Appendix C

LIMONITE STUDY

An Analysis of Limonite/Ironstone Artifacts from some Prehistoric Sites in the Middletown, Delaware Route 301 Corridor.

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Abstract

This study was commissioned by Hunter Research Inc., of Trenton, New Jersey as a complement to ongoing investigations along the proposed Route 301 corridor near Middletown, Delaware. This report documents research and analysis conducted between December of 2010 and June of 2011. It describes and evaluates certain prehistoric artifacts and the limonitic material from which they were made. In addition it places the prehistoric use of limonite in a regional archaeological context.

The artifacts in question are principally stemmed bifaces, which are characteristic of certain phases of Late Archaic and Early Woodland cultures in the Middle Atlantic region. In addition to artifact description, the report evaluates the qualities of limonitic sandstone that occurs within or near the project area and evaluates the implications of those qualities in terms of potential tool use. These materials are placed into geological as well as cultural context.

Experimentation concerning the composition and knappability of this material was an important aspect of this study. This work shows that locally available limonite is of generally poor quality, thus limiting its suitability for use in tool production. Better grades of similar material, available from Herring Island and other sources along the Elk River, about 10 miles distant, provide better prospects for use as tool-stone. Controlled heating of the better grades of limonite enhances its knappability but also poses the risk of severe loss of physical integrity. Thus, the application of heat can be seen as a compromise between enhanced knappability and diminished material strength.

A consideration of reported archaeological assemblages from Herring Island strongly suggests that the putative claim of that site's importance in a regional lithic exchange network is in need of revision. This study advances our understanding of the role of limonite as a raw material in prehistoric lithic technology and as a medium of exchange.

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Introduction

This research was undertaken at the request of Hunter Research in Trenton, N.J. The study had two goals, that is, to examine limonite artifacts recently collected along the Route 301 corridor and to compare those specimens against geological materials from the site locale and beyond. The artifacts come from two portions of the Levels Road site, respectively investigated by Hunter Research and Richard Grubb Associates (RGA). All of the artifacts were manufactured from various forms of iron-rich sedimentary and metasedimentary materials, variously known as limonite, ironstone, siderite, or ferruginous quartzite. Figure 1 shows the area in question as mapped by the U.S. Geological Survey. Figure 2 is an airphoto of the same location.

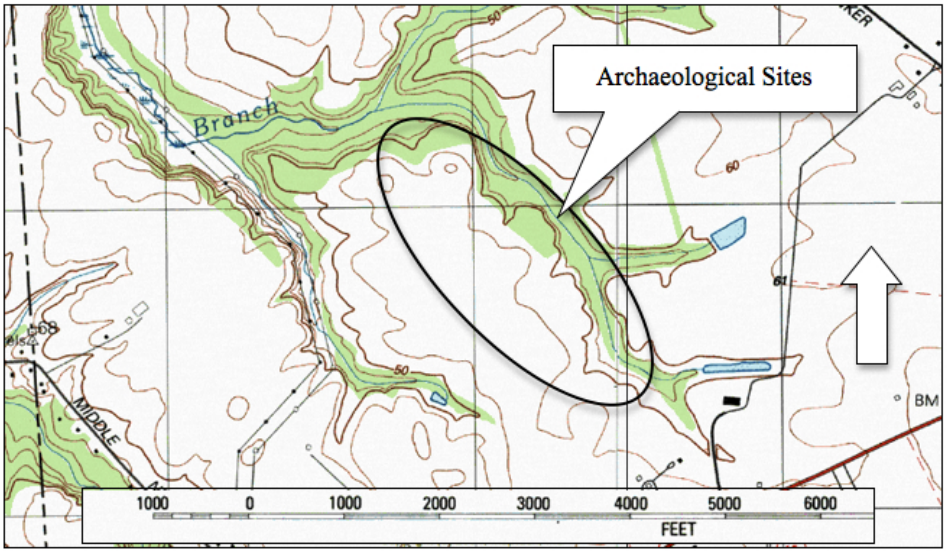

Figure 1: Map of Project Area and Environs
U.S.G.S. Ceciltown, MD-DE and Middletown, DE Quadrangles (1993)

The comparison of specimens against local or extra-local deposits and archaeological finds served to implement inferences of similarities and dissimilarities regarding aspects of lithic procurement and distribution within the locale and region. In former work it has been proposed that much of the prehistoric limonite used in the Delmarva was part of an extensive trade and exchange network centered on the Herring Island in the Upper Chesapeake Bay (Custer 1988, 1989; Ward 1984, 1985, 1988; Ward and Doms 1984). Much of this material occurs as tablets or slabs (Figure 3).

Fieldwork was conducted on December 16, 2010 and subsequent days for the purpose of examining local mineral deposits and retrieving comparative samples. Some of the artifacts were clearly of different grades of ironstone. The natural occurrence of local ironstone deposits both in the upper soil horizons as well as in the underlying subsoil provided the impetus to test the suitability of these materials for potential use in tool manufacture. In this regard, Hunter Research provided a backhoe test cut, measuring approximately 2½ x 50 feet, into an iron-rich portion of their project area. This cut provided an opportunity to observe limonite in situ as well as to collect fresh specimens for testing (Figure 4).

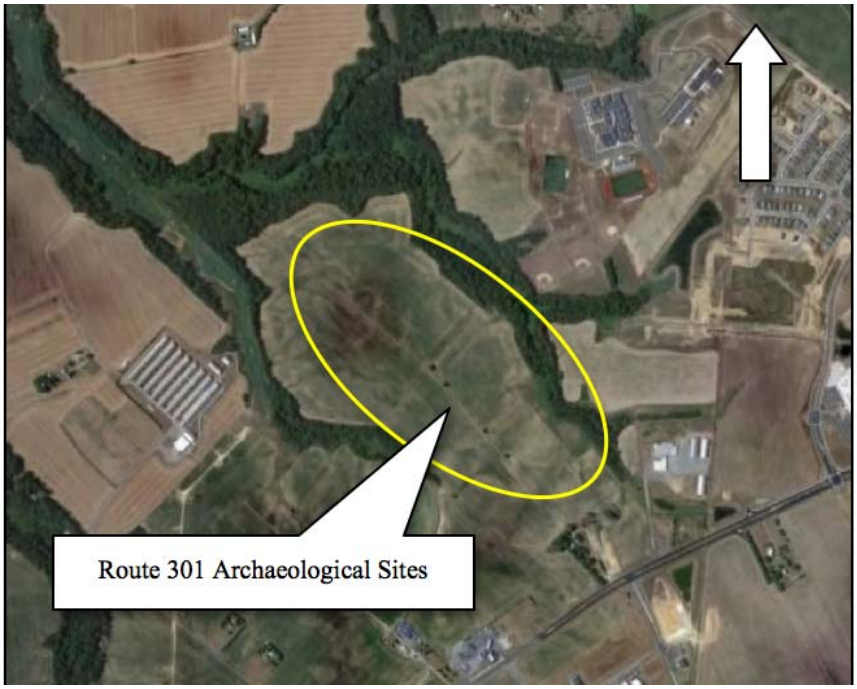

Figure 2: Airphoto of General Site Area
Google Earth (July 4, 2010)

Figure 3: Natural Slabs of Elk River Limonite
Photograph by Jack Cresson

Procedures

Samples were taken from a variety of sources—stream valley gravels, beaches and upland surface exposures—in Delaware, Maryland, and New Jersey. The samples were labeled numerically and sectioned with a lapidary diamond saw. The cut surfaces were then further planed and polished to prepared for

macro- and microscopic examination. The analysis sought to compare samples according to color, mineral structure, size of individual particles, matrix composition, and characteristics of cementation, as well as their potential knappability. The use of a Celestron hand-held digital microscope with LED illuminated field allowed examination of specimens at 10x – 150x magnification along with the capture of related electronic images.

Figure 4: Earth Cut, Revealing Limonitic Deposits
The author is exposing limonitic slabs for collection and examination. Note ice extrusions.
Photograph by R. Alan Mounier (December 2010)

Each of the test pieces was fully analyzed using this technique. Both cut and polished and fractured edges were examined. One half of each specimen was subject to thermal treatment, while the other was tested to judge the potential as a tool-stone for flaked implements. If a specimen showed moderate to good conchoidal fracture, it was worked into a bifacial or unifacial tool. Further experiments on suitable specimens included attempts at heat-treatment to test for material changes and the potential improvement of flaking qualities, as has been demonstrated for other sedimentary and metasedimentary stones (Brown 2000; Buenger 2003; Domanski and Webb 2007; Gregg and Grybrush 1976; Mounier 2008.) The heat-treating procedure followed an established process known to work on various quartzites. This process involves heating the specimens in outdoor fires or a small oven under a covering of sand for up to 2 hours at a mean temperature of 500º F (Cresson n.d.).

Also, comparisons were made with other known silica-cemented sandstones and orthoquartzites found throughout the Eastern and Southeastern Regions, using photomicrographs of fractured surfaces when possible (see photographs in Appendix I).

Brief Summary of Limonite in Regional Prehistory

Limonite has long been known as a material employed within some prehistoric cultures as a lithic material for variety of tool forms and functions. Although not as diversely functional as some stone materials, it is clear that certain phases of the Archaic and Woodland Periods adapted markedly to limonitic materials, leaving clear patterns of use (Cross 1941; Ward 1984, 1985, 1988; Ward and Doms 1984, Custer 1988, 1989; Douglas Kellogg, Glen Mellin, pers. comm.)

In general, wherever limonitic materials appear in nature, a dichotomy occurs in their use by prehistoric populations. Several grades of ferruginous sediments can develop locally. Some grades are clearly much too friable and loosely cemented to provide efficient cutting edges, while others are much harder and more compact. These indurated materials show both conchoidal fracture and edge sharpness. The friable, less well-cemented materials saw service as expedient, simple edged tools, slab tools, anvils, and hammers. Inferred functions include plant processing, incipient butchering, and bone working. Mounier (1990) demonstrated that grooved limonitic abraders from the Abature site (28-Mo-134) in Monmouth County, N.J. were probably used to manufacture pointed implements of wood, bone, or antler.

Direct percussion and pressure flaking on the tool-grade variety exhibits good knappability that can result in fully or partially flaked bifaces. This material can support the sharp edges necessary for projectile points, scrapers, and knives. Sometimes circumferential edging served to formalize a limited range of recognized stemmed bifaces that are characteristic of the Archaic and Early Woodland periods. This range embraces points of the Morrow Mountain, Stark, Poplar Island, Lackawaxen, Bare Island, Normanskill and Rossville types.

Characteristics of the Herring Island Material

Ward (1984) refers to the Herring Island species as being "solidly cemented with superior grade ferruginous quartzite." On the basis of analysis, this specific material is not truly an iron-cemented sandstone; however, its petrology and petrogenesis remain uncertain. Other silica-infused sedimentary deposits, comparable to the Herring Island material, have been identified in Cretaceous and Tertiary deposits that occur along the Atlantic seaboard from New Jersey to the Gulf coast, and extending as far as Mississippi. These materials include Cohansey quartzite, (southern N.J.); ferruginous quartzite, Cecil County, Md.; Magothy quartzite, Anne Arundel County, Md.; Stafford quartzite, Fairfax County, Va.; Daltonite, South Carolina and Georgia; and Tallahatta quartzite, Alabama and Mississippi (Appendix I).

The Elk River (Herring Island) lithofacies is now known to be associated with marine advances along the Mid-Atlantic, South Atlantic, and Gulf coasts during Cretaceous and Tertiary periods (170 to 70 mybp). The Herring Island lithic materials have been identified as part of the Potomac Group, of lower Cretaceous age (Maryland Geological Survey Map, 1968). This material bears distinct similarities to several identifiable orthoquartzites from other formations across the Middle Atlantic region (Table 1).

Table 1: Geological Sources of Orthoquartzites in the Middle Atlantic Region

Formation	**Source Locality**	**Geological Age**
Magothy Formation	Anne Arundel County, Maryland	Cretaceous
Aquia Formation	Stafford, Virginia	Eocene
Chesapeake Formation	Smyrna Beach, Delaware	Miocene
Cohansey/Kirkwood Formations	Southern New Jersey	Miocene

The ironstone, or bog iron, used in the early smelting of iron is dissimilar to most of the limonitic materials used in prehistory. Bog iron is a soft, poorly consolidated sediment that can form in less than 30 years. It can be classified as a mudstone, with a high proportion (≥15%) of ferruginous compounds. The petrogenesis involves catalytic bacterial action leading to the precipitation of dissolved iron (Braddock-Rogers 1930; Crerar, Knox, and Means 1979; Bricker et al. 2003; see Figure 5). Prehistoric lithic technologies demanded a more compact, indurated sandstone or quartzite, with good cementation of silica grains in the lithic matrix.

Figure 5: Precipitation of Limonite in Creek Bottom at Levels Road
Photograph by R. Alan Mounier (December 2010)

Ancient ironstones, along with silica-cemented sandstones, formed under marine and lacustrine settings in relatively horizontal strata that once covered vast areas of the coastal plain. These strata, generally of Cretaceous or Tertiary origin, now lie on the surface at the highest elevations and upon the adjacent slopes. Many of these areas were exploited and mined in prehistoric and historic times. For example, in New Jersey alone, there are many crests that exhibit ironstone deposits: Sugar Loaf Hill, Arney's Mount, Taylor's Mount, Heulings Hill, Darnell Mount, Mount Laurel, Big Hill, Stone Mountain, Redman Hill, Irish Hill, Mullica Hill, Eldridges Hill, along with Turnip and Burden Hills.

The silica-cemented materials (in New Jersey commonly referred to as Cuesta and Cohansey quartzites) formed similarly but in more discrete or discontinuous occurrences across the coastal plain. For the most part it is these materials that provided tool-grade sources for flaked tool assemblages. In iron-rich environments, some deposits produced dark brown, silica-cemented sandstones analogous to the Herring Island mineral suites. This material exhibits a range of colors (10R 3/1-3/2, 4/1-4/2 & 5YR 4/2) nearly identical to the Maryland specimens. The New Jersey material has a coarser composition, with individual sand and pebble inclusions ranging from 0.01mm to 0.06mm in diameter. Ferruginous quartzite of this sort occurs as flaked tools at the Savich Farm (Evesham Township, Burlington County, N.J.) and nearby localities. Because of its color, Richard Regensburg (pers. comm.) referred to this material as “liver stone.”

Still other locations on the lower Inner Coastal Plain (in Gloucester and Salem Counties, N.J.) have produced Cuesta quartzite in similar grades and colors. These manifestations occur along Raccoon Creek, near Swedesboro, along Oldman's Creek, in Logan and Oldmans Townships, and along the Salem River around Mannington, as well as in both Upper and Lower Penn's Neck Townships. In addition to its geological expressions, brown varieties of Cohansey quartzite are also known from a number of large artifact collections from the lower New Jersey coastal plain. It appears that within the Mid-Atlantic Province the formation and cultural distribution of tool-grade ironstone occurs in a north to south gradient. Generally, it appears that the quality of the material improves toward the southern limits of the range.

Description of Archaeological Assemblages

The analysis covered 38 specimens, 14 from the Hunter study and 24 from the RGA investigations. The items included incomplete and formalized bifaces, biface fragments, a uniface, mixed debitage, and a single piece of thermally altered rock. A sample of these bifaces appears in Figure 6, while Figure 7 illustrates similar artifacts from sites in New Jersey.

Nine specimens (23.7% of the total) were formalized bifaces or fragments, while 27 items (71.1%) exhibited evidence of tool production, the remainder consists of a single flake tool (2.6%) and one piece of thermally altered rock (2.6%).

Most of these samples revealed fully flaked surfaces from the interior portions of limonite plates. A number also showed natural surface planes with patinated cortical surfaces. All of this material is very similar across the study universe in terms of color, material grade, and range of forms. On fractured surfaces the Munsell colors range from 10R 3/1 – 3/2 to 10R 4/1 – 4/2 (dark reddish gray, dusky red, and weak red) to 5YR 4/2 (dark reddish gray). The cortical or patinated surfaces ranged from 10Y 5/4 to 5YR 5/3 (weak red to reddish brown).

Figure 6: Formalized Bifaces from Levels Road Sites
Photograph by Jack Cresson

At least half of the sample shows patination on one or more surfaces; many exhibit two weathered planes on opposing faces, thus revealing rectangular slabs as starting forms. These items vary in thickness from 6.4mm to 2.5mm (¼ – 1 inch).

The debitage revealed evidence of thin, flat, platy, oblong, rectangular, oval, or sub-triangular configurations that were subsequently trimmed by means of edge flaking, followed by one or two reduction stages. Episodes of thinning and final shaping define the bifacial type. Given observed flake attributes, making the finished forms involved initial percussion with hammerstones and organic billets, along with pressure flaking.

Most of the knapped samples from the Route 301 prehistoric sites exhibit very compact microcrystalline structures, showing fine mineral sorting and purity. Patination on the surfaces and edges demonstrate tabular starting forms varying in thickness from 6.4 – 19mm (¼ – ¾ inches). The fracture surfaces are very clean, with highly reflective silica matrix that is similar to many varieties of orthoquartzite. The artifacts show a much finer in composition than most of the geological specimens collected on the Route 301 sites, in the nearby stream gravels, and in the trial cut. These geological specimens resemble the rather poorly structured limonitic sandstones found on the New Jersey coastal plains. The generally poor quality of the

limonite deposits in the Route 301 vicinity probably rules out their use as reliable sources of material for the production of formalized bifaces. Nevertheless, several early-stage bifaces and flake fragments from the Route 301 locale reflect attempts to use the local materials.

Figure 7: Formalized Bifaces from Archaeological Sites in New Jersey
Photograph by Jack Cresson

The cut sections of geological samples proved less definitive than freshly broken edges, which more closely resembled the prehistoric analogs. It was difficult to get all the surfaces to the same finish, but photomicrographs were still taken to aid comparison. It was found that a fuller and more meaningful approach was to compare fractured surfaces of both archaeological and test specimens collected from the Route 301 locale and other specimens from the Elk River or Herring Island sources, as well as other limonites found elsewhere on the coastal plain.

All of the samples taken from the field by the Hunter crew, as well as those collected by the author from the back hoe trench and from surficial gravel exposures displayed low to very low grade composition. These items exhibit poorly cemented layers or crusts with sandy, friable compositions of silica particles in the range of 0.5 to 0.15mm in diameter. The sections revealed many voids between grains, which were generally not well anchored within the matrix. It is known that fresh material will harden when dry, sometimes to the advantage of workability. That is, seasoned stone can be more successfully worked than stone taken fresh from the ground. As a rule the grades found at and near the project location lacked sufficient cementation to provide reliably knappable structures. At best, a few specimens of harder, platy composition could be simply shaped by flaking along their edges.

Comparative samples from various New Jersey sources showed a range of cementation from weak to very robust and an overall hardness suitable for simple flaking. Deposits in Burlington and Camden County showed both larger aggregate composition (0.1 to 15mm) as well as more complete cementation, although the absence of silica binding between grains produced less workable materials.

Experimentation

A test was established to explore the efficacy of heat-treating applications for the ferruginous orthoquartzite from the Herring Island vicinity. Test flakes were taken, and attempts were made to produce formalized bifaces by knapping, using a range of techniques. Heated and unheated (control) samples were employed.

Four samples of Elk River/Herring Island limonitic sandstone/orthoquartzite were subject to heat-treating applications. These items include two specimens (Sample# 4a and 4b, of unknown provenience) and two of Elk River material (Specimens 2a and 2b).

The samples were heated in a small toaster oven with a maximum temperature capacity of 500°F (260°C). The treatment procedure followed a long-established, successful protocol used in the experimental applications to alter a variety of lithic materials (Cresson n.d.; Mounier 2008). Samples were placed in a preheated oven, embedded in sand matrix in a shallow metal tray (1½ inches deep). These specimens were then heated in stages to 300°, 400°, and 500°F (149°, 204°, 260°C) for variable time periods not exceeding two hours. Incremental shifts occurred at 15- to 30- and 60-minute intervals per test. Samples 4a and 4b were treated for two hours at a maximum temperature of 500° F (260°C) for one hour. The Elk River samples were heated for 1½ hours.

The test flaking and lithic reduction experiments for the heat-treated samples produced mixed results. Both Specimens 4a and 4b were detrimentally affected by the treatment process, which rendered each unflakable. Apparently heating weakened the structural, chemical, and mineralogical bonds, resulting in very friable, crumbly fracture characteristics. Both of the untreated samples prematurely failed in process despite exhibiting apparently satisfactory tool-grade characteristics. Both revealed clean flake detachments and well formed conchoidal fractures. One remnant fragment of Sample 4b was successfully carried to an early-stage biface form (Figure 11, second from left).

The heated Elk River/Herring Island sample was subjected to heat alteration (Specimens ER2b) for 1½ hours. This sample was successfully reduced to a good biface preform (Poplar Island type). Heat-treating enhanced the ease of flake detachment as compared to the unheated control sample (ER2a). This unheated sample, while of good, tool-grade stone, broke after seven minutes of flaking during preliminary thinning.

Heating Sample ER2b was detrimental to its physical integrity. Although flakes released readily, thermal spalling led to inconsistent flaking characteristics. The duration of test-flaking was four minutes. The unheated specimen of this sample proved to be the toughest of all the Elk River material. This specimen was very difficult to edge and failed during the early-stage reduction process.

Only one of the treated samples produced a useful product (ER2a), the flaking characteristics of another were marginally enhanced (ER2b), while two others (4 a and b) witnessed severe degradation of mineral and chemical composition. While it is known that heat-treating applications for various grades of silica-cemented sandstones and orthoquartzites were integral to lithic reduction process, it is still unknown if heat treating applications were used in the samples from the Levels Road vicinity.

Some of the prehistoric specimens do exhibit certain characteristics of heat-treatment, but many do not. Highly reflective, fractured flake surfaces and reddened remnant cortical surfaces were not observed on the archaeological specimens. Upon heating, the test samples were altered to distinctly different surface colorations (Figure 8 and Figure 9) along with the other characteristics noted above. Previous experiments show that slightly modifying the heat-treatment protocol can materially improve knappability. Variations in process might include increasing or decreasing the thickness of the sand matrix or slightly altering the temperature intervals and heating times. The results of the present experiments support the idea that certain varieties of this material could have been successfully heat-altered to improve aspects of the lithic production process.

The following paragraphs summarize the results obtained with specific experimental samples.

Specimen 4b: The first experiment produced a formalized bifaces of contracting-stemmed form (Figure 11, second from left). The starting form was an early-stage biface (Figure 10, right), which measured 79 x 39 x 15mm (L x W x T). The finished specimen measured 75 x 33 x 13mm. Knapping the early-stage form took 21 minutes; the formalized version required an additional 35 minutes. The total time expended was 56 minutes.

The lithic material used in this replica responded well to percussion with stone, wooden, and antler hammers, and to indirect percussion, as well as with antler pressure flakers. The material shows moderate to difficult workability comparable to some of the more fracture-resistant, tough orthoquartzites from New Jersey (e.g. Cuesta quartzite).

Figure 8: Color Shift from Thermal Alteration
Cut samples, showing heated (red) and unheated (yellow-brown) portions
Left: 4a; Top, Center: ER2a; Top Right: ER2b; Bottom Center: 4b
Photograph by Jack Cresson

Figure 9: Color Shift and Reflectivity from Thermal Alteration
Note the reddened cortex and the glossy, reflective nature of the broken surfaces.
Photograph by Jack Cresson

Specimen ERc: This specimen was first transformed into a Stage III biface that measured 111 x 65 x 18mm (Figure 10, second from left). The specimen was subsequently formalized into a corner-removed (straight-stemmed) biface type measuring 95 x 35 x 14mm (Figure 11, second from right). Achieving an acceptable replica was difficult because of the inferior grade of material. Percussion with wooden billets and pressure flaking proved to be extremely advantageous. The production time from starting slab to formal item totaled 52 minutes.

Specimen ERd: Initial flaking resulted in a Stage III biface that measured 92 x 62 x 15mm. The end product was a formalized, corner-removed (straight-stemmed) biface, measuring 82 x 24 x 14mm (**Error! Reference source not found.**Figure 11, right). Initial flaking took 10 minutes to form an early-stage biface; an additional 58 minutes were expended to finalize the formal specimen. The material was of inferior grade, giving rise to very difficult flake removals. As with Specimen ERc, the inferior material proved to be intractable, resulting in a thick, stepped finish. However, all modes of process worked effectively with indirect percussion, wood-percussion and pressure being used to good advantage.

Specimen ER2a: Specimen ER2a was produced from a cut slab of ironstone that was subjected to heat-treatment. The original slab measured 126 x 62x 17mm. The measurements of the intermediate preform were not recorded. A contracting-stemmed preform was completed in 37 minutes. The formalization of this specimen took 22 minutes (59 minutes, total). The result was a contracting-stemmed Poplar Island biface replica that measured 103 x 35x 14.5mm (Figure 11, left).

Figure 10: Unformalized Experimental Bifaces
Left to Right: Samples ER1a, ERc, ER2a, 4b

Photograph by Jack Cresson

Discussion and Conclusions

Most of the archaeological samples from the Route 301 corridor have very similar coloration, patinated surfaces, and good fracture characteristics that indicate likely origins in the nearby Herring Island or Elk River deposits. One well-known source at Herring Island is less than ten miles away. The distance hardly compares with regional primary source lithics that often involve transportation over dozens if not hundreds of miles.

Figure 11: Formalized Experimental Bifaces
Left to Right: Samples ER2a, 4b, ERc, ERd

Photograph by Jack Cresson

This association between stone source and site occurrence is similar to some of the cultural expressions of Cohansey quartzite in Southern New Jersey. Still, the claim that Herring Island was the major ironstone production site in a regional exchange network does not seem to be warranted. Based on the initial reports, the paucity of related archaeological remains is noteworthy. According to Ward's (1984) Herring Island study, the yield of ironstone artifacts from 30- 1x1 meter squares consisted only of 13 bifaces and unifaces, along with 569 flakes. Almost 83% of the debitage consisted of late-stage flakes. The paucity of early- and middle-stage flakes is remarkable for a site that is claimed to be a primary production station. Given the evidence at hand one must question whether the production of ironstone artifacts at Herring Island could have underpinned a regional lithic distribution network. Rather, as reflected in the reported cultural diagnostics, it appears that the location witnessed limited, even sporadic, resource extraction during the Archaic and Woodland periods.

The small but telling assemblage garnered during the Route 301 investigations shows something apart from the normal sequence of bifacial reduction to preforms, carried on to biface formalization, with distribution to consumer sites far and near. Considered with evidence relating to biface production at Herring Island, one can infer intermittent exploitation by foraging opportunists at key times during seasonal cycles. Moreover, the highly accessible and easily transportable tabular forms that occurred in nature were the principal economic focus. In other words, the distribution network, to the extent that it could be said to exist, dealt in raw materials rather than in finished or partially finished commodities (i.e., bifaces). This is a very different economic strategy than those that characterize the exploitation of jasper, rhyolite, and argillite across the Mid-Atlantic region.

As expected, experimentation showed that heating specimens prior to knapping enhanced their workability. All percussion techniques worked well, and pressure flakes released noticeably easier than in unheated specimens. Indirect percussion with wooden percussors and pressure applied by flakers were extremely advantageous. Clearly, heating reduced fracture toughness, resulting in easier flake detachments in all knapping modes. On the other hand heating cannot overcome major flaws in stone, and several samples were rendered useless after the application of heat. One can assume that native knappers understood the value and risks of heat-treatment when it came to working Herring Island/Elk River limonite.

Previous work has laid the groundwork for describing Herring Island/Elk River limonite and for preliminarily defining the broad patterns of lithic procurement and processing activities at Herring Island. The present study advances our knowledge concerning technological aspects of working this material, with special reference to its suitability to tool fabrication by knapping. The work reiterates the value of thermal

processing to facilitate lithic reduction by knapping. The study further challenges the assertion that locally produced limonite bifaces were the principal commodity in a broad-based prehistoric exchange network.

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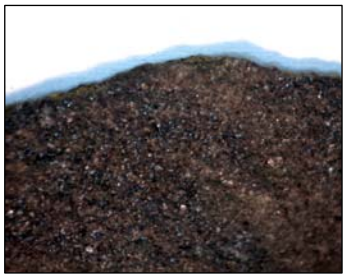
Appendix I: A Quartzite Gallery

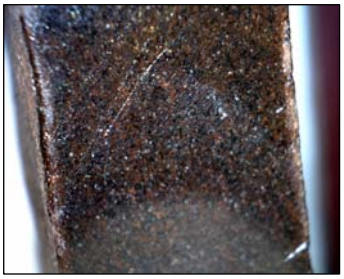
Photomicrographs of Various Quartzite Samples — Materials, Conditions, and Sources as Noted



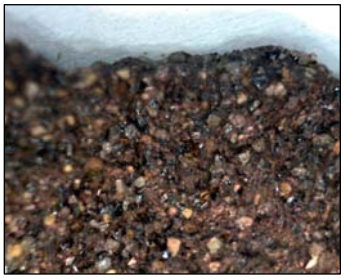
Elk River Quartzite
Maryland/Delaware

Elk River Quartzite
Maryland/Delaware

Elk River Quartzite
Cut and Oiled

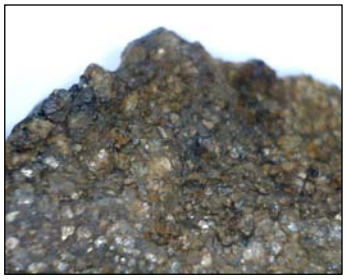


Elk River Quartzite
Cut and Oiled



Limonite
Levels Road Site, Delaware

Daltonite
Georgia



Limonite
New Jersey

Cohansey Quartzite
Cumberland County, N.J.

Cuesta Quartzite
Southern New Jersey