XVI. JASPER EXPERIMENTS

Introduction

Jasper artifacts recovered from Lums Pond were selected by aboriginal groups during visits to northern Delaware quarry sources. Archaeologists have noted that the jasper within the Delaware quarries is known to vary in lithological structure, ranging from fine grained, high quality material that can be predictably reduced and shaped into tools, to coarse grained and flawed material that does not allow for controlled conchoidal flaking (Wilkins 1976; Custer et al. 1986; Lothrop et al. 1987; Vidal 1988; Doms 1995; Petraglia and Knepper 1995). Since few formal lithic replication experiments have been conducted for the Delaware jaspers to examine material properties and reduction mechanics, it was felt that a preliminary experimental study was warranted for making more secure inferences about the Lums Pond assemblage.

The main aim of the lithic reduction experiment was to compare the variable flaking characteristics of the jasper. Once the range of flaking characteristics was determined, a comparison could be made to the archaeological samples from Lums Pond. Such a comparison would allow for greater insight into whether the jasper at Lums Pond represented unusable and discarded debris or higher quality materials that were manufactured into tools.

Sample Sources

Jasper for the experiments was obtained from three recorded sources; Iron Hill (7NC-D-34), Chestnut Hill (7NC-D-3), and the Iron Hill Cut Quarry (18CE65). The material from Iron Hill was collected adjacent to areas mined for iron ore historically. Iron Hill jasper of varying quality was collected from outcrops on the surface, from a stream (an unnamed tributary of Muddy Run) and from the side walls of a historic mine pit. Jasper from Chestnut Hill was collected from surface outcrops along its northern slopes. Jasper from the Iron Hill cut quarry was collected from primary boulder outcrops along the Amtrak railroad route (Plate 36) and secondary scree sources along a stream. Boulders and slabs of jasper were examined in the field (Plate 37) and collected for experiments (Plate 38).

Plate 36. Jasper Outcrops, Amtrak Locality

Plate 37. Jasper Procurement

Plate 38. Jaspers Collected for Experiments

Experiments

To examine the flaking characteristics of the jasper, a wide range of materials with visual distinctions were selected. Materials ranged from fine to coarse grained specimens with signs of inclusions and flaws which could hinder conchoidal fracture. Prior to experimental replication, three analytical categories were established to provide an framework for recording differences in flaking characteristics.

The first category was “homogeneity”, subdivided into three classes: (1) fine grained texture; (2) medium grade texture, with minor flaws, and (3) low grade materials with many flaws and inclusions. The second category was “fracture”, which was subdivided into two classes: (1) conchoidal fracture of pieces with observable flaking characteristics (e.g., platforms, bulb of percussion, ripples) or, (2) fracture into pieces that hinged, split, or shattered. The third category was “usability”, which was subdivided into two classes: (1) pieces that were usable for artifact manufacture, or (2) pieces that were unusable for artifact manufacture. Although these categories are qualitative measures and not necessarily discrete, they provided a way to record and control direct observations.

A total of 25 jasper groups were selected for reduction (Table 124). Each core was numbered, followed by a letter in parenthesis, indicating the quarry from which it was obtained. (IH) indicates Iron Hill; (CH) indicates Chestnut Hill and (IC) indicates Iron Hill Cut Quarry. A total of 9 cores were reduced from IH, 8 from CH, and 8 from IC.

Initial reduction of each core selected required an individual approach due to the size of the initial pieces and the type flakes that were to be detached. Large hammerstones were utilized on the larger blocks, while smaller hammerstones and either moose or white tail deer antler billets were used depending on the desired flake detachment. Combinations of the percusors were sometimes used during the experiments (Plate 39). The results are described in Table 124.

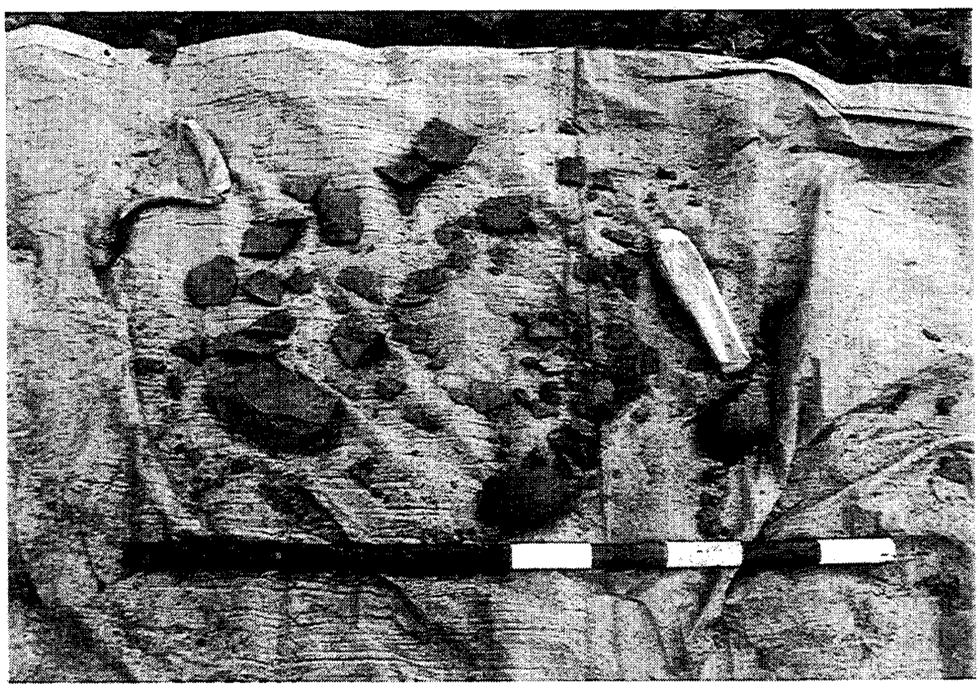

Plate 39. Percussors Used for Experiments and Experimental Debitage

Core #	Homogeneity	Fracture	Usability
1 (IH)	1	1	1
2(CH)	3	2	2
3(IC)	3	2	2
4(IH)	2	1	1
5(CH)	3	2	2
6(IC)	3	2	2
7(IH)	1	1	1
8(CH)	3	2	2
9(IC)	3	2	2
10(IH)	1	1	1
11(IC)	3	2	2
12(CH)	3	2	2
13(IH)	1	1	1
14(CH)	3	2	2
15(IC)	2	2	2
16(IH)	2	1	1
17(CH)	3	2	2
18(IC)	3	2	2
19(IH)	2	1	1
20(CH)	3	2	2
21(IC)	2	2	2
22(IH)	2	2	2
23(IC)	3	2	2
24(CH)	3	2	2
25(IH)	1	1	1

Table 124. Experimental Results

Results

Homogeneity

The lithic replication experiments showed a large degree of variation in material textures, 14 (56%) classified as low grade, 6 (24%) as medium grade, and 5 (20%) as fine grained. While the groups could be generally classified, cores contained some textural variability, making classification less than straightforward in some cases.

Five cores were categorized as highly homogeneous (Plate 40). These cores showed a fine grained texture without any major inclusions, although some minor variation in their grainy structure could be observed. Six cores were classifiable as

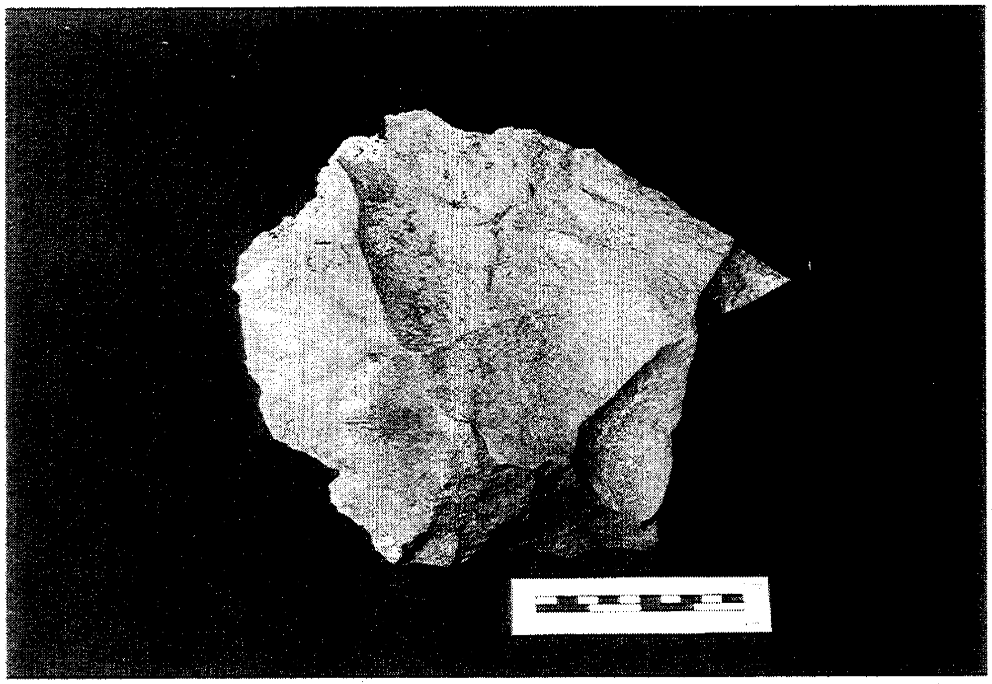

Plate 40. Homogeneous Jasper

medium grade, the pieces showing some degree of textural variability with patches of low grade material and some visible flaws. The remainder of the experimental pieces, or over half the cores, were categorized as low grade materials, with little internal homogeneity, sometimes with masses of unconsolidated material and some with many internal flaws and inclusions (Plate 41).

It is of interest to note that among the sources, there was some variation in the homogeneity classification. Of the 9 cores from Iron Hill, 5 were classified as high grade materials, and 4 were medium grade. The 8 cores from Chestnut Hill materials were all classified as low grade. Of the 8 cores from the Iron Hill Cut Quarry, 6 were low grade and 2 were medium grade. While it is probably the case that a variation can be found in

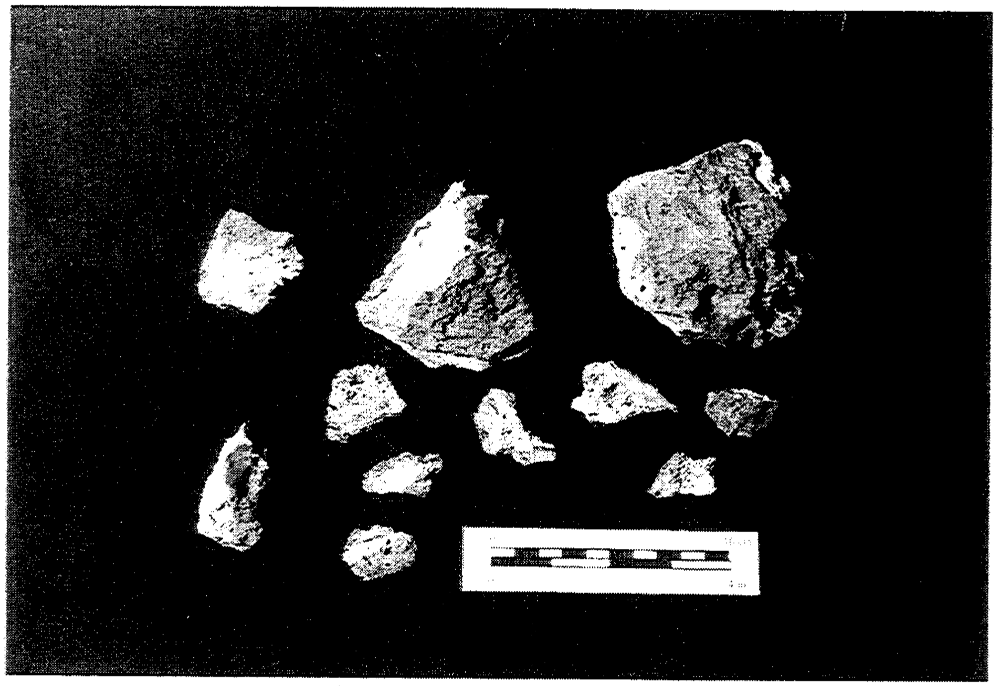

Plate 41. Flawed Jasper

each one of these sources, this data may imply that certain sources may have more of a relative abundance of homogeneous materials, with Iron Hill as a good source for collecting internally homogeneous pieces.

Fracture

The Lums Pond jasper reduction experiments provided useful information with respect to material fracture mechanics. A total of 8 (32%) of the cores could be classified into pieces that produced good conchoidal fracture, and 17 (68%) produced pieces that were highly fractured and devoid of any pieces that displayed characteristic percussion signatures.

Eight cores, all from Iron Hill, displayed excellent conchoidal flaking characteristics and these could be successfully reduced into cores, flakes, and bifaces (Plate 42). The core byproducts showed diagnostic signs of percussion flaking and materials. A total of 5 were from high grade materials and 3 were from medium grade materials. The ability to conchoidally fracture the jasper led to the production of predictable pieces of debitage. Long and wide flakes could be struck from the cores and core blanks and flakes could be further reduced for tool manufacture. The medium grade pieces exhibited relatively good fracturing characteristics, but these pieces contained

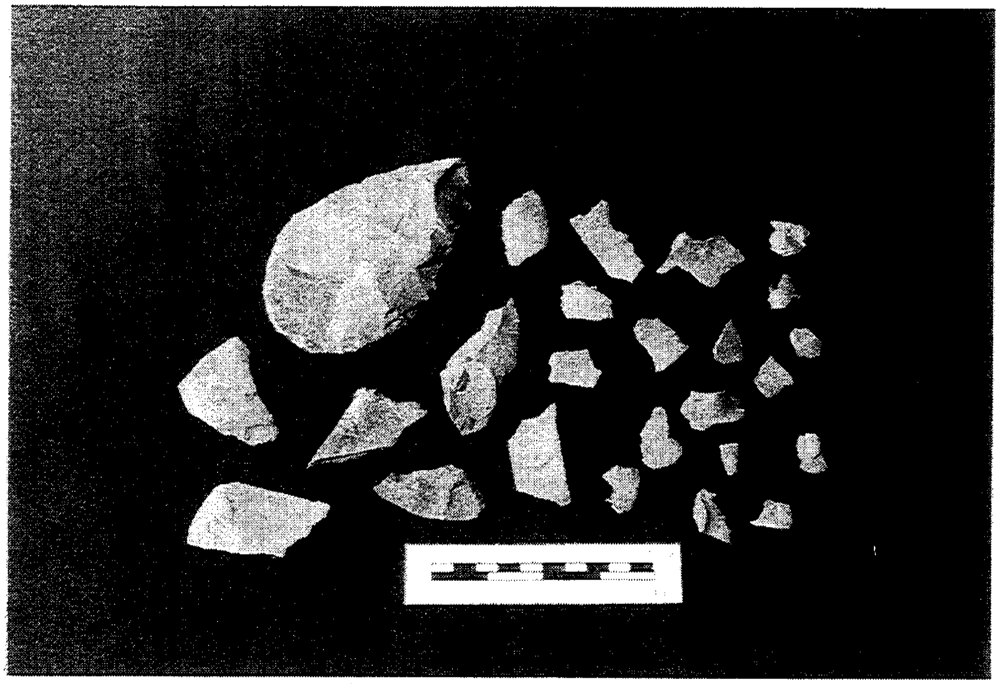

Plate 42. Jasper Showing Good Fracturing Characteristics

material flaws that required special preparation and prediction of platform angles for the successful detachment of usable flakes. The initial blow with a large hammerstone could split large nodules along quartz flaws. These material flaws contributed to the easy detachment of flakes and slabs when blows were struck parallel to these inclusions. However, when blows were struck perpendicular to these flaws (when not visible), they caused hinging and splitting, generally forming pieces that could not be further reduced. The large majority of the cores produced pieces with poor fracture mechanics and predictability, many with highly angular surfaces (Plate 43). The large majority were from low grade materials (n=14) and a few were derived from medium grade materials (n=3). Many of the cores of low grade materials produced debitage that was nearly unidentifiable as humanly manufactured flaking debris.

Usability

Eight cores (32%) produced usable debitage for artifact production. The debitage consisted of both cores and flakes. Large, thin flakes were produced that were suitable as

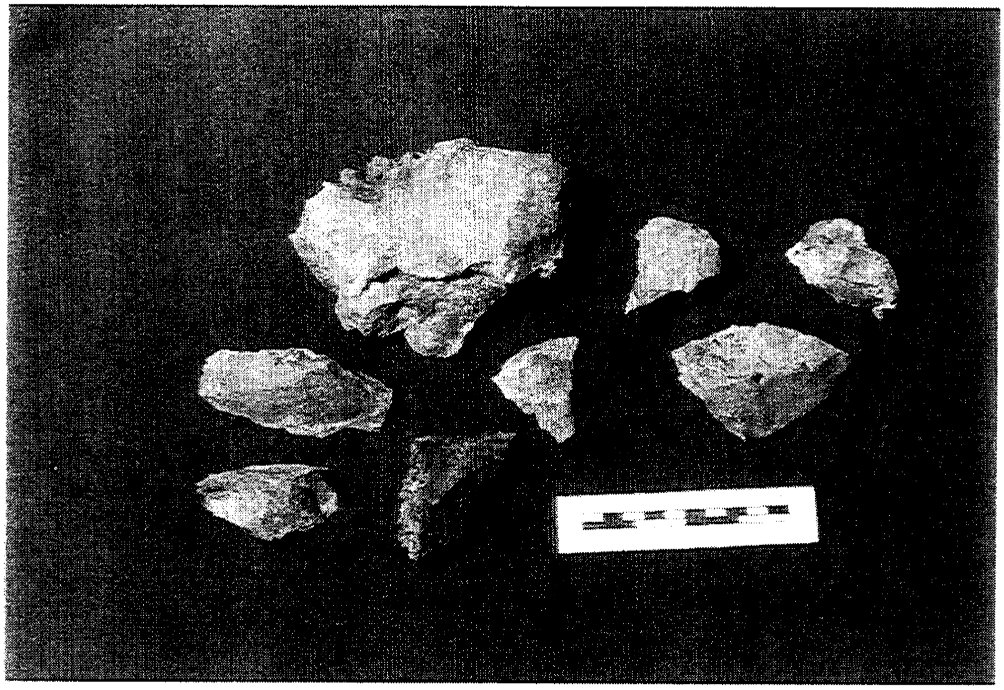

Plate 43. Jasper Showing Poor Fracturing Characteristics

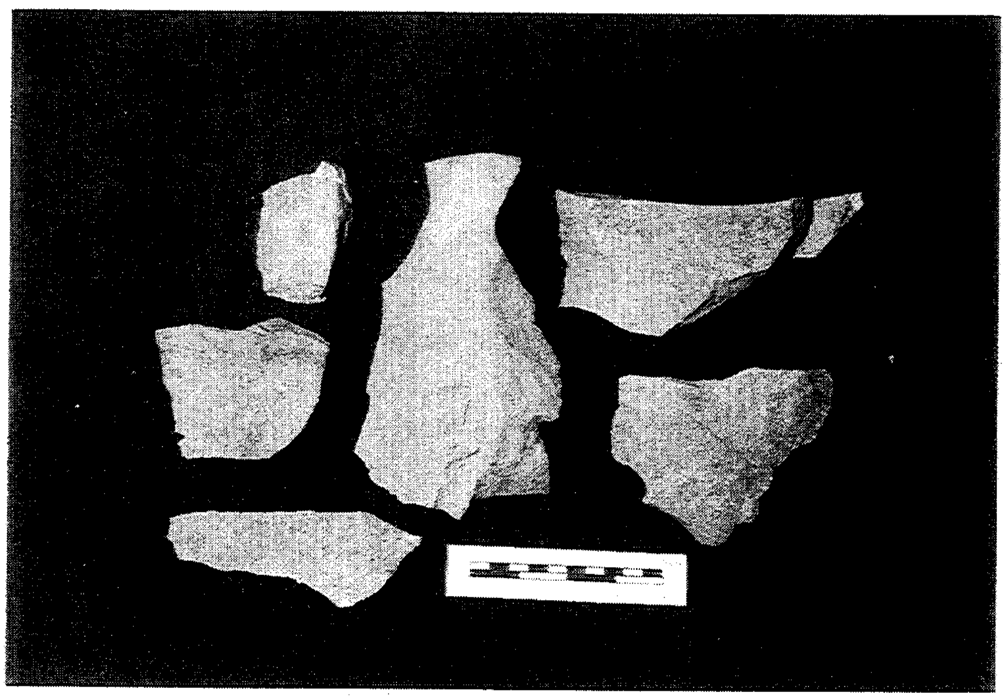

Plate 44. Jasper Producing Usable Flakes

blanks for further reduction and artifact manufacture (Plate 44). If desired, many of the smaller flakes from these cores could be retouched into flake tools or bifaces (Plate 45). The large majority, or 17 cores (68%), produced mostly unusable debitage. These cores produced debitage that could not be easily reduced any further to manufacture formal tool types. Undesirable characteristics included hinging, splitting and a generally highly fractured internal structure.

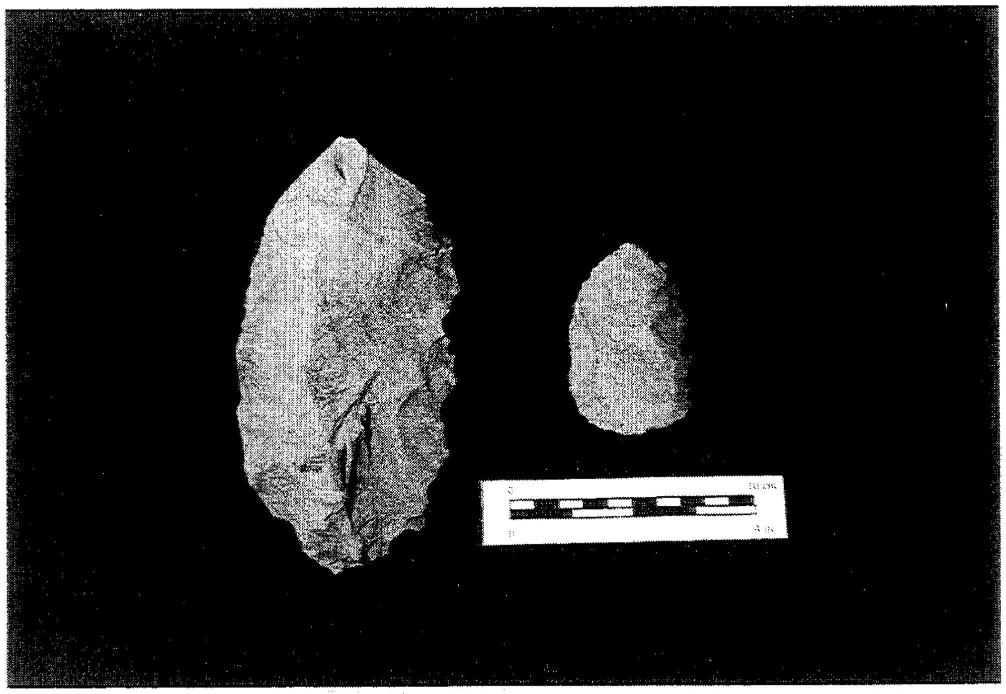

Plate 45. Jasper Yielding Bifaces

Comparison to the Lums Pond artifacts

One of the main goals of the replication experiments was to better understand the flaking characteristics of jasper allowing for greater insight into the Lums Pond artifacts. The experimental pieces were therefore compared to the archaeological assemblage to examine similarities and differences in homogeneity, fracture, and usability.

An immediate conclusion drawn from the comparison was that the archaeological pieces generally displayed a much larger range of the high grade materials compared to the chosen experimental pieces. Some of the jasper specimens from Lums Pond were of a higher grade jasper than materials collected for the replication experiments, exceeding even the highest grades reduced. Some of the pieces from Lums Pond had a very tightly bonded, homogeneous and sometimes glassy appearance, with definable flaking attributes. The lack of the highest quality grades for the experiments may be the result of the inability to locate the source(s), selection factors or exhaustion of the best sources by prehistoric inhabitants, or historic destruction during mining activities.

Several commonalties were noted in the direct comparison of the experimental pieces and the Lums Pond assemblage. Some of the jasper artifacts recovered from Area 1 at Lums Pond, including flakes, utilized flakes and a core (e.g., 1023-3; 1032-1; 1034-4; 1034-7; 1037-3; 1037-5; 1042-1; 1049-1; 1050-7), showed a similar level of homogeneous structure in comparison to eight of the nine experimental cores recovered from Iron Hill (e.g., 1, 4, 7, 10, 13, 16, 19, 25). Similarities between the experimental groups and the artifacts included a generally high grade, but grainy structure, with the presence of slight, but well-bonded bands of brown and yellow inclusions. This evidence, together with the size, reduction attributes, and refitting of the Area 1 pieces, indicates reduction of cores and discard of bifaces. The reason for discard of the bifaces is unknown, but it may be tied to material grade characteristics. That is, cores may have been originally selected and transported to Lums Pond, and once turned into bifaces, certain bifaces may have been selected for use, whereas others were discarded. The experiments showed that prehistoric knappers would have designed and planned reduction strategies to account for the flaws and fracture planes in the jasper. The artifacts from Lums Pond showed that this variable was controlled for as indicated by successfully reduced pieces, some with visible quartz bands and inclusions. However, the refitting evidence also showed that transverse fractures occurred on some of the jasper artifacts indicating that pieces likely split during the manufacturing process.

The Lums Pond assemblage generally lacks the low grade jaspers with poor homogeneity and fracturing characteristics. Missing was the large mass of material that is produced during reduction of poor and medium grade jasper, as recovered near sites along the fringes of the quarries, such as the Iron Hill East site (7NC-D-108) (Petraglia and Knepper 1995). The lack of this material at Lums Pond is a further indication of the initial examination, testing, and reduction of jasper at the quarry sources, with selection of the best grades for further reduction, transport, and use. Only one jasper artifact set, which was Refit set #1 from Block B of Area 3, was of a low grade, highly flawed material (Plate 46). This refit set was of such low grade that it was not certain if the fractures represented naturally breakage or percussion by aboriginal inhabitants.

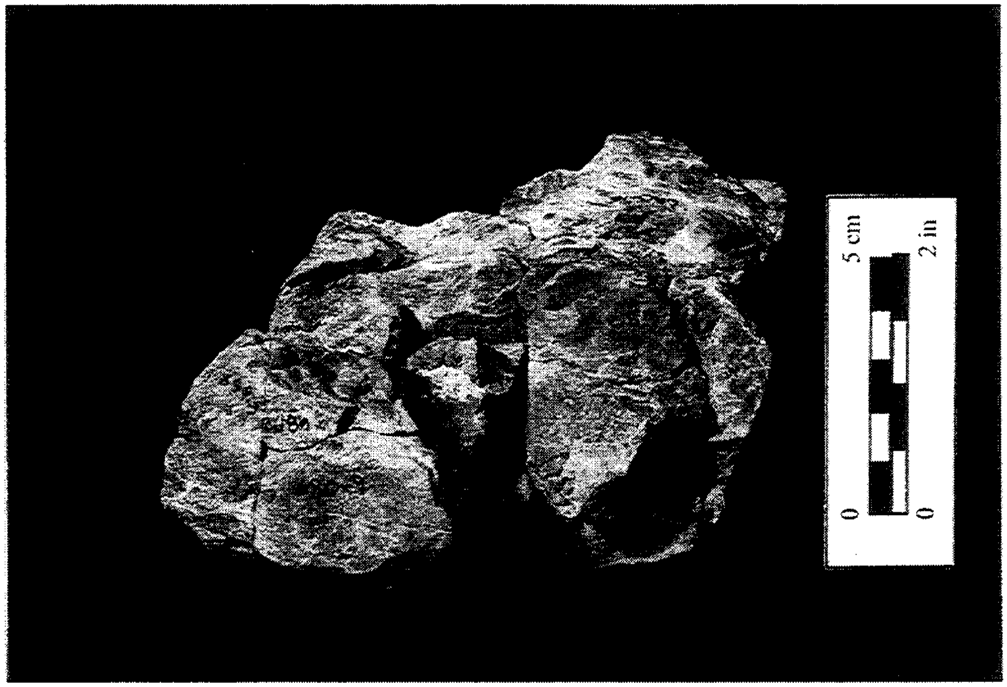

Plate 46. Refit Jasper Showing Poor Characteristics

Discussion

The goal of the present study was to conduct jasper replication experiments to examine homogeneity, fracture, and usability. Experimental work with the jaspers from the three quarries was used as a basis of comparison to the Lums Pond artifacts. The Lums Pond artifacts, on the whole, were of a higher grade than the experimentally reduced cores. The Lums Pond artifacts displayed similarities with the best grade materials procured from the Iron Hill quarry. The Iron Hill jaspers were generally found to be homogenous displaying the least amount of internal flaws among the material collected during this experiment. The Iron Hill cores were easily knapped, and produced large flakes with diagnostic percussion attributes. The flakes and cores could be reduced into tools such as bifaces. The jaspers recovered from Chestnut Hill and Iron Hill Cut Quarry did not produce any raw materials that could be successfully reduced into bifaces as they were heterogeneous with many internal flaws. None of this necessarily implies that the Lums Pond artifacts were derived from the Iron Hill source, but it does suggest that there is real variability in the homogeneity, fracture, and usability of jaspers from these various sources, and that these likely influenced the procurement and transport behaviors of aboriginal groups. Comparison of the experimentally reduced pieces and the archaeological assemblage provided evidence which indicated that primary reduction most likely occurred in areas away from the Lums Pond. Preforms, consisting of cores and early stage bifaces were initially reduced at the sources and then transported to Lums Pond (e.g., Area 1) where further reduction and thinning of preforms occurred at this location. While the Iron Hill jaspers did contain numerous internal material flaws and inclusions, visual inspection and the careful placement of initial impacts on large blocks of the jaspers allowed for the predictable and successful manufacture of blanks or preforms. To manufacture bifaces the aboriginal knappers would have been highly selective of various materials, and to successfully produce a tool, some forethought would have been required to control for the specific conchoidal fracturing properties of the jasper materials. On the whole, the experimental work therefore provided general support for secondary stage reduction of homogeneous cores with favorable fracturing properties.

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