E-87-3: A Small, Dry-Season Occupation at the Onset of the Green Phase

by Christopher L. Hill

**INTRODUCTION**

The artifact assemblage from the small Middle Paleolithic occurrence called Site E-87-3 is unique in the Tarfawi area in its high frequencies of retouched tools of the Mousterian Group, the near-absence of cores, and the relatively high proportion of retouched tools overall.

The site was discovered during archaeological and geological surveys in 1986, and was studied in 1987. It lies in the northwestern part of Section BT-B of Bir Tarfawi, on a small ridge formed by part of a sedimentary remnant, at an elevation of around 245 m asl (Figs. 3.23 and 3.24; see map on p. 358). The sit’s east of the Sand Pan sites and E-87-2, and northeast of E-86-2, E-86-3 and E-86-4.

E-87-3 was investigated because of the unusual character of the surface remains. The artifacts on the surface consisted of clusters of retouched tools with a high proportion of Mousterian points and sidescrapers and relatively few denticulates. This was very unusual for Tarfawi, where the tools of most sites are dominated by unretouched Levallois flakes or denticulates. The density and size of the surface scatter suggested a short-term, possibly single-occupation, locality, and the surficial geology suggested dry-season use. A Middle Paleolithic site with similar “Typical Mousterian” affinities and spatial configurations, E-72-4, is known in the Dyke area of the Desert between Tarfawi and Dakhla (Schild and Wendorf 1975: 73-74, 1977: 102-113).

**COLLECTION AND EXCAVATION**

An 8 x 10 m grid was set up, oriented north-south (Rows J-Q) and east-west (Rows 29-38). The mapping of the surface material followed the standard procedures of the Combined Prehistoric Expedition, except that all artifacts other than chips were numbered and mapped (a procedure usually followed only for tools and cores). Chips identified during surface collection or excavation were mapped and collected by square meter. The provenances of the artifacts recovered during screening are known only to the square meter; they do not appear on the scatter-pattern (Fig. 31.1) but are included in the contour diagrams (see below).

The artifact zone was excavated by trowel, while small pick-mattocks and hoes were used to excavate the sediments without artifacts. All the sediment was sifted through a 4-mm screen. The major area of the excavation was in Squares L-P,29-34; excavation beyond this area was conducted to discover the limits of the artifact concentration. A stratigraphic trench was placed on the southern side of the excavation (Squares P30-P34), after archaeological excavation had removed the stratum on which the artifacts had been lying. Two other stratigraphic trenches were dug to the east of the excavation to determine the site's lithostratigraphic setting (Figs. 3.23 and 3.35).

**PALEOGEOGRAPHIC SETTING**

Interpretations of the paleogeographic setting of the E-87-3 artifacts are based on the lithostratigraphic studies of R. Schild (Ch. 3, this volume) and sedimentological studies by myself (Ch. 4, this volume). The artifacts were found on a surface consisting of a semi-continuous layer of cemented, sandy, mudstone plates or, in the basal section, of pale brown, sandy muds overlying the mudstone plates. The artifacts were eroding from and within these sediments. There were a few artifacts below this surface, which probably fell into desiccation cracks between the plates (Fig. 31.2).

The paleolandscape associated with the deposition of the artifacts was probably the surface of a pan or seasonally dry lake. The muddy sands and sandy muds contain Melanoides tuberculata, indicating the presence of a freshwater basin. The cemented plates appear to have formed during a period of desiccation, when the surface of the basin became dry. The artifacts were deposited on this surface and then buried by the sandy muds associated with another phase of water within the basin.

The excavated artifacts were not severely weathered, indicating that the interval between their deposition and their burial was fairly short. The presence of chips also
suggests that the period before burial was not long enough for the small pieces to be destroyed or substantially dispersed by erosional processes.

**SPATIAL DISTRIBUTION OF ARTIFACTS**

Fig. 31.1 shows the horizontal distribution of the artifacts mapped during surface collection and excavation. The area with the highest concentration of artifacts is generally delimited by Row P in the south, Row 29 in the west and Row 35 in the east; the northern limit is probably in Row K, but only one square (K30) of this row was excavated. Although the spatial patterning of the site as a whole indicates that it has maintained its structural integrity, there is some clustering by size within this larger concentration. If the pattern is evidence of geological structuring, it probably indicates a single, short episode of flooding, which caused some slight redistribution of the occupation debris.

Two distinct subconcentrations of artifacts can be seen (Figs. 31.1 and 31.3). The northern subconcentration is based in Squares L30-L32. Most of the artifacts are chips, but larger unretouched debitage (flakes) is also present. There are 87 chips in Square L31 and 55 in L30, while the highest density of flakes and tools (combined) is 20 in Square L30. There is some horizontal differentiation based on artifact size: larger artifacts (unretouched and retouched flakes) cluster towards the southern part of the subconcentration, while there are relatively more chips in the northern part. There are three sidescrapers and two Mousterian points (or possibly convergent sidescrapers) in the southwestern part of the subconcentration and three Mousterian points (or convergent sidescrapers) and a possible Levallois core on the southeastern margin of the subconcentration (Fig. 31.1).
The southern subconcentration is larger than the northern one; its densest part is in Squares N-P,30-34. Debitage density is less than half that of the northern subconcentration (averaging ca. 28 pieces per m² vs. 75). There is a higher flake:chip ratio than in the north: on average, there are about four times as many chips per m² in the north as in the south, and slightly more flakes per m² in the south. The northern squares with high chip densities each have one retouched tool, while the three densest squares in the south have 3-4 retouched tools. The southern subconcentration is also typologically more varied than the northern: it yielded unretouched Levallois flakes, Mousterian points (or convergent sidescrapers), sidescrapers and denticulates.

The available evidence does not show definitively whether the subconcentrations are patterns imposed by human or geological structuring. They could reflect the locations of artifacts at the time of occupation, or after some horizontal displacement by preburial dispersal, or during burial by the overlying sediments. If the pattern is essentially human-induced, it might indicate one area where mostly smaller waste was struck (tool sharpening?) and another with a higher incidence of larger flake removal (removing flakes from prepared cores?), which was also associated with higher frequencies of retouched tools (an area of tool use?). If the pattern represents geological structuring of the original configuration, it probably indicates that the northern subconcentration of artifacts was originally deposited as part of the southern subconcentration.

One aspect of the spatial configuration may indicate some post-occupational redistribution: the density of chips is lower between the subconcentrations (Squares M30-M32) than in them. Because it separates an area rich in larger artifacts from one rich in smaller artifacts, this gap may indicate redistribution by running water (Schick 1986: 100). The running-water effect could result from a flood caused by rainfall. Alternatively, the gap could be a relict of human activities: it could be the place where the knapper was actually located, surrounded by lithic debris.

The dimensions of the subconcentrations can also be interpreted in terms of either human activities or geologic structuring. In the first case, the northern subconcentration would be similar to the flaking scatter produced by an individual squatting or kneeling in the area of Squares M31-M32 and facing towards that subconcentration (Schick 1986: 38). The southern subconcentration could represent a flaking scatter produced from a standing position.

Neither the vertical dispersal of the artifacts (the archaeological zone is ≤5 cm and usually ≤3 cm thick) nor the texture of the overlying sediments (medium and fine sands and muds, implying a medium-to-low-energy environment for clastic deposition) is of much help in determining which processes structured the internal patterning. The vertical range could indicate that some of the artifacts were removed from the surface of the original occupation and redeposited within the overlying sediments. No sedimentary structures were observed in the deposits, so it could not be determined whether they were deposited as clastics transported during a flood, or as part of a pan-delta, or in standing water. A playa/pan setting would indicate that the shallow basin was probably filled with water derived from local rainfall (implying a higher-energy depositional environment, and, consequently, the possibility of artifact redistribution), but it could also result from fluctuating groundwater or fluctuating evaporation rates, which imply a lower-energy environment.

Post-depositional factors do not appear to have affected the integrity of the archaeological record at E-87-3, although late Holocene erosion has removed the overlying protective sediments. The presence of chips on the surface of the remnant indicates that even the deflated artifacts have not been biased substantially. Pedogenic processes do not appear to have affected the associated sediments.

E-87-3 could represent a single-season occupation on the dried surface of a playa (seasonal) lake, or on the margin of a permanent shallow lake, during its seasonal regressive stage. In either case, the occupation would have occurred during the interval between the maximum dry period and the onset of the next wet episode. Occupation could have been
in a part of a shallow basin usually inundated during the wet season but left dry during the period of high evaporation although near the remaining body of water.

RAW MATERIALS
The raw materials used at E-87-3 consist almost solely of varieties of quartzitic sandstone (a metamorphosed siliceous sandstone or quartzite), which were grouped by texture and color. Three variants were defined: A (purple, coarse-to-medium grained), B (yellow, coarse-grained) and C (grey, fine-grained). The variants appear to be parts of a continuum in a single raw-material source, although this has not been verified by further field studies. Some individual artifacts exhibit characteristics of more than one "variant" and were classified as undifferentiated quartzitic sandstone.

Two other raw materials were found at the site, quartz and a basalt with phenocrysts, but both were extremely rare; their sources are not known. The basalt outcrops shown on the 1:500,000 map of Klitzsch and others (1987) are 130-140 km away. The "Bir Sarsaf inlier", east of Tarfawi, contains mafic dykes (Bernau et al. 1987: 79, 87), and Issawi (1971a: 79, 80) has described basalt with phenocrysts cutting through or covering the Nubia and Kurkur Formations.

The most abundant varieties of quartzitic sandstone in the debitage are Variant A and undifferentiated (each around 30%), while Variant B is slightly more abundant than C (ca. 22% and 16%, respectively). There is no difference in

Figure 31.3. E-87-3, contour diagram of the densities per m² of (A) all debitage, (B) chips, (C) unretouched flakes, and (D) tools.
raw material frequencies between the major debitage types. Compared to the debitage, however, higher proportions of undifferentiated and Variant C were used for formal tools, and slightly lower proportions of Variants A and B.

The various quartzitic sandstones are found in both subconcentrations, but there are proportional differences between them. If the three squares with the highest artifact densities in the north are compared with the six central squares in the south, there are higher proportions of the undifferentiated, A, and C in the north, and a higher frequency of Variant B in the south. This might indicate that the two subconcentrations reflect a humanly created pattern. If they are the products of geological structuring, then the raw material frequencies should have been essentially the same, since they would be derived from a single, larger concentration. However, this argument is weakened by the apparent continuum between the varieties of quartzitic sandstone, which makes it possible that one core could have produced flakes of two or more "variants". Interpreting the distributions of the raw material varieties in human terms relies on the assumption that they represent scatters derived from cores of single variants, which were not "undifferentiated" at the outset. If the cores were initially undifferentiated, then the proportional differences between the subconcentrations only variations within the cores being reduced.

ARTIFACTS
Of the three major artifact categories at E-87-3, >93% of the collection consists of debitage, about 6% are tools, and there is one possible fragment of a Levallois core. The near-absence of cores, the relatively high proportion of tools, and the structure of the debitage indicate that the assemblage may reflect activities focused on the use and reshaping of retouched tools, in contrast to localities where cores were roughed out or exploited.

DEBITAGE
Table 31.1 presents the absolute and percentage frequencies of types of debitage. Only 15 pieces were measured (Table 31.2).

The debitage was divided into three categories based on the amount of cortex on the dorsal surface. Primary flakes account for 17% of the identifiable debitage, excluding chips and chunks; there are only two whole examples, with mean dimensions of 69.0 x 45.0 x 17.5 mm, and a mean length:width ratio is 1.5; the only identifiable platform is cortical. Secondary flakes appear to be smaller than primary, but only two were measured; their mean size is 34.0 x 32.0 x 6.5 mm and mean length:width ratio is 1.1. Tertiary flakes seem to be smaller than primary but larger than secondary flakes. Eleven tertiary flakes were measured and their mean dimensions are 53.4 x 39.7 x 9.2 mm and mean length:width ratio is 1.5. No platforms were identifiable on the secondary flakes; identifiable platforms on tertiary flakes are lisse (five) and dihedral (two).

Levallois core-preparation flakes (all tertiary) are 30% of the identifiable debitage, excluding chips and chunks. There is a significant difference between the length and width of Levallois core-preparation flakes and those of flakes which might be derived from either biface-trimming or core-preparation (p<0.05), but there are no significant differences in thickness or length:width ratio. The four whole Levallois preparation flakes have a mean size of 71.5 x 59.5 x 12.75 mm and a mean length:width ratio of 1.3. Lisse (five) and dihedral (two) platforms occur.

Levallois or biface-trimming flakes constitute about 46% of the identifiable debitage. Their mean size is 41.1 x 29.2 x 7.0 mm, and mean length:width ratio 1.4; all the identifiable platforms are lisse. Most (78%) are on tertiary flakes and the rest are secondary.

CORES
There is one possible fragment of a Levallois core on quartzitic sandstone (Variant B). It has some preparation only near the faceted platform; the platform-angle is 81°. The piece classified as a variium among the tools might also be an early-stage core, but, if so, it did not produce any of the blanks made into retouched tools found at the site.
TABLE 31.3
E-87-3. Absolute and Percentage Frequencies of Types of Tools

<table>
<thead>
<tr>
<th>Type</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Levallois flake</td>
<td>2</td>
<td>4.9</td>
</tr>
<tr>
<td>Atypical Levallois flake</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Mousterian point</td>
<td>11</td>
<td>26.8</td>
</tr>
<tr>
<td>Elongated Mousterian point</td>
<td>2</td>
<td>4.9</td>
</tr>
<tr>
<td>Single straight sidescraper</td>
<td>3</td>
<td>7.3</td>
</tr>
<tr>
<td>Single convex sidescraper</td>
<td>5</td>
<td>12.2</td>
</tr>
<tr>
<td>Double straight-convex sidescraper</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Double biconcave sidescraper</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Dégjet sidescraper</td>
<td>2</td>
<td>4.9</td>
</tr>
<tr>
<td>Bifacial sidescraper</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Notched piece</td>
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<td>2.4</td>
</tr>
<tr>
<td>Simple denticulate</td>
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<td>14.6</td>
</tr>
<tr>
<td>Piece with obverse retouch</td>
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<td>4.9</td>
</tr>
<tr>
<td>Convergent denticulate</td>
<td>1</td>
<td>2.4</td>
</tr>
<tr>
<td>Unpointed bifacial foliate</td>
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<td>2.4</td>
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<tr>
<td>Varius</td>
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</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>99.7</td>
</tr>
</tbody>
</table>

TOOLS

Table 31.3 presents the inventory of tools (including unretouched Levallois flakes). The blanks for tools are almost evenly divided between Levallois (15), secondary (13) and tertiary (13) flakes. Most of the Levallois flakes were worked as Mousterian points (five) or denticulates (four). Most of the secondary pieces are sidescrapers (eight); three are Mousterian points. Tertiary flakes are Mousterian points (five) or sidescrapers (four). No variant of quartzitic sandstone is uniquely associated with any tool-class. The following description of the tools is by class; however, it might be equally appropriate to organize some of these categories according to particular attributes (such as absolute size, or extent of retouch), and this is discussed more fully below.

Levallois Pieces

Typical Levallois Flakes (Type 1). Both these have lisse platforms. One piece measures 60 x 62 x 15 mm, and the other 77 x 31 x 9 mm.

Atypical Levallois Flake (Type 2). This has a lisse platform and measures 76 x 49 x 10 mm.

Mousterian Points

Most of these exhibit some asymmetry and many resemble convergent sidescrapers. Their mean dimensions are 81.9 x 58.3 x 13.9 mm and their mean length:width ratio is 1.4.

Mousterian Points (Type 6). These are the single most common tool-type at E-87-3 (Fig. 31.4: a-c; Fig. 31.6: b, d), but many could be classified as convergent sidescrapers (Figs. 31.5: c, d). Their mean dimensions are 78.4 x 60.2 x 14.3 mm, with a mean length:width ratio of 1.3. Most are on tertiary or Levallois flakes. All have bilateral retouch. On eight, the edges are entirely retouched; two are retouched along the whole of one edge and the distal part of the other; one is retouched on the distal part of one edge and the central part of the other.

Seven pieces have primarily scaled retouch, three have stepped retouch and one has subparallel. Almost every piece has more than one form of retouch: three have scaled plus stepped retouch, another has scaled plus stepped plus denticulated retouch, and the bifacial piece has scaled, stepped, and sub-parallel retouch (Fig. 31.4: b). The only piece with inverse retouch is scaled (Fig. 31.4: a). Altogether, nine pieces are obverse, one is inverse and one is bifacial.

Five points are skewed, two to the sinister side (Fig. 31.5: c) and three to the dexter (Fig. 31.5: d). The dégjet sinister pieces have obverse, stepped retouch. All the dégjet dexter points have obverse, scaled retouch (one is bifacial; Fig. 31.4: b), and two of them might easily be classified as dégjet sidescrapers.

Elongated Mousterian Points (Type 7). One measures 90 x 41 x 11 mm and is a slightly asymmetrical, bifacial point made on a Levallois flake (Fig. 31.5: b). It has scaled retouch on the sinister side. The central and proximal areas of both sides have invasive retouch. The bulb is inversely thinned and the proximal end is obversely rounded. The second piece is broken (102 mm long and 12 mm thick) and has obverse, scaled retouch on the dexter side and slightly subparallel retouch on the sinister side; it is made on a secondary flake.

Sidescrapers

The sidescrapers are evenly divided between pieces with sinister, dexter, and bilateral retouch, one artifact having retouch on the dexter and distal edges. Retouch occurs along the entire lateral side or on the distal and central portions; it is either scaled or stepped with one instance of scaled plus stepped.

Single Straight Sidescrapers (Type 9). All three have scaled, obverse retouch. One is a slightly sinuous, sinister scraper with a maximum retouch-depth of 9 mm; it measures 74 x 42 x 9 mm. The other two (dexter) are broken and have width and thickness measurements of 55 x 13 mm and 68 x 15 mm.

Single Convex Sidescrapers (Type 10). Their mean size is 90.3 x 47.7 x 12.2 mm. Three are sinister, two are
dexter. Three have retouch on the distal and central areas, two have retouch along the entire side. Three have stepped retouch, two have scaled and stepped retouch; the mean depth of the retouch is 15.8 mm. Two are on tertiary flakes and three are on secondary flakes. The illustrated example (Fig. 31.6: a) shows some similarities to a Mousterian
point from Jebel Brinikol (Marks 1968: Fig. 49: a); it is also similar to, but more symmetrical than, a sidescraper from Site ETH-72-1 (Wendorf and Schild 1974: Fig. 4).

*Double Straight-Convex Sidescraper (Type 13).* This is on a secondary flake measuring 79 x 49 x 11 mm. The sinister side has central, scaled retouch and the dexter side has central and distal, scaled and stepped retouch. The retouch, all obverse, has a maximum depth of 17 mm, and the scraper shape is convex and sinuous.

*Double Biconcave Sidescraper (Type 16).* This is a Levallois flake, measuring 80 x 51 x 9 mm. It is unusual because most of the retouch is not on the distal part of the flake; the sinister side has proximal and central retouch; the dexter side has central and distal retouch (Fig. 31.6: c). The retouch is obverse and scaled and reaches a maximum depth of 7 mm.

*Déjeté Sidescrapers (Type 21).* One piece is a tertiary (Levallois?) flake, 77 mm wide and 15 mm thick, with obverse, slightly stepped retouch along the dexter side and distal end (Fig. 31.4: d). The edges are slightly sinuous and the maximum depth of scraper-retouch is 19 mm. The other is a bifacial sidescraper, measuring 82 x 52 x 21 mm, with scaled retouch 29 mm deep. The sinister side is concave with distal retouch; the dexter side has retouch on the central and distal areas. It is skewed towards the right.
Bifacial Sidescraper (Type 28). This is bilateral and made on a secondary flake; it measures 95 x 58 x 33 mm and has stepped retouch (29 mm deep) on the central and distal parts of the edge.

Notched Pieces

Notched Piece (Type 42). This is a secondary flake, measuring 91 x 39 x 11 mm. The obverse, retouched notch is on the central part of the dexter side, and is 11 mm long and 2 mm deep.

Denticulates

Simple Denticulates (Type 43). Three are Levallois flakes, two are tertiary flakes and one is a secondary flake. Four are obverse, one is alternating and one alternate. Four are sinister, one is dexter and one is on the dexter side and distal end. Two denticulates are formed by retouch only and four have a combination of single-blow and retouched denticulations. Their mean size is 68.7 x 52.6 x 10.8 mm, and their mean length:width ratio is 1.3 (with a range of 0.9-1.6). One example (Fig. 31.5: a) is a Levallois flake of dark, aphanitic, igneous rock (probably basalt) containing phenocrysts; this was the only piece of this material at the site.

Convergent Denticulate or Tayac Point (Type 51). This is a fragment of a Levallois flake, 61 mm wide and 19 mm thick. The distal end is broken, so it may have been a simple (bilateral) denticulate, although it was more probably convergent. It has obverse retouch along the whole of both edges.
Pieces with Continuous Retouch

Pieces with Obverse Retouch (Type 46). A typical Levallois flake has obverse scaled retouch along the central part of the dexter side and distal end. It measures 56 x 58 x 18 mm, and has a dihedral platform. A broken (67 mm wide and 9 mm thick), atypical Levallois flake has slight nibbling, obverse retouch on the distal end of the dexter side, and a lisse platform.

Bifacial Foliates

Unpointed Bifacial Foliate (Type 64). This is a tertiary flake, measuring 105 x 67 x 28 mm, and is skewed towards the right. The sinister side is convex and has distal and proximal, bifacial retouch; the dexter side is slightly concave, and the reverse face is more fully retouched than the obverse.

Other Flake-Tools

Varium (Type 99). This is a reused tertiary flake, measuring 95 x 54 x 18 mm (Fig. 31.6: e). The sinister side has earlier weathered retouch that may have been denticulated. The dexter side is entirely retouched with a combination of two single-blow notches and proximal and central retouch. There are two flakes struck from the distal end. This piece might be a core during an early stage of preparation.

DISCUSSION OF THE ARTIFACTS

Unlike almost all other assemblages from Tarfawi and Sahara East, Levallois technology is not the most characteristic component of this assemblage. Slightly more than half of the debitage is composed of chips, and most of the larger debitage (unretouched flakes excluding Levallois pieces) are unidentifiable; Levallois core-preparation flakes constitute about 30% of the identifiable debitage (excluding chips).

The most common, identifiable flake is the Levallois core-preparation or biface-trimming flake. For each Levallois flake (15, both retouched or unretouched), there are about 41 pieces of debitage (the proportion would be even lower if we added four other flakes which could be atypical Levallois), and there are only some 17 pieces of debitage for every retouched tool. It seems that the debitage essentially represents products from the sharpening and resharpening of retouched tools and possibly from the later stages of core-reduction or Levallois flake removal.

The occurrence of only one fragmentary core (plus a possible early-stage core classified as varium) could indicate two different core-reduction strategies. The core:retouched tool ratio (1:37) makes it unlikely that all these flakes were obtained from that core, although the core probably was used to exhaustion. It is possible that other cores were brought to the site, flaked and then taken away. In this case, the cores must have been (almost) fully prepared when they were brought in, since there is little initial and core-preparation debitage. Alternatively, the flakes made into tools may have been brought to the site as struck flakes. If there were never any cores at the site except the one found, then there should be high frequencies of extensively retouched tools (see below), since new tool-blanks could not be struck at will.

The retouched tools are interesting from both technological and taxonomic perspectives. If the dimensions of unbroken unretouched flakes (except Levallois) are compared with formal tools, there are significant differences (p<0.05) in length, width and thickness (the formal tools are larger), but not in length:width ratios. (The average dimensions for all formal tools are 80.9 x 54.9 x 13.9 mm, with a length:width ratio of 1.6.) This indicates that larger pieces were preferred as blanks for tools.

The E-87-3 collection differs from other assemblages in its high frequency of retouched tools. Retouched tools are almost evenly divided between secondary, tertiary, and Levallois flakes (each at 32-34%). Most unretouched flakes are tertiary, while primary plus secondary and Levallois pieces constitute about 20% each.

It is also possible to analyse the tools in terms of other shared attributes. Some 39% of the retouched tools can be placed in Wendorf's and Schild's (1974: 72) set of Mousterian and bifacial points and convergent sidescrapers. In fact, some of the pieces from E-87-3 might be most appropriately regarded as examples of the continuum within this group. Their average dimensions are 81.9 x 60.0 x 14 mm. Eleven of the 14 are on tertiary or Levallois flakes and the same proportion have obverse retouch.

The problems of differentiating between Mousterian points and convergent sidescrapers and inferring their functions (Bordes 1954, 1961; Wendorf and Schild 1974; Dibble 1988; Shea 1988, 1990; Holdaway 1989, 1990) are relevant to the interpretation of these artifacts at E-87-3. The covariation of these types in some sites has led to the suggestion that they represent cutting tools (Wendorf and Schild 1974: 156). Dibble (1988: 186) also noted a strong correlation between the percentage of Mousterian points and convergent sidescrapers (and bilateral sidescrapers) and asked whether the two classes might be stages in the continuous reduction of tools through resharpening. A strong correlation would be expected, according to Dibble, if the classes were functionally and technologically the same. Holdaway (1989, 1990: 115) argued that the proportion of distal to proximal fragments in some assemblages indicates that they were not used as projectiles, while Shea (1988: 448, 1990: 112) reached the opposite conclusion.

To try to distinguish reduction stages among the retouched tools at E-87-3, we may compare tools with single and multiple retouched edges. There are almost twice
as many multiple- as single-edged (23 vs. 13) tools. Except for one piece with alternating retouch, all the single-edged tools are obverse, while only 61% (14) of the multiple-edged tools are purely obverse (five are bifacial, two are alternate and one is inverse). Seventy-four percent (17) of the multiple-edged pieces are on tertiary or Levallois flakes, while only six (ca. 46%) of the unifacial retouched pieces are on these two forms of blanks, and most (ca. 54%) are secondary. The only significant difference in size between multiple- and single-edged tools is that the multiple-edged are thicker (p<0.05).

Given the near-absence of cores, the high frequency of multiple-edged tools might indicate high intensity of use of retouched tools at E-87-3. In comparison, E-72-4, although it has a nearly identical frequency of the Mousterian Group (Table 31.4), has a higher number of cores and more than twice as many single-edged as multiple-edged tools (23 vs. 10).

We can also compare unifacial and bifacial (here including alternate, alternating and bifacial) tools. There is no significant difference in any of the dimensions of these two sets (p>0.05). Unifacial tools are more than three times as common as bifacial. The presence of bifacially retouched flakes may be an indication that usable blanks were being intensively used.

The taxonomic status of E-87-3 is based on the relative frequencies of types of tools and comparisons of these with other assemblages. The presence of Levallois technology means that, technologically, the assemblage can be broadly placed within a complex using flakes from prepared cores, or the Middle Paleolithic as defined by Rolland (1981).

In typology, E-87-3 has a high frequency of the Mousterian Group and the relatively low frequencies of unretouched Levallois flakes and denticulates. The assemblage is comparable to that from E-72-4, a small Middle Paleolithic site in the Dyke area about 140 km south of Balat (Schild and Wendel 1975: 73-74, 1977: 101-113; Wendel and Schild 1980: 206-207). E-72-4 is considered to be "closely similar to the 'Typical Mousterian' as defined by Bordes" (Schild and Wendel 1977: 107).

Table 31.4 lists the artifacts from the two sites. There are more unretouched pieces at E-87-3, but both sites have low absolute frequencies and similar proportions of chips to flakes. Levallois pieces form <1% in each collection of unretouched artifacts. The most obvious differences are higher frequencies of primary flakes and cores at E-72-4. Both assemblages have <10% primary flakes, <2% cores, <1% Levallois pieces, >40% flakes, and >40% chips and chunks.

Both assemblages are technologically similar to the Nubian Mousterian (Marks 1968: 292) in their low Levallois indices, but there are technological and typological differences from the material from northern Sudan. There are only four Levallois pieces (two atypical Levallois points, one flake and one bilateral scraper) at E-72-4; the index is higher at E-87-3 because about a third of the retouched tools are on Levallois flakes.

The absolute frequencies of retouched tools from the two sites are the same. The most striking similarity is in the importance of the Mousterian Group: >65% in each case. Within this group, there are some major differences: Mousterian points and sidescrapers are equally common at E-87-3, while sidescrapers are more common at E-72-4. This dichotomy may be partially a result of preferentially classifying pieces as Mousterian points at E-87-3. Among other tool-classes, denticulates are about twice as frequent at E-87-3, while pieces with continuous retouch constitute about 16% of the E-72-4 assemblage but only 5% at E-87-3.

Part of the assemblage from the 1973 excavation of BS-13, referred to as the "Typical Mousterian subcluster" (Wendorf and Schild 1980: 254), can also be compared with the E-87-3 collection. This was originally interpreted as a special activity area consisting of a cluster of 14 tools, including three Levallois points, a Mousterian point, a partially bifacial Mousterian point, a notched flake and two denticulates (Wendorf and Schild 1980: 48), but is now considered to be a separate component. The frequency of the Mousterian Group in this component of BS-13 is about half of that at E-87-3 and E-72-4.
FAUNAL REMAINS

Two types of faunal materials were recovered from E-87-3, molluscs and ostrich eggshells. The ostrich eggshell fragments were found among the artifacts and in the same geological context, lying on the sediments of Unit 2a (Ch. 3, this volume).

The molluscs, identified by the writer based on a reference collection provided by A. Gautier, are *Melanoides tuberculata*. They occur on the same surface as the artifacts and in the finer-grained sediments overlying and including the artifacts. *Melanoides* were also recovered from the carbonate unit which is the lowest part of the sedimentary sequence at E-87-3, as well as from the sandy muds and muddy sands unconformably overlying the carbonates and underlying the indurated sandy mudstone plates on which almost all the artifacts were found.

AGE OF E-87-3

There is no direct stratigraphic connection between E-87-3 and other sites in Section BT-B, so the chronological placement of the assemblage relies primarily on estimates based on amino acid racemization of the ostrich eggshells and uranium-series dating of the underlying carbonates (Unit 1 in Figs. 3.27 and 3.30).

The underlying carbonate bed at E-87-3 (Unit 1) has a uranium-series date of 118 ± 39 ka (Ch. 11, this volume). A sample from the same unit in the trench east of the excavation has a date of 172 ± 43 ka. The carbonates are unconformably overlain by the sediments which contain the artifacts at E-87-3, and might correlate with some of the carbonates in Tr. 7/86, east of E-86-2. This would imply that E-86-3 and E-86-4 are older than E-87-3, and E-87-3 might be roughly contemporaneous with the upper occupations (the Green Phase) at E-86-2.

There are two sets of racemization dates on the eggshell directly associated with the artifacts at E-87-3 (Ch. 18, this volume): the estimated age range is about 115-130 ka, and the average of the ratios yields an estimate of about 125 ka. The racemization results from E-86-2 are nearly identical to those of E-87-3, which would indicate that the occupations at the two sites were roughly contemporaneous.

COMPARISONS AND DISCUSSION

Most other aspects of E-87-3, such as site size, artifact densities, internal arrangement of artifacts, and possible season of occupation, show striking similarities to E-72-4.

Both sites are small (9 x 8 m at E-87-3; 9 x 10 m at E-72-4), have low artifact densities and have similar internal configurations. The site-size and artifact-distribution led Wendorf and Schild (1980: 207) to suggest that E-72-4 represented a "a single short-lived camp made by a small group". The site consists of two distinct and one diffuse subclusters, while two distinct subclusters can be discerned at E-87-3. The density of artifacts at E-72-4 is 5 per m², which is slightly less than the 7 per m² at E-87-3. The artifact density at E-72-4 suggests a shorter period of occupation (Schild and Wendorf 1977: 113).

The presumed season of occupation at E-87-3, based on the setting of the site, is comparable to at least two other sites. Area C at BT-14 (Ch. 21, this volume), although different in artifacts, is similar to E-87-3 in context. The site was "presumably occupied during a dry phase, possibly seasonal" (Wendorf and Schild 1980: 254). E-72-4 lies within a sand pan measuring 300 x 500 m; the artifacts were on and probably embedded in a massive (unbedded), slightly gravelly sand. Wendorf and Schild have suggested that occupation occurred after rainfall had filled part of the shallow basin with water; this is similar to the interpreted season of occupation at E-87-3.

In conclusion, E-87-3 consists of a small set of Middle Paleolithic artifacts, characterized by a relatively high proportion of retouched tools belonging to the Mousterian Group. The small site-size and low density of artifacts suggest that the artifacts were deposited during a brief interval. The sedimentological context indicates that they were deposited on a surface that was exposed during a very short interval and buried by clastics during a moister interval. The only faunal remains associated with the artifacts were fragments of ostrich eggshell.

The site is interpreted as a single encampment of very short duration (one or two days?), by a small group, near the remnant of a shallow, seasonally reduced lake. The high proportion of multiple-edged tools and the near-absence of cores indicate intensive use of the retouched tools, which, in turn, suggests that the occupation occurred at a time when the group had not much available raw material. I conjecture that E-87-3 represents a temporary camp, possibly to collect water and other resources available at a remnant lake during the dry season.

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LATE PLEISTOCENE PLUVIAL ENVIRONMENTS NEAR CLOVIS, NEW MEXICO; GEOECOLOGIC INFERENCES BASED ON LITHOSTRATIGRAPHIC, PALEOBIOTIC, AND RADIOCARBON EVIDENCE

Hill, Christopher L., Ice Age Research Program, Museum of the Rockies, Montana State University, Bozeman, Montana, 59717; Wendorf, Fred, Department of Anthropology, Southern Methodist University, Dallas, Texas, 75275.

Pluvial conditions on the Southern Plains of North America appear to have been generally contemporaneous with the interval centered on the last glacial maximum. A terminal Pleistocene glacial pulse, the Younger Dryas, is associated on the Southern Plains with a less extensive climatic wet event, or sub-pluvial. A sedimentary sequence at the Barrow Pit Locality (situated within Blackwater Draw, between Portales and Clovis, New Mexico) consists of laminated muds dated to about 16,000 RCYBP (A-669B) and correlated with the Tahoka Pluvial (the local equivalent of the last glacial maximum). Overlying silts date to about 10,600 RCYBP (A-493) and are attributed to the Lubbock Sub-pluvial (interpreted as the local equivalent of the Younger Dryas).

Fossil pollen recovered from some strata at the Barrow Pit Locality contain high amounts of pine and relatively high levels of spruce. The ratio of identifiable pollen relative to unknown (or indeterminable) pollen was used to evaluate changing preservational circumstances. The Tahoka-equivalent laminated muds have higher pine and spruce and lower unknowns, or low pine and spruce and high unknowns. The Lubbock Sub-pluvial silt contains over 30% pine with low unknowns. Comparison of the chronometric, lithostratigraphic, and paleobiologic data from the Barrow Pit Locality with other paleoenvironmental records from the Southern High Plains indicates the possibility of gallery woodland habitats around stream valleys, and parkland or savannah landscapes around upland pond and lake basins during peak times of available moisture within the Late Pleistocene pluvials and sub-pluvials.

AMERICAN MASTODON (MAMMUT AMERICANUM) 
FROM THE DOEDEN GRAVELS, NO. 2 TERRACE, 
LOWER YELLOWSTONE RIVER

Hill, Christopher L., Ice Age Research Program, Museum of the Rockies, 
Montana State University, Bozeman, Montana, 59717 (chill@montana.edu)

Terrace deposits north of the Yellowstone River at Miles City, Montana, 
contain Pleistocene fossils. Taxa represented in the Museum of the 
Rockies (MOR) collections from the Doeden gravel pit (MOR Fossil Locality 
No. PL-084) include mastodon, mammoth, ground sloth, muskox, horse, 
camel, and giant short-faced bear (Wilson in Kurten and Anderson 1980 
Pleist. Mam. Nth. Am., Columbia U. Press; MOR accession archives and 
specimens). The mastodon remains consist of a fragment of the maxilla 
(MOR specimen no. 605) with both upper 3rd molars (M"3) intact.

Both teeth show extensive wear of the protoloph. The median sulcus 
becomes more prominent from the anterior to the posterior and there is 
progressively less wear on the metaloph, tritoloph, tetartoloph, and 
pentaloph. Based on tooth replacement and age group wear patterns (cf. 
Saunders 1977 Ill. State Mus. Rpt. Inv. 33) the mastodon was a mature 
individual.

The Doeden "gravels" appear to form the No. 2 terrace (Alden 1932 
U.S.G.S Prof. Paper 174) or parts of terraces C-D (Smith 1956 U.S.G.S. Map 
I-155; Colton et al. 1984 U.S.G.S. Map MF-1682). They are overlain by silts 
(loess). Alden considered the No. 2 terrace to be Early or Middle 
Pleistocene and correlated it with Blackwelder's Circle terrace in the Wind 
River. The Circle terrace can be traced to Bull Lake age outwash and 
moraines. Cosmogenic nuclide dating suggests an association with either 
isotope stage 6 or 5d (150-102 ka, Chadwick et al. 1997 GSA Bull. 109:1443-
1452).

Taphonomically, the mastodon was probably redepsoited along with 
the sediments of the No. 2 terrace. Thus, the mastodon may have lived 
slightly prior to the deposition of the Doeden gravels. In terms of 
paleoenvironmental conditions, the specimen hints at the presence of 
wooded, forested or parkland landscapes within the lower Yellowstone 
drainage sometime prior to 100 ka, perhaps during the Illinoian or 
Sangamon. Other fossils from the gravels indicate more open landscapes. 
If the fossils have similar taphonomic trajectories, a mosaic pattern for the 
Pleistocene environmental context may be indicated.

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