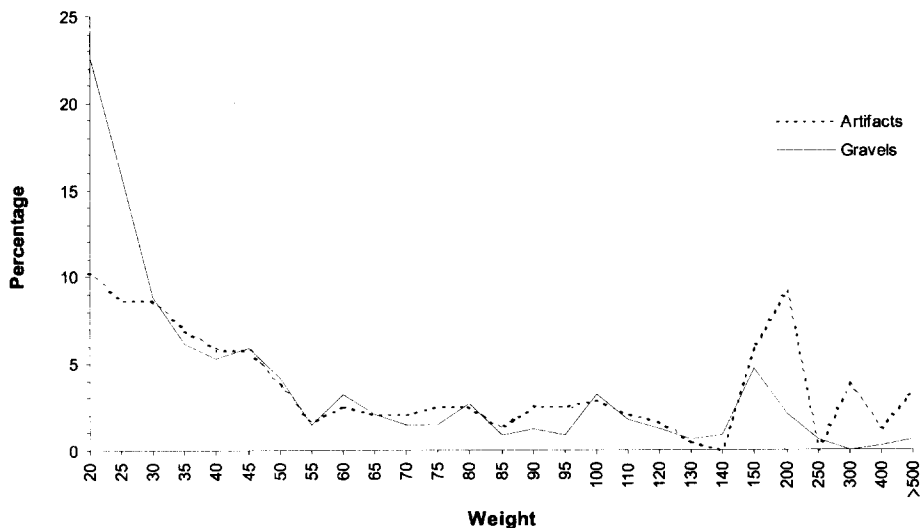


Figure 7. Weight distribution of all lithic artifacts (excluding retouched gelifragments) compared with distribution of combined sample of sediment.

whether or not the lithic assemblage was derived is to compare size distributions of artifactual material and nonartifactual material from the same bed. Clearly, level II is composed of fluvial sediments, and so the size distributions of these particles will reflect stream loads at the time of their deposition. If the lithic artifacts were deposited *in situ* by hominids occupying the site, then their size distributions should be quite different. In fact, Bed II contained a significant gravel component, and, as shown in Figure 7, the gravel and lithic artifacts are virtually identical in size. To make this comparison, a total of 14 seven-liter samples of sediment from level II were randomly selected and all of the nonartifactual particles were individually weighed. In the figure, the distribution of the combined sediment samples is shown superimposed with that from the entire aggregate of lithic artifacts from level II. The fact that the distributions match so well suggests similar processes of deposition for both classes of material. This in itself suggests a higher energy environment than would be implied by the description "*fluvatile fin*."

Beginning in the 1992 season, wet screening was implemented to recover small artifacts. In terms of taphonomy, size sorting is important for recognizing many kinds of geological disturbances, especially movement by water. If large artifacts are concentrated where fine material is

scarce, for example, this could indicate significant disturbance of the artifactual material due to the winnowing out of the smaller fraction by stream erosion. Conversely, on-site tool manufacture and reduction, as evidenced by small resharpening and preparation flakes, is one criterion for an occupation surface where maintenance activities (core reduction, tool production, and tool reduction) were taking place (Cahen et al. 1979; Sullivan and Rozen 1985).

Figure 7 shows that the smallest fractions of worked lithics are underrepresented, but this is partly because only numbered artifacts were included here and therefore the artifact distribution reflects the minimum size cutoff used in excavation. However, small lithic artifacts were clearly underrepresented even in the screened samples, which were cleaned and sorted under controlled conditions.² Out of a total 292 samples, each representing the material recovered from a seven-liter bucket of sediment with a 3-mm mesh, only an average of 3.81 flakes or flake fragments (with an average combined weight just over 1 g) were recovered from each. Numerous experiments clearly show that the number of small flakes should be greater than larger flakes by several orders of magnitude under conditions of normal manufacture and maintenance (Amick and Mauldin 1989; Kluskens 1995; Newcomer 1971b;

Schick 1986). Their almost total absence here strongly suggests a significant winnowing out of the smaller material due to stream action.

In sum, the lithic artifacts exhibit a high degree of damage and match the nonartifact matrix in terms of weight distribution, although almost all of the smallest fraction of flakes are missing. Taken together, this suggests that the lithic assemblage at Cagny-l'Épinette was at least significantly affected by stream action and that most probably it was washed into the site along with the surrounding matrix, rather than deposited in situ.

Zooarchaeological Studies of the Faunal Material

The faunal material used in the taphonomic study consisted mostly of the material from level II that had been studied by the paleontologist (Anne-Marie Moigne) before the summer of 1994. This consisted of material excavated in 1988, 1989, 1990, and 1992. Only parts of the material excavated in 1991 and 1993 were available for study; these were excluded because it was impossible to determine if they were representative or biased in terms of their priority for paleontological identification. The number of specimens used were *Bos*, 276; *Cervus*, 59; *Equus*, 8; and 333 specimens not clearly identifiable to genus. As reported previously by Moigne (in Tuffreau et al. 1995), these are the principal faunas from level II. The majority of *Bos* specimens apparently came from juvenile animals. Of the bones where epiphysal fusion could be observed, 68 percent were either unfused or partially fused.

In the ground, the bones were extremely fragile and friable and many, even heavy dense ones, broke in the course of excavation or crumbled due to uneven drying before they could be removed. A few bones had been crushed in situ, apparently by the weight of overlying sediments. However, when dried, the bone surface is in excellent condition. Only 22 of the specimens show signs of weathering, and, except when the surface was obscured by carbonate deposits or consolidants used during excavation, it was possible to examine the surfaces for marks. Traces of carnivore gnawing are evident on very few specimens.³ Any significant attrition to the assemblage would therefore appear to have been due to stream action before deposition and to chemical action after deposition.

Traces of human butchery in the Cagny-l'Épinette faunal remains are very rare. As Moigne (Tuffreau et al. 1995) has already reported, such traces usually consist of (a) stress fractures typical of those made by humans in their efforts to access marrow and (b) traces of cutting with stone tools. However, as the data she presented show, such traces were very few in number. In addition, it has been shown that natural causes can produce both cut marks and fractures that mimic those made by human butchers. Especially in a matrix of flint gravel, such as occurs here, marks may be the result of contact between bones and sharp stone edges caused either by trampling by animals or by stream action (Behrensmeyer et al. 1986)—such cut-mark mimics have even been observed in paleontological sites from the Miocene (Behrensmeyer et al. 1989). Several specimens bear very light, randomly oriented scratches that almost certainly resulted from being rolled or dragged along the stream bed. One *Bos* rib with the proximal epiphyses fused (21X-14-0) bears a wavering gouge that would have required a great deal of pressure to make and could not have resulted from butchery. It is, however, exactly what one would expect to see had the bone been scraped across a stone when stepped on by a large animal such as *Bos*.

Only five other specimens have traces of what might conceivably be tool marks: (1) an adult *Bos* first phalanx (19X-10-9) bears a series of short, light subparallel cuts; (2) an *Equus* fourth metatarsal (24W-16) has two cuts across the lateral surface about 2 cm below the proximal end, such as could result from disjuncting the tarsal-metatarsal joint; (3) a *Cervus* antler (21M-34) also has a cut mark, but it is difficult to attribute this to butchery, especially since such marks occur naturally on unshed antlers (Olsen 1989); (4) a partially fused proximal anterior rib fragment (21N-17-0) with most of the head and tubercle missing has a possible cut mark across the face of the shaft opposite the tubercle; (5) an adult *Cervus* canon bone (metatarsal III+IV) (15Y-3-8) has cuts adjacent to and parallel to the proximal articulation. This last specimen is the surest sign of human butchery.

The remarkable thing about these data is their paucity. For *Equus* and *Cervus*, this is perhaps explainable by the relatively small sample of

remains. For *Bos*, especially juvenile specimens, there is only one possible conclusion: this species was either not used or only very lightly used by humans. This conclusion is strongly reinforced by the lack of evidence for fracturing of bones for marrow. Only a few *Bos* specimens show the kinds of fractures one would expect from marrow extraction: eight long bones and one first phalanx with fused epiphyses. Among these are only three possible juvenile specimens: a fragment of humeral shaft (adult or juvenile status indeterminate) that also bore scratches and marks of carnivore teeth (21S-50-0); a fragment of femoral shaft whose adult or juvenile status was also indeterminate, but that from the state of the bone appeared to be adult (25W-11); and the distal portion of an unfused diaphysis of a *Bos* radius (17Z-5-9). On this last specimen, the break is obscured by consolidant. Judging by what can be observed in spite of the consolidant, the break is probably not the kind of helical fracture typical of marrow extraction.

This last specimen, unlikely though it is, is the only subadult specimen studied that had a possible percussion fracture. The other two may have been juveniles, but this is not demonstrable. Thus, there is almost no evidence that the largest single class of animal in level II, young *Bos*, was butchered at all, and no evidence that its presence in the site is due to human activity rather than natural causes. Among the adult *Bos* bones, evidence for intentional breaking is also weak. The strongest candidates are a radiocubitus (17Z-2-9), a first phalanx (20X-1-9), and especially a metacarpal (21M-42), where the break was through bone so heavy and dense that stream action certainly cannot have caused it. However, Haynes (1983, 1986) has documented the breaking of both elephant and bison long bones due to trampling by members of their own species. Since both dynamic (percussion) and static (pressure) loading produce extremely similar fractures (Lyman 1994), the morphology of a single break gives little clue as to the cause. Given the paucity of fractured bone in this assemblage, it is not clear that those fractures one does observe are due to hominid action. Certainly there is no consistent pattern of fracturing bone for marrow.

Regarding the butchering of the animals represented in level II, therefore, it can be said that young *Bos*, the most common class of animals,

was either completely or essentially unexploited by humans, and there is no evidence that they owe their presence in the deposits to human activity. Some specimens of *Equus* and adult *Bos* show probable signs of exploitation, which may suggest that they were very lightly exploited. However, such traces are few, and it should be emphasized that the bulk of the specimens in the site do not show any evidence reflecting human activity. Based on the evidence of a single bone, it could be that *Cervus* was butchered, although obviously the sample of material from this species is so small that it is impossible to reconstruct the kind of exploitation or activity involved. Moreover, it is doubtful that the most obvious remains of this species, its antlers, had anything to do with human occupation, since they showed no definite signs of use by humans. Other sites, both archaeological and paleontological, have been reported with high frequencies of antler (e.g., Grotta Guattari [see data in Piperno 1976 and analysis by Stiner 1991], and Tönchesberg [Conard 1992]). The reasons for such accumulations are therefore at present unknown. In any case, even if the *Cervus* remains at the site are in situ, they make up such a small percentage of the whole assemblage that they cannot provide a *raison d'être* for the site.⁴

The refitting of artifacts and bones, while not a panacea (Bordes 1980a, 1980b), is one necessary part of the process of evaluating the reality of an occupation surface, and patterns of vertical lithic refits have also been used to test the unity and the discreteness of a hypothesized living surface (Villa 1982, 1983). Refits of animal bones are also crucial and, in demonstrating that a level represents a discrete occupation surface, may be even more important than lithics: cores and flakes may be reused and remodified months, years, or even millennia after initial abandonment (McDonald 1991), but meat rots quickly and therefore its use and distribution should reflect a more restricted unit of time. Thus, the horizontal distribution of refitted faunal elements (whether between parts of a broken bone or between bones from the same animal) can provide important clues about the contemporaneous use of a surface and the minimum size of the area in simultaneous use (Enloe and David 1989). It is also conceivable that overlapping occupations could be distinguished from one another, on the basis of refits on a rather fine vertical scale.

Refits recognized in the process of paleontological analysis were recorded by Moigne, and others were recognized in the process of zooarchaeological analysis. Because faunal refits are not always definitive, each refit was assigned a estimated probability between 0 and 100 percent, based on the closeness of the fit between the specimens and the nature of the refit (across a break, an articulation, a suture, and so forth). Of the 14 assigned a probability of 90 percent or better, two indicated considerable movement of bones that could not be attributed to human activity. Both were proximal epiphyses that refit with their respective diaphyses-plus-distal epiphyses: the first, a *Bos* first phalange found 7.27 m apart (19Z-1-9 and 21S-30-0); the second, a *Bos* second phalange, found 7.24 m apart (21S-35-0 and 18Y-13-9). Because the movement must have taken place after the soft tissue was quite thoroughly decayed, this movement cannot be attributed to human action. In addition, there were no refits indicating significant movement of bones that could be attributed to human activity (e.g., butchering). It should be stressed, however, that available data on refits is limited at this time, and systematic search for refits must await the end of the excavation.

Spatial Distributions and Artifact Orientations

One reason that an occupation surface or living floor is of such interest to archaeologists is that it permits them to use the spatial patterning of artifacts to analyze hominid behaviors across the site. Some sites where material has been moved subsequent to occupation, or sites where a number of occupations have become superimposed and thus inextricably commingled, may still be of considerable interest in certain regards, but only a relatively few Paleolithic sites hold clues to the behavior of the site's inhabitants as revealed through the horizontal distribution of remains.

It is important to bear in mind that while a site may exhibit a certain degree of non-random spatial patterning of artifacts, it is not always true that all spatial patterns can be attributed to behavioral rather than natural causes. Clearly, certain kinds of spatial patterning can also be produced by natural causes. Artifacts in a stream environment, for example, will be sorted by weight and density, and

certain areas of the site may be more subject to erosion or deposition than others. To rule out the role of natural agencies, it must be shown that phenomena believed to have behavioral implications must be differentially distributed across the site. Such phenomena include different classes of lithic artifacts (tools vs. debitage, etc.), remains of different species, or parts of the skeleton of one species that are associated with different kinds or amounts of useful material, such as meat or marrow. If patterning of these kinds is found, and it is related not only to weight or density of the objects, then it implies that the cause was a spatial organization of different activities by the hominid occupants of the site. However, if such patterning is absent, it is much harder to make the argument that the site represents an undisturbed occupation surface.

It does not follow, however, that a simple examination of the *horizontal* distribution of such variables within level I1 would be sufficient. Such a procedure would be valid only if the material resulted from a single, brief occupation. However, such an occupation, if undisturbed, could not have produced the depth of the archaeological deposits in level I1 (see below). If it is undisturbed, the assemblage must instead represent multiple superimposed occupations, each of them horizontally differentiated in terms of activities. In such a case, a simple overall horizontal examination, by mixing several occupations, could produce a false randomization of the artifact distribution. In this case, however, three-dimensional examination should turn up "lenses" of behaviorally interpretable material, each of them representing a specific activity area within one occupation horizon.

The material from level I1 was examined by breaking both lithic and faunal material into such behaviorally meaningful classes. For the lithics, these were bifaces, cores, scrapers, and denticulates. This was done on the assumption that different classes of material will be left behind by different activities, such as core reduction or tool manufacture/maintenance, butchering, and so on. Faunal remains were broken down by species in order to investigate either different processing of different animals or different episodes of hunting (or scavenging). For *Bos*, the only genus numerous enough for such analysis, the elements were grouped into cranial, postcranial axial, proximal

limb, and distal limb bones. These are major categories of bone known to be associated either with different kinds or qualities of resources (e.g., brains and tongue vs. marrow, different fat values of marrow) or different quantities of meat relative to bone (i.e., proximal limbs are meatier and therefore have less dead weight than distal limb bones) (Binford 1981; Lyman 1979; Speth and Spielmann 1983). Different treatment of these parts of the carcass during butchering or consumption is thus to be expected and is found even among non-humans (e.g., Blumenschine 1986).

The distributions of these variables were examined using (1) horizontal plots; (2) stereoscopic plots that showed artifacts in real three-dimensional space (not illustrated here); and (3) plots of vertical slices through level II made along both the X and Y axes and using different thicknesses of slicing. It should be emphasized that the figures shown here are illustrative examples and represent only a very small portion of the plots actually inspected.

One of the defining characteristics about any living floor is that it represent a very limited vertical dispersion or, in other words, a thin occupation surface. In fact, however, the artifacts and fauna from Level II are scattered through a thickness ranging from 11 to 64 cm, with an average thickness of 36.6 cm. This represents virtually the entire vertical spread of the geologically defined bed and would not normally be taken to represent a distinct surface. Furthermore, there are no discernible vertical separations into two or more dense layers separated by poorer sediments. Further, none of the horizontal distributions examined (see Figures 8, 9, and 10) shows any patterning that unambiguously points to different activity areas. While there are areas of denser vs. poorer artifact concentrations, such sorting is to be expected in a fluvial environment.

Thus, on the grounds of spatial distribution alone, which does not show any clear behavioral patterning, it cannot be argued that the material in level II represents a living floor or even a series of living floors. This is not the same thing as saying that, in themselves, these data prove that it is not a living floor. It is still possible that the lack of patterning seen here may have resulted from superimposition of several ephemeral occupations to the point that one cannot be distinguished from the

other. The vertical depth of the artifacts may reflect this. Unfortunately, even if it did, this would also mean that it would simply be impossible to study behavior at Cagny-l'Épinette using spatial data simply because there is no way of separating out these various lenses.

Orientation data was obtained for clearly elongated artifacts by recording the x, y, and z coordinates of the two endpoints and calculating both the horizontal (strike) and vertical (dip) orientations. These provenience measurements were taken with an electronic theodolite (Dibble 1987; Dibble and McPherron 1988; McPherron and Dibble 1987), which is a very precise and accurate method of recording. Horizontal orientations provide one way of detecting stream flow because objects moved by a stream are typically oriented either parallel and/or perpendicular to the direction of stream flow or slope (Blatt et al. 1980; Isaac 1967; Kelling and Williams 1967; Kluskens 1995; Rick 1976). In addition, vertical orientations of artifacts deposited on a surface normally follow the contours and topography of that surface, while the dips of artifacts disturbed by trampling, bioturbation, and other processes should be random. Stream action also tends to dip down, or imbricate, the upstream end of artifacts as the current removes fine sediments from the this upstream end of an object and redeposits them behind the downstream end (Briggs 1977; Kluskens 1995; Schick 1986; Sengupta 1966). Unfortunately, the orientations of the Cagny-l'Épinette material tend to follow these patterns and thus point to significant disturbance by stream action.

The horizontal orientations of both the lithic and faunal objects show a reorientation of the pieces from a random pattern that would be expected from an in situ occupation. As shown in Figure 11, there is a clear tendency for the artifacts and bones to be aligned according to two major axes, at 40-220 and at 90-270, and minor axes perpendicular to those. The first of these corresponds roughly to the direction of flow of the Avre River at the time of deposition, while the 90-270 axis follows the slope of the terrace. Such alignments, both parallel and perpendicular to the direction of terrace slope and stream direction, strongly suggest disturbance. Even more telling is that the alignment of the artifacts follows closely the alignment of the nonartifactual material

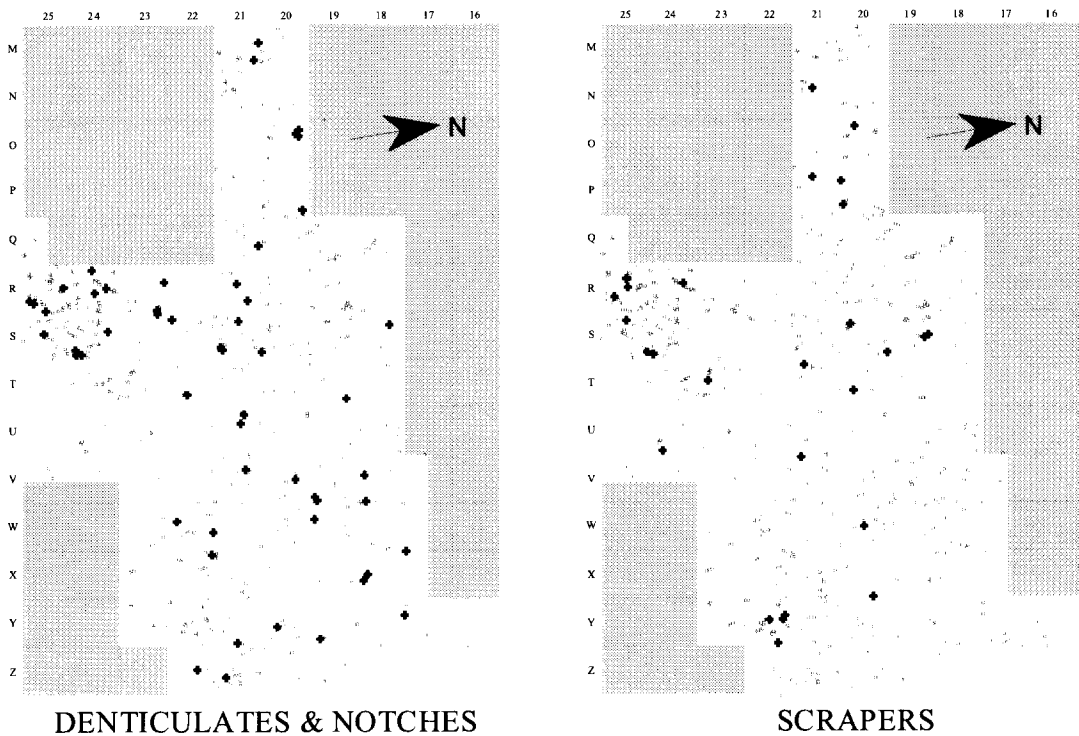


Figure 8. Horizontal distributions of lithics from level II. All lithics are represented in each plot, although the filled circles correspond to the specific classes named at the bottom of the plot. Shaded portions represent unexcavated areas of the site.

(unworked flint, see note 1), which would be unexpected under two different processes of deposition, one by hominids and the other by stream action.

There is also significant agreement between the natural and artifactual data in terms of the vertical orientations. Both sets of data show strong alignments near the horizontal, with minor spikes close to the perpendicular. In this figure, the upstream direction is toward the right, which means that any imbrication would be reflected by a clockwise rotation in the figure. Given the slope of the deposits themselves (as seen in section views of Figures 9 and 10), then an average dip close to the horizontal actually indicates some degree of imbrication in the predicted direction.

Summary and Conclusions

The taphonomic study of level II at Cagny-l'Épinette was directed at determining whether or

not the level represented a living floor, in the sense that both site formation processes and postdepositional factors had produced an archaeological deposit that could be used to reconstruct the behavior of the hominids who occupied or visited the site, in particular by means of spatial analysis. Criteria for determining whether or not this was the case were based on many independent observations taken on both the lithic and faunal material.

Virtually all of these data are in agreement in suggesting that, at least to some extent, the material from level II was disturbed through stream action and thus not in the place of its primary deposition. Different portions of the archaeological material may have been affected to differing degrees. At the very least, some or all of the lithic artifacts and bones may have been deposited at the site but subsequently disturbed by stream action; it is most likely, however, that some or all of them

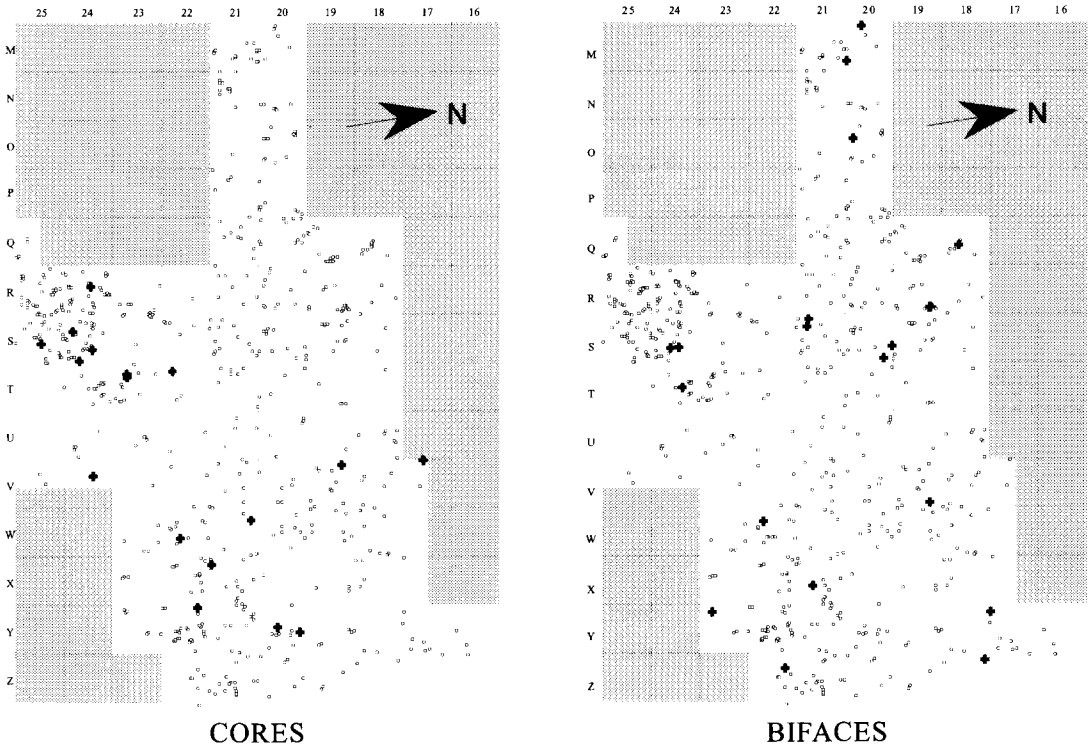


Figure 8 (continued).

were washed downstream and redeposited at the site.

While there are many lithic artifacts, including the flakes, bifaces, and other tools that clearly show hominid manufacture, the considerable edge damage on the pieces suggests a significant degree of transport, and this, in fact, may be responsible for much of the typological character of the assemblage. The nature and extent of this damage, the random spatial distributions, the alignment of the orientations, and the almost total lack of small lithic debris all suggest a considerable degree of postdepositional disturbance. Arguing for the interpretation that the lithic material was derived, and not simply damaged, in situ is that many aspects of the industry matches the nonartifact component, which is certainly not a result of hominid activity. Thus, our ability to analyze this assemblage in behavioral terms is severely limited, both in terms of the composition and character of the assemblage as well as its spatial distribution.

Several sets of faunal data—the unpatterned horizontal and vertical distributions of the material, orientations of the bones, sediment scratches, and refits—all indicate that these remains were disturbed as well. It is also possible that many of the animals died upstream and their skeletal remains were washed downstream and eventually deposited at this site. However, if this happened, the bones themselves may not have moved very far, since they show only relatively light signs of stream damage. (For comparison, bones carried 1.5 to 3 km in a sandy stream bed showed abrasion that removed the external laminar bone [Behrensmeier 1982].) On the other hand, it is possible, given the lack of evidence of human or carnivore exploitation, that the complete carcasses of some animals, in particular the young *Bos*, may have floated downstream to this spot and subsequently decayed there, thus resulting in the minimal damage to the bones themselves.

Little evidence supports more than a coincidental association between the lithics and fauna, as

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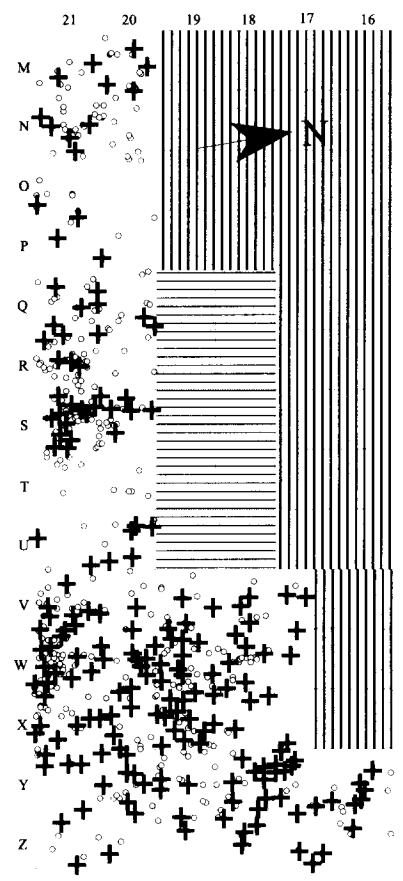
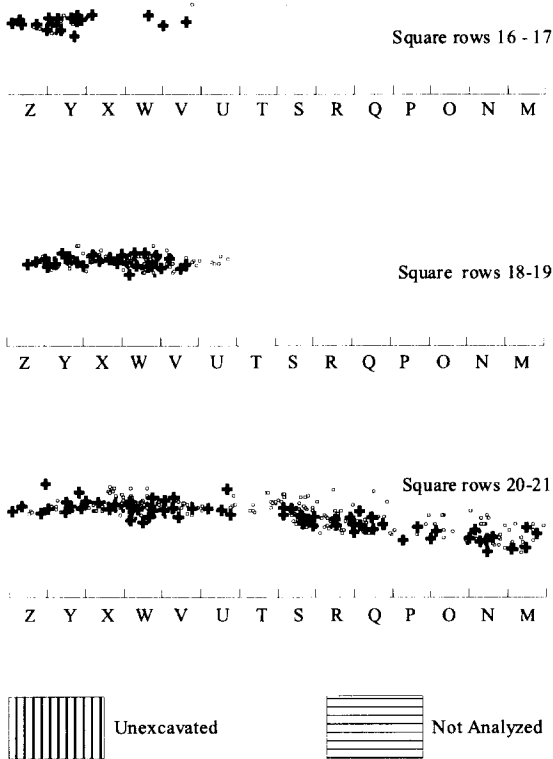


Figure 9. Vertical and horizontal distribution of *Bos* remains in bed II (filled circles) and of other faunal remains (open circles). Vertical distributions represent 2-m-thick “slices.” To avoid false clusters due to the fragmentation of a single bone, only those *Bos* specimens that would be used to calculate MNI are highlighted. These specimens are fragments (such as whole teeth or proximal tibiae but unlike long bone shaft fragments) whose number in the skeleton can be defined.

illustrated by the very few bones that show any signs of butchering. Given that such a minute portion of the faunal remains shows any signs of human exploitation, the zooarchaeological interest of this particular assemblage is virtually nil. On the other hand, the large sample of juvenile *Bos primigenius* remains means that, especially in terms of the growth and development of this species, the site is clearly of real paleontological interest.

While these results are generally negative in terms of the archaeological potential of Level II at Cagny-l’Epinette, it is quite possible that further work at the site may uncover other levels that do represent true occupational surfaces. But beyond

the implications for this particular level, these results carry with them some very important lessons for archaeologists working with material from virtually any period of prehistory.

The first and most important lesson is that however undisturbed a site may look in the course of routine excavation, there is simply no way of understanding its taphonomic history without a rigorous and comprehensive set of tests of the archaeological material. These tests must be incorporated into the excavation strategy. It is one thing to excavate a level as though it were a living floor, but in general the kinds of data needed to demonstrate such an interpretation, such as orientations and screened fractions, must be obtained during

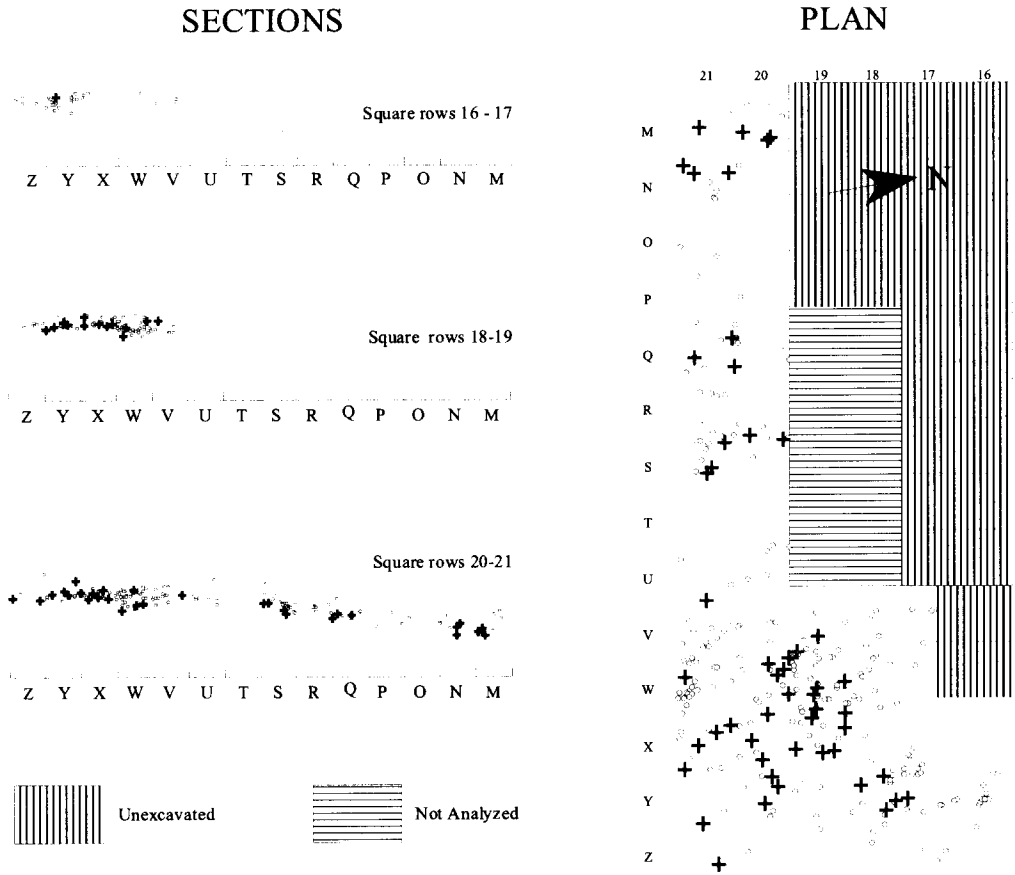


Figure 10. Vertical and horizontal distribution of *Bos* axial skeleton (filled circles) and of other specimens of *Bos* (open circles) in bed II. Vertical distributions represent 2-m-thick “slices.” To avoid false clusters due to the fragmentation of a single bone, only those axial specimens that would be used to calculate MNI are highlighted. These specimens are fragments (such as whole teeth but unlike cranial fragments) whose number in the skeleton can be defined.

the excavation. Many of the findings concerning the lithic artifacts that were most relevant to testing the validity of the Cagny-l’Epinette living floor were based on data that probably would not have been recorded in the absence of an explicit intent to perform such a test. It is important to stress that Level II at Cagny-l’Epinette did initially appear to be an excellent candidate for a living floor, and it was only on the basis of such tests that this interpretation was shown to be false.

Second, this study again emphasizes that the taphonomic investigation of a site must involve not only analysis of its geological context, but also of the archaeological material. As this site clearly demonstrates, these two lines of evidence are inde-

pendent, at least to some extent. Moreover, archaeologists and geologists have somewhat different interests and therefore somewhat different ideas about what constitutes disturbance or lack of it. In fact, different archaeological questions require different kinds of archaeological integrity. For this reason, it is important to test whether or not the archaeological material from a site is amenable to a given kind of analysis, whatever the geological context. (For an contrasting example, one that illustrates that archaeological material may have sufficient integrity for some purposes even when the geological sediments indicate disturbance, see Dibble 1995).

Third, it is very important to apply as many

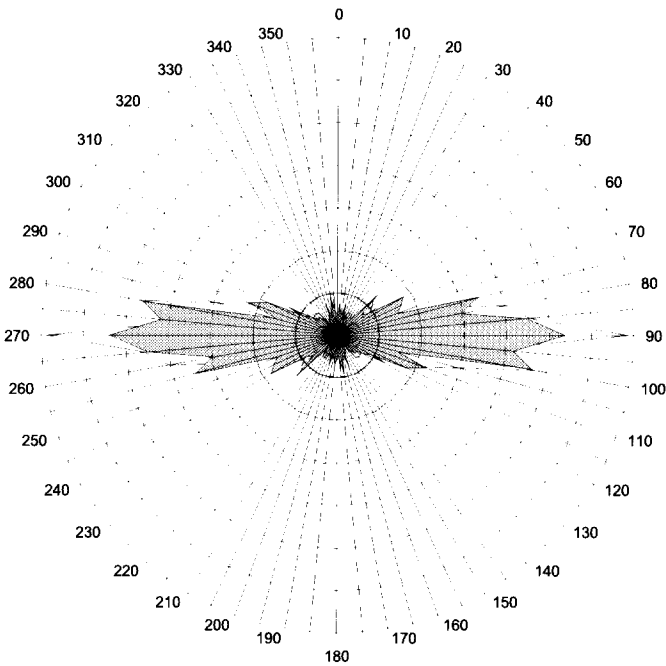
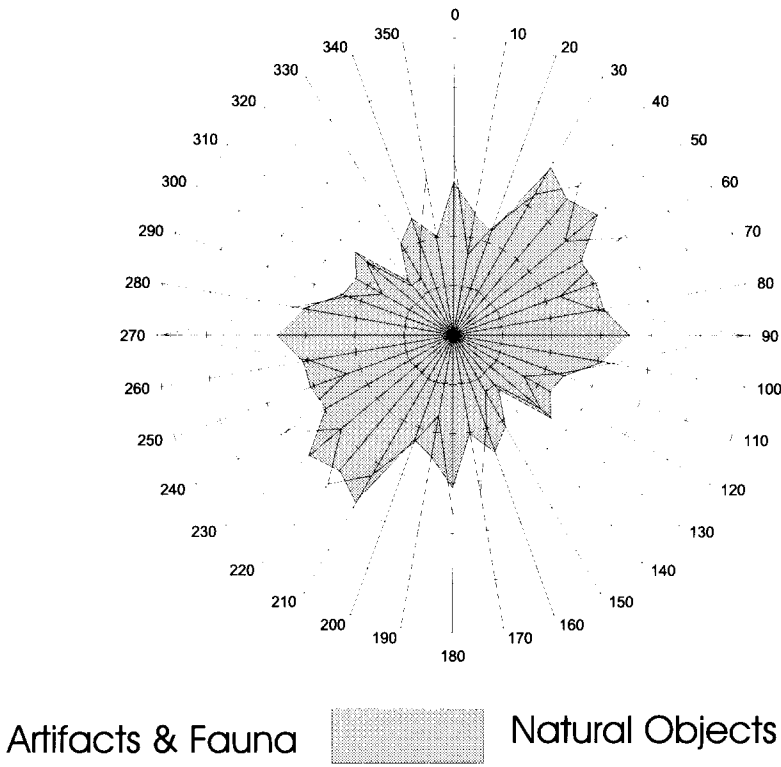


Figure 11. Horizontal (“strike”) orientations of lithic artifacts and fauna compared with nonartifactual material (top). Note that the 0–180 axis corresponds to the grid north used in the excavation, which is actually oriented more toward magnetic west. At the bottom, vertical (“dip”) orientations of same data set as used in a. The 0–180 axis represents the true horizontal through the N–S grid axis of the site, with the direction of stream flow from right to left.

tests as possible. In the present study, a number of different observations all combined to indicate disturbance or redeposition. In fact, it would be easy to dismiss any one of these patterns if it were considered in isolation. The lack of butchering evidence on the young *Bos*, for example, could reflect the cutting of cartilaginous tissue; the high blank-to-core ratio could have resulted from the importation of flake blanks; and it would definitely be wrong to say that any industry dominated by notches and denticulates has suffered from postdepositional disturbance. But while any number of arguments could be advanced to explain each of these aspects of the industry, there are other lines of evidence, such as the identical weight distributions and orientations of both artificial and natural objects, that cannot be explained in behavioral terms. The fact is that while all of these results can be explained in terms of taphonomic processes, it is much more difficult, if not impossible, to account for all of them in behavioral terms.

Finally, it is worthwhile to emphasize again that there is always a very high probability that any site has suffered some degree of postdepositional disturbance. It is not just a question of whether a site is in situ or not, but rather the nature and extent of the disturbances. While we all would like to be the one to find a prehistoric Pompeii, all of our reconstructions of human prehistory will be far more accurate if they are based on a thorough understanding of taphonomy and its effects on prehistoric assemblages.

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Notes

1. The difficulty of identifying worked objects from unworked but damaged gravels and gelifracsts led us to instruct all excavators to collect and plot any piece that showed signs of possible modification. After cleaning, the artifacts were then analyzed more carefully and, if necessary, reclassified as unworked. Such objects form the basis of the orientation studies, presented later in this paper, that compare the artifactual and natural objects.
2. Although wet screening of the sediments was started in 1992, most of the recovered material was mistakenly discarded during the off season in 1993, before full analysis of it was undertaken. The data presented here represent a 100 percent sample from the 1994 season and a small portion of material recovered earlier.
3. Seven specimens had good evidence of carnivore chewing; 11 had questionable traces.
4. It should be noted that two bones do carry traces of hominid activities other than butchering (see Tuffreau et al. 1995). An adult *Bos* right metatarsal (20Q-25-0) has a series of short parallel grooves (not cut marks) on the posterior part of the shaft, near the proximal end. How or why these grooves were made is unknown, but it is probable that they are of human origin. The distal end of the left humerus of a horse (20V-50-0) may have been used as a hammer in flintknapping.

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