Smudge Pits and Stone “Drills”: The Use of Chipped Stone Tools at Burrell Orchard

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Recent investigations by the Cleveland Museum of Natural History (CMNH) identified an extensive Late Archaic occupation at Burrell Orchard (33LN15), located on a promontory overlooking the Black River in northern Ohio. CMNH excavations have documented widespread midden deposits, prepared clay floors, post molds, and pit features including numerous smudge pits. The formal chipped stone tool assemblage is dominated by lanceolate projectile points and bifacial “drills.” High-powered lithic microwear analysis was performed on 28 formal chipped stone tools recovered from the 2008 and 2014 CMNH field seasons. Tool types examined included complete and fragmentary lanceolate points, drills, and other bifaces. The results indicate that many “drills” were actually used to perforate dry hide and, thus, may have held a unique place in the hide-processing activities conducted at the site.

Keywords: Use-wear, Archaic, Bifacial Perforator, Great Lakes, Functional Analysis

Recent investigations at Burrell Orchard (33LN15) in northern Ohio have documented widespread midden deposits, prepared clay floors, post molds, and pit features, including numerous smudge pits dating to the Late Archaic period (Redmond and Scanlan 2009; Redmond et al. 2015, 2016). The presence of dozens of smudge pits suggests that hide-processing in general (smoke-curing) was a major activity conducted at the site. However, other than the presence of smudge pits, this inference of intensive hide-processing appears unsupported by the chipped stone tool assemblage, as few morphologically recognizable hide-working implements (e.g., end- or side-scrapers) were identified in the formal stone assemblage. Instead, the assemblage is dominated by lanceolate projectile points and relatively long and narrow-bladed bifaces generally identified as “drills.” This discrepancy led to an examination of the potential hidden uses of stone tools at Burrell Orchard. Thus, further insight into the function of a sample of stone tools, and their relationship to other remains recovered from the site, was sought through microwear analysis. The activities performed with chipped stone tools at Burrell Orchard are of even broader interest, because the site is quite unique in comparison to other Late Archaic sites in the area. Specifically, no midden deposits of similar scale or prepared clay floors have been documented at other Late Archaic components in northern Ohio (Purtill 2015; Redmond and Scanlan 2009). Instead, most sites of this age are smaller in scale and consist of small pit clusters, limited structural evidence, and thin midden deposits (Purtill 2009; Stothers and Abel 1993). The construction of clay floors within thick midden deposits is in fact more similar to Late Archaic components in the lower Ohio River Valley, such as the “clay platforms” constructed at the Late Archaic Riverton site in the Wabash River Valley of southeastern Illinois (Winters 1969:97–102). Consequently, research into the function of the chipped stone tools from Burrell Orchard is likely to provide important insights into regional Late Archaic lithic technologies, as well as new interpretations of lifeways in the southern Lake Erie region.

In regards to the relationship between tool form and function, numerous morphological types including projectile points, drills, scrapers, and other bifaces have been identified at the site. While insight was gained into the function of each of these types, the examination of drills from Burrell Orchard also provided an opportunity to address an underexplored—and rather
ambiguous—typological form, that of the bifacial perforator. In general, drills and perforators share important similarities in that both types contain a sharp point to produce holes in other materials. On the other hand, the two types refer to very different activities and worked materials. Relatively long, slender (i.e., a large length-to-width ratio), roughly parallel-sided bifacial tools are commonly referred to as drills. As with the modern electrical equivalent, prehistoric stone drills are assumed to have been used to produce holes in hard materials using a rotary motion. However, some scholars have assigned a different functional interpretation to similar implements by labeling them “bifacial perforators.” In contrast to drills, bifacial perforators are more analogous to awls—often made of organic materials such as bone or wood by prehistoric individuals throughout the world—that are used to produce holes in softer materials using pressure and a twisting or boring motion. While both tool types have been identified in the North American archaeological record, the difference between drills and bifacial perforators has been largely unexamined by microwear analysis to date. Instead, those scholars that distinguish between bifacial drills and perforators do so based on inferred function or macroscopic use-wear (Deller et al. 2009; Dincauze 1976; Ellis et al. 1991; Henning and Schermer 2004). Often, however, these terms appear to be used interchangeably in the literature. While geographic and temporal variations certainly exist, the tools we focus on as drills or bifacial perforators can generally be described as bifacially flaked, long, and rod-like with roughly parallel sides and bi-convex cross sections with pointed or slightly rounded tips. Drills and bifacial perforators may be knapped from blanks, flakes, or reworked projectile points. This definition covers the range of bifacial perforators described in the literature but does exclude some objects described as drills. For example, Mississippian microdrills found at Cahokia in the American Bottom are little more than marginally retouched blades (Yerkes 1983). While microwear analysis demonstrated that these tools functioned as drills, they are clearly of a different morphological type (i.e., metric attributes and flaking pattern) than the definition provided here.

Definitions of bifacial drills are fairly ubiquitous, with Ellis et al. (1991:9) providing a representative definition as long, narrow, bifacial tools whose “tips are narrow and blunt to relatively pointed and are sometimes polished from use. Fore-sections have a marked bi-convex to diamond-shaped transverse section.” These types of tools have been reported from Paleoindian through Historic period sites across North America. Sometimes, however, similar artifacts are described as bifacial perforators. For example, Dincauze (1976:54) describes “bifacially flaked narrow perforator shafts” present in all layers but the plow zone at the Middle Archaic to Historic period Neville site in New Hampshire. Henning and Schermer (2004:Table 5.1) report the recovery of a bifacial perforator (as a distinct category from drills) from the surface of the early European Contact period site of Blood Run/Rock Island on the border of Iowa and South Dakota. Macroscopic evidence in the form of edge blunting and crushing is given as a rationale to distinguish between the two tool types (Henning and Schermer 2004:488). Outside of the USA, Ellis et al. (1991:10) list bifacial perforators at the Early Archaic Nettling site in southwestern Ontario as “well-made, elongated, narrow forms with marked Plano-convex transverse sections, a lack of any expansion of the base, and thin pointed tips or working ends.” Ellis et al. (1991:9) note that the bifacial perforators are distinct from drills, with the latter exhibiting expanding bases and biconvex to diamond-shaped cross sections. Deller et al. (2009:Figure 9e) present a drawing of a bifacial perforator made on a flake, with a bi-convex or diamond-shaped cross section, from the Paleoindian period Crowfield site, also in Ontario. The difficulty in macroscopically distinguishing between drills and perforators is reflected by Bement (1994:67) at Bering Sinkhole in Texas, in which a “drill bit” with “a diamond shaped cross section” is classified as a “drill/perforator.” Ives (2014:11) notes that while many archaeologists have identified bifacial perforators among Middle Archaic assemblages in the Northeast, use-wear analysis is needed to differentiate between drills and perforators. In other words, the bifacial drill and perforator distinction has only been addressed through macroscopic functional inference or difference in base form (e.g., expanded vs. strait). No microwear analysis has been conducted on the class of tools explicitly described as bifacial perforators in order to definitively demonstrate their function as such. As functional studies have not been utilized to address this dichotomy, it is unclear whether the two terms reflect actual functional differences or simply idiosyncratic differences in nomenclature.
<table>
<thead>
<tr>
<th>CMNH CAT. #</th>
<th>Artifact Type</th>
<th>Context</th>
<th>Depth/Feature*</th>
<th>Used?</th>
<th>Motion</th>
<th>Material Worked</th>
<th>Other Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1082A131-22</td>
<td>Drill, base/midsection</td>
<td>498N 512E</td>
<td>48 cmbd</td>
<td>Yes</td>
<td>Perforate</td>
<td>Dry hide</td>
<td>Hafted; refit with 1082A131-24</td>
</tr>
<tr>
<td>1082A013-04</td>
<td>Drill</td>
<td>474.54N 510.20E</td>
<td>28 cmbd</td>
<td>Yes</td>
<td>Drill</td>
<td>Bone</td>
<td>Hafted</td>
</tr>
<tr>
<td>1082A045-07</td>
<td>Drill</td>
<td>500N 504E F. 08-03</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A024-04</td>
<td>Drill</td>
<td>490N 509E</td>
<td>60 cmbd</td>
<td>Yes</td>
<td>Perforate</td>
<td>Dry hide</td>
<td>Thinner than others, no hafting evidence</td>
</tr>
<tr>
<td>1082A028-07</td>
<td>Drill</td>
<td>496N 509E 43 cmbd</td>
<td>Yes</td>
<td>Perforate</td>
<td>Dry hide</td>
<td>Hafted</td>
<td></td>
</tr>
<tr>
<td>1082A127-01</td>
<td>Drill</td>
<td>490N 497.5E</td>
<td>F. 14-04</td>
<td>Yes</td>
<td>Perforate</td>
<td>Dry hide</td>
<td>Hafted</td>
</tr>
<tr>
<td>1082A131-24</td>
<td>Drill tip</td>
<td>498N 512E 54 cmbd</td>
<td>Yes</td>
<td>Perforate</td>
<td>Dry hide</td>
<td>Refit with 1082A131-22</td>
<td></td>
</tr>
<tr>
<td>1082A032-03</td>
<td>Drill tip</td>
<td>500N 504E 10-17 cmbd</td>
<td>Yes</td>
<td>Drill</td>
<td>Stone</td>
<td></td>
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<tr>
<td>1082A036</td>
<td>Lanceolate point tip</td>
<td>501.08N 497.92E</td>
<td>28 cmbd</td>
<td>No</td>
<td></td>
<td></td>
<td>Spots of stone polish</td>
</tr>
<tr>
<td>1082A125-06</td>
<td>Lanceolate point, broken base</td>
<td>490N 497.5E</td>
<td>29 cmbd</td>
<td>Yes</td>
<td>Projectile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A47-01</td>
<td>Lanceolate point tip</td>
<td>500N 514E 40-45 cmbd</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A138-03</td>
<td>Lanceolate point</td>
<td>500N 512E 35-38 cmbd</td>
<td>Yes</td>
<td>Butcher Meat</td>
<td>Hafted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A025-06</td>
<td>Lanceolate point</td>
<td>490N 509E 32 cmbd</td>
<td>?</td>
<td></td>
<td></td>
<td></td>
<td>Hafted; patinated obscuring wear</td>
</tr>
<tr>
<td>1082A024-03</td>
<td>Lanceolate point</td>
<td>490N 509E 41 cmbd</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>Hafted</td>
</tr>
<tr>
<td>1082A125-05</td>
<td>Lanceolate point, base/partial blade</td>
<td>490.12N 498.40E</td>
<td>26 cmbd</td>
<td>Yes</td>
<td>?</td>
<td>Generic weak</td>
<td>Hafted; resharpened and used after removal</td>
</tr>
<tr>
<td>1082A85-09-38</td>
<td>Lanceolate point, base/partial blade</td>
<td>Burrell Farm</td>
<td>Surface</td>
<td>Yes</td>
<td>Cut</td>
<td>Dry hide</td>
<td>Hafted</td>
</tr>
<tr>
<td>1082A85-09</td>
<td>Lanceolate point midsection</td>
<td>Burrell Farm</td>
<td>Surface</td>
<td>No</td>
<td></td>
<td></td>
<td>One spot of stone polish</td>
</tr>
<tr>
<td>1082A85-28</td>
<td>Lanceolate point, base/partial blade</td>
<td>Burrell Farm</td>
<td>Surface</td>
<td>Yes</td>
<td>Butcher Meat</td>
<td>Hafted; resharpened and used after removal</td>
<td></td>
</tr>
<tr>
<td>1082A85-01</td>
<td>Lanceolate point</td>
<td>Burrell Farm</td>
<td>Surface</td>
<td>Yes</td>
<td>Projectile</td>
<td>Hafted</td>
<td></td>
</tr>
<tr>
<td>1082A85-44</td>
<td>Lanceolate point, broken tip</td>
<td>Burrell Farm</td>
<td>Surface</td>
<td>?</td>
<td></td>
<td></td>
<td>Hafted, possible projectile break</td>
</tr>
<tr>
<td>1082A024-09</td>
<td>Genessee point (refit)</td>
<td>490.98N 509.14E</td>
<td>27 cmbd</td>
<td>Yes</td>
<td>Butcher Meat</td>
<td>Hafted</td>
<td></td>
</tr>
<tr>
<td>1082A030-04</td>
<td>Madison point, broken tip</td>
<td>500N 496E 15-24 cmbd</td>
<td>No</td>
<td></td>
<td></td>
<td>Hafted</td>
<td></td>
</tr>
<tr>
<td>1082A030-03</td>
<td>Brewerton point</td>
<td>500N 496E 13-15 cmbd</td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td>Hafted</td>
</tr>
</tbody>
</table>

*Continued*
Despite the frequent use of the term “drill” and the less frequent, but still prevalent, use of “bifacial perforator” in the literature, as well as the apparent difficulty in distinguishing between the two, there has been minimal functional research on the topic. To address this incongruity and obtain a more detailed view of the activities conducted at the site, we turned to lithic microwear analysis. We utilize common terms such as projectile points and drills—as opposed to the less common bifacial perforator—for simplicity, even though subsequent analysis may have assigned different functions to these morphological types. In this paper, we present the results of microwear analysis that provided some surprising insights into the deer-processing and hide-working industry at Burrell Orchard.

**BURRELL ORCHARD**

The Burrell Orchard site is located in Sheffield Village, Lorain County, Ohio, on a glacial lake plain landform overlooking the floodplain of the Black River (Figure 1). Intensive survey and test excavations by the Cleveland Museum of Natural History, in cooperation with the Firelands Archaeological Research Center in Amherst, Ohio, began in 2008 and continued through 2016 (Redmond and Scanlan 2009; Redmond *et al.* 2015, 2016). To date, the project has documented a Late Archaic period, stratified, sheet midden covering approximately 0.46 ha of the bluff-top and extending as much as 80 cm below the surface. These midden deposits have produced only Late Archaic material culture. Ten radiocarbon assays on midden and pit feature contents (nine hickory nutshell and one bone) span a maximum two-sigma, calibrated date range of 2572 to 1776 BC (Redmond and Scanlan 2009; Redmond *et al.* 2015, 2016). Recent excavations have recorded at least two prepared clay floors that may have served as foundations for structures. Formal artifacts consist primarily of flaked stone projectile points and drills, groundstone celts/adzes, anvilstones, abraders, mortars, hammerstones, slate bannerstones, and various bone and antler awls, billets, and pin fragments.

As noted above, formal flaked stone artifacts, which are the focus of this study, primarily include projectile points and drills (Figure 2). The most frequently recovered form of projectile point is a lanceolate which is widest at its midsection (waist) and tapers gradually to a straight to slightly concave base. All points of this form are thin and were fashioned by percussion flaking, which, in the better-worked specimens, exhibits parallel flaking. Most points have been retouched (pressure-flaked) along the lateral edges, and grinding is rare. Some points show evidence of reworking below the waist, which produced slight shoulders and straight to tapering stems. These artifacts most closely resemble the types *Adder Orchard* in Ontario (Fisher 1997:20) and *Steubenville* found in the upper Ohio River Valley (Mayer-Oakes 1955; Ritchie 1971:50–51). Related point forms, but not raw materials, can be seen among the stemmed lanceolate points of the so-called Satchell complex of northwestern Ohio, southern Michigan, and

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**Table 1. Continued**

<table>
<thead>
<tr>
<th>CMNH Artifact Type</th>
<th>Context</th>
<th>Depth/Feature*</th>
<th>Used? Motion Worked Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1082A085-08 Biface midsection Burrell Farm Surface</td>
<td>Yes Butcher</td>
<td>Meat/bone</td>
<td></td>
</tr>
<tr>
<td>1082A138-01 Biface 500N 512E 0–23 cm bd</td>
<td>Yes Scrape Dry hide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A030-02 Biface 500N 496E 0–15 cm bd</td>
<td>Yes Butcher Meat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A050-04 Biface base 500N 514E F. 08-08</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1082A035-01 Biface fragment 501.08N 496.39E</td>
<td>No</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*cmbd=centimeters below datum.
southwestern Ontario (Stothers and Abel 1993:33–34). The vast majority of projectile points from Burrell Orchard are made from one or another variety of Pennsylvanian age cherts derived from the Upper Mercer limestone formation of the Pottsville group (Kagelmacher 2001). These cherts outcrop primarily in the Whirling River Valley of west-central Coshocton County, Ohio—approximately 130 km south of the site—and range from dark blue-gray to gray to light brown in color. They are referred to by a number of names including “Nellie,” “Upper Mercer,” and “Upper Mercer-Gray” (DeRegnaucourt and Georgiady 1998:80–89), among others.

Drills often have expanded bases, though not always, with long shafts measuring up to 12 cm in un-reworked specimens. Cross sections are generally biconvex with shafts that taper gradually from the tips to expanded bases with straight basal margins. Raw materials of the drills are divided between Upper Mercer cherts and Vanport (Flint Ridge) cherts. The most intensively utilized aboriginal outcrops of Flint Ridge chert are located approximately 170 km south of the Burrell Orchard site in eastern Licking County, Ohio (DeRegnaucourt and Georgiady 1998).

Study of subsistence remains from Burrell Orchard indicates that significant effort was expended in the acquisition and processing of hickory nuts and white-tailed deer. For example, 11 of 36 pit features (31 per cent) contained deer bone. Due to the highly fragmented condition of the bone assemblage, minimum number of individuals (MNI) was not calculated. Number of identified specimens (NISP) was used and resulted in
the following counts: 267 deer, 24 squirrel, seven woodchuck, six muskrat, and < 5 for raccoon, red fox, opossum, and dog (Redmond et al. 2015). Based on these results, deer remains dominated the faunal assemblage and, although not ubiquitous, were found in the largest number of feature contexts. This we interpret as convincing evidence of the importance of deer hunting and processing by the site inhabitants. In terms of nutshell ubiquity, 20 of 21 features (95 per cent) sampled for flotation processing contained nutshell. The 93 g of nutshell identified in the flotation samples are dominated by hickory (86.6 per cent), followed by black walnut (13.0 per cent), and other taxa, such as acorn and butternut (0.4 per cent) (Redmond and Scanlan 2009; Redmond et al. 2015, 2016).

All major skeletal elements of the deer are represented in the bone assemblage, which strongly suggests that whole deer carcasses were returned to the site for processing. Systematic butchering is well represented by cut marks, and roasting of selected body portions is indicated by charred or smoked bone fragments. The extraction of marrow from deer longbones, as well as the boiling of bones for grease, is suggested by the large number of epiphyseal ends and smashed shaft fragments found in midden deposits and some pit features (Outram 2001). The presence of at least 26 smudge pits, most likely used for hide-smoking (i.e., Binford 1967), reveals that deer were harvested for more than just meat and marrow. The use of deer bone and antler for implements such as awls, pins, projectile points, and at least one billet is readily in evidence.

**Microwear Analysis**

Lithic microwear analysis has demonstrated that the use of stone tools on various materials will produce wear patterns that are distinct from those caused by non-use-related processes as well as those of other materials. Microwear analysis, as developed by Keeley (1980) based on initial work by Semenov (1964), uses incident light microscopy to identify polishes, striations, and edge damage caused by utilization. Tool function is interpreted through controlled comparison with experimental tools of known use to distinguish specific motions on specific materials. The method has been validated by several independent blind tests that have led to its adoption in countless studies worldwide (Evans et al. 2014; Yerkes and Kardulias 1993; see also Evans 2014 for an up-to-date review of blind testing).

Prior to microscopic analysis, artifacts were photographed so that locations of use-wear could be noted. Each artifact was then placed in an individual plastic container and washed in an ultrasonic cleaner. During the ultrasonic cleaning process the artifacts were submersed in liquid soap for 10 minutes, drained and rinsed, and then submersed in tap water for 10 minutes. Tools were also spot cleaned with acetone as needed during the analysis to remove finger grease. After air drying, the artifacts were examined with an Olympus model BHM incident light microscope, equipped with a digital camera, at magnifications of 50–500x. In order to interpret material worked and motion employed, microwear traces on the artifacts were compared to an experimental reference collection of over 200 tools composed of over a dozen Midwestern chert types, including the Upper Mercer and Vanport cherts common at Burrell Orchard (Miller 2010, 2013, 2014a). Particularly relevant to this study is that this experimental collection included numerous tools used to drill bone and wood in addition to perforating dry hide (Figure 3).

Twenty-eight chipped stone tools recovered from Burrell Orchard were examined for microwear patterns (Table 1). The microwear sample included artifacts from CMNH excavations in 2008 and 2014 as well as surface collections by the Burrell Family. The sampling strategy focused on obtaining a total sample of the bifacial tools with complete, or reasonably complete, functional edges. For example, complete projectile points and those with only a portion of the tip missing were included in the sample while recovered projectile point bases were not included. The sample consisted of 12 complete and broken lanceolate projectile points. The sample also included eight drills and drill fragments. These represent all of the drills recovered in two seasons of excavations. Four of the drills were complete and unbroken while one base and one tip fragment refit to form another complete drill. Drill fragments included one tip and one base. Five of the drills were made of Vanport chert, two were made of Upper Mercer gray chert, and one consisted of a coarse, gray type of stone, possibly greywacke/metasediment (Redmond and Scanlan 2009:133; Redmond et al. 2015:28). Eight additional projectile points and biface fragments were included in the sample. These include one
Genesee-type point base (CMNH catalog # 1082A24-09) of Upper Mercer gray, which is considered a transitional Middle to Late Archaic form that has been dated from the early fifth to early fourth millennia BP (Justice 1987:159–160; Ritchie 1971:24–25). An unfinished or damaged side-notched point (1082A30-03) most closely resembling the transitional Middle to Late Archaic Brewerton Side-notched type (Ritchie 1971:19–20) and made of Delaware chert, available in Erie and Sandusky counties to the west of the site (DeRegnaucourt and Georgiady 1998:48), was also included. The sample also included a triangular point (1082A30-04) of the Madison type (Justice 1987:224–27) from the plow zone and representing a Late Woodland to Late Prehistoric reoccupation of the area. Microwear analysis determined that this tool was hafted but did not show evidence of further utilization; therefore, it is excluded from further analysis, leaving only Late Archaic artifacts in the sample. Additional artifacts included a large, thin biface midsection (1082A085-08), a bifacial thumbnail scraper (1082A138-01), and other untyped biface fragments.

RESULTS

Overall, 17 of the 28 artifacts examined in this sample exhibited use-related microwear traces (Table 1). Most of the tools were utilized for hunting and the subsequent preparation and processing of animal hides. However, drilling hard materials was represented as well. Many of the artifacts with no evidence of use were basal fragments in which the utilized end may have broken.

Overall, six of the 12 lanceolate points exhibited evidence of utilization. They were used for three separate identifiable tasks, with one exhibiting generic weak polish that could not be assigned to a particular material. The five lanceolate points for which worked material could be identified were used as projectiles ($n=2$), to butcher meat ($n=2$), and to cut dry hide ($n=1$). Those points that were unused but contained fully intact bases showed signs of hafting in the form of hafting bright spots, polish, and edge damage (Rots 2010). As is the case with 1082A85-44, the portion with microscopic evidence for use may have broken on impact (Figure 4). Other complete specimens, such as 1082A24-03, contained no visible signs of use, through either impact fractures.
or microscopic polishes. Many factors may prevent the formation of diagnostic use-wear on projectile points (Fischer et al. 1984; van Gijn 1990, 2010). Thus, it is not currently possible to say whether or not this point was used. Two lanceolate points did exhibit the bright linear streaks of polish at their tips characteristic of projectile impact (Figure 5). Some projectile points, like 1082A85-28, were removed from the haft before being used as knives, as evidenced by dull, greasy meat polish extending into the haft area, and evidence of resharpening (Figure 6). Others, such as 1082A138-03, may have been used to butcher meat while still hafted (Figure 6). Dull, greasy meat polish is present on the slightly concave lateral edge. This polish terminates above the stem area that contains hafting bright spots and other hafting wear.

Another lanceolate point (1082A138-09-38) was used to cut dry hide, as indicated by edge rounding and pitted polish. The polish is limited to the blade and does not extend into the haft area, indicating that the tool was probably still hafted during use. The point exhibiting generic weak polish (i.e., polish formed through use but not diagnostic of a particular material), 1082A125-05, was used in a manner similar to the de-hafted meat knife (1082A85-28) discussed above in that it was de-hafted and probably resharpened during use as a hand-held knife.

Eight additional bifaces and biface fragments were examined, with seven reported here (as the Late Woodland to Late Prehistoric Madison point was excluded from further analysis; see the Methods section above). Of these, four exhibited evidence of utilization. Three contained dull, greasy, invasive polish indicative of butchering meat. These meat knives included such varied forms as the Genesee point base (1082A24-09), the large, thin biface midsection (1082A085-08), and a small, roughly triangular biface fragment (1082A-030-02). A small scraper (1082A138-01) was used in a transverse motion to scrape dry hide as indicated by edge rounding and a matte, large-pitted polish (Figure 7).

Eight drill fragments representing seven separate drills were examined. Six of the seven drills showed evidence of utilization. Four of these were used to perforate dry hide while one each was used to drill bone/antler and stone. The one that did not have evidence of use was hafted, however. In fact, five of the six drills with intact bases contain indications that they were hafted at some point during their use life (Figures 8 and 9). There is no evidence to suggest that they were removed from the haft (i.e., overlap between use wear and hafting wear as seen on some lanceolate points) before performing these functions. In other words, nearly all drills were hafted during use (see description of 1082A024-04 below for the lone exception). Four of the drills (or five of the fragments) contained a matte polish associated with edge rounding, and large pits characteristic of working dry hide (Figures 8 and 9). The location of this polish along high points and ridges with

![Figure 4](image4.png)

**Figure 4.** Lanceolate projectile point (1082A85-44) with a possible impact damage scar and hafting bright spot. Magnification of inset photo is 187.5×. Dotted line indicates upper extent of hafting evidence.
striations running perpendicular to the lateral edges indicates that the tools were used in a twisting motion to perforate dry hide. One drill, 1082A024-04, made of Vanport chert, is much thinner than the others. It was also used to perforate hide but there is no evidence that it was hafted (Figure 9). Thus, while the ultimate function of 1082A024-04 was the same as the others, it is of a different form and was used in a slightly different manner (i.e., unhafted vs. hafted) than the others.

Other drills functioned as drilling implements. One specimen (1082A013-04) contained a highly developed bright polish restricted to the working edge of the tool and associated with macroscopically visible edge damage (Figure 10). This pattern is associated with drilling bone or antler.

**Figure 5** Lanceolate projectile points (left: 1082A85-01, right: 1082A125-06) exhibiting bright linear streaks of polish indicative of projectile use near their tips. Both tools were also hafted, and a representative hafting bright spot is included for 1082A85-01. All inset photo magnifications are 187.5×. Dotted line indicates upper extent of hafting evidence.

**Figure 6** Left: Lanceolate point (1082A138-05) with dull invasive meat polish present above the hafted base. Right: Lanceolate point (1082A85-28) with dull, greasy, invasive meat polish extending down into the haft area. All inset photo magnifications are 187.5×. Dotted line indicates upper extent of hafting evidence. Dashed lines indicate extent of utilization.
It may be associated with producing something like the bone pin fragment recovered at the site (Redmond et al. 2015:32–33).

A small drill tip fragment, 1082A032-03, contained extensive edge damage and patches of bright flat polish matching those used in experiments to drill stone (Figure 10). The only drilled stone artifacts recovered from the site are several bannerstone fragments, but most research suggests that bannerstone holes were produced by cane drilling and not with stone drills (Kinsella 2013; Sassaman 1998:101). Therefore, it is unknown what type of object this drill was used to produce.

Of the seven drills or drill fragments examined in this study, five were manufactured from Flint Ridge chert; one was a gray variety of Upper Mercer chert; and one consisted of a coarse, gray type of stone, possibly greywacke/metasediment.
typical of contemporary Satchel Complex assemblages found in northwestern Ohio (Stothers et al. 2001:238). Thus, Flint Ridge chert appears to have been the preferred raw material for hide-working tools. This may have to do with the superior knapping qualities of this chert, which would have facilitated the manufacture of such long and narrow bifaces. Notably, the drill tip used to perforate stone (1082A32-03) is made from coarse metasediment, which may have been more suitable for drilling of dense material.

In addition to presentation of the results based on tool type, the examination of drill function by stratigraphic unit may prove informative. Three

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**Figure 9** Left: Refit “drill” (1082A131-22 and 1082A131-24) with edge rounding and matte, large pitted polish on the tip and shaft. This artifact contained hafting bright spots as pictured. Both inset photo magnifications are 187.5×. Right: Unhafted “drill” (1082A024-04) with microscopic use-wear indicative of perforating dry hide. Inset photo magnification is 250×. Dotted line (in left photo) indicates upper extent of hafting evidence. Dashed lines indicate extent of utilization.

**Figure 10** Left: “Drill” (1082A032-04) with very bright, small-pitted polish associated with extensive edge damage indicative of drilling bone/antler. Right: Drill tip (1082A032-03) with bright, flat polish associated with extensive edge damage indicative of drilling stone. Note the similarities with Figures 3b and 3c, respectively, and the differences in texture and extent of polish in comparison to Figures 8 and 9. Dotted line indicates upper extent of hafting evidence. Dashed lines indicate extent of utilization.
different stratigraphic levels have been identified at Burrell Orchard above culturally sterile sub-soil. The uppermost stratum is the historical plow zone. Below this are two undisturbed strata interpreted as an upper midden (Stratum III) and a lower midden (Stratum II) (Redmond and Scanlan 2009; Redmond et al. 2015). Analyzed drills were recovered from each of these levels (Table 1). The thin, unhafted drill made of Vanport chert (1082A24-04) was recovered near the base of stratum II. All of the other tools used to perforate dry hide were recovered from the midden in stratum II and III or cooking features originating in Stratum II levels (Table 1). The two drills recovered from the plow zone were used to drill bone/antler and stone.

**DISCUSSION**

A major research objective addressed in this study was documenting the activities conducted at the site using chipped stone tools. Comparison of these activities with the features and artifact assemblage provides a more nuanced view of site activities than any individual class of data could on its own. The chipped stone tools examined from Burrell Orchard were largely used for animal procurement and subsequent processing. Lanceolate points were successfully used as projectiles in hunting, presumably largely in the procurement of white-tailed deer. Whole carcasses were transported back to the site and lanceolate points were subsequently used, both hafted and unhafted, to butcher meat and process hides. The identification of over two dozen smudge pits at the site indicates that hide smoking and curing was a major undertaking as well. Curiously, no fresh hide scrapers and only one dry hide-scraping implement have been identified. The use of the drills to perforate dry hides at this site is well documented. Thus, we have identified procurement (in terms of projectile use), processing via butchering, smoking hides over smudge pits, and finishing the products with perforations for sewing or other uses. Activities also involved the production of other items as indicated by implements used to drill stone and bone.

All of the drills from the upper and lower middens and associated features were used to perforate dry hide. This provides some evidence for continuity in site function through time. It is interesting to note that the two drills used to drill hard material were recovered from the plow zone (Table 1). These two tools may date to a more recent occupation than the others, assuming the law of superposition holds. However, a sample of two is far from sufficient to demonstrate a relationship, and this pattern requires further analysis. A second research objective involved the examination of the relationship between tool form and function at Burrell Orchard. Two major types of bifacial artifacts, projectile points and drills, are especially pertinent to this objective and will be discussed further here.

As the name implies, projectile points are generally assumed to be designed for throwing, or being otherwise propelled, at targets in hunting or warfare. Functional analysis of projectile points often documents their uses as projectiles as well as butchering knives (e.g., Ahler 1971). However, points were not always used solely for these purposes, as numerous additional activities have been identified as well (Ahler 1971; Miller 2013, 2014b; Smallwood 2015). The Burrell Orchard points follow these previously identified patterns. Lanceolate points at Burrell Orchard were used as projectiles in many cases. They were also used as knives to butcher meat and cut dry hide. Their use as knives occurred both while hafted and while unhafted.

Several projectile points displayed no evidence of use. This can be explained for some by their fragmentary nature or missing tips. However, only one point (1082A85-44) contained identifiable macrofractures attributable to projectile use. Identification of projectile use through macrofracture analysis is still a highly problematic pursuit (Rots and Plisson 2014).

Other complete points and tips contained no evidence of use. Even when used as projectiles, often, projectile points do not contain microwear on their edges or surfaces. Linear polish is the most distinctive type of projectile microwear that has been observed on experimental darts and arrows (Fischer et al. 1984; van Gijn 1990, 2014), but not all experimental stone projectiles had these linear traces on their surfaces. In simulated hunting experiments, it was found that most darts and arrows broke after only one or two shots, and any microwear traces that were present were weakly developed (Cheshier and Kelly 2006; Dockall 1997). Thus, it is unclear how many points were actually used as projectiles.

Examination of the other major type of bifacial tool at the site, drills, indicates that the term “bifacial perforator” does reflect a functional category at Burrell Orchard. However, the tools from Burrell Orchard functioned as both bifacial...
perforators and drills. The only macroscopic difference is the extensive edge damage resulting in a high attrition rate and marked narrowing to the tip of the tools used to drill hard materials (see Figure 9). As only two drills were used on hard materials such as these, a much larger sample is needed to demonstrate whether this pattern is a reliable indicator of use. Additionally, while this study has demonstrated the relevance of the term “bifacial perforator” at Burrell Orchard, microwear studies in other sites and regions are needed to determine the extent of this tool type in prehistory. It is also possible that further microwear analysis will reveal even greater variation in the function of drills, as Lewenstein (1987) identified scraping, graving, and cutting, in a sample from Belize, as secondary functions to drilling.

A couple of isolated examples of tools that functioned as bifacial perforators exist in the literature, and they both began with classification as drills before interpreting their use as hide perforators. For example, Kimball (1994:169) documented a hafted drill that was used to “bore dry hide” in the Late to Terminal Archaic assemblage at the Padula site (36NM15) in eastern Pennsylvania. At Dust Cave in northern Alabama, Walker et al. (2001) report the results of microwear analysis of two drills from the Late Paleoindian levels. Only one of these showed evidence of utilization, and it is described as an awl for perforating hide (Walker et al. 2001:187). Thus, the bifacial perforators at Burrell Orchard may be part of a wider, yet under-recognized, pattern of tool function. Further analysis of additional assemblages is needed to document how widespread the existence of bifacial perforator use was.

CONCLUSION

In conclusion, microwear analysis has helped to clarify the relationship of the formal chipped stone tool assemblage to the activities inferred from the features and other remains to have been conducted at Burrell Orchard. Chipped stone tools were used in the procurement, preparation, and processing of hides by the site’s inhabitants. The lack of chipped stone hide-scraping tools is deserving of further study. Perhaps the scraping tools lie outside of the formal tool assemblage as unmodified flake tools. It is also possible that the hide-scraping tools are located in an as-yet-unexplored portion of the site or that hide scraping was conducted with bone, wood, or other non-chipped stone implements. Interesting insights into the relationship between tool form and function have been documented at Burrell Orchard as well. The documentation of numerous bifacial perforators used to produce holes in dry hide is a unique feature of the site. However, this was not a specialized tool form as morphologically similar tools were used on hard materials such as bone and stone. Further analysis of additional assemblages is needed to document the spatial and temporal distribution of drills and bifacial perforators.

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