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Technical Descriptions of Artifacts from the Dresden Mound Cache, Ohio

Metin I. Eren[1,2]*, Damon Mullen[1], Linda Spurlock[1], Bob Christy[3], G. Logan Miller[4], Briggs Buchanan[5], Jennifer Bush[6], and Michelle R. Bebber[1]*

Abstract

We describe artifacts from a terminal Middle Woodland cache excavated from Dresden Mound, Ohio, including 17 flaked stone projectile points, a slate gorget, sheets of mica, and a stone celt. Our descriptions include morphometrics, microwear, and high-resolution images. We also provide a brief written description of human bone associated with the cache. Given the lack of contextual data associated with the cache, we cannot make any broad conclusions. However, we anticipate our reported descriptions and recorded data will be of use to other researchers and other interested parties. We conclude the report with some preliminary thoughts on two phenomena relevant to flaked stone technology: bi-beveling and resharpening.

Introduction

Carskadden and Morton (1983) described avocational excavations of a mound, located on a terrace above the Muskingum River, near the confluence of Wakatomika Creek in Dresden, Ohio, that took place in the 1960s (Figure 1). The collection of artifacts from this mound had been donated to the Johnson-Humrickhouse Museum in Coshocton, Ohio in 1974 by Glenn Longaberger. The excavations had yielded a cache of 17 knapped bifaces made on chert macroscopically consistent with either Upper Mercer or Flint Ridge chert, a ground stone celt, and a broken slate gorget. We also report other materials associated with the mound excavation, that may or may not be part of the cache, including sheets of mica, a second ground stone celt, and human remains (Carskadden and Morton 1983:44).

Carskadden and Morton (1983:44) examined the materials from the Dresden Mound in person in 1972, but the film from their photographs of these artifacts was "ruined" and the materials were unable to be located at the time of their writing in the 1980s. In 2018 Michelle Bebber was contacted by Jennifer Bush, Director of the Johnson-Humrickhouse Museum, regarding human remains that had been found during a re-organization of the museum's collections during that year. Prior to this discovery, the museum staff was unaware of any human

Corresponding authors: meren@kent.edu , mbebber@kent.edu

[1] Department of Anthropology, Kent State University, Kent, Ohio, 44242, U.S.A.
[2] Department of Archaeology, Cleveland Museum of Natural History, Cleveland, Ohio, 44016, U.S.A.
[3] University Communications and Marketing, Kent State University, Kent, Ohio 44242, U.S.A.
[4] Department of Sociology and Anthropology, Illinois State University, Normal, Illinois, 61790, U.S.A.
[5] Department of Anthropology, University of Tulsa, Tulsa, Oklahoma, 74104, U.S.A.
[6] Johnson-Humrickhouse Museum, Coshocton, Ohio, 43812, U.S.A.

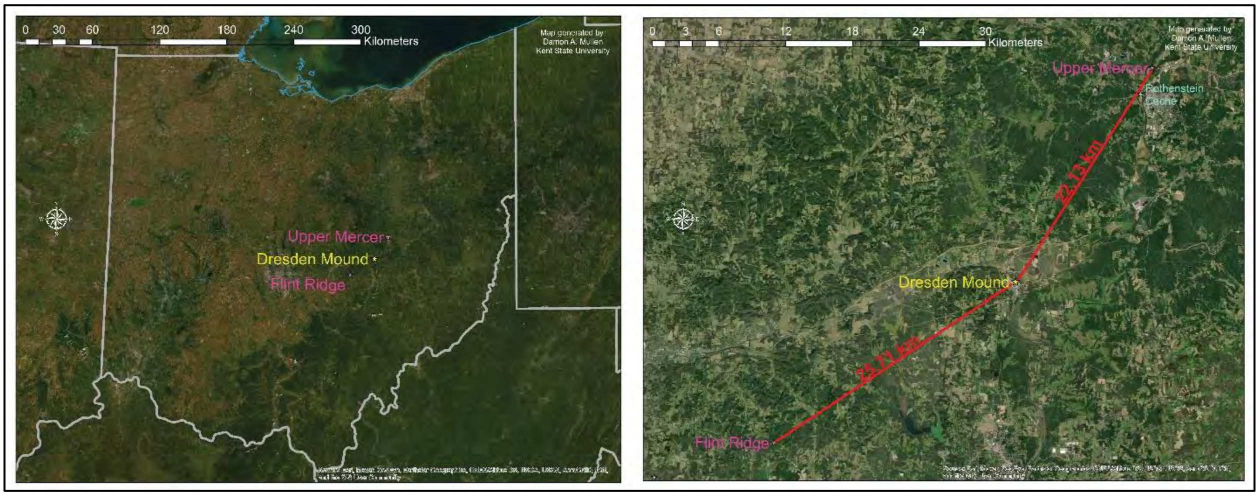

Figure 1. Location of the Dresden Mound Cache, Ohio.

remains in their museum as a prior inventory had been conducted in 1998 under the direction of Midge Derby. In order to maintain NAGPRA compliance, the museum was eager to have the remains and associated materials examined and repatriated to a tribal representative. Three archaeologists from Kent State University (Bebber, Eren, and Spurlock) went to the Johnson-Humrickhouse Museum to look at the collections and prepare the proper documentation for repatriation. Bebber and Eren described and inventoried the associated artifacts. Spurlock analyzed the human remains and wrote up the description. It is assumed that some of the bone fragments, namely the parietal bones and one of the occipital bones, had been excavated from the mound. These bones were referred to as a "skullcap" in the brief description by Carskadden and Morton (1983).

Carskadden and Morton (1983) focused on the excavation context of the mound, as they were unable to perform detailed artifact analysis due to the inability to directly examine the artifacts at the time of their writing and the loss of their photographs. Given the recent re-discovery of the artifacts, we provide technical descriptions, data, and high-resolution images of these artifacts in this article. The second celt, which is depicted in Carskadden and Morton's Figure 2 (1983:46), is not with the assemblage and its location is currently unknown. As a result, this article adds to the literature on sub mound caches and artifact deposits that were a common aspect of regional ceremonial practices during the Early and Middle Woodland periods (Carr et al. 2005; Dragoo 1963; Greber 1996; Mayer-Oakes 1955; Moorehead 1922). Many of these caches contain flaked stone bifaces, but these artifacts do not always receive detailed analysis (see McConaughy 2005; Prufer et al. 1984; Yerkes et al. 2020 for some notable exceptions). The analysis presented here provides further insight into the manufacture and use-life of the bifaces, giving useful comparative data for similar assemblages in the region and to address broader issues of lithic technology in general.

Flaked Stone Biface Descriptions

There are 17 flaked stone bifaces in the cache (Table 1). Other than Biface #1, which seems to be a preform, all the bifaces are typologically consistent with the Lowe Cluster of projectile points, which predominately date to the terminal Middle Woodland period (Justice 1987:208-214).

Biface #1 (Figure 2). This specimen, made on a dark blue Upper Mercer chert with tiny "dot" inclusions, appears to be a preform. It is longer, wider, and thicker than any of the other bifaces in the cache. It also possesses higher L:W and W:T ratios than any other specimen (Table 1). These data are consistent with the hypothesis that more knapping would have been required to get it "into shape." Although there is variability in the flake scar patterning, many flake scars are parallel to each other and reach diagonally across each face. Most flake scars terminate close to the mid-line axis, although a few overface flakes are present. Some ground lateral edges are present, suggesting that edge grinding was used as platform preparation.

Figure 2. Biface #1.

Biface #2 (Figure 3). This specimen is made on a dark blue and highly siliceous Upper Mercer chert. Although the chert this specimen is made on possesses no inclusions, the chert of the distal tip is rougher than the waxier chert of the proximal base. The presumable pressure flake scars appear to be haphazardly applied, resulting in a less organized impression than Biface #1. The lateral edges are also jagged in both plan- and profile-view. Perhaps this specimen had yet to be completely finished.

Table 1: Morphometric data recorded from the 17 Dresden Mound flaked stone projectile points.

Specimen	Mass	Length	Medial width	Shoulder width	Neck width	Basal width	Medial thickness	Shoulder thickness	Neck thickness	L:W	W:T	T:L
1	34	98.72	32.76	n/a	n/a	33.76	10.02	n/a	n/a	3.01	3.27	0.10
2	13	64.92	26.54	27.59	19.94	26.48	6.38	6.28	6.00	2.45	4.16	0.10
3	21	82.43	31.11	30.14	21.45	26.71	6.48	6.75	6.82	2.65	4.80	0.08
4	16	71.34	27.34	29.95	20.27	27.61	5.92	6.74	6.39	2.61	4.62	0.08
5	17	81.94	29.65	30.58	21.03	27.96	6.23	5.35	4.96	2.76	4.76	0.08
6	15	69.48	26.40	28.67	20.30	28.14	6.89	7.27	7.20	2.63	3.83	0.10
7	15	65.19	27.54	30.33	20.67	28.80	7.01	7.11	6.53	2.37	3.93	0.11
8	13	67.69	26.54	27.50	18.33	21.80	6.79	6.20	5.75	2.55	3.91	0.10
9	13	73.02	27.33	27.29	18.89	23.84	5.89	5.66	5.74	2.67	4.64	0.08
10	12	60.91	29.37	31.57	19.79	21.32	5.93	6.64	6.04	2.07	4.95	0.10
11	16	69.42	28.02	28.57	18.44	26.49	6.68	7.50	6.84	2.48	4.19	0.10
12	19	75.42	32.36	31.65	22.08	26.65	6.13	6.36	6.08	2.33	5.28	0.08
13	14	61.81	29.83	31.13	19.21	25.22	6.46	8.17	7.49	2.07	4.62	0.10
14	13	63.61	28.09	29.52	19.92	26.35	6.61	6.55	5.76	2.26	4.25	0.10
15	18	76.86	30.18	31.51	19.42	26.18	6.92	7.69	7.15	2.55	4.36	0.09
16	17	74.92	27.62	31.08	19.98	28.03	7.13	6.22	5.84	2.71	3.87	0.10
17	7	49.48	27.00	29.31	18.30	28.00	4.78	5.23	5.18	1.83	5.65	0.10

Figure 3. Biface #2.

Biface #3 (Figure 4). The dark blue Upper Mercer chert that this specimen was knapped from possesses several reddish-brown and white inclusions, as well as a light blue crystal. Although these inclusions were likely the cause of several small step fractures, the specimen is overall well knapped. There appears to be a set of “finishing” pressure flakes along the lateral edges, resulting in a straight, sharp, and smooth appearance in both plan- and profile-view.

Biface #4 (Figure 5). This finished specimen is made on a dark blue Upper Mercer chert that exhibits several tiny inclusions and two larger ones, the latter both visible on each face. This specimen is interesting for two reasons. First, the biface-midline axis that bisects the distal tip is not perpendicular to the basal edge, resulting in a “leaning” appearance. Second, this distal half of this specimen is bi-beveled.

Biface #5 (Figure 6). This finished specimen is made on a dark blue Upper Mercer chert that, upon close inspection, is almost “pumice-like,” given the presence of many tiny holes.

Biface #6 (Figure 7). Similar to Biface #2, the lateral edges of this biface are rough and jagged, perhaps suggesting it was not yet finished. However, like Biface #4, it also possesses a bi-bevel. Made on a dark blue Upper Mercer chert, a white, linear inclusion is present in the base; otherwise the chert is highly siliceous.

Biface #7 (Figure 8). The red and white chert that this specimen is made on is macroscopically consistent with Flint Ridge chalcedony. With several step fractures present on each face; a rough, jagged, sinuous lateral edges; and a clunky, bulbous tip; this specimen does not appear to have been finished.

Figure 4. Biface #3.

Figure 5. Biface #4.

Figure 6. Biface #5.

Figure 7. Biface #6

Figure 8. Biface #7.

Biface #8 (Figure 9). This specimen is made on a dark blue Upper Mercer chert with reddish-brown inclusions scattered throughout. Fairly well-spaced and organized flake scars and straight, smooth lateral edges suggest this specimen was finished. Interestingly, only the very distal-most tip is bi-beveled.

Figure 9. Biface #8.

Biface #9 (Figure 10). Made on a rougher, inclusion-heavy dark blue Upper Mercer chert, this finished specimen exhibits well-spaced and organized flake scars.

Biface #10 (Figure 11). This finished specimen is made on a gray and yellowish chert. In profile-view this specimen is plano-convex. The edges, although jagged, appear to be finished; almost serrated. The basal edge is square, perhaps the face of a tabular piece of chert. This square basal edge was used as a platform, and several step fractures in the point stem resulted.

Biface #11 (Figure 12). Made on a siliceous dark blue Upper Mercer chert, this specimen does not appear to be finished. The tip is rounded, the lateral edges are rough and sinuous, and the basal edge is heavily ground smooth. The flake scars, however, are well-spaced and fairly organized.

Biface #12 (Figure 13). This specimen is made on a "pumice-like" dark blue Upper Mercer chert. It is highly symmetrical in both plan- and profile-view, and possesses sharp, straight edges.

Biface #13 (Figure 14). The chert this finished specimen is made on appears to be the "inverse" of Biface #2. It is made on a dark blue and highly siliceous Upper Mercer chert, but this time the chert of the proximal base is rougher than the waxier chert of the distal tip.

Biface #14 (Figure 15). This specimen is plano-convex, and it is difficult to infer whether it was finished or not. Made on a dark blue Upper Mercer chert with several inclusions – including a large, white fossil inclusion visible on one face of the proximal half – its lateral edges

Figure 10. Biface #9.

Figure 11. Biface 10.

Figure 12. Biface #11.

Figure 13. Biface #12.

Figure 14. Biface #13.

Figure 15. Biface #14.

Figure 16. Biface #15.

Figure 17. Biface #16.

Figure 18. Biface #17.

appear to possess some "finishing" pressure flaking, but are still rough and sinuous. The distal tip on one face exhibits a series of compounding step fractures.

Biface #15 (Figure 16). Some sections of this specimen's lateral edges are still ground, suggesting that it isn't finished. This biface is made on an inclusion-free dark blue Upper Mercer chert.

Biface #16 (Figure 17). Similar to biface #15, some sections of this specimen's lateral edges are still ground, suggesting that it isn't finished. The flaking appears to be rather haphazard, and there are several small step fractures adjacent to the edges.

Biface #17 (Figure 18). This smallest biface in the cache, it is made on a grey chert which possesses a large white fossil inclusion in the proximal half. Like Biface #10, also made on a gray chert, Biface #17 possesses serrated edges. Its basal edge possesses a unique "S" shape, but otherwise this specimen is highly symmetrical in both plan- and profile-view.

Flaked Stone Biface Morphometrics

We used geometric morphometric techniques to statistically compare the shape of bifaces from the Dresden Mound cache with bifaces from five caches dating from the Archaic period to the Late Woodland from the same region of Ohio. Table 2 shows the breakdown of our biface sample from five different time periods. Two of the caches in our sample are from the Hopewell period (the Hopewell Dresden Mound cache n=16, and 48_110 n=30).

Geometric morphometric (GM) techniques focus on capturing, visualizing, and analyzing objects or organisms, or forms within objects or organisms, using sets of landmarks (Adams et al. 2004, 2013; Bookstein 1991; Dryden and Mardia 1998; Marcus et al. 1996; Slice 2007; Rohlf and Marcus 1993; Zelditch et al. 2012). To carry out GM studies, digitized landmark configurations associated with different objects are translated, rotated, and scaled via the superimposition method (Slice 2007; Zelditch et al. 2012). Landmark placement on different objects ideally is standardized by using homology. However, for GM studies of stone tool shape homologous landmarks can be difficult to identify. To ameliorate this situation researchers have employed secondary and sliding landmarks to delineate the form of stone tools (e.g., Archer and Braun 2010; Buchanan et al. 2014, 2015, 2018, 2020; Cardillo 2010; Charlin and González-José 2012, 2018; Costa 2010; Eren et a. 2015; Lycett and von Cramon-Taubadel 2013; Lycett et al. 2010; Selden et al. 2018; Serwatka and Riede 2016; Suárez and Cardillo 2019; Thulman 2012, 2019; Wang et al. 2012).

Table 2. List of caches in our study by time period and number of bifaces examined for analyses.

Time period	Site/Cache name	Number of bifaces
Hopewell	Hopewell	16
Hopewell	48_110	30
Archaic	A216	18
Adena	A3490	30
Late Woodland	Red Ochre	35
Adena	Rothenstein	30
Total		159

For our comparative analysis of cache biface shapes presented here, we follow the procedures that we established in a previous study comparing caches from the late Pleistocene to the Late Woodland periods of Ohio (Eren et al. 2021). These methods included using a single primary landmark and 59 semi-landmarks to delineate the outline form of the bifaces in our sample. To do this we first oriented the digital images of the bifaces with the narrow or pointed end facing to the right (if the biface was closer to elliptical in shape and thus did not have a clear narrow or pointed end, we arbitrarily chose one end of the ellipse to face right). We defined the single primary landmark as the pointed right end where the edges converge, or the apex of more rounded bifaces, and from this landmark we used the line tool in the MakeFan7 program (Sheets 2019) to place the second landmark at the opposite end of the biface. From a line segment drawn between the primary and second landmark we used the MakeFan program to project 60 equally spaced radiating lines on each of the biface images. We used the 'Circle 1-2' fan function in the MakeFan program to project the lines. The MakeFan program creates the desired number of radiating lines from the center of the line segment drawn between two landmarks. After projecting the radiating equally spaced lines on all the biface images in our sample we used tpsDIG2 software (Rohlf 2017) to place 60 landmarks at the intersections of the radiating lines and the perimeter of the biface in each image. We saved the 159 sets of 60 landmarks and used these in our superimposition procedure and for the subsequent extraction of shape variables (the weight matrix) using the tpsRel program (Rohlf 2016). The weight matrix includes the partial warp scores (eigenvectors of the bending-energy matrix that describe local deformation along a coordinate axis) and the uniform component (variation along the X and Y axes) that together represent all of the information about the shape of the bifaces (Rohlf et al. 1996; Slice 2007). We use the consensus figures generated from superimposition procedure to visually compare shape differences.

After computing the weight matrix of the 159 cache biface shapes we imported these data into PAST 3.25 (Hammer et al. 2001) to conduct multivariate comparative analyses of the caches. We first carried out canonical variates analysis (CVA) to compare the shapes of bifaces from the different caches. In the CVA we used the cache name as the grouping variable. This procedure calculates the Mahalanobis distance from the pooled within-group covariance matrix and uses this as a linear discriminant classifier. We used a leave-one-out (jackknifing) procedure to cross-validate group assignments (Kovarovic et al. 2011). Following the CVA we used a non-parametric MANOVA to test for statistical differences among the groups. We used a non-parametric MANOVA opposed to the parametric MANOVA because our weight matrix data were not multivariate normal (Mardia tests: skewness statistic <0.000, $p<0.000$; kurtosis statistic <0.000, $p<0.000$). The non-parametric MANOVA assesses significance by permutation of group membership using 9,999 replicates.

Figure 19 shows the consensus or average outlines of the bifaces from the six caches. Visual inspection of the outlines shows that the bifaces from the Dresden Mound cache are the most different with a slight stemmed base, however, the blade portion is tapered and similar in appearance to bifaces from the Archaic A216 cache and the Adena-aged Rothenstein cache. The blades of the A3490 and 48_110 caches are both rounder and straighter, respectively, relative to the Dresden Mound bifaces (Figure 19). A plot of the first two linear discriminant functions from the CVA representing little more than 60% of the overall variation in the dataset shows that

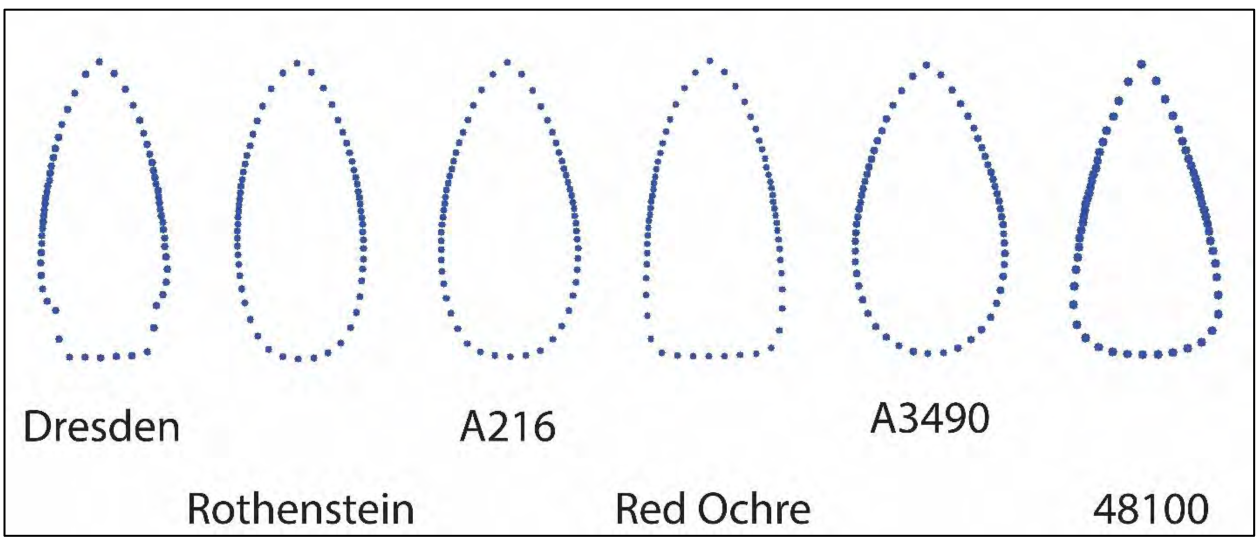

Figure 19. The consensus or average outlines of the bifaces from the six caches.

Dresden Mound cache bifaces are distinguished from the other caches by being on the low end axis 1 and the high end of axis 2 (Figure 20). However, on the Axes 3 and 4, representing almost 32% of the overall variation, the Dresden Mound cache overlaps with the other Hopewell cache, 48_110 (Figure 21). The CVA returned an overall correct classification rate of 54.7% (Table 3). The classification of the bifaces by cache shows that the Dresden Mound cache had four bifaces misclassified, or 25%, two were misclassified as being from an Adena cache (A3490) and two were misclassified as Archaic (A216). The non-parametric MANOVA indicated that the cache bifaces differ significantly (F=13.24, p=0.0001). Bonferroni-corrected pairwise comparisons indicate that only the Dresden Mound cache and the Archaic A216 (p=0.0585) and Adena Rothenstein (p=1) caches are similar in shape. All other comparisons are significantly different.

Table 3. Cross-validated confusion matrix of group membership. Group classifications by cache are read by row and the diagonal cells show the number correctly classified. Overall 54.72% of the cache bifaces were correctly classified.

	Hopewell	Hopewell_48_110	Archaic_A216	Adena_A3490	LW_RedOchre	Adena_Rothstein	Total
Hopewell	12	0	2	2	0	0	16
Hopewell_48_110	0	20	2	1	4	3	30
Archaic_A216	1	0	6	1	6	4	18
Adena_A3490	0	5	3	12	2	8	30
LW_RedOchre	2	4	5	4	17	3	35
Adena_Rothstein	0	1	1	5	3	20	30
Total	15	30	19	25	32	38	159

Microwear of Flaked Stone Bifaces

Analysis utilized low and high magnification microscopy following current standards for qualitative use-wear analysis (Van Gijn 2014). A Wolfe stereomicroscope with magnification up to 60x provided the wide field of view necessary to evaluate patterns in edge damage (Odell 1979; Van Gijn 2014). An Olympus BX51M metallurgical microscope, with magnification between 50 and 500x, was used to identify polishes, striations, and edge wear with use on different classes of raw material (Keeley 1980). Comparison of these patterns with those produced under controlled experiments allows for functional interpretations of tool use, hafting, transport, or post-depositional alterations (see examples of our experiments in Kirgesner et al. 2019; Miller 2014, 2015, Miller and Redmond 2016; Rutkoski et al. 2020; as well as other published experimental programs utilizing chert tools in Chabot et al. 2017; Keeley 1980; Van Gijn 1990; Vaughan 1985). Preparation of the artifacts for use-wear analysis involved washing using liquid soap and then water in an ultrasonic cleaner, following the methods utilized in previous studies of other Middle Woodland chipped stone tools form the region (Miller 2014, 2015, 2018).

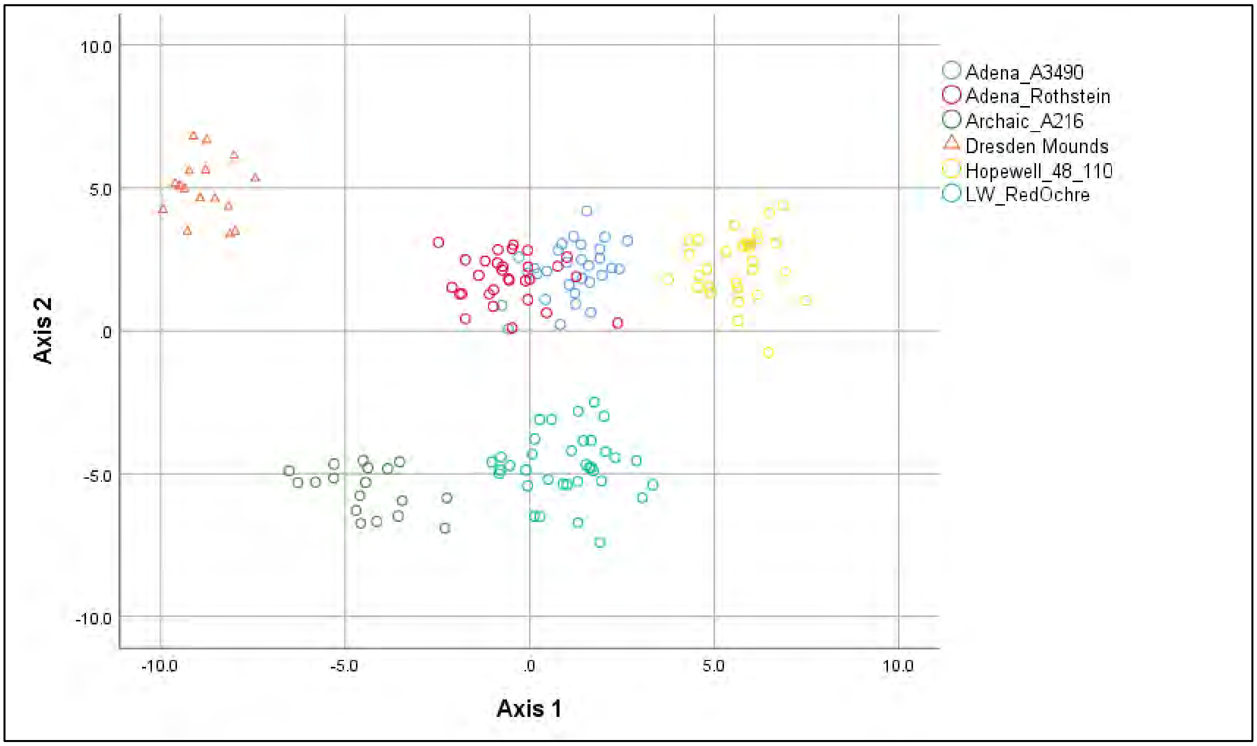

Figure 20. Canonical variate analysis of cache bifaces. Axis 1 represents 33.6% of the overall variation and axis 2 represents 27.18% of the overall variation.

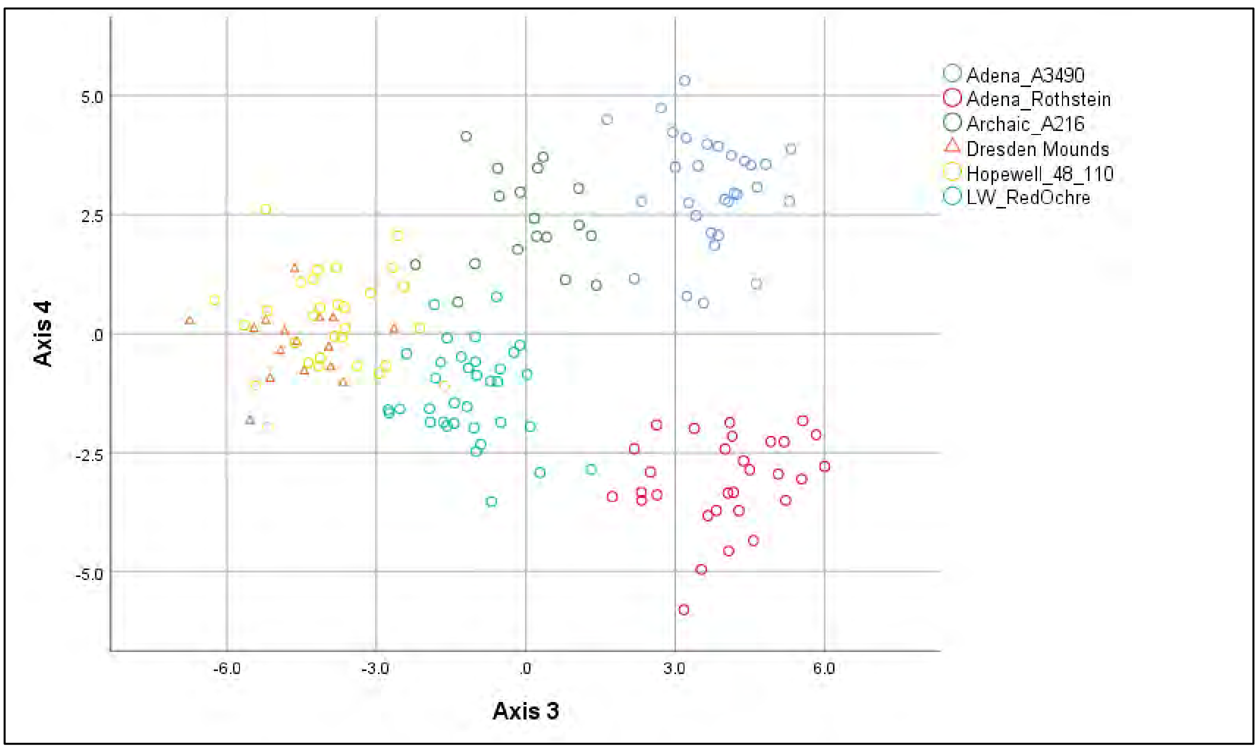

Figure 21. Canonical variate analysis of cache bifaces. Axis 3 represents 22.2% of the overall variation and axis 4 represents 9.28% of the overall variation.

Thorough microscopic examination indicated no evidence of projectile use, or any utilized edges on the 17 bifaces. Ridge rounding accentuated by areas of bright, flat polish, consistent with stone-on-stone contact, occurred on 14 of 17 bifaces (Figures 22 and 23). In all 12 cases, rounded and polished ridges were noted on the haft and blade sections of each tool. This is consistent with experimental evidence for artifact transport in which rounding of high spots like ridges and the formation of stone-on-stone polish forms as the artifacts are jostled about in a container (Figure 22A; see also Mazzucco and Clemente 2013; Miller et al. 2019; Rots 2010; Wolski and Kalita 2015). The lack of rounding or polish on the tips of these points indicates that they were likely not transported as hafted tools in a quiver (e.g., Wolski and Kalita 2015) and this is consistent with the lack of identified hafting wear on any of the bifaces. The intensity and extent of documented wear varied somewhat across the assemblage as six of these artifacts (#s 1, 4, 8, 11, 12, 14) contained fairly well developed wear in that rounding and polish was noted on the majority of ridges on both faces while the wear on six others was present on less than half of the ridges on both faces and tended to be less well developed (#s 3, 5, 6, 7, 13, 15, 16, 17). Additionally, little to no edge rounding or bright spots of polish was noted on three (#s 2, 9, 10) bifaces (Figure 23A, B). It is possible that this could be a reflection of the mode of transport in which these bifaces did not come into contact with other materials or were secured in such a way that rounding and polish did not form. Another possible explanation is that some points were made closer to the place of final deposition and, thus, use-wear formed minimally or not at all.

Description of Other Cache Artifacts

Slate Gorget

The gorget is made from ground, banded slate and weighs 31 grams (Figure 24). The overall length is 74.1mm. The gorget is tapered towards the intact end which is 29.2 mm wide and 1.9 mm thick. The opposite (broken) end has a width of 37.5mm and a thickness of 5.0mm. The maximum width overall is 38.9 and the maximum thickness overall is 5.5 mm. Striae are visible along the posterior lateral margins. Striae are either nonexistent or have been removed via polishing on the anterior surface.

The gorget has two holes drilled near the midline. These holes would likely have been used to suspend the gorget as a personal ornament. The lower hole has maximum diameter of 7.1 mm and was drilled from both sides of the gorget. The upper hole has a maximum diameter of 8.7 mm and was drilled from only one side. There is slight chippage on the posterior side where the drill broke through. Along the broken margin of the gorget, there is evidence of a partial hole. It could be that this hole was drilled too close the edge and caused the top margin to fracture. There is a break extending from this attempted hole along the top right edge of the gorget.

Mica sheets

There are several sheets of muscovite mica included with the cache (Figure 25). The total mass for the mica is 43 grams. The sheets of mica consist of two irregularly shaped masses. The

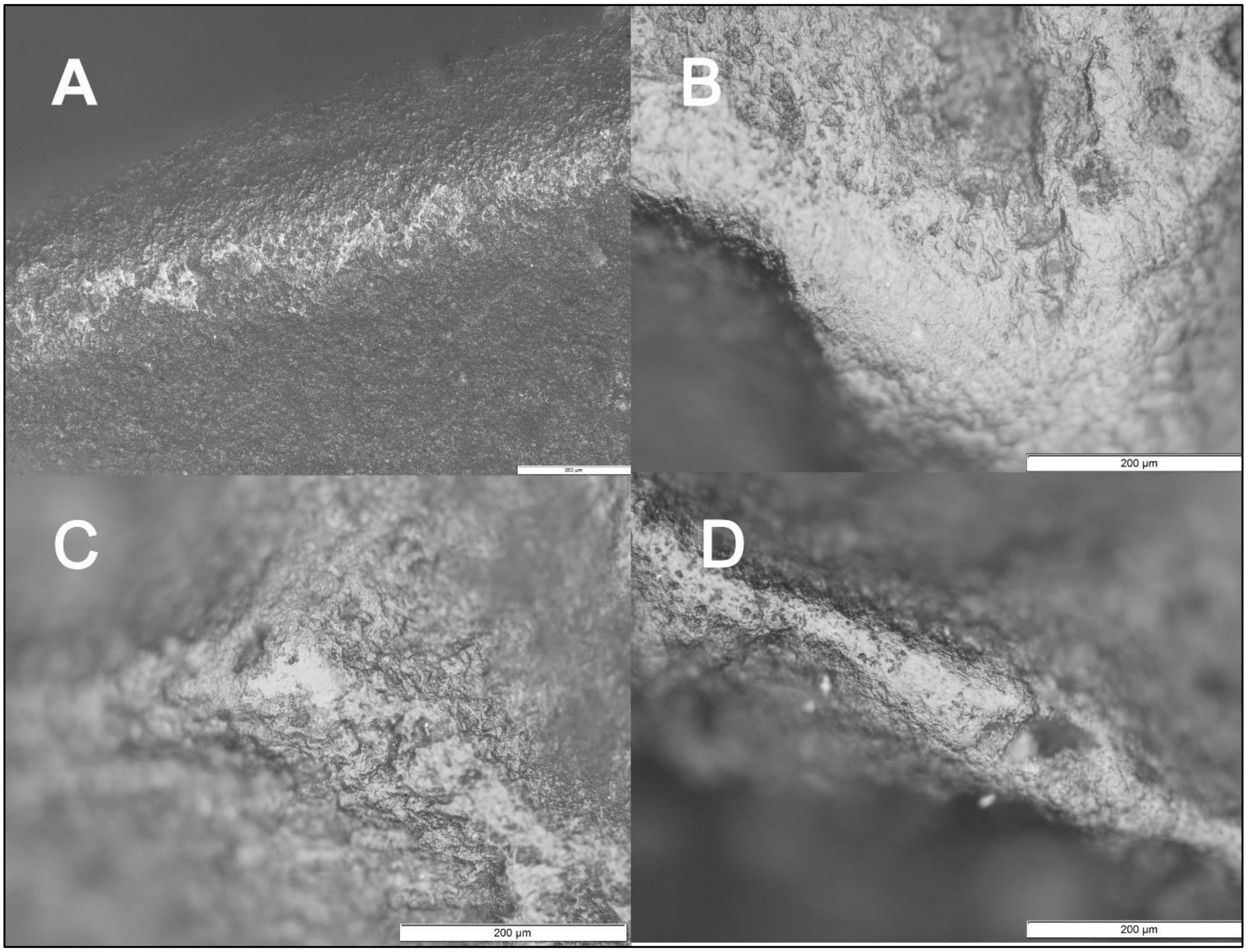

Figure 22. A. Experimental use-wear, including ridge rounding and bright, flat stone-on-stone polish, on the dorsal ridge of a chert flake carried with six other flakes for 50km in a leather bag. Magnification is 100x and the scale bar is 200 µm. B. Well-developed ridge rounding and polish on a flake ridge of artifact #1. Magnification is 200x. C. Rounding and bright, flat stone-on-stone polish on a ridge of artifact #4. Magnification is 200x. D. Bright, flat stone-on stone polish on a ridge of artifact #8 as seen at 200x magnification.

first mass is loosely "t" shaped and weighs 20 grams. The maximum length for this mass of mica is 16 cm and the maximum width is 14 cm. The second mass is "kidney" shaped and weighs 23 grams. The maximum length for this mass of mica is 20 cm and the maximum width is 11 cm.

Stone Celt

The celt, which might be made from slate, is an ungrooved stone axe with an unbalanced rectangular shape (Figure 26). The mass is 132 g, the overall length is 8.2cm, the width at the bit end is 4.6 cm and the width at the poll end is 3.8 cm. The maximum thickness is 2.5cm at the poll which tapers towards the bit edge.

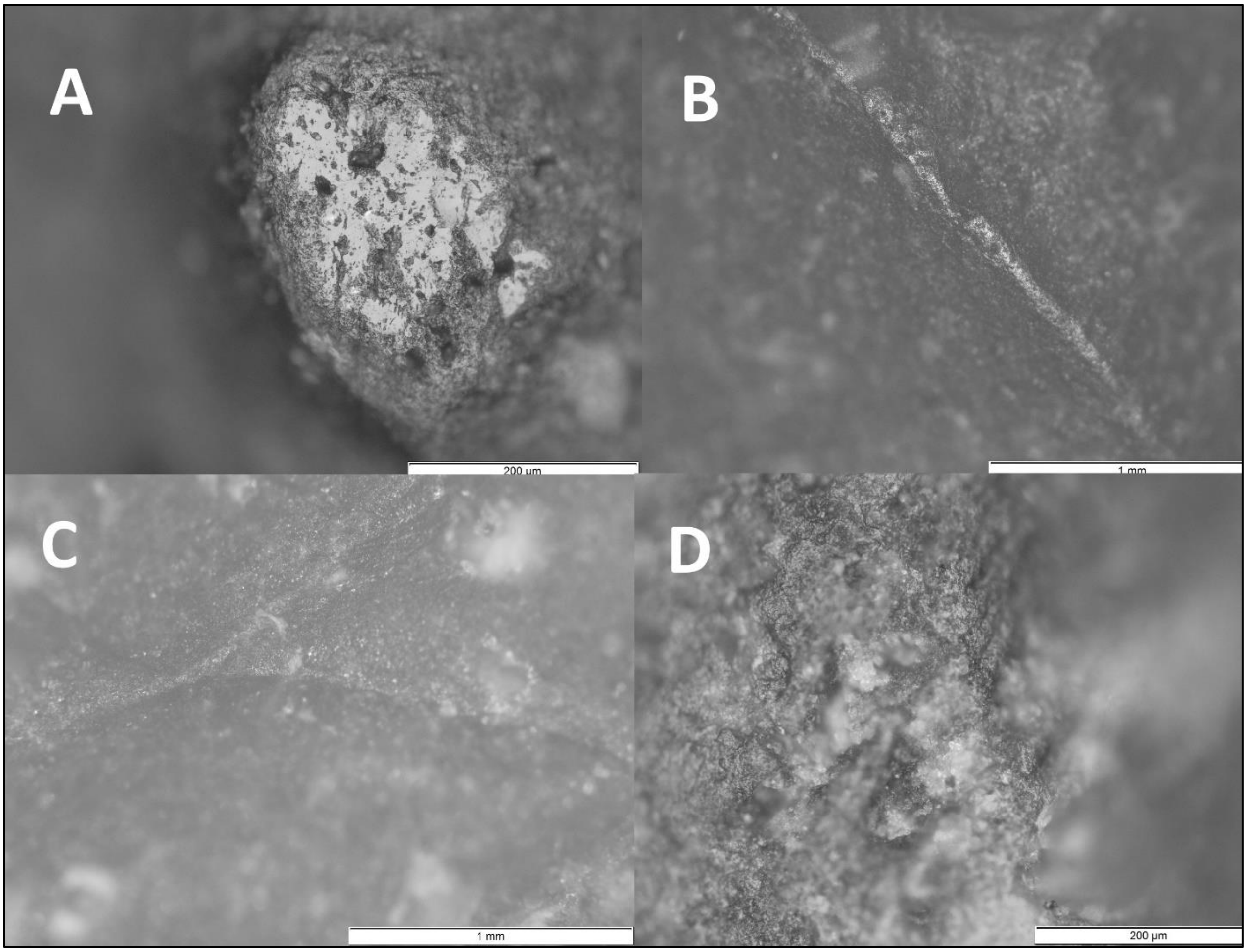

Figure 23. A. Bright, flat stone-on-stone polish on a ridge of artifact #12 as seen at 200x magnification. B. Polish and rounding of a ridge on artifact #14 as seen at 50x magnification. C. Unpolished and unrounded ridge of artifact #9 as seen at 50x magnification. D. Another un-rounded, unpolished ridge on artifact #9, shown at 200x magnification.

Description of Human Crania and Mandible

The human bones are in very poor condition and fragmentary. All of the cranial fragments have tiny flakes of mica on them. The human skull fragments from the Hopewell deposit consist of two occipital bones, detached at the sutures, and a pair of left and right parietal bones, which are still joined at the sagittal suture. The parietal sections fit with one of the occipital bones to form a “skullcap” described very briefly by Carskadden and Morton (1983) that was stated as having been a part of the original cache. Temporal and frontal bone fragments are also present. Because of the extremely damaged and fragmentary condition of the bones, only a few conclusions can be stated with certainty. At least two individuals are present. Sex cannot be determined due to lack of any diagnostic features on skull fragments. Based on the cranial sutures, they were both quite young at death; one was definitely an adolescent (as seen from tooth eruption in the mandible) and one was a young adult (20-34 years). Based on the

Figure 24. Slate gorget.

limited data, we tentatively conclude that these bones are of the same age and could be from Middle Woodland times or could possibly represent a later "intrusive burial", most likely Shawnee, mentioned by Carskadden and Morton (1983).

Discussion

It is difficult to make any broad conclusions about the Dresden Mound cache without more contextual information beyond what has already been published (Carskadden and Morton 1983). Our findings indicate that the Dresden Mound cache can be distinguished morphologically from other Holocene caches in Ohio. Microwear analysis indicates that the bifaces were not used as projectiles or knives prior to deposition. However, they do not appear to

Figure 25. Mica sheet.

Figure 26. Stone celt.

have been made on site, directly prior to deposition. Instead, at least most of them were transported some distance after manufacture, but prior to deposition, similar to the Early Woodland Lukens Cache from Portage County, Ohio (Prufer et al. 1984). Beyond these findings, we feel the publication of artifact descriptions are worthwhile endeavors for three reasons. First, such descriptive reports alert the broader scientific community to the artifacts' existence. Second, artifact descriptions can inspire new, testable ideas or shed light on old hypotheses. Third, descriptive reports provide data that might be profitably used in future analyses. Along the lines of our second point above, the 17 flaked biface specimens described in this study provide the opportunity to briefly discuss the occurrence of bi-beveling and resharpening.

It is noteworthy that three of the bifaces (#4, #6, and #8) exhibit bi-beveling (see Pettigrew et al. 2017 and references therein). The presence of bi-beveling has often been interpreted as a result of point resharpening (Bradley 1997; Morse 1997; Sollberger 1971). In this particular case, however, that interpretation cannot be applied. There is no evidence of use, and the points' placement in a burial cache suggests the points were not intended for use. Additionally, Biface #6 was not yet finished. All of these factors suggest that the bi-beveling was not the result of resharpening, but instead due to other factors. For example, bi-beveling may have been an intentionally applied design by the Dresden cache knapper(s) to select points. It is currently uncertain whether this intention was simply idiosyncratic and the preferred style of the knapper, or one that that provided a functional advantage (Lipo et al. 2012; Pettigrew et al. 2017). Speaking to the latter possibility, Pettigrew et al. (2017) and Ashby (2007) have documented that a bi-beveled morphology can increase damage to prey because the point twists upon impact. However, if bi-beveling was intended by the knappers, or provided a functional advantage, it begs the question as to why all of the Dresden cache bifaces were not bi-beveled. We are thus left to consider a second factor: the relationship between raw material morphology and time constraints (e.g. Schillinger et al. 2014). If the Dresden knapper(s) were expediently knapping their points, and if particular unmodified nodule or flake morphologies already possessed a "twist", then a knapping path of least resistance may have simply resulted in the final biface morphology mirroring the original unmodified raw material form.

The 17 Dresden cache bifaces also stimulate questions about point resharpening. Microwear analysis suggests that the Dresden bifaces were manufactured and cached prior to use. Traditionally, it has been assumed that the basal portion of projectile points, the section that is hafted to a foreshaft in a multiple component projectile system, would be more standardized (and thus exhibit relatively less variation) than the blade portion of the point (see Judge 1973; also Buchanan et al. 2012 for a contra example). Conversely, the blade portion of projectile points has been assumed to be more variable relative to the base due to serial reduction through resharpening. We thus examined the variation associated with each of the eight linear variables measured on the points with a view to comparing the blade and base portion of the points. We reasoned that if the Dresden bifaces had been resharpened, their blades should be more morphologically variable than their hafts. For our analyses we compared the coefficient of variation (CV) computed from measurements taken on the blades of points with those taken on the base. The CV is calculated by dividing the sample standard deviation by the sample mean and multiplying the quotient by 100, this expresses the normalized amount of variation in a set of measurements. The blade measurements include length, medial width, and medial thickness. The base measurements include shoulder width, neck width, basal width, shoulder thickness, and neck thickness. We used the Fligner-Kileen (1976) test to make pairwise statistical comparisons between each of the blade and base measurements (see Buchanan et al. 2012 for a description of the test). The results of our comparisons suggest that the blade and base are similarly variable. Table 4 shows the CVs for each variable. The measurement with the highest CV is shoulder thickness of the base followed by length, and neck thickness. The remaining measurements have CV values less than 10. Pairwise comparison using the Fligner-Killeen test shows that none of the comparisons between blade and base measurement are statistically different (**Table 5**). This result, along with the microwear results, supports the hypothesis that the Dresden cache bifaces were not used and resharpened prior to burial.

Hopefully, this information on the Dresden Mound cache will prove useful to future analysis.

Table 4. Coefficient of variation (CV) values for eight linear dimensions of cached bifaces from the Dresden Mound.

	Length	Medial width	Medial thickness	Shoulder width	Neck width	Basal width	Shoulder thickness	Neck thickness
CV	12.17	6.26	9.16	5.02	5.54	8.39	12.36	11.62

Table 5. Results of Fligner-Kileen two-sample distribution free tests of equal coefficient of variation values. The first column gives variable names for blade measurements and the first row gives variable names for base measurements. Interior cells contain p-values. The alpha level is adjusted for 15 sequential tests (=0.0033). None of the pairwise tests are significant.

	Shoulder width	Neck width	Basal width	Shoulder thickness	Neck thickness
Length	0.013	0.021	0.2568	0.923	0.791
Medial Width	0.4378	0.694	0.6014	0.031	0.0261
Medial Thickness	0.1177	0.213	0.666	0.331	0.3289

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References Cited

Adams, D.C., F. J. Rohlf, and D. E. Slice
2004 Geometric Morphometrics: Ten Years of Progress Following the ‘‘Revolution’’ *Italian Journal of Zoology* 71:5–16.

Archer, W., and D. R. Braun
2010 Variability in Bifacial Technology at Elandsfontein, Western Cape, South Africa: A Geometric Morphometric Approach. *Journal of Archaeological Science* 37:201–209.

Ashby, E.
2007 Why Single-Bevel Broadheads? Report from Ashby Bowhunting Foundation (https://www.ashbybowhunting.org/). Accessed 3 November 2020, https://static1.squarespace.com/static/5d0443b188b6c900011e0ccc/t/5d0e5bcbb3f1e700013faa8c/1561222093571/Single_Bevel_Broadheads.pdf

Bookstein, F. L.
1991 *Morphometric Tools for Landmark Data: Geometry and Biology*. Cambridge University Press, Cambridge.

Bradley, B. A.
1997 Sloan Site Biface and Projectile Point Technology. *Sloan: A Paleoindian Dalton Cemetery in Arkansas*, pp. 53-57. University of Arkansas Press, Fayetteville.

Buchanan, B., M. J., O'Brien, J. D. Kilby, B. B. Huckell, and M. Collard
2012 An Assessment of the Impact of Hafting on Paleoindian Point Variability. *PLoS ONE* 7(5):e36364.

Buchanan, B., M. J. O’Brien, and M. Collard
2014 Continent-wide or Region-specific? A Geometric-Morphometrics-Based Assessment of Variation in Clovis Point Shape. *Archaeological and Anthropological Sciences* 6:145–162.

Carr, C., B. J. Goldstein, and J. D. Weets
2005 Estimating the Sizes and Social Compositions of Mortuary-Related Gatherings at Scioto Hopewell Earthwork-Mound Sites. In: C. Carr & D. Case (Eds.), *Gathering Hopewell*, pp. 480-532. Springer, Boston.

Carskadden, J., and J. Morton
1983 A Hopewell Mound, Dresden, Ohio. *Ohio Archaeologist* 33(1):44-47.

Chabot, J., M. M. Dionne, and S. Paquin
2017 High Magnification Use-Wear Analysis of Lithic Artefacts from Northeastern America: Creation of an Experimental Database and Integration of Expedient Tools. *Quaternary International* 427:25-34.

Charlin, J., and R. González-José
2018 Testing an Ethnographic Analogy through Geometric Morphometrics: A Comparison between Ethnographic Arrows and Archaeological Projectile Points from Late Holocene Fuego–Patagonia. *Journal of Anthropological Archaeology* 51:159–172.

Dragoo, D. W.
1963 *Mounds for the Dead: An Analysis of the Adena Culture*. Annals Vol. 37. Carnegie Museum, Pittsburgh.

Eren, M. I., B. Buchanan, and M. J. O'Brien
2015 Social Learning and Technological Evolution during the Clovis Colonization of the New World. *Journal of Human Evolution* 80:159–170.

Eren, M. I., Bebber, M., Mika, A., Flood, K., Maguire, L., Norris, D., Perrone, A., Mullen, D., Centea, S., Centea, C., Christy, B., Daud, R., Jackson, J., Patten, R., Redmond, B., Buchanan, B., Haythorn, R., Miller, G., Conaway, M., Biermann Gürbüz, R., Lycett, S., Kilby, D., Andrews, B., MacDonald, B., Boulanger, M., and Meltzer, D.
2021 The Nelson Stone Tool Cache, North-Central Ohio, U.S.A.: Assessing Cultural Affiliation. *Journal of Archaeological Science:Reports*: In Press.

Fligner. M. A., and T. J. Killeen
1976 Distribution-Free Two-Sample Tests for Scale. *Journal of the American Statistical Association* 71:210–213.

Greber, N'omi B.
1996 A Commentary on the Contexts and Contents of Large to Small Ohio Hopewell Deposits. In: P. Pacheco (Ed.), *A View From the Core: A Synthesis of Ohio Hopewell Archaeology*, pp. 150-173. The Ohio Archaeological Council, Columbus.

Judge, W. J.
1973 *Paleoindian Occupation of the Central Rio Grande Valley in New Mexico*. University of New Mexico Press, Albuquerque.

Justice, Noel D.
1987 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States: A Modern Survey and Reference*. Indiana University Press, Bloomington.

Keeley, Lawrence H.
1980 *Experimental Determination of Stone Tool Use: A Micro-Wear Analysis*. University of Chicago Press, Chicago.

Kirgesner, Samantha., Michelle. R. Bebber, Ashley. Rutkoski, G. Logan Miller, and Metin I. Eren
2019 Toward Recognizing the Prehistoric Butchery of Frozen Meat: An Archaeological Experiment and Stone Tool Microwear Analysis. *Lithic Technology* 44(1):1-7.

Kovarovic, K., L. Aiello, A. Cardini, and C. A. Lockwood
2011 Discriminant Function Analyses in Archaeology: Are Classification Rates Too Good to Be True? *Journal of Archaeological Science* 38:3006–3018.

Lipo, C. P., R. C. Dunnell, M. J. O'Brien, V. Harper, and J. Dudgeon
2012 Beveled Projectile Points and Ballistics Technology. *American Antiquity* 77(4):774-788.

Lycett, S. J., N. von Cramon-Taubadel, J. A. Gowlett
2010 A Comparative 3D Geometric Morphometric Analysis of Victoria West Cores: Implications for the Origins of Levallois Technology. *Journal of Archaeological Science* 37:1110-1117.

Mayer-Oakes, William J.
1955 *Prehistory of the Upper Ohio Valley: An Introductory Archaeological Study*. Annals of Carnegie Museum 34, Pittsburg.

Mazzucco, N., and I. Clemente
2013 Lithic Tools Transportation: New Experimental Data. In: A. Palomo, R. Piqué, & X. Terradas-Batlle (Eds.), *Experimentación en Arqueología. Estudio y difusión del pasado. Presentación*, pp. 237-245. Museu d'Arqueologia de Catalunya, Girona.

McConaughy, Michael A.
2005 Middle Woodland Hopewellian Cache Blades: Blanks or Finished Tools?. *Midcontinental Journal of Archaeology* 30:217-257.

Miller, G. Logan
2014 Ohio Hopewell Ceremonial Bladelet Use at the Moorehead Circle, Fort Ancient. *Midcontinental Journal of Archaeology* 39:83–102.

Miller, G. Logan
2015 Ritual Economy and Craft Production in Small-Scale Societies: Evidence from Microwear Analysis of Hopewell Bladelets. *Journal of Anthropological Archaeology* 39:124–138.

Miller, G. Logan
2018 Microwear Analysis of Hopewell Bladelets from Two Sites Associated with the Stubbs Earthworks, Southwest Ohio. *Midcontinental Journal of Archaeology* 43(3):281-297.

Miller, G. Logan, and Brian G. Redmond
2016 Smudge Pits and Stone "Drills": The Use of Chipped Stone Tools at Burrell Orchard. *Lithic Technology* 41:164-178.

Miller, G. Logan, Michelle. R. Bebber, Ashley Rutkoski, R. Haythorn, Matthew T. Boulanger, B. Buchanan, J. Bush, C. Owen Lovejoy, and Metin I. Eren
2019 Hunter-Gatherer Gatherings: Stone-Tool Microwear from the Welling Site (33-Co-2), Ohio, USA Supports Clovis Use of Outcrop-Related Base Camps during the Pleistocene Peopling of the Americas. *World Archaeology* 51:47-75.

Moorehead, Warren K.
1922 *The Hopewell Mound Group of Ohio.* Fieldiana Anthropology 6(5). Field Museum of Natural History, Chicago.

Morse, Daniel
1997 *Sloan: A Paleoindian Dalton Cemetery in Arkansas.* University of Arkansas Press, Fayetteville.

Odell, G. H.
1979 A New and Improved System for the Retrieval of Functional Information from Microscopic Observations of Chipped Stone Tools. In: B. Hayden (Ed.), *Lithic Use-Wear Analysis*, pp. 329-344. Academic Press, New York.

Pettigrew, D. B., J. C. Whittaker, J. Garnett, and P. Hashman
2015 How Atlatl Darts Behave: Beveled Points and the Relevance of Controlled Experiments. *American Antiquity* 80(3):590-601.

Prufer, Olaf H., Mark F. Seeman, and Robert P. Mensforth
1984 The Lukens Cache: A Ceremonial Offering from Ohio. *Pennsylvania Archaeologist* 54(3-4):19-31.

Rohlf, F. J.
2016 Relative Warps Version 1.46 Shareware Program. Department of Ecology and Evolution, State University of New York, Stony Brook. http://life.bio.sunysb.edu/morph.

Rohlf, F. J.
2017 tpsDig2 Shareware Program. Department of Ecology and Evolution, State University of New York, Stony Brook. http://life.bio.sunysb.edu/morph.

Rohlf, F. J., and L. F. Marcus
1993 A Revolution in Morphometrics. *Trends in Ecology and Evolution* 8:129–132.

Rots, V.
2010 Prehension and Hafting Traces on Flint Tools: A Methodology. Leuven University Press, Leuven.

Rutkoski, Ashley R., G. Logan Miller, L. Maguire, Metin I. Eren, and Michelle R. Bebber
2020 The Effect of Heat on Lithic Microwear Traces: An Experimental Assessment. *Lithic Technology* 45(1):38-47.

Schillinger, K., A. Mesoudi, and S. J. Lycett
2014 Considering the Role of Time Budgets on Copy-Error Rates in Material Culture Traditions: An Experimental Assessment. *PLoS ONE* 9(5):e97157.

Slice, D. E.
2007 Geometric Morphometrics. *Annual Review of Anthropology* 36:261–281.

Sollberger, J. B.
1971 A Technological Study of Beveled Knives. *The Plains Anthropologist* 16:209-218.

Van Gijn, A.
1990 The Wear and Tear of Flint: Principles of Microwear Analysis Applied to Dutch Neolithic Assemblages. *Analecta Praehistorica Leidensia* 22, University of Leiden, Leiden.

Van Gijn, A.
2014 Science and Interpretation in Microwear Studies. *Journal of Archaeological Science* 48:166-169.

Vaughan. P.
1985 *Use-Wear Analysis of Flakes Stone Tools*. University of Arizona Press, Tucson.

Wolski, D., and M. Kalita
2015 An Attempt at Interpreting Untypical Modifications of Flint Arrowheads: An Experimental and Use-Wear Perspective. *Sprawozdania Archeologiczne* 67:301-314.

Yerkes, R. W., A. Pépin, and J. Toth
2020 Indigenous Native American Perspectives on Functions of Large Hopewell Bifaces from Mound 25, Hopewell Mound Group (33Ro27), Ross County, Ohio. In: B. Redmond, B. Ruby, & J. Burks (Eds.), *Encountering Hopewell in the 21st Century, Ohio and Beyond: Volume 2*. University of Akron Press, Akron.

Zelditch, M. L., D. L. Swiderski, and H. D. Sheets
2012 *Geometric Morphometrics for Biologists: A Primer*. 2nd. ed. Academic Press, London.