# XVII. LITHIC REFITTING

## Introduction

The reassembly of material remains, including fauna, ceramics, chipped stone, and fire-cracked rock, has led to a more refined understanding of prehistoric technology and site formation (Cziesla et al. 1990; Hofman and Enloe 1992). Archaeologists working in the Middle Atlantic region have begun to use the refitting technique at various prehistoric sites (e.g., Custer and Watson 1985; Whyte 1985; Carr 1986; Bergman and Doershuk 1992; Petraglia 1993, 1994). The refitting of chipped stone artifacts has become a particularly valuable method, providing for a more refined understanding of stone tool manufacture and discard practices. Since stone tool manufacture is a reductive process, archaeologists have the opportunity to piece together core byproducts and tools, thereby reconstructing the original sequence of flake removal, and reconstructing stages in manufacturing and use processes. Refitting has also proven to be valuable for interpreting the integrity of stratigraphic deposits and for determining the degree to which archaeological patterns are the result of natural and cultural processes. The mending of stone tools and fire-cracked rock may help to assess whether archaeological patterns across horizontal surfaces and through vertical profiles represent arrangements of human activity, or conversely, whether patterns represent alterations by natural processes.

Since refitting has been shown to be of benefit to archaeological interpretation, it was employed at Lums Pond. Field observations and artifact patterning at Lums Pond presented several areas of research interest. The concentration of jasper from Area 1 was considered to be of potential interest since mends could help to determine if the jasper tools and debitage were in fact positively related. If connections were present, refits could provide additional insights about the manufacturing process. Refitting in Area 3 was attempted since it was observed that a variety of raw material types and artifact sizes were present, hence it was recognized that positive refits could provide information about stone tool technology and reduction techniques. In addition, Area 3 contained chipped stone artifacts and fire-cracked rock in stratigraphic context. Refitting could therefore help to determine depositional integrity and the degree to which the spatial distributions represented cultural patterns and natural transformations.

## Methods and Results

Of importance to finding refits in close spatial proximity, Areas 1 and 3 of the Lums Pond site were excavated using contiguous block excavations. To facilitate refitting, artifacts were placed on tables by their respective provenience units so that spatial juxtapositions of potentially conjoinable pieces could be viewed (Plate 47). The artifacts were laid out by unit, stratum, and level, and artifacts of similar type and material were examined. The refitting study was conducted over the course of three weeks by one individual.

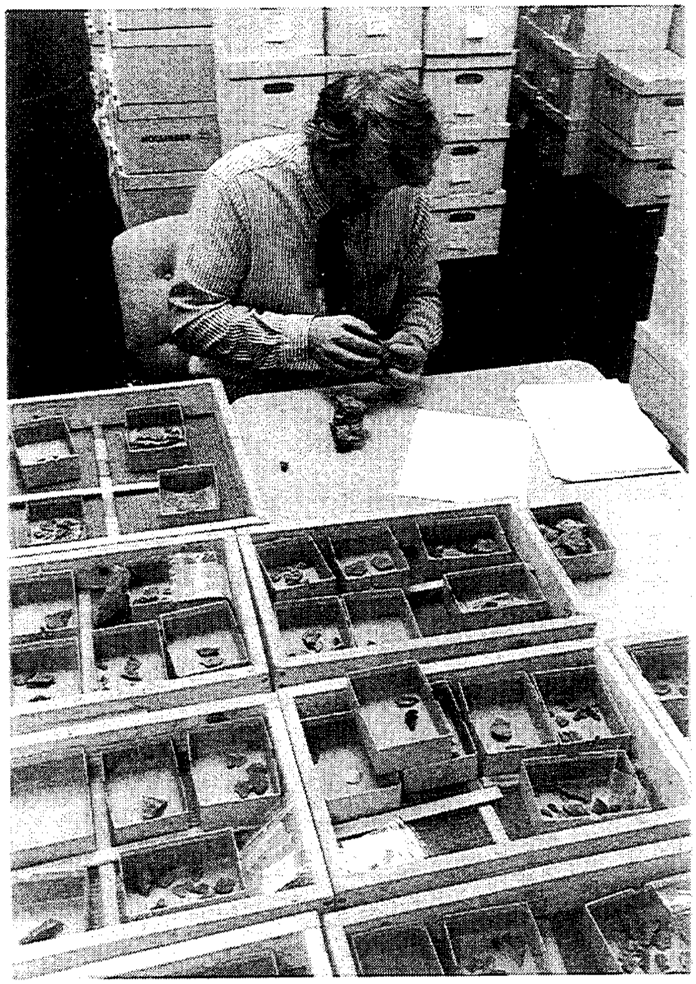

Plate 47. Refitting in Progress

Since artifacts were not piece-plotted in the field, the finest level of precision for discussion of the refit data is within a one-meter unit and a 10 cm level. Refits between two contiguous horizontal proveniences could be less than 1 m but no greater than 2 m. For refits among two consecutive vertical proveniences, refits could be less than 10 cms but no greater than 20 cms. In discussing the vertical separation of artifacts it is important to recognize that some of the differences may be the result of excavation strategy, which may have bisected thicker depositional surfaces. Artifact proveniences in figures are illustrated by unit and level designations, but they should not be considered exact positions.

*Area 1*

Major effort was expended on identifying potential matches for the jasper, the major raw material type represented in Area 1. The large degree of similarity of the jasper and the predominance of flakes made the refitting process somewhat challenging. There were some minor discernible material variances (e.g., subtle color differences, varieties of crystalline structure) that aided lithic refitting. Five groups of jasper refits were identified during the analysis of Area 1 (Table 125).

| *Group Number* | *Provenience* | *Artifact Type* | *Material* | *Cortex* | *Segment* | *Weight (gm)* | *Artifact Number* |
|---|---|---|---|---|---|---|---|
| #1 | N372/E402 A1 | flake | jasper | 0 | whole | 5.2 | 1050-7 |
| | N373/E402 A1 | flake | jasper | 0 | proximal | 1.6 | 1055-6 |
| #2 | N373/E402 A1 | flake | jasper | 0 | proximal | 13.6 | 1055-1 |
| | N373/E402 A1 | flake | jasper | 0 | distal | 5.3 | 1055-2 |
| #3 | N377/E398 B1 | potlid | jasper | 0 | fragment | 0.6 | 1083-2 |
| | N377/E398 B1 | flake | jasper | 0 | distal | 13.5 | 1083-1 |
| #4 | N377/E403 A1 | flake | jasper | 0 | proximal | 8.6 | 1037-3 |
| | N377/E403 A1 | flake | jasper | 0 | proximal | 1.7 | 1037-5 |
| #5 | N380/E399 A1 | flake | jasper | 0 | whole | 6.8 | 1034-4 |
| | N380/E399 A1 | flake | jasper | 0 | proximal | 0.8 | 1034-7 |

Table 125. Area 1, Refit Data

*Area 3*

The large degree of material differences of chipped stone artifacts in Area 3 helped to visually separate material into potential refit groups. A number of raw material types for chipped stone artifact manufacture were evident, including argillite, chert, jasper, quartz, and quartzite. In addition, a variety of fire-cracked rock were viewed and separable on the basis of their material, fracturing characteristics, and size. In total, 27 groups of refits were found during the examination of Area 3, 23 groups were recovered from Block A (Tables 126-127) and 4 were found in Block B (Tables 128-129). Refits consisted of pieces that were the product of stone tool reduction and heating.

| *Group Number* | *Provenience* | *Artifact Type* | *Material* | *Cortex* | *Segment* | *Weight (gm)* | *Artifact Number* |
|---|---|---|---|---|---|---|---|
| #1 | N227/E237 D4 | flake | quartzite | 90 | distal | 3.1 | 634-11 |
| | N227/E237 E1 | flake | quartzite | 30 | proximal | 38.7 | 635-7 |
| #2 | N228/E238 D2 | ESB | chert | 10 | proximal | 21.3 | 530-1 |
| | N229/E238 D2 | flake | chert | 0 | whole | 0.3 | 505-5 |
| #3 | N228/E239 D3 | ESB | quartz | 0 | medial | 16.1 | 539-1 |
| | N228/E242 E1 | ESB | quartz | 0 | medial | 9.0 | 565-3 |
| #4 | N229/E237 D1 | flake | quartzite | 10 | proximal | 16.3 | 658-2 |
| | N228/E237 D1 | flake | quartzite | 40 | proximal | 26.8 | 592-13 |
| | N228/E240 D2 | flake | quartzite | 40 | distal | 8.6 | 544-6 |
| #5 | N230/E239 D3 | flake | jasper | 0 | whole | 0.4 | 732-4 |
| | N230/E239 D3 | core | jasper | 10 | whole | 32.1 | 732-15 |
| | N230/E239 D4 | flake | jasper | 0 | whole | 0.5 | 733-7 |
| | N229/E240 C2 | flake | jasper | 0 | whole | 4.8 | 417-2 |
| | N230/E240 D3 | flake | jasper | 0 | whole | 2.9 | 737-2 |
| | N230/E239 C1 | flake | jasper | 10 | whole | 1.8 | 664-1 |
| | N230/E239 D5 | flake | jasper | 0 | distal | 0.2 | 734-5 |
| #6 | N228/E237 D4 | core | quartzite | 50 | whole | 493.0 | 646-7 |
| | N228/E238 D3 | flake | quartzite | 30 | whole | 8.0 | 528-14 |
| | N227/E237 D2 | flake | quartzite | 50 | whole | 3.7 | 576-6 |
| | N227/E237 D4 | flake | quartzite | 20 | whole | 17.9 | 634-4 |
| #7 | N232/E241 D5 | flake | quartzite | 10 | proximal | 5.7 | 851-5 |
| | N232/E241 D4 | flake | quartzite | 70 | distal | 2.8 | 852-10 |
| #8 | N228/E242 C1 | core | jasper | 0 | bipolar fragment | 22.2 | 561-2 |
| | N229/E242 D3 | core | jasper | 0 | bipolar fragment | 13.5 | 521-1 |
| #9 | N231/E239 D1 | chip | jasper | 20 | bipolar fragmemt | 8.2 | 798-1 |
| | N231/E240 D5 | chip | jasper | 0 | bipolar fragment | 11.2 | 799-2 |
| #10 | N230/E240 D3 | core | jasper | 0 | bipolar fragment | 3.3 | 737-32 |
| | N228/E237 D1 | core | jasper | 0 | bipolar fragment | 11.3 | 592-1 |
| #11 | N230/E241 D4 | flake | chert | 40 | whole | 7.5 | 744-5 |
| | N230/E241 D4 | core | chert | 10 | whole, bipolar | 14.2 | 744-7 |

Table 126. Area 3, Block A Refit Data

| Group Number | Provenience | Artifact Type | Material | Cortex | Segment | Weight (gm) | Artifact Number |
|---|---|---|---|---|---|---|---|
| #12 | N228/E237 D3 | LSB | argillite | 0 | proximal | | 594-1 |
| | N228/E237 D3 | LSB | argillite | 0 | lateral | | 594-1 |
| | N228/E237 D3 | LSB | argillite | 0 | lateral | | 594-1 |
| | N228/E237 D3 | LSB | argillite | 0 | lateral | | 594-1 |
| #13 | N229/E238 D3 | hamm | quartzite | 80 | proximal | 49.8 | 506-1 |
| | N229/E238 D3 | hamm | quartzite | 60 | fragment | 114.6 | 507-1 |
| #14 | N231/E239 E1 | flake | jasper | 0 | distal | 0.7 | 843-8 |
| | N231/E239 E1 | flake | jasper | 20 | proximal | 6.5 | 843-11 |
| #15 | N227/E239 D4 | cobb | quartzite | 20 | fragment | 3852.7 | 875-1 |
| | N227/E239 D4 | cobb | quartzite | 20 | fragment | 218.2 | 875-2 |
| | N230/E239 D4 | cobb | quartzite | 50 | fragment | 833.0 | 876-1 |

Table 126 (cont'd). Area 3, Block A Refit Data

| Group # | Provenience | Material | Weight | Artifact # |
|---|---|---|---|---|
| #1a | N230/E239 D2 | quartzite | 3812.6 | 722-1 |
| | N230/E239 D2 | quartzite | 299.9 | 722-1 |
| | N230/E239 D2 | quartzite | 100.4 | 722-1 |
| | N230/E239 D2 | quartzite | 28.1 | 722-1 |
| | N230/E238 D3 | quartzite | 311.1 | 709-5 |
| #2a | N230/E242 D2 | quartzite | 143.4 | 754-8 |
| | N230/E242 D2 | quartzite | 64.0 | 754-8 |
| #3a | N230/E240 D2 | quartzite | 85.4 | 736-14 |
| | N230/E240 D2 | quartzite | 7.8 | 736-14 |
| | N230/E240 D3 | quartzite | 38.4 | 738-1 |
| | N229/E241 D2 | quartzite | 38.2 | 514-11 |
| | N229/E241 D2 | quartzite | 13.0 | 514-11 |
| #4a | N230/E240 D2 | quartzite | 113.3 | 736-14 |
| | N230/E240 D2 | quartzite | 60.7 | 736-14 |
| | N227/E238 D3 | quartzite | 169.7 | 578-11 |
| | N230/E242 D2 | quartzite | 150.1 | 754-8 |
| #5a | N230/E240 D2 | quartzite | 33.3 | 736-12 |
| | N230/E239 D2 | quartzite | 346.0 | 730-1 |
| | N229/E241 D2 | quartzite | 44.6 | 514-11 |
| | N228/E241 D2 | quartzite | 135.6 | 551-1 |
| | N229/E240 C1 | quartzite | 135.8 | 416-16 |

Table 127. Area 3, Block A Refit Data -- Fire-Cracked Rock

| Group # | Provenience | Material | Weight | Artifact # |
|---|---|---|---|---|
| #6a | N229/E237 E1 | quartzite | 261.8 | 657-2 |
| | N229/E237 E1 | quartzite | 103.4 | 657-2 |
| #7a | N232/E240 D1 | quartzite | 180.6 | 809-5 |
| | N232/E240 D1 | quartzite | 45.7 | 809-5 |
| | N231/E241 D1 | quartzite | 97.2 | 763-12 |

Table 127 (cont'd). Area 3, Block A Refit Data--Fire-Cracked Rock

| Group Number | Provenience | Artifact Type | Material | Cortex | Segment | Weight (gm) | Artifact Number |
|---|---|---|---|---|---|---|---|
| #1 | N239/E254 E2 | chip | jasper | 10 | fragment | 3.1 | 679-1 |
| | N239/E254 E2 | chip | jasper | 0 | fragment | 2.1 | 679-2 |
| | N239/E254 E2 | chip | jasper | 20 | fragment | 35.5 | 679-3 |
| | N239/E254 E2 | core | jasper | 70 | fragment | 241.2 | 679-4 |
| | N239/E254 E3 | chip | jasper | 10 | fragment | 19.9 | 680-1 |
| | N239/E254 E3 | chip | jasper | 10 | fragment | 21.0 | 680-2 |
| | N239/E254 E3 | chip | jasper | 20 | fragment | 13.9 | 680-3 |
| | N239/E254 E3 | chip | jasper | 20 | fragment | 5.4 | 680-4 |
| | N239/E254 E3 | chip | jasper | 30 | fragment | 1.4 | 680-5 |
| | N239/E254 E3 | chip | jasper | 50 | fragment | 0.1 | 680-6 |
| | N239/E254 E3 | chip | jasper | 10 | fragment | 39.8 | 680-7 |
| | N239/E254 E3 | chip | jasper | 20 | fragment | 22.8 | 680-8 |
| | N239/E254 E3 | chip | jasper | 10 | fragment | 117.7 | 680-9 |
| | N239/E254 E3 | core | jasper | 70 | fragment | 252.6 | 680-10 |
| #2 | N240/E255 E1 | flake | quartzite | 80 | whole | 128.3 | 626-2 |
| | N240/E255 E1 | flake | quartzite | 0 | proximal | 4.8 | 626-3 |
| | N239/E257 E1 | flake | quartzite | 30 | distal | 5.5 | 674-3 |
| #3 | N240/E255 E1 | flake | quartzite | 50 | proximal | 13.7 | 626-1 |
| | N240/E257 D1 | flake | quartzite | 30 | whole | 12.4 | 501-1 |

Table 128. Area 3, Block B Refit Data

| Group # | Provenience | Material | Weight | Artifact # |
|---|---|---|---|---|
| #1a | N240/E257 D1 | sandstone | 176.4 | 501-3 |
| | N240/E257 D1 | sandstone | 44.9 | 501-3 |
| #2a | N241/E255 C2 | quartzite | 31.5 | 496-2 |
| | N241/E255 C2 | quartzite | 13.8 | 496-2 |

Table 129. Area 3, Block B Refit Data -- Fire-Cracked Rock

## Area 1

*Technology*

In Area 1, five groups of refits were identified, all of jasper material. Three of the groups were refit flakes (Groups 1, 4, 5), one was a broken flake (Group 2), and one was a potlided flake (Group 3).

The three groups of flake refits (Groups 1, 4, 5) were all non-cortical pieces, each consisting of two matches. Two sets consisted of matches of whole and proximal flakes, and the third consisted of two proximal flake reattachments. The flakes were small to moderate in size, flake weights ranging from 1.6 to 8.6 gms. The two whole pieces weighed 5.2 and 6.8 gms respectively. Groups 1 and 5 each joined to share dorsal and ventral surfaces of flakes, both refitting along their striking platforms. Group 4 joined a small flake on the dorsal side of a large flake.

Group 2 was comprised of two flake fragments that conjoined to form a whole flake. The proximal fragment refits with the distal end. This flake was slightly reddened at the extreme distal portion. The refit artifact exhibited some evidence of retouch along its distal edge. There was a material flaw (a grainy inclusion) at the point of breakage. The artifact may have broken during retouching or use.

Group 3 consisted of a large flake fragment and a small potlid conjoined in the center portion of the flake. The artifacts showed signs of heating as indicated by a deep red color and the potlid. The exterior surface of the artifact was grainy in appearance while its interior was finer.

The refitting data, taken together with the general material evidence from Area 1, indicated that core and biface reduction were activities that occurred in this location. Although relatively few, the refits positively confirmed that the jasper materials in Area 1 were indeed related, supporting the conclusion that the clusters represented one or more reduction areas (Figure 137). Consistent with general technological patterns for Area 1, the five groups of refits were non-cortical jasper flakes, sizes ranging from .8 to 13.6 gms.

The small to moderate size of the flakes, their lack of cortex, their relative thinness, and their small platforms all were signs that they were the product of secondary stage lithic reduction. The absence of cores resulted in difficulty of finding attachments for the flakes, thus obtained refits were flakes to flakes. A total of 6 of the 8 refits represented proximal and distal fragments, indicating that the jasper material was brittle or flawed, often resulting in breakage during the manufacturing process. The high percentage of non-cortical flakes shows that the jasper that came into the site was probably first shaped at the quarry. The stemmed jasper bifaces do not appear to have been completed, representing relatively late stage, but discarded pieces. Based upon the presence of incomplete bifaces, the absence of cores, and the high percentage of secondary stage flakes, it appears that blanks or preforms were brought to this location for bifacial thinning, some byproducts were discarded on the spot, and others were transported away.

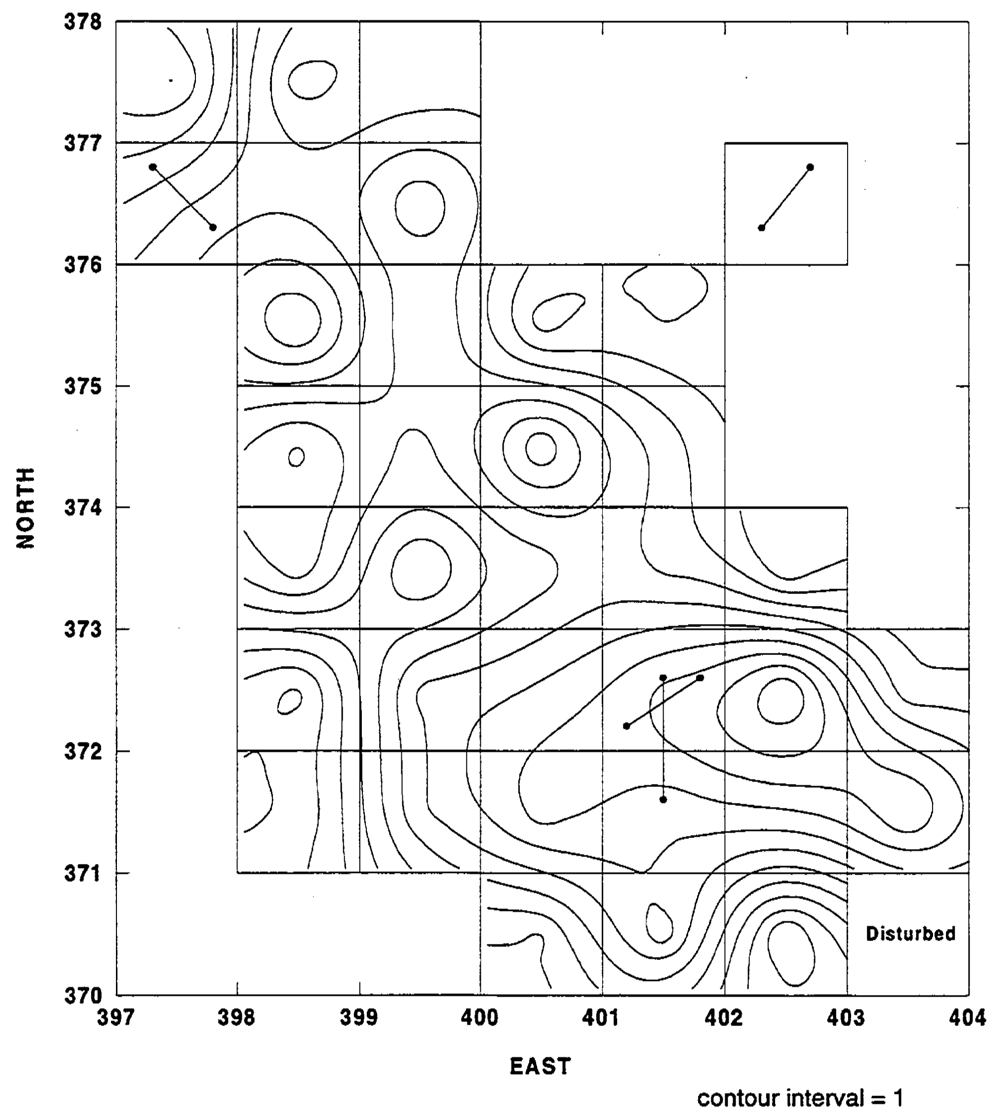


Figure 137. Refits in Area 1, Contour Lines Indicate Artifact Concentrations.

## Area 3

*Block A*

*Technology*

Block A contained 15 refit groups of chipped stone artifacts, consisting of a variety of materials including jasper, chert, argillite, quartz, and quartzite. Fourteen of the groups supplied inferences about prehistoric stone tool procurement and reduction techniques. One group (Group 12) consisted of a late stage biface of four heavily weathered argillite fragments occurring in four pieces, probably the result of postdepositional breakage.

*Extraction*

At least two groups (Groups 6, 9) showed signs having been locally procured. Both groups reformed to show their cortical surfaces. In the case of the quartzite cobble, flakes were struck from a core which still retained most of its rounded edges, and in the case of the jasper core, the split pieces fully reconstructed to form a pebble. The relatively complete nature of the two cores indicates that they were probably retrieved locally, most likely from gravel beds located near the stream. Local procurement was also indicated from 12 of the 15 groups (Groups 1-2, 4-7, 9-11, 13-15), these showing cortical surfaces. The six quartzite groups, in particular, retained the highest cortical percentage, some flakes exhibiting up to 90% cortex, and the materials constituting the largest refit pieces.

*Core Reduction*

Two groups (Groups 5-6) showed percussion flaking of cores. Group 5 consisted of 7 pieces, a single core and 6 flakes (Figure 138). Several core surfaces were flat and angular, apparently having been struck off of a larger cortical piece. At least 6 flakes were then removed from the core, the sequence of which could be reconstructed The first and outermost flake removed from the core was artifact #664-1. It appears artifact #737-2 was then removed, followed by artifact #417-2, which shared its ventral surface with the core. A sequence of smaller innerlying flakes was then removed, each of which directly attach onto the core, including #734-5, which overlay #732-4, followed by flake #733-7. The combination of slightly larger outlying flakes and smaller and thinner innerlying flakes implies that the knapper likely used a combination of controlled manufacturing techniques, including soft hammer percussion and direct pressure. The resultant core edge had a serrated and sharp appearance, although no tool use was apparent, and based on its small dimensions, it was likely discarded.

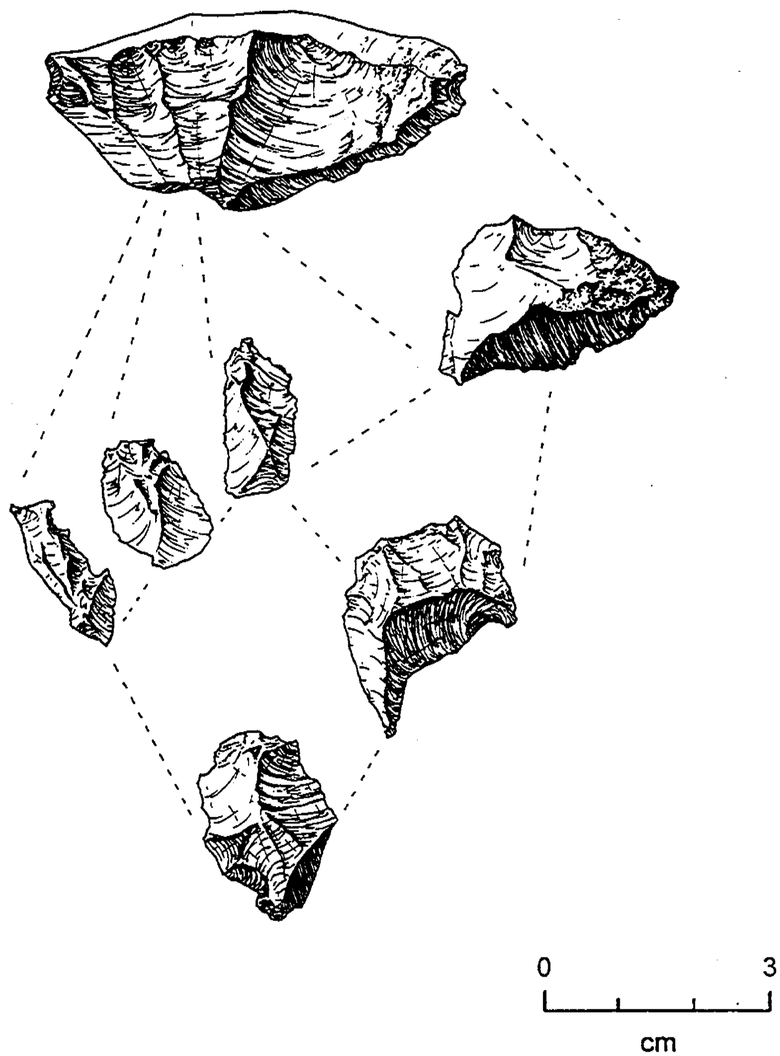


Figure 138. Refit Group showing Flaking Sequence

Group 6 was comprised of 4 refits, a core and 3 cortical flake removals. The core was clearly a cobble, as several faces still retained cortex and rounded edges. One half of the cobble appears to have been flaked a number of times. These large, outlying cortical flakes were not recovered from the excavation block implying that initial flaking took place elsewhere. The three flake reattachments represented an innerlying sequence of flake detachments first starting with flake 634-4, followed by 576-6, and finally flake 528-14. The relatively large to moderate size of the flake removals from the core implied hard hammer percussion was used.

Certain groups do not provide much technological information other than indicating that they were flaking byproducts. Groups 1 and 7 each consisted of two portions of single decortication flake that conjoined along transverse breaks. Group 4 was comprised of three fragments that reattach along flaw lines to form a single large flake. The total length of the conjoined flake is 98 mm, indicating the core or biface from which it was struck was relatively large. Two pieces conjoined along a transverse snap along its proximal end, and these two fragments joined a third to reform the distal part of the flake and the platform. The refits are most likely the result of initial flake detachment from a core, the flake fragmenting along the flaws. Groups 1, 4, and 7 are quartzite flakes showing breakage along flaw lines. Group 14 consisted of two jasper flakes, the larger piece refitting on the dorsal side of the distal portion of the former.

*Bipolar Technique*

The three refit groups (Groups 8, 9, 11) shared some technological and morphological similarities indicative of employment of the bipolar technique. Two of the cores (Groups 8, 11) appear to have been subject to bipolar reduction as demonstrated by their small, exhausted appearance. Group 8 consisted of two non-cortical core fragments. The core exhibited negative flake scars which were wide and relatively shallow, probably indicative of removal by hand held-percussion. Once flakes were removed, it appears that the small core was exhausted, and was further split using a bipolar technique. Intentional splitting was indicated by a small, battered striking surface at the center point of the top surface of the core. After the core was split, the two halves were discarded and not further utilized. Discard of the pieces may be due to their small size, the relatively low grade of the material, and the presence of crystalline inclusions. Group 11 was composed of a core fragment and a flake, the two artifacts conjoining to form most of a small core. Group 9 consisted of two fragments that refit to form a whole cortical pebble that was tested (Plate 48). A striking surface was apparent at the juncture of the two split flakes. The pebble appears to have been selected, split, and discarded, showing no signs of further modification or use.

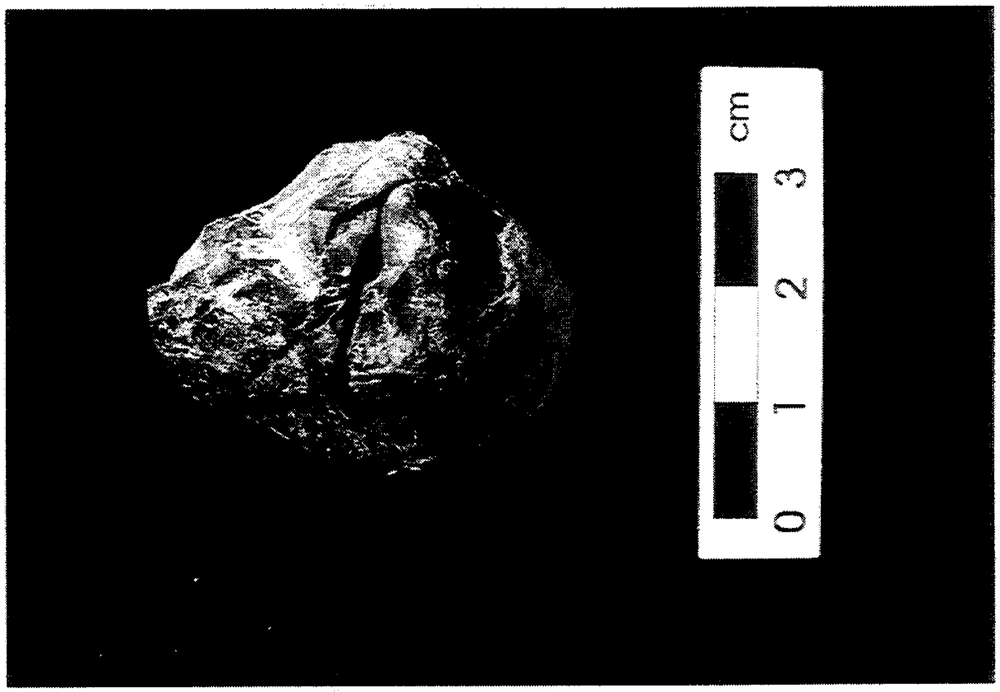


Plate 48. Refit Bipolar Pebble

*Biface Manufacture*

Four groups (Groups 2-3, 10, 12) were indicative of breakage and rejection during biface manufacture. Group 2 was comprised of a small flake that fits onto an early stage biface. The flake was removed during the decortication along one edge. The biface was short and thick and was probably rejected by the knapper for further thinning. Group 3 consisted of two fragments of a biface that conjoined along a transverse fracture to form a medial section of an early stage biface. The first fragment had a deep flake scar adjacent to the transverse fracture, and no visible material flaw was related to the break. The transverse fracture was probably a result of a platform angle error on the part of the knapper. Group 10 was comprised of two fragments of a jasper biface. The transverse break was the result of a flaw which occurred near the distal end of the biface.

*Broken Hammerstones*

Group 13 consisted of two fragments of a broken hammerstone. The two fragments were part of a larger piece which was not recovered during excavation. One distal end of the hammerstone exhibited heavy battering from use and the second piece exhibited a wear pattern that suggested use as an abrader. Group 15 consisted of three fragments of a cortical, tabular cobble. These artifacts conjoined along break surfaces which showed material flaws. There were no apparent signs of percussion flaking and only one of the pieces showed possible signs of battering.

*Fire-Cracked Rock*

Block A produced a total of 7 groups of fire-cracked rock (Plate 49). While Stratum D2 and 3 showed a generally organic appearance, there was no obvious or concentrated signs of burning or charcoal on particular surfaces. All 7 groups consisted of quartzite. The use of quartzite may indicate that this raw material was readily available to the site occupants or that it was intentionally selected. The seven groups of refits consisted of two to five pieces each. Of the four groups (Groups 1, 3, 5, 7) that could be reformed to mostly complete clasts, there was a large range of variation in the selected sizes, group weights ranging from 172 gms to 4.5 kilos.

Plate 49. Refit Fire-Cracked Rock

*Spatial Patterns*

The 15 groups of refit artifacts and the 7 groups of refit fire-cracked rock contribute in the interpretation of the vertical and horizontal patterns within Block A. Available information indicates that spatial patterning was both the result of areas of human activity and rearrangements by natural processes.

*Vertical Patterns*

Vertically, the refits provide information about stratigraphic succession as well as postdepositional disturbance. In viewing the stratigraphic profile, the most obvious pattern was the wide vertical separation among refits (Figures 139 and 140). This was especially notable for the flake and core refits. The largest vertical transformation noted was one group which had refits ranging 60 cms. One other group had a separation of 40 cms and two others showed movements of 30 cms. While the vertical transformations and the connecting lines on the map may appear striking at first glance, it is significant to point out that there was evidence for vertical stability. A total of 11 of the 15 chipped stone groups (73%) were separated by no more than 20 cms, while multiple refits from 6 groups were found in the same level. Moreover, it is important to note that even within the refit group that ranged over 60 cms vertically, most of the refits in the set occurred within one or two 10 cm excavation levels.

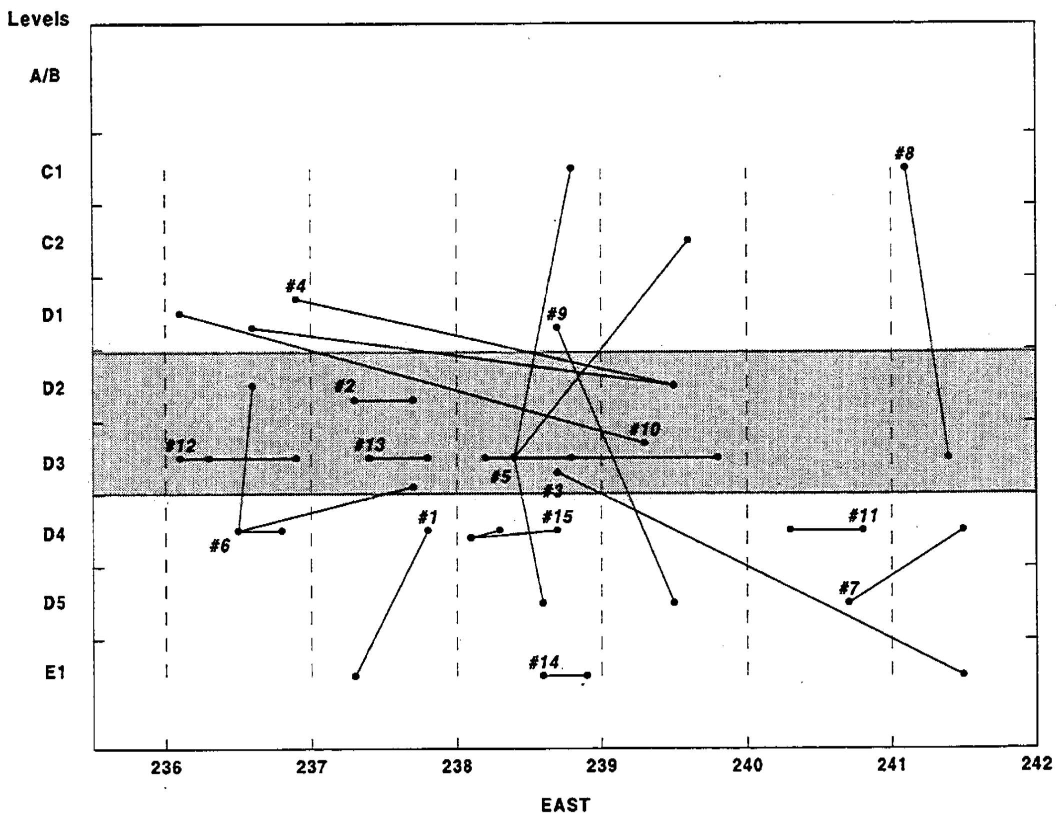


Figure 139. Vertical Profile of Refit Flakes and Cores, Area 3 Block A

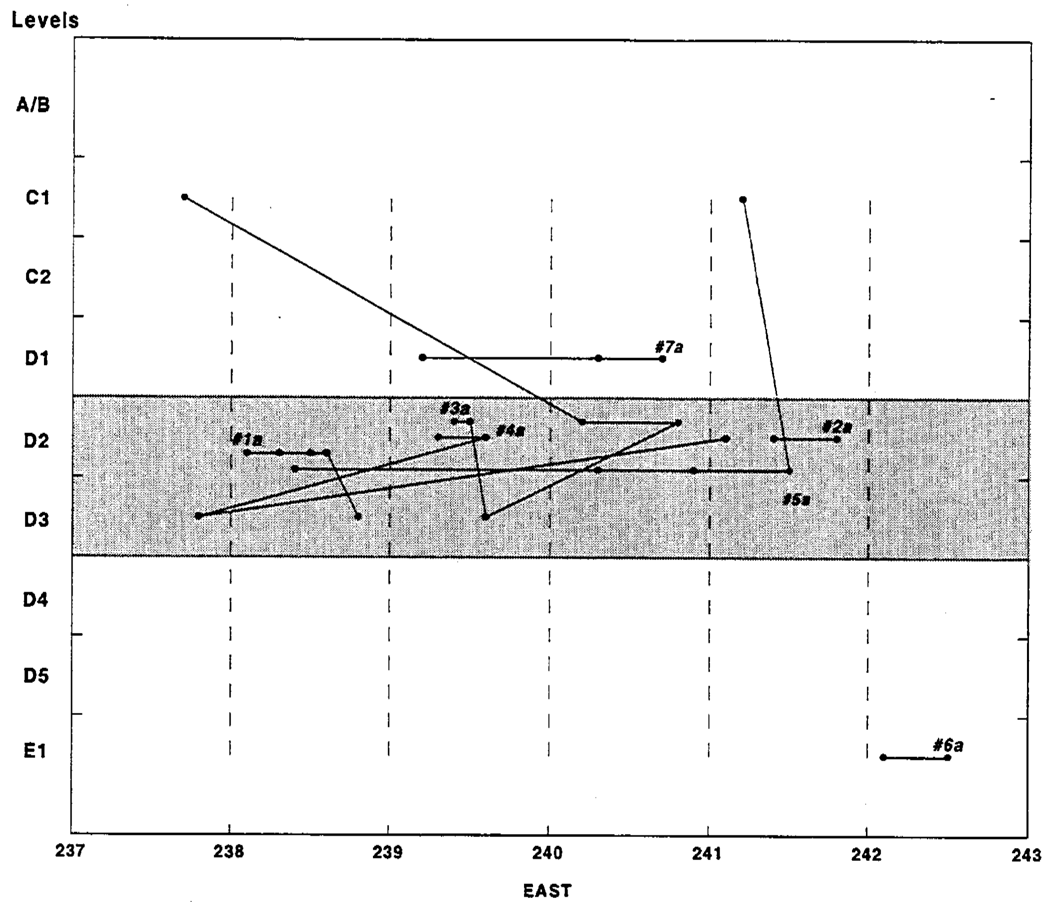


Figure 140. Vertical Profile of Refit Fire-Cracked Rock, Block A, Area 3

The vertical pattern for fire-cracked rock contrasted somewhat with the chipped stone distribution, showing a greater amount of stability of pieces on horizontal surfaces. The fire-cracked rock pattern indicated that most pieces were confined to a 10 to 20 cm spread. Only two groups had pieces which spanned more than two levels, Group 5a ranging over 30 cms and Group 3a ranging over 40 cms. In each of these two groups, however, artifacts were confined to the same level or within two levels. The general lack of vertical transformation of fire-cracked rock in comparison to chipped stone is probably due to their greater size range and weight, thereby inhibiting downward and upward movement in the stratigraphic column.

One question that comes to mind is the agent or processes responsible for the vertical transformations of the stone artifacts and fire-cracked rock. The environmental context of Block A is a floodplain with sandy soils. As a consequence, a variety of biological and geological factors may have led to the transformations. Artifact migration may have been caused by burrowing animals, root action, or shrinking and swelling of soils induced by a fluctuating water table, for example. While some environmental process(es) are likely the cause, no single geological or biological agent can be pinpointed in causing the movements. Human postdepositional activities such as trampling may be ruled out in causing the vertical artifact transformations given that pieces are found upward in the sequence, thereby indicating that artifact movements occurred after burial. The refit evidence therefore shows that a buried cultural horizon certainly occurs in Stratum D2 and D3. The inter-level conjoins show that vertical transformations occurred after burial. As a consequence, based solely on the vertical distributions, it is difficult to ascertain the numbers of occupations that may be represented in the stratigraphic profile. The relatively few refits of chipped stone artifacts and fire-cracked rock that occur in the three other proveniences (Strata D1, D4, E1) preclude any statements about the cultural significance of these levels.

### *Horizontal Patterns*

Horizontally, 12 of the 15 artifact sets were found within either the same 1 m unit (n=6) or in a contiguous unit (n=6) (Figure 141). Three artifact sets had pieces separated by 3 meters. Of the seven fire-cracked rock groups, horizontal separations ranged somewhat more, two sets from the same unit, two sets from adjacent units, and three sets separated by 2 m, 3 m, and 4 m respectively.

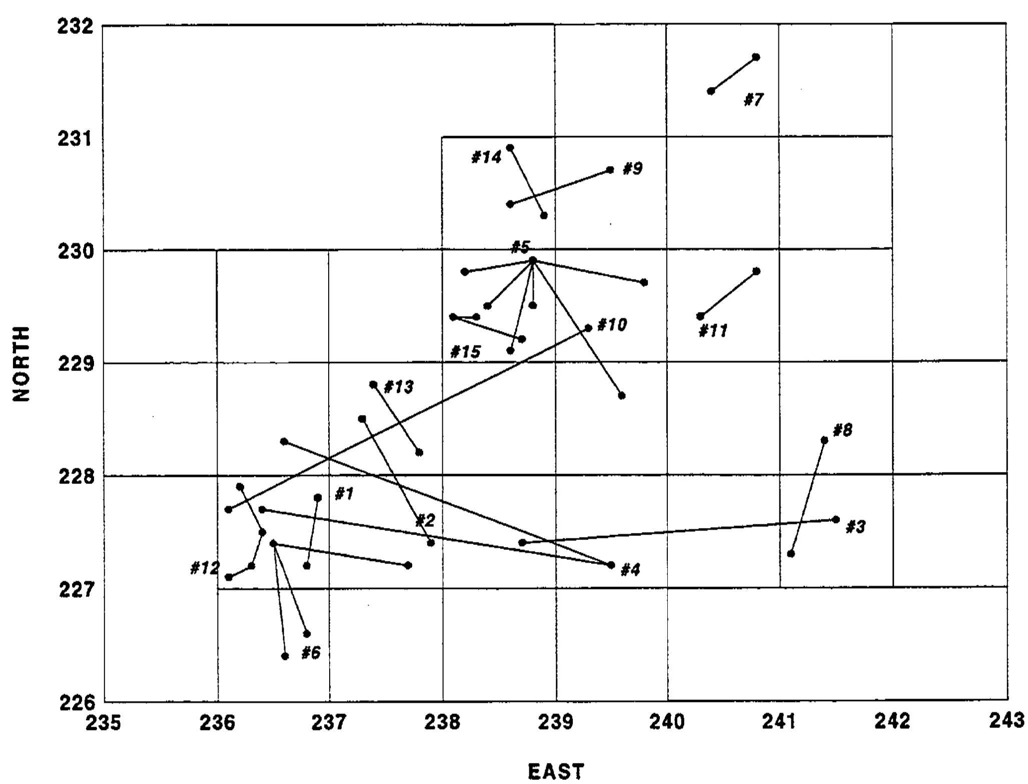


Figure 141. Horizontal Distribution of Artifact Refits, Block A, Area 3

It is of interest to examine how the horizontal patterns relate to interpretations of stone tool reduction. Two groups considered to be the result of core percussion (Group 5, 6) showed similar spatial patterns, with Group 5 having 4 of its refits within contiguous units and Group 5 having 7 of its refits in contiguous units. It is interesting to note that three of the flakes that attached to the Group 6 core occurred in an arc away from the core, as if they fell in 1 m away during reduction. Most of the flakes that reattached to the Group 5 core were found in the same unit, although two flakes occurred at a distance of 1 m, also implying that separations may have occurred during reduction.

All three cores interpreted to be the result from bipolar reduction (Groups 8-9, 11) shared similar spatial patterns. Each of the two refits from each group were recovered in close spatial proximity, matches found either within the same unit or confined to contiguous units.

The refit groups showing the greatest horizontal separations (Group 3, 4, 10) may be related to artifact manufacture and percussion flaking. Two of the groups (3, 10) each consisted of two biface fragments that appear to have broken during biface manufacture, and in each case refits were separated by a distance of 3 m. The 3 m separation among the Group 4 refits may be related to breakage during extraction and flaking.

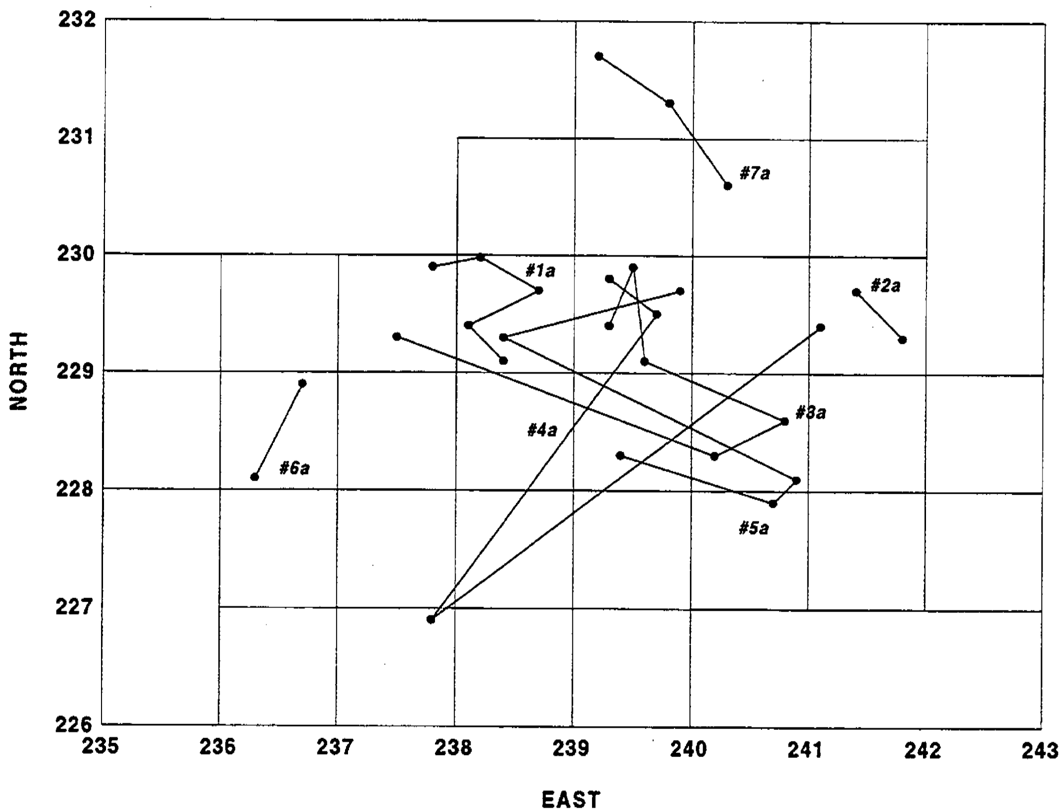


Figure 142. Horizontal Distribution of Fire-Cracked Rock Refits, Block A, Area 3

Of the fire-cracked rock refits in Block A, two sets were found within the same unit and two sets were found in contiguous units. Other fire-cracked rock were found at greater distances, one set was separated by 2 m, one set by 3 m, and one set by 4 m (Figure 142). The fire-cracked rock sets were recovered from a general cluster located at approximately N229-230 E238-241, spanning a horizontal distance of 6 $m^2$. While most of the fire-cracked rock was horizontally and vertically confined thereby occurring on a similar surface, no particular feature type or clear boundaries could be identified.

Of interest in interpreting prehistoric activity, there appears to be some spatial overlaps and differences in the general location of the refits of chipped stone artifacts and the fire-cracked rock (Figure 143). The cluster of fire-cracked rock contrasts with refits

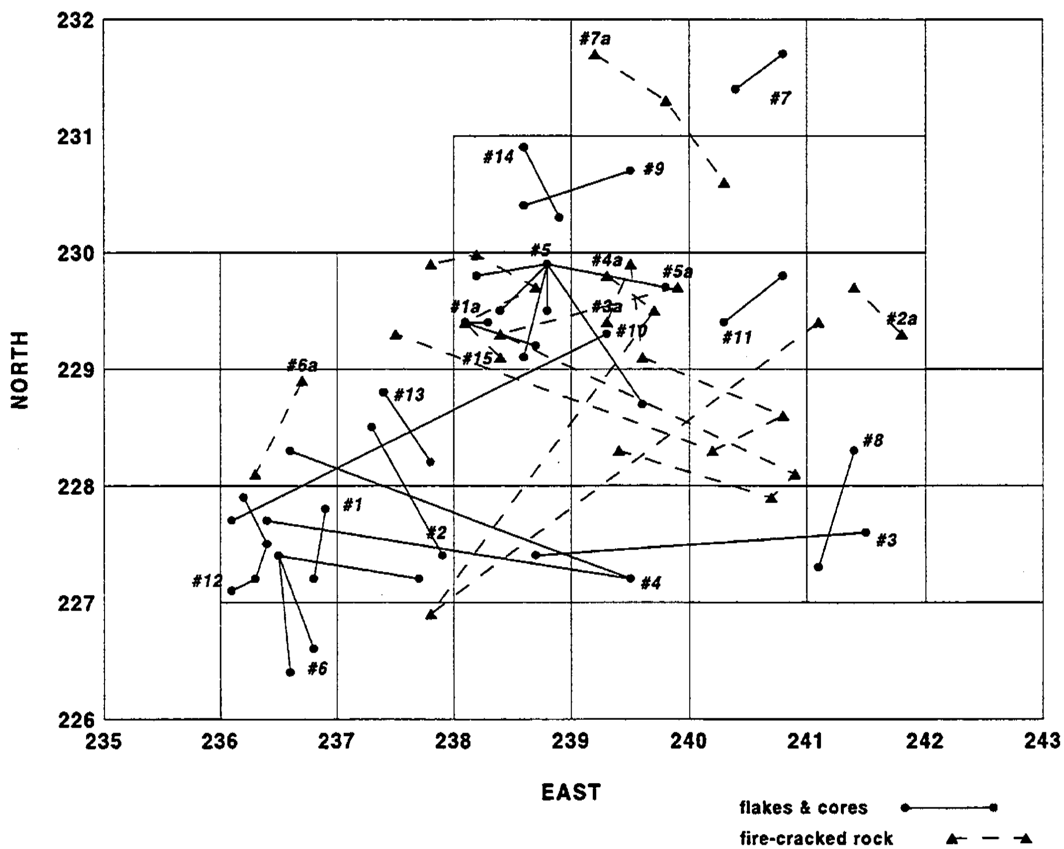


Figure 143. Spatial Distribution of Artifact and Fire-Cracked Rock Refits
Block A, Area 3

found in the southwest quadrant of Block A. While no direct functional relationship can be drawn between these two concentrations, it indicates separate activity sets may be present. There is evidence to suggest that the activity associated with the fire-cracked rock clustering occurred after some of the artifacts were discarded. Groups 3, 5, and 9 each have evidence of burning or reddening of artifacts. Group 5, a core reduction set, occurred in direct association with the fire-cracked rock, whereas Groups 3 and 9 were peripheral to the fire-cracked rock clustering. Heated artifacts in these three groups attached to artifacts that showed no signs of burning, implying that burning took place after their discard. The heating activity after artifact discard may account for some of the horizontal reshuffling of artifacts. Moreover, once heating activity ended, the horizontal separation of fire-cracked rock may have occurred as a result of additional activity on the same surface prior to burial.

## Block B

### *Technology*

Block B of Area 3 contained four sets of refits (Groups 1-4), inferred to be the result of stone tool reduction. Groups 2 and 3, although not refit to each other, appear to be derived from the same core.

Group 1 consisted of 14 conjoined jasper fragments recovered in a single unit. The pieces refit to comprise a relatively large, tabular cobble (772 gms) with cortex. The refitted pieces in Group 1 conjoined along natural breaks. The refit group was somewhat problematic in that no definite flaking patterns or battering marks were evident. The large size of the cobble compared to natural clast in Stratum E suggested that it may have been recovered from the nearby stream for potential flaking. It is possible that the cobble was then split by percussion to examine the quality of the jasper material. If this was the case, the material was probably considered to be low quality for flaking, and therefore it was left in place and none of the pieces were used for reduction.

Groups 2 and 3 were comprised of 5 flakes, all of which were from a green quartzite. In addition to the two groups of refits, their lithological and technological homogeneity implied that all of the pieces in the two sets were derived from the same core. The five artifacts were cortical, appearing to be detached from a cobble. Group 2 consisted of three refit flakes. Two smaller flakes refit to dorsal and ventral sides of the largest flake (128.2 grams), at a common striking surface and along a natural flaw in the material. The flaw appears to run throughout the cobble, likely resulting in rejection of the recovered pieces. Group 3 consisted of two cortical flakes which appear to have made up one of the corners of the initial cobble. In addition to the 5 pieces comprising the two groups, 8 other flakes of this green quartzite were recovered. These were likely products of the same core. The 13 pieces were recovered in the central portion of Block B. The location of the finds appears to indicate that additional, unrecovered pieces were reduced or transported elsewhere.

Group 4 consisted of two refit sandstone fragments which showed evidence of battering, inferred to be the result of anvil use. The piece also showed signs of heating. The relationship between the anvil use and fire heating could not be determined.

*Fire-Cracked Rock*

Two groups, each consisting of two pieces of fire-cracked rock, were recovered from Block B. The lack of other associated pieces in these locations likely represents postdepositional splitting along burned fracture planes rather than cracking during in situ heating.

*Spatial Patterns*

On the whole, the six refit groups from Block B provide support for the relative integrity of the stratigraphic deposits (Figure 144). Vertically, most matches from Group

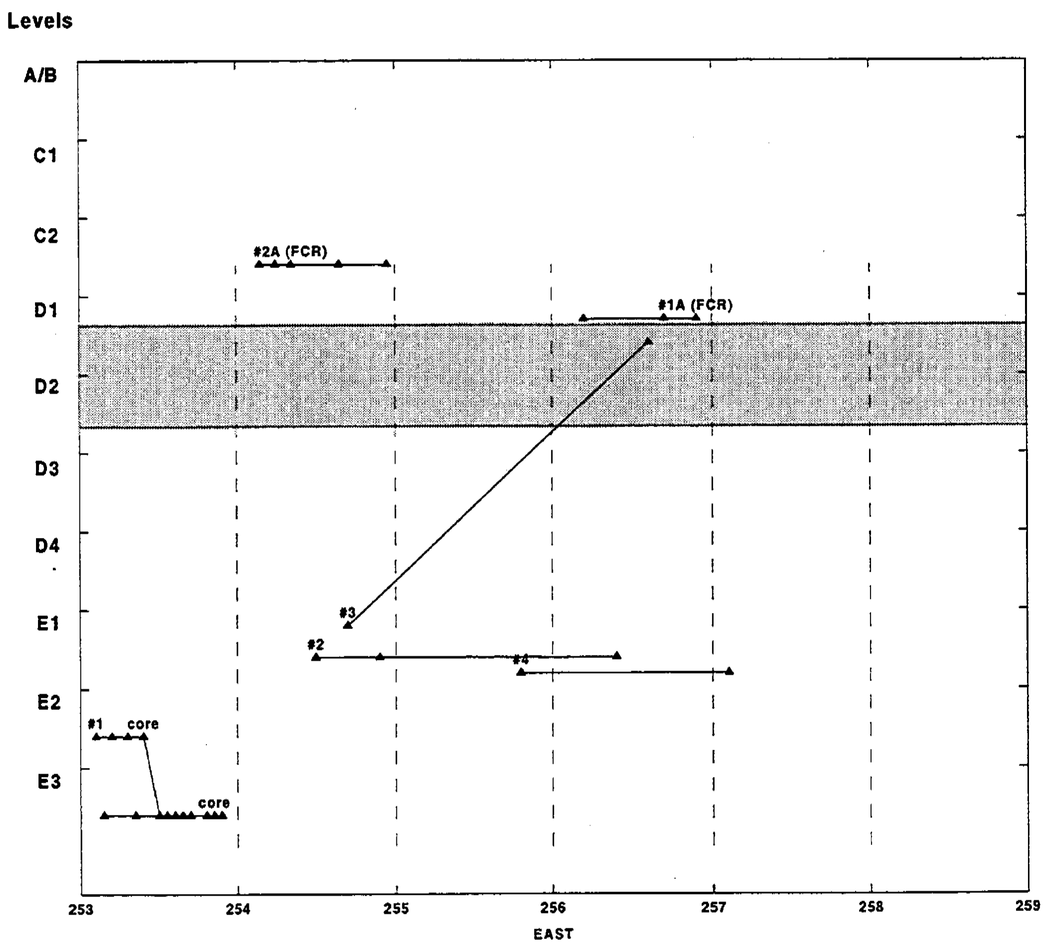


Figure 144. Vertical Distribution of Refits, Block B, Area 3

1 occurred within a 10 cm provenience ranging over a maximum of 20 cms. Four other groups (Group 2, 4, 1A, 2A) were found within the same 10 cm level. Horizontally, distances ranged no greater than 2 m, with three of the groups (Group 1, 1A, 2A) within the same 1 m provenience (Figure 145). This implies that pieces were buried in the position in which they were discarded, not horizontally sorted by natural processes. The only evidence for potential postdepositional disturbance was from Group 3, where one small flake (501-1) weighing 12.4 gms was recovered from a provenience that was separated from the Group 2-3 cluster by ca. 40 cms. The position of the single flake in level D1 is interpreted to be the result of upward movement of this piece by a natural agent. The two groups of fire-cracked rock most likely result from postdepositional breakage based on the fragmented characteristics of the pieces, their close spatial relationships, and the lack of other associated artifacts.

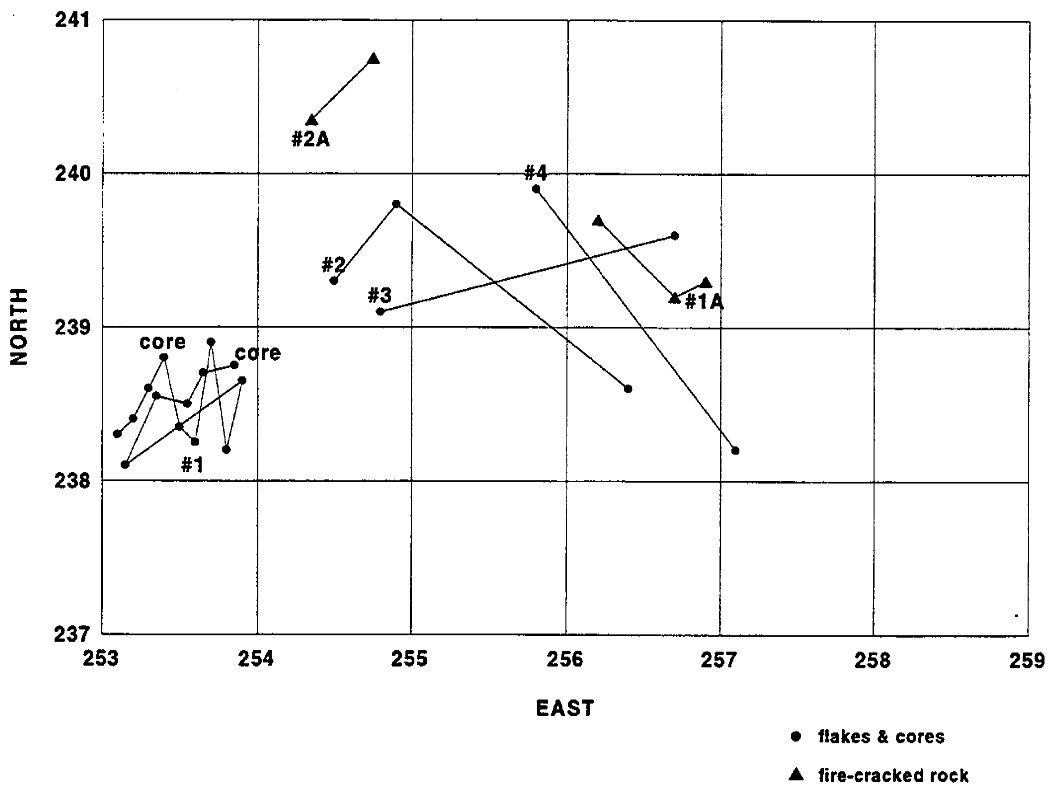


Figure 145. Horizontal Distribution of Refits, Block B, Area 3

The refits in the vertical profile provide support for a general stratigraphic succession. At least two discernible vertical units were implied, one in Level E2-3 (Group 1), and one in E1 (Groups 2-4). The Group 1, Group 2-3, and Group 4 refits imply that artifacts generally remained where they were originally reduced. Beyond these two clusters, the relatively low number of refits could not be used to discern any behavioral patterns within stratigraphic levels. The lack of refits in the D1 to D2 levels constrasts with the success of the Block A results, where the layer yielded a number of matches.

## Conclusions

The lithic refits obtained in Area 1 positively confirmed that a proportion of the jasper artifacts were related. The refits help to support the fact that the jasper represented reduction areas, mostly related to biface reduction. The low number of Area 1 refits was partially the consequence of the relative lack of large pieces which would aid in reassembly (e.g., cores, bifaces). The conjoining of broken flakes showed that the jasper material also sometimes fractured in unpredictable ways. Based on the large number of flakes and the dominance of small, non-cortical pieces, it is probable that preforms or early stage bifaces were brought to Lums Pond after initial extraction and roughing out at the quarry source. The presence of incomplete bifaces and the general absence of cores and other bifaces indicates that some pieces were likely successfully reduced and carried away.

The refitting of lithic artifacts and fire-cracked rock in Area 3 provided significant information about human activity and depositional processes. The refitting evidence showed that the Area 3 patterns were a complex amalgamation of cultural and natural processes. The refitting data indicated that the 1 m deep profile was probably the consequence of successive superpositions of occupations. The refitting data implied horizontal strata were present. The combined lithic and fire-cracked rock data suggested that there were activity episodes on the same surface or reoccupations over the course of time. In Block A, from the oldest to youngest deposits, four levels were implied: E1, D4, D2/3 and D1, with the large majority of refits confined to D2/3. Given the large number and vertical range of refits found across the two levels, it is possible that Block A levels D2/3 represent more than one occupation or multiple episodes in activity during the same occupation. In Block B, two levels were indicated by the refits, confined to the lowermost and oldest occupation surfaces, including E2/3 and E1. The Stratum E surfaces in Block B are probably comparable to the E1 level of Block A, perhaps representing the same occupation surface.. While some refits could be found over horizontal surfaces, it is not possible to suggest that these levels may be taken as discrete depositional layers due to vertical transformations and the probable slow rate of burial after artifact discard.

Vertical differences among refits indicated the importance of considering the role of natural processes in site formation and the inherent danger in assuming that all spatial patterning represents cultural activities. The movement of pieces across vertical levels was clearly operating in Area 3. In this case, this was considered to be the product of movement of material postdepositionally, possibly the consequence of faunal or floral agents. The maximum vertical separation documented by the refitting data was 60 cms. Other groups ranged from 30-40 cms in vertical separation, although most refits were confined to a 10-20 cm spread. There was apparent size sorting of the refitted artifacts, the larger and heavier fire-cracked rock pieces having a lower vertical distance range among pieces compared to the smaller pieces of debitage. The apparent size sorting of refits is an important observation since it reveals that larger clasts are more likely to be in a closer proximity to their original cultural pattern than the smaller material. The size sorting also indicates that whatever natural process occurred in this spot, upward or downward migration was not forceful or energetic enough to move larger pieces. The vertical differences of refits is a reminder that simplistic functional associations can not be assumed for all artifacts within a deposit, even when there is apparent soil development. The Area 3 translocations were probably a product of the circumstances encountered in this locality, the area containing sandy and silty sediments which would not have necessarily prevented artifact mobility, and the higher frequency of biological activity that would have occurred in this floodplain setting, burrows and root action aiding post-burial artifact movements.

While vertical separation of 30-60 cms was documented for refits, it is important to emphasize that these distances were not the most common among the groups, 75% of the conjoins were confined to within 20-30 cms and many were found from 0-10 cms. Occupation surfaces were probably no thinner than this, hence horizontal patterns, in many cases, may be taken as generally representative of activity. Horizontally, about three-quarters of the refit groups were confined to the same 1 m provenience or ranged no more than 1 m. Some of the horizontal separations of 2-4 m were considered to be the result of activity over a larger area, separation of pieces during stone tool manufacture, or rearrangement by trampling. In Area 3, multiple lithic reduction sets could be identified, and in Block A a burning area was delimited. The refitting data supported evidence for raw material extraction, core reduction and percussion flaking, bipolar reduction, biface manufacture and failure, and hammerstone breakage. In some cases, refits and their attributes indicated that the inhabitants extracted raw materials from nearby gravel beds. The refits indicate that held percussion flaking was used, employing hard and soft hammer techniques. On smaller clast, such as pebbles, the bipolar method was used for splitting pieces. Biface rejuvenation was also conducted, and in some cases the refurbishing resulted in unintentional fractures, leading to artifact discard. These chipped stone manufacturing and reduction episodes likely account for some of the horizontal spatial patterning. In some cases, cores considered to be the result of percussion flaking and bipolar reduction had pieces in close spatial proximity, with pieces confined to the same provenience or separated by no more than 1 m away from the set. Several other refit sets showed a larger horizontal separation of pieces, interpreted to be the result of separation during core percussion and breakage during biface manufacture. In Block A, there was some interesting spatial relationships among the refit artifact sets and the fire-cracked rock. In several cases it appeared that the lithic artifact sets were heated after discard, indicting overlapping activity on the same surface. While suggestive, other reduction sets along the perimeter of the feature may have occurred outside the zone of burning, although a direct one to one relationship could not be drawn. The evidence for repeated activity on the same surface may also account for some of the 2-4 m wide horizontal separations among pieces as well as account for some of the minor vertical differences among refits.

In sum, the refitting project was considered a success, the multiple goals of the analysis having been achieved. The information derived from the analysis provided important information about the formation of the Lums Pond deposits and the archaeological patterning. In particular, the lithic refitting analysis contributed specific data for interpretation of stone tool technology, intra-site activities, and depositional integrity. Without the application of the refitting project, inferences about human behavior and arrangement by natural processes clearly would have been less informed, thus hindering interpretations about the meaning of the archaeological patterns.

## REFERENCES CITED


Carr, K.W.

1986 Core reconstructions and community patterning at the Fifty site. *Journal of Middle Atlantic Archaeology* 2: 79-92.

Bergman, C.A., and J.F. Doershuk

1992 How the data come together: refitting in lithic analysis. *Journal of Middle Atlantic Archaeology* 8: 139-160.

Custer, J.F., and S.C. Watson

1985 Archaeological investigations at 7NC-E42, a Contact Period site in New Castle County, Delaware. *Journal of Middle Atlantic Archaeology* 1: 97-116.

Cziesla, E, S. Eickhoff, N. Arts, and D. Winter (eds)

1990 *The Big Puzzle: International Symposium on Refitting Stone Artefacts*. Holos-Verlag, Bonn.

Hofman, J.L., and J.G. Enloe

1992 *Piecing Together the Past: Applications of Refitting Studies in Archaeology*. BAR International Series, Oxford, 578.

Petraglia, M.D.

1993 Small sites not forgotten: investigations of a temporary manufacturing station in Maryland. *Journal of Middle Atlantic Archaeology* 9: 97-116.

1994 Reassembling the quarry: quartzite procurement and reduction along the Potomac. *North American Archaeologist* 15: 283-319.

Whyte, T.R.

1985 Cross-mending burned chert artifacts to evaluate postdepositional disturbance in an archaeological deposit. Paper presented at the Middle Atlantic Archaeological Conference, Rehoboth.