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REPORT

Rethinking Stone Drill Manufacture

William Engelbrecht

William Engelbrecht, Professor Emeritus, Department of Anthropology, SUNY Buffalo State, Buffalo, NY, USA
Corresponding author: William Engelbrecht, email: engelbwe@gmail.com

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Abstract

Drills and projectile points from a site often share a similar shaped base, and it is typically assumed that these drills are reworked hafted points. Measurements of triangular-shaped drills and triangular arrow points from an Iroquoian site indicate that, on average, these drills had narrower bases and were thicker than points. Additionally, most preserved point foreshafts from the western United States are too short if used as a simple drill shaft, and most dart and arrow shafts are too long to serve as convenient drill shafts if used with a strap or bow drill. These data call into question the assumption that drills were reworked hafted points at Iroquoian and possibly other sites.

Résumé

Les perçoirs et pointes de projectiles provenant de sites archéologiques ont souvent des extrémités proximales semblables; il est donc fréquemment supposé que les perçoirs sont en fait des pointes emmanchées et retouchées. Les mesures de perçoirs et de pointes de projectiles triangulaires provenant d'un site iroquoien indiquent que les perçoirs étaient plus épais que les pointes. Puisque la transformation de pointes en perçoirs implique un processus de réduction de la matière, il apparaît alors peu probable que ces perçoirs soient des pointes transformées. De plus, la plupart des préhampes de projectiles qui se sont préservées sont trop courtes pour permettre leur utilisation comme préhampes de perçoirs, et la plupart des hampes de lances ou de flèches sont trop longues pour servir adéquatement de hampes de perçoirs, lorsque utilisés avec une courroie ou un archet. Ces constats remettent en question la croyance que les perçoirs étaient des pointes emmanchées et retouchées, tant sur les sites Iroquoiens qu'ailleurs.

Keywords: stone drills; Iroquoian lithics; Frison Effect; tool use life; lithic technological organization

Mots clés: perçoirs; lithique iroquoien; Effet Frison; durée de vie; organisation technologique lithic

It is widely assumed that some drills are reworked points or knives (Ellis et al. 1991:9; Lennox and Fitzgerald 1990:423; Morrow 2016:98; Stothers and Abel 1993:43; Winters 1969:51–52). This is a common assumption for sites where the bases of both points and drills are similar in shape and where good quality toolstone is scarce (Poulton 1985:2). Implicit in this view is that the point would remain hafted while being reworked into a drill (Goodyear 1974:33). Albert Goodyear (1974:30–32) illustrated a likely sequence of repeated resharpening of Dalton points into what he termed a "Final" stage of drill-like forms. Recognition of the possibility that sharpening the edge of a stone tool can result in changes to its shape and sometimes its use can be traced in part to George Frison (1968). Arthur Jelinek (1976:22) later referred to this type of reduction as the Frison Effect.

This report tests whether the Frison Effect applies to the relationship between Iroquoian triangular points and drills. Points and drills having similar shaped bases from the same site were measured. Typically, reworking a point into a drill would result in a shorter drill than point, especially if a point tip broke. Drills from reworked points would be expected to have less mass than the points. If points were reworked while remaining hafted, drill bases would be expected to be unaffected

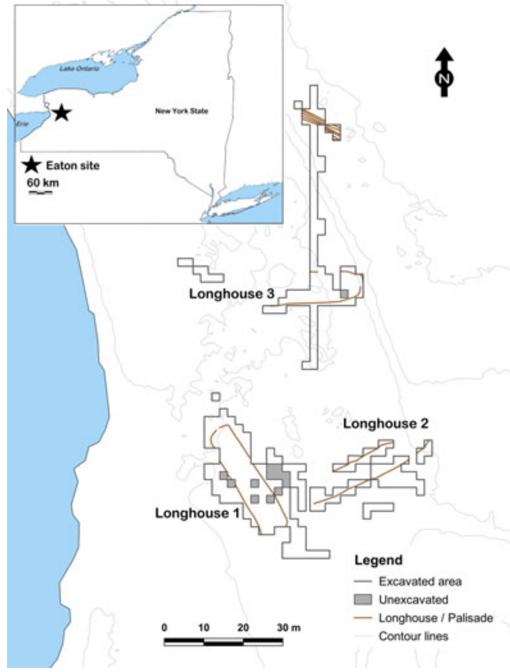

Figure 1. Map of the Eaton site. (Map by Roderick Salisbury.) (Color online)

and have the same width and shape as the original point. The maximum width of both triangular points and drills occurs at their base. Given that points would be expected to be longer and to have the same basal width as drills, on average, points would be expected to have a greater length:width ratio than drills. Thickness of drills, such as basal width, should be unaffected by making them from points.

Drills and Points from Eaton

The drills and points in this study come from the multicomponent Eaton site in West Seneca, New York (see Figure 1). The major component is an Iroquoian village dating to the middle of the sixteenth century. Eaton was the focus of 17 summer archaeological field schools between 1975 and 2000. Students excavated 257 excavation units, each measuring 2 m^2. Portions of three Iroquoian longhouses are represented by post molds, as is a palisade, across a northern portion of the site. Unlike many Iroquoian sites that were bulldozed during cultural resource management investigations in order to plot post mold distribution, the excavated plowzone was sifted, which resulted in the recovery of a rich lithic assemblage. This included a total of 335,433 pieces of lithic debris and 3,085 utilized flakes (publications on lithics from Eaton include Engelbrecht 2014, 2015; Engelbrecht et al. 2020, 2021; Salisbury and Engelbrecht 2018; Poplawski et al. 2012; Roets et al. 2014).

A total of 82 whole drills of various forms and 121 drill fragments were identified from excavations at Eaton. Three refits of drill fragments reduced the total number of specimens to 200. Triangular-shaped drills are the most common drill form, with 42 whole triangular drills and 19 triangular drill fragments (see Figures 2 and 3). Other drill forms from Eaton are as follows: key-shaped, $N = 19$ whole, 5 fragments; rod-shaped, $N = 9$ whole, 11 fragments; microdrills, $N = 9$ whole; and T-shaped, $N = 1$ whole, 2 fragments. Madison arrow points are the most common point form on the site, with 516 whole points and 1,714 fragments. Both triangular points and triangular drills have similar shaped bases.

Whereas bits of nontriangular drills from Eaton are typically diamond shaped in cross section, the bits of triangular drills tend toward oval in cross section. Some drills narrow considerably above the base, suggesting that these specimens were hafted with the ligature wrapping around the edges of the drill in a manner similar to that of side-notched points. The triangular points, on the other

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Figure 2. Triangular drills: (*top*) 1481, 1414, 1428, 1401; (*middle*) 1537, 1408, 1357, 1512, 1396; (*bottom*) 1379, 1389, 1361, 1422, 1458.

hand, were likely hafted by wrapping the ligature only around the shaft (Engelbrecht 2014:355). Functionally, there is an advantage for projectile points to detach from their shaft in the target, but no advantage for a drill to easily detach from the shaft.

The triangular points from Eaton have been discussed in three publications: Engelbrecht (2014, 2015) and Salisbury and Engelbrecht (2018). Based on similarities in basal shape, it is assumed that the triangular drills and triangular points are contemporaneous and associated with the Iroquoian village component. For images of triangular points from Eaton, see Engelbrecht (2014:258).

The average maximum length, maximum width, the length:width ratio, maximum thickness, and mass of triangular points and triangular-shaped drills were compared (see Table 1). Although there

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Figure 3. Triangular drills: (*top*) 1397, 1363, 1518, 1546; (*middle*) 1461, 1558, 1462, 1510, 1457; (*bottom*) 1485, 1321, 1358, 1382, 1525.

is overlap in metric values between triangular points and drills, *t* tests indicate a significant difference in the means of width, length:width ratios, and thickness. Figure 4 illustrates the range of thickness values for points and drills. On average, triangular drills also tend to be longer and weigh more than points, though these differences are not statistically significant.

Given that morphology is not always an indicator of function, it is possible that some specimens classified as points were used as drills and vice versa. Use wear studies by Smallwood and colleagues (2020) indicate that two Final Stage Dalton points having a drill-like form were used as perforators. Miller and Redmond (2016) indicate that Late Archaic drill forms at a site in northern Ohio were

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Table 1. Eaton Triangular Points and Drills.

	Triangular Points	Triangular Drills	Difference
	$N = 516$	$N = 42$	
Maximum Length (mm)			
mean	27.4	28.8	$t = -1.85$, $df = 556$, $p = 0.29$
range	16–46	15–45	
SD	5.01	5.59	
Maximum Width (mm)			
mean	15.1	14.0	$t = 2.61$, $df = 556$, $p = 0.01$
range	9–28	6–23	
SD	2.49	3.49	
Length:Width Ratio			
mean	1.81	2.19	$t = -5.48$, $df = 556$, $p = 0.00$
range	0.94–3.2	1.24–6.33	
SD	0.39	0.79	
Maximum Thickness (mm)			
mean	4.2	4.8	$t = -2.84$, $df = 556$, $p = 0.002$
range	2–8	3–11	
SD	1.26	1.89	
Mass (gm)			
mean	1.6	1.8	$t = -1.50$, $df = 556$, $p = 0.13$
range	0.4–4.6	0.7–5.8	
SD	0.79	1.21	

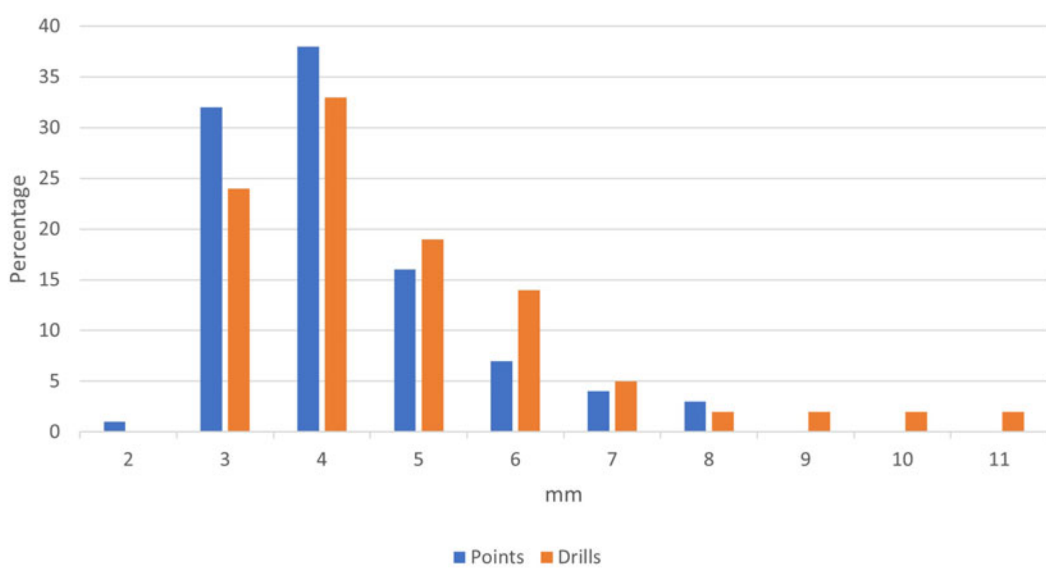

Figure 4. Histogram comparing thickness of points and drills. (Color online)

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used to perforate dry hide. It is therefore possible that both triangular drill forms and points could have served as perforators of deer skin, an important resource for Iroquoians (Engelbrecht et al. 2020).

Studies of points and drills at other Iroquoian sites document metric differences between points and drills that also cast doubt on the manufacture of drills from points. In a study of Huron chipped stone tools at the Keffer site in Ontario, Lerner (2000:67) noted that drill thickness tended to be relatively greater than point thickness. Wright (1977:80, 86), while stating that the 17 drills from the Neutral Walker site are reworked points, also notes that the average length of drills was 33 mm, whereas that of points was 28.8 mm.

Discussion and Conclusion

It seems unlikely that points were refashioned into drills while hafted. Point foreshafts are generally too short, and arrow or dart shafts are too long, to function as ideal drill shafts. A foreshaft is advantageous to a mobile hunter in reloading a projectile point without the necessity of carrying numerous shafts (Frison 1978:333). If it is of a stronger material than the main shaft, it can be of lesser diameter, facilitating penetration (Howard 1995:294–295). These would not be advantages for a drill hafted to a foreshaft in a sedentary situation. Whereas longer foreshafts could be rolled between the palms for drilling, shorter foreshafts could not. A listing of the length of 45 foreshafts from the western United States ranges from 56.9 mm to 446 mm, with an average of 141.2 mm (Zeanah and Elston 2001:115, Figure 4). Although drills were not likely used when hafted to foreshafts, other stone tools may have been. A drill form hafted to a foreshaft could have been used as a perforator at the Dalton Brand site (Goodyear 1974:33; Smallwood et al. 2020).

If a point were hafted to a simple arrow or dart shaft, the length would prove cumbersome for drilling or for use as a handle for a perforator. A study of ethnographic and archaeological arrow shafts from across the country in the American Museum of Natural History (New York) indicates that they were on average over 80 cm in length (Thomas 1978), whereas ethnohistoric accounts suggest even greater length for arrow shafts in the Eastern Woodlands (Kent 1984:1898). Although long shafts could be shortened, this also seems unlikely given that a fletched arrow shaft takes longer to manufacture than a stone projectile point (Keeley 1982:800; Pope 1923:54).

There is some debate as to whether the bow drill was used in the Americas before the Europeans arrived. Martin (1934:96) notes that one was excavated from a Southwest pueblo in 1890, and the regular striations found on microdrills in Mississippian sites suggested to Yerkes (1983:511) that the bow drill was used. Speck (1911:224, Figure 33) illustrates a horizontal chest bow drill in use among the Hurons of Lorette (near Quebec) between 1908 and 1911. As McGuire (1894:658–659) early noted, both the strap drill and the bow drill are improvements over the shaft drill because of the increased revolutions that can be made in a given period of time. Use of both of these requires that a concave object be placed at the butt end of the shaft to steady it either in the mouth (strap drill) or with the free hand (bow drill). In either case, the use of a long shaft would be unwieldy. Lewis Henry Morgan (1962 [1851]:381) illustrates an Iroquois pump drill for starting fires (*DA-YA-YÄ-DÄ-GÄ'-NEÄ-TÄ*) and states that they were used since time immemorial. Ground stone collections from Iroquoian sites should be checked to see if there are circular stone disks with a hole in the center that could have been used in a pump drill.

Hayden and colleagues (1996:28, 29, 40) suggest that stone drills are specialized tools. The greater mean thickness of the Eaton triangular drills contrasted with triangular points suggests that drills were manufactured intentionally rather than being resharpened triangular points. If they were resharpened while hafted, basal width would be expected to be the same, not significantly narrower. The difference in the mean length:width ratios between points and drills is striking. The drills in this study do not weigh significantly less than points, nor are they significantly shorter—both of which would be expected if they were reworked points. Onondaga chert was readily available to the inhabitants, so conservation of lithic material was likely not a high priority for the knappers at this village site (Engelbrecht et al. 2021). The greater thickness of drills would confer durability, a desirable quality for use in drilling. Arrow points for warfare were made to be used once, and they likely shattered upon hitting bone, which caused greater damage, whether

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their target was human or animal. Unlike drills, arrow points were made to be broken (Engelbrecht 2015).

If drills were not made from points, why are their bases similar? Assuming they are contemporaneous, the knapper likely made the type of base for points and drills that he/she was most accustomed to fashioning and hafting. The Frison Effect describes morphological changes that occurred with the resharpening of Dalton points into drill-like forms, but it has been uncritically applied to the production of drills from points in other sites without adequate consideration. Drill shafts, arrow shafts, and spear shafts have different design characteristics, which argue against the reworking of projectile points into drills while the tool remained hafted. The frequency with which knappers worked points into drills at other sites remains to be explored.

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Data Availability Statement. The drills that form the basis of this study are curated in the Anthropology Department at SUNY Buffalo State. Data from the Eaton site have been uploaded to tDAR. The drill attribute list (document 468910) and drill Access table (dataset 468911) are part of the Eaton Chipped Stone Collection (collection 21804), which is part of the Eaton Site Project (project 6030) on tDAR.

Competing Interests. The author declares none.

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