November 2015

Practice Makes Projectiles: Genesse Biface Technology in Southern Ontario

Kaitlyn C.M. Malleau
The University of Western Ontario

Supervisor
Chris J. Ellis
The University of Western Ontario

Graduate Program in Anthropology

A thesis submitted in partial fulfillment of the requirements for the degree in Master of Arts

© Kaitlyn C.M. Malleau 2015

Follow this and additional works at: https://ir.lib.uwo.ca/etd
Part of the Archaeological Anthropology Commons

Recommended Citation
https://ir.lib.uwo.ca/etd/3309

This Dissertation/Thesis is brought to you for free and open access by Scholarship@Western. It has been accepted for inclusion in Electronic Thesis and Dissertation Repository by an authorized administrator of Scholarship@Western. For more information, please contact tadam@uwo.ca, wlswadmin@uwo.ca.
PRACTICE MAKES PROJECTILES: GENESEE BIFACE TECHNOLOGY IN SOUTHERN ONTARIO

Monograph

by

Kaitlyn Malleau

Graduate Program in Anthropology

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Arts

The School of Graduate and Postdoctoral Studies
The University of Western Ontario
London, Ontario, Canada

© Kaitlyn Malleau 2015
Abstract

In this study I investigate the lithic technology practice communities of what is now southwestern Ontario between 3800 and 3400 B.P., the latter part of the period dubbed “the Broad Point Archaic.” I seek to propose historical processes by which Genesee bifaces might have entered Ontario, and how they were used by past First Nations peoples. I observe both the form (using qualitative and metric traits) and use-wear (using macroscopic diagnostic impact fractures) of Genesee bifaces from seven sites located in southwestern Ontario: Davidson, Sadler, Desjardins, Parkhill, Brodie, R&K, and Hamilton Golf Course. The evidence suggests Genesee bifaces were used as projectiles throughout the region. Additionally, it appears that the communities in the Ausable and Komoka drainages altered their technological system (Adder Orchard) in order to adopt aspects of Genesee technology. The spread, and use, of broad-bladed bifaces in the region is now better understood.

Keywords

First Nations archaeology, Great Lakes archaeology, broad point, Genesee, projectile points, lithic technology, communities of practice, practice theory, form and function, diagnostic impact fractures.
Acknowledgments

This project would not have been possible without the help of a great many people, to whom I am so grateful. I would first like to thank the members of Six Nations who contributed to the work conducted at the R&K site, as well as the members of Kettle and Stony Point Nation for their involvement in the excavations at the Davidson site.

Next, I would very much like to thank my supervisor, Chris Ellis, who was kind enough to not only take me on as his graduate student, but to allow me to be a part of the wonderful work he is currently doing on the Davidson site. His passion for archaeology is infectious, and he has always given me great guidance and shown me great patience — I’d like to say that he’s “got it all,” but, he “hasn’t gotten any complaints yet”!

I would also like to thank my committee—Neal Ferris, James Flath, and especially my advisor Lisa Hodgetts, for their thought-provoking questions, and their valuable feedback.

The experimental portion of this project was the result of great cooperative effort from the Western University community, and it would not have been completed without any of the following people. I would like to thank Ed Eastaugh, for lending us his canoe and accompanying us on our quest for coarse-grained materials down the Ausable, as well as for arranging for, and aiding in, the projectile and butchery experiments. I am also indebted to Darryl Dann, who not only helped us to collect coarse-grained cobbles at Komoka and helped to make the frame to support the bow (along with Ted Hallberg), but who used his optimism as a superpower to fix any problem that came-up along the way. Additionally, I would like to thank Patricia Wells and Tessa Plint, who helped immensely with the projectile and butchery experiments. I must also thank Dan Long for showing such fine craftsmanship in knapping, and hafting, the replica Genesee bifaces, (even though he knew what we intended to do with them). Thank you too, to Djordje Romanic, the good man who guided me in the use of certain physics principals to estimate the speed of my projectiles. Thanks also goes out to Ted Barney for delivering a deer carcass to us.

Others helped to give me access to certain collections which became invaluable for this study. I was only able to access the R&K collection thanks to Peter Timmins, and was only
able to access the Hamilton Golf Course collection thanks to Jacqueline Fisher — thank you very much to you both!

I must thank all the members of the Anthropology Department for each contributing to such a supportive environment for education and learning. I am grateful to all of my instructors, but especially to Lisa Hodgetts and Alexis Dolphin whose teachings helped me to develop the theoretical framework for this study, and to Andrew Nelson, whose class helped me to develop my methodology. I would like to thank all my classmates, but especially Annya, Katie, Diana, Hallie, Paulina, and Kyle, for their interesting ideas, feedback, and insight on this project—conversations with you all has helped develop it into its present form.

I would like to thank my whole family — especially my Mom who always encouraged creativity and being true to yourself, who taught me that it was okay to have your head in the clouds sometimes; and my Dad, who always encouraged scientific thought, who taught me there was a time and place to keep my feet firmly planted on the ground. Thank you to my brother who uses his good humour and wit to lighten the load on everyone else’s shoulders; and my sister who continues to teach me that there is strength in beauty, and beauty in strength. I am so thankful to all of my grandparents—Nanny and Papa, and Gram and Gaston—who have never wavered in their support for me.

Finally, I would like to thank the institutions that have provided financial support for this research. This support includes funding from the Social Science and Humanities Research Council (SSHRC) and the Western Graduate Research Scholarship (WGRS).
Table of Contents

Abstract ........................................................................................................................................... ii
Acknowledgments .......................................................................................................................... iii
Table of Contents ............................................................................................................................ v
List of Tables ......................................................................................................................................... viii
List of Figures ....................................................................................................................................... ix
List of Plates ......................................................................................................................................... xi
List of Appendices .............................................................................................................................. xii
Chapter 1 .............................................................................................................................................. 1
  1 Introduction ...................................................................................................................................... 1
    1.1 Broad-bladed biface technology ............................................................................................... 2
    1.2 Theoretical Perspective .............................................................................................................. 3
    1.3 Research Methodology .............................................................................................................. 4
    1.4 Thesis outline ............................................................................................................................ 5
Chapter 2 .............................................................................................................................................. 6
  2 The Genesee type as Broad Point technology .............................................................................. 6
    2.1 The appearance and spread of broad-bladed bifaces ............................................................. 7
      2.1.1 Broad-bladed bifaces across Eastern North America ...................................................... 8
      2.1.2 Broad-bladed bifaces of Ontario ...................................................................................... 18
      2.1.3 Manner of Transmission .................................................................................................. 26
      2.1.4 Introduction into Ontario ................................................................................................. 34
    2.2 Broad point function ................................................................................................................ 37
      2.2.1 Broad points and fishing .................................................................................................. 37
      2.2.2 Broad points: Projectiles or knives? ............................................................................... 41
      2.2.3 Genesee use in Ontario ................................................................................................. 48
Chapter 3. Practice theory with chaîne opératoire methodology

3.1 Past approaches for studying technology

3.2 Practice theory and its applications in archaeology

3.3 Accessing communities of practice through chaîne opératoire

Chapter 4. Materials and Methods

4.1 The archaeological samples

4.1.1 The Davidson site (AhHk-54)

4.1.2 The Sadler site (AhHk-70)

4.1.3 The Desjardins site (AhHk-69)

4.1.4 The Parkhill site (AhHk-49)

4.1.5 The Brodie site (AfHi-19)

4.1.6 The R&K site (AgHb-265 & AgHb-266)

4.1.7 The Hamilton Golf Course site (AhGx-20)

4.2 Analyzing the archaeological material

4.3 The experimental study

Chapter 5. Results

5.1 The many forms of the Genesee biface

5.1.1 Raw material collection and use

5.1.2 Blade Morphology

5.1.3 Stem Morphology

5.1.4 Base shape

5.1.5 Co-occurrence of base and edge traits

5.1.6 Metrics

5.1.7 Width to thickness ratios
List of Tables

Table 4-1. Measurement definitions ................................................................. 71

Table 4-2. Macroscopic fracture types ............................................................... 73

Table 4-3. Measurements of the replica sample contextualized among metric studies in the literature ............................................................................................................. 75

Table 5-1. Co-occurrence of convex edge shapes and non-triangular blade shapes. .......... 84

Table 5-2. Relationship between edge shape and base shape .................................. 88

Table 5-3. The mean measurements of nine different biface attributes for each collection (maximum and minimum shoulder heights were combined). ................................................. 89

Table 5-4. Mean width to thickness ratios for each collection .................................... 94

Table 5-5. Observations from launching replica spears at deer target............................ 97

Table 5-6. Observations from launching replica spears in an open environment ............ 98
List of Figures

Figure 1-1. The locations of the archaeological sites included in this study: Ausable River Valley sites (Davidson, Sadler, Desjardins, and Parkhill), Brodie, R&K, and Hamilton Golf Course; the location of an archaeological site discussed in this study: Peace Bridge; as well as the major chert outcrops discussed. 4

Figure 2-1. The broad-bladed biface types of Eastern North America and their approximate spatial distribution. This map is not meant to definitively delineate regions in which these biface types were used (as will be discussed below there are always exceptions), but only meant to guide those unfamiliar with the literature. (*The Susquehanna Broad type is distributed throughout a large region from southeastern Pennsylvania to at least as north as the Maine region—not marked on map for clarity.) 9

Figure 4-1. Length and width measurements. Drawn by Ian Kenyon. Reproduced with the permission of the Ontario Archaeology Society Inc., Toronto, Ontario, from Kenyon (1980b). (Dotted lines were added) 70

Figure 5-1. The percentages of the bifaces made from Onondaga chert, Kettle Point chert, coarse-grained materials in each collection. 79

Figure 5-2. The percentage of bifaces displaying triangular and non-triangular forms in each collection. 82

Figure 5-3. The percentage of bifaces displaying straight, concave, and convex edge shapes in each collection. 83

Figure 5-4. Percentage of bifaces with straight, narrowed, and expanded stems in each collection. 86

Figure 5-5. The percentage of bifaces with straight, concave, and convex base shapes. 87

Figure 5-6. The results for the principal component analysis on the metric traits of the bifaces. The bifaces of the Hamilton G.C. and Sadler sites seem to cluster. 92
Figure 5-8. The plotted relationship between the number of trials each biface survived, and its shoulder width. ........................................................................................................................................ 100

Figure 5-7. The plotted relationship between the number of trials each biface survived and its overall length. .......................................................................................................................................................... 100

Figure 5-9. The plotted relationship between the number of trials each biface survived and its length to width ratio. .................................................................................................................................................. 101

Figure 5-10. The percentage of bifaces with diagnostic impact fractures of each collection. ........................................................................................................................................................................... 105

Figure 5-11. The percentage of coarse-grained and chert bifaces with bending fractures, step-terminating fractures, spin-off fractures, cone-initiating fractures, impact burins, impact flutes, and crushing. ........................................................................................................................................................................ 106

Figure 5-12. The mean overall length of bifaces with diagnostic impact fractures, and the mean of those that do not. .................................................................................................................................................. 107

Figure 5-14. The mean of the length to width ratio of bifaces that display diagnostic impact fractures, and the mean of those that do not. .................................................................................................................................................. 109

Figure 5-13. The mean shoulder width of those bifaces that display diagnostic impact fractures and the mean of those that do not. .................................................................................................................................................. 108
List of Plates

Plate 5-1. Chert remnants found in the bones of the deer.................................................. 96

Plate 6-1. On the left is the expertly-made biface from Davidson displaying an Adder Orchard like form. On the right is the Genesee-like uniface found in a neighbouring unit. 112
List of Appendices

Appendix A: Speed calculations ................................................................. 143
Appendix B: Collections ........................................................................ 144
Appendix C: Diagnostic impact fractures (archaeological collections) .... 153
Appendix D: Projectile experiment photographs and videos ................. 157
Appendix E: Statistics .............................................................................. 171
Chapter 1

1 Introduction

Forty-seven hundred years ago, people began using a broad-bladed, lithic biface technology in the Savannah River Drainage, on the border of South Carolina and Georgia (Sassaman 2006). While the earliest examples of the technology have been observed in the Southeast, broad-bladed bifaces appear in the archaeological record of other regions throughout Eastern North America. Likely because of their unique and easily recognizable appearance, there have been many debates in the literature surrounding the spread and use of broad-bladed bifaces. The investigation of broad point technologies has become a centerpiece in discussions surrounding how certain lithic technologies become so widely used over such large regions, as well as in discussions concerning the relationship between a lithic biface’s form and its function (at least in North American archaeology).

Researchers believe that the Genesee bifaces observed in what is now southern Ontario, between 3800 and 3400 years ago, are also part of this wide-spread technological trend (Ellis et al. 1990a, 2009, Kenyon 1980a, b). It is not clear why the trend spread over such a distance, but according to the research conducted by Kenyon (1980a, b) on the Genesee biface form, and Ritchie (1971: 24) and Funk (1976) on the geographical distribution of Genesee bifaces, the technology in Ontario seems to most closely resemble biface forms seen to the east, such as in New York. More recent research has suggested that the Genesee form could have spread to new areas through material exchange networks (Williamson and MacDonald 1998). Despite the information provided by these studies, the means by which the broad-bladed Genesee technology replaced an existing narrow-shouldered biface technology in the southwesternmost part of the province (Adder Orchard), is still unclear.

Additionally, there have long been questions surrounding whether Genesee bifaces were used as stone tips for projectiles, or if they were in fact too large, and served other functions (Ellis et al. 1990a; also see Snow 1980). Despite these questions, no extensive
use-wear study of these bifaces has yet taken place. In fact, only a few use-wear analyses of broad points have been conducted in all of Eastern North America (see Custer 1991; Dunn 1984; Funk 1993; Sassaman 2006; Truncer 1990), and for the most part they have been concerned with the types found in the Southeastern (Savannah River stemmed) and Mid-Atlantic (Perkiomen) regions. Far fewer use-wear studies have been conducted in the Northeast (but see Funk 1993). Therefore, the practices in which the varieties of broad points were employed, and the variation of these practices over eastern North America is relatively unknown. Because the broad-bladed biface is so distinctive from the point forms that come before and after in the archaeological record, the paucity of broad point use-wear studies in the Northeast is surely a wasted opportunity to investigate the relationship between the form of a lithic biface and its function—something that has long been of interest to lithic analysts (Dockall 1997; and see Ahler 1971; Fischer et al. 1984; Odell and Cowan 1986; Semenov 1970).

In my research, not only do I take account of the variation of Genesee form that exists within the region, but I also conduct a use-wear study on the Genesee bifaces of what is now southwestern Ontario. Using this data, I will compare the distribution of Genesee *making* practices, to the distribution of Genesee *using* practices, with the aim of investigating the technological knowledge sharing between different communities of practice.

### 1.1 Broad-bladed biface technology

The debate on whether the spread of broad-bladed bifaces across Eastern North America could be better explained by migrating groups or by local groups adopting new technology first manifested in the mid-1970s (see Cook 1976a and Turnbaugh 1975). Researchers have since found it more useful to approach these questions on a regional scale. Some specific instances, such as the appearance of the biface type in Maine (see Bourque 1975, 1995; Dincauze 1972) and in the uplands of the Savannah River drainage (see Sassaman 2006), might be explained by the movements of people. Overall, however, the spread of broad-bladed bifaces has been attributed to the diffusion of technology (Pagoulatos 2010), often by means of material exchange networks (Custer 1984; Stewart 1987, 1994; Williamson and MacDonald 1998).
The function of broad point bifaces has been a source of great debate for archaeologists since their first recorded recovery (see Witthoft 1953). This debate often seems to have been tied to a discussion of their rapid spread over large distances, as well as their large and unusual form. Many researchers believe that while broad point bifaces often look like projectile points, they were too large and heavy to be effective in such a task under most circumstances (Ellis et al. 1990a; also see Snow 1980), or too wide-shouldered to effectively penetrate the hides of animals (see Cook 1976a; Custer 1984, 1991). For this reason, some researchers have suggested that it might have been a weapon tip used as hand-held, thrusting spears at close-quarters (Ellis et al. 1990a; Ritchie 1965).

Alternatively, many researchers have begun to accept the explanation that some, or all, of these bifaces were used as knives rather than as weapon tips (see Cook 1976a; Custer 1984, 1991; Dunn 1984; Sassaman 2006).

It is possible that no single answer applies to the entire Broad Point period. Still, the question remains whether there is a single use for broad points, or if they have many functions within the same site and between sites. If a use-wear analysis of the lithic material recovered from specific sites is conducted, we will gain a better understanding of broad point function. Then we may begin to ask whether the broad point form was adopted to complete a certain set of tasks, or if different tasks could be ascribed to the form by different communities.

1.2 Theoretical Perspective

Researchers who investigate the Archaic period of North America have of late begun to question the progressivist theoretical perspective that is still relatively predominant in the field (Eastaugh et al. 2013; Emerson and McElrath 2009; Sassaman 2010). In other words, more archaeologists are abandoning the idea that past people underwent gradual and unidirectional change to become more suitably “adapted” to the environment, and instead are turning to practice-based theories. For those research projects investigating archaeological sites of limited preservation for which many post-processual approaches are difficult to apply, it seems more and more as though these practice-based perspectives offer an alternative to the older processual ideas linked to the progressivist view of change. I approach this study from the perspective of communities of practice, and
Pauketat’s (2001a, b) historical processualism. I also argue, using Latourian Actor-Network Theory, that lithic bifaces were also members of the communities of practice, and allow us to access the information networks that existed in the past.

1.3 Research Methodology

In this thesis, I first examine seven samples of Genesee bifaces all recovered from archaeological sites in southwestern Ontario (the Davidson site; the Sadler site; the Desjardins site; the Parkhill site; The Brodie site; the R&K site; and the Hamilton Golf Course site see Figure 1-1). I recorded elements of the Genesee biface form, including metric traits and the lithic material used to make them, based on the methodology used in previous studies by Kenyon (1980b) and Fisher (1987). I also observe some qualitative traits of the bifaces. Next, I recorded macroscopic features of the biface thought to be related to their use, such as diagnostic impact fractures (DIFs) and the asymmetry of the biface blades (which may indicate use as knives). Finally, I conduct an experimental study on a sample of replica Genesee bifaces to better understand the material consequences of using these bifaces in projectile and butchery activities.

Figure 1-1. The locations of the archaeological sites included in this study: Ausable River Valley sites (Davidson, Sadler, Desjardins, and Parkhill), Brodie, R&K, and Hamilton Golf Course; the location of an archaeological site discussed in this study: Peace Bridge; as well as the major chert outcrops discussed.
1.4 Thesis outline

This thesis consists of seven chapters. In Chapter 2, I summarize past research on the distribution of broad-bladed technology in Eastern North America. By tracing similarities in the biface forms, and ordering the sequence of their appearance in the record using associated radiocarbon dates, there does seem to be a historical connection between the varied forms that have been recovered. Next, hypotheses that researchers have proposed to explain the spread of particular broad-bladed technologies are discussed. As stated above, it would seem that most researchers who have investigated these patterns believe that these forms were often introduced to new areas through material exchange networks. Finally, Chapter 2 discusses the different functions that have been attributed to this technology by different researchers, as well as use-wear studies that have been conducted on different broad-bladed biface types. It would seem that broad-bladed biface variants were used differently in different regions.

In Chapter 3 I will briefly discuss how this research benefits from using the theoretical toolset provided by perspectives like historical processualism and communities of practice. I also makes use of Actor-Network Theory to justify using chaîne opératoire as a methodological framework to investigate past practices in the archaeological record. Chapter 4 discusses the origin of the samples used in this study, as well as the methodologies employed. I observed qualitative and metric traits to investigate the distribution of Genesee making practices, while I used macroscopic diagnostic impact fractures to investigate the distribution of Genesee using practices. I discuss the results of my study in Chapter 5, where I argue that Genesee bifaces were ubiquitously used as projectiles throughout the region. I also explain how Genesee bifaces differed in form between the eastern and the western samples. In Chapter 6, I discuss these observations in the context of the literature, using communities of practice to help explain these patterns. While people throughout the region seemed to engage with Genesee technology, participating in a large-scale community of practice, micro-traditions persisted at smaller scales. Finally, I make concluding statements and comment on potential areas of future research in Chapter 7.
Chapter 2

2 The Genesee type as Broad Point technology

The Genesee biface type, observed in Ontario and New York, is usually thought of as part of a larger technological trend that researchers have observed throughout Eastern North America. This trend, or parts thereof, is known by such names as the Broadspear Horizon (Witthoft 1953), the Broadpoint Dispersal (Turnbaugh 1975), the Broadpoint Archaic (Ellis et al. 1990a), sometimes the Susquehanna Tradition (Dincauze 1972), and even the Transitional Period (Witthoft 1953). Our current understanding of the Genesee biface, then, as well as the research questions that I hope to address in this study, must be contextualized in the current understanding of this time period.

Since the first recorded broad point find in 1872 (Spier 1918) this trend in biface technology has been steeped in debate concerning its antiquity, its diffusion, its relation to other lithic technologies, and, of course, its function. Some of these debates have since been resolved—the antiquity of these broad-stemmed and shouldered points was put to rest through the application of radiocarbon dating. More and more, the transmission of the broad point form throughout Eastern North America is thought to have been through a mixture of technology adoption and, in certain cases, the migration of groups into new areas. Finally, broad point technology seems to represent a time period in which they were the sole lithic biface technology used in most places. The tasks in which broad points were used in the past, however, have not been completely ascertained. In part, the continued debate on broad point function has to do with this classification being applied over a very large area, and over a variety of biface types. Though some work has been done on certain forms in certain areas, it is likely that each region will demonstrate slightly different use-wear results.

In section 2.1, I will review the broad-bladed biface types usually included in this technological trend, then discuss the possible means for its rapid transmission throughout the Northeast. Secondly, in section 2.2, I will review the studies which have explored the relationship between the form of broad points and their function.
2.1 The appearance and spread of broad-bladed bifaces

As archaeologists move away from the taxonomic classification system first proposed by Willey and Phillips in 1958, discussion of the so-called “Broadpoint Horizon” may be seen by some as inappropriate. As Sassaman states (2010: 20), “[these constructs] simplify reality by emphasizing traits that help discriminate amongst units.” He warns that the use of these categories encourages normative thinking, and instead of describing historical processes researchers may use these terms to describe ahistorical spatio-temporal units, or worse, to describe “cultures” (2010).

It is true that in the past these categories have been used in restricting ways, and that these typologies are always subject to the political and ideological views of the researcher (Gnecco and Langebaek 2014). Emerson and McElrath (2009) have discussed how, not only is there an unfortunate past of researchers equating projectile points to people, but also of researchers trying to force past time periods into progressive “stages,” to suit some kind of evolutionary framework. Even so, Pauketat (2001b), argues that these large patterns observed in the archaeological record can be real, even if they do not indicate what researchers once thought they did. Though typologies are imposed on past materials by researchers, they may be useful in investigating real processes (Read 1974). Even Sassaman (2010) admits that certain categories are useful to draw comparisons between different datasets. So long as researchers continue to be critical of the classifications they use and the way they use them, classifications can be valuable to draw connections, tracing patterns through time and space (Odell 1981; Read 1974).

In light of these recent changes in research, I would like to note that the following discussion of the broad-bladed bifaces of Eastern North America is meant to trace a connection between technological trends that occur within a similar time-frame (between 4700 B.P. and 3200 B.P, with some later-dating exceptions), not to draw a boundary around a taxonomic classification clearly imposed on the material by archaeologists themselves. Indeed, there has been some difference of opinion over what is considered a “broad point” and what is not. While most researchers focus on more eastern variants with broad-shouldered blades (Bourque 1975; Dincauze 1972; Pagoulatos 2010; Ritchie 1965; Turnbaugh 1975; Witthoft 1953), some forms further in-land that would fit this
trend are commonly left out of the discussion. For example, Coe (1964: 45) related Savannah River stemmed to bifaces from Tennesee (such as Appalachian, Benton, and Kays Stemmed); Cook (1976b) likewise related the Etley points of Illinois to the trend due to their broad stems. The boundaries of the “Broadpoint Horizon” are not above questioning — biface types that have been considered part of this larger trend, after all, show great variation (Ellis et al. 1990a; Fisher 1997; Pagoulatos 2010), and some bifaces that are discussed as being historically related to this technological trend, such as Fishtail points, are not broad-bladed at all (see Ritchie 1965: 167, plate 55; Ellis et al. 2009:814). Despite their great variety, though, most forms share enough traits — namely being large, relatively wide, long, thin, and triangular-shaped (Custer 1984; Ellis et al. 1990a; Kenyon 1980; Ritchie 1961; Turnbaugh 1975) with wide stems (Ellis et al. 1990a; Turnbaugh 1975) — for researchers to believe that they are manifestations of the same trend.

Witthoft (1953) from the first remarked upon the uniqueness of the broad-bladed bifaces, and since that time archaeologists have continued to agree that the technological trend that spurred the production of broad shouldered lithic bifaces was relatively distinct to Eastern North America between 4700 and 3200 years ago.

2.1.1 Broad-bladed bifaces across Eastern North America

Witthoft’s work in the rhyolite quarries of Pennsylvania lead to the first definition of the “Broad Spearpoints,” describing them as “broad, thin, well-flaked, and often asymmetrical” (Witthoft 1953: 4). He observed a greater similarity between the broad biface types he observed; including Susquehanna, Perkiomen, and Lehigh points than any other point form that he could observe in the region (Witthoft 1953). However, it was not until 1954 that Sears first suggested that other broad-bladed bifaces of the east were a part of the same trend (Turnbaugh 1975: 53).

2.1.1.1 Georgia and South Carolina

It would seem that Savannah River stemmed points (see Figure 1) are the earliest broad-bladed biface, first appearing in the archaeological record of the Savannah River drainage area approximately 4700 B.P. (calibrated to c. 3500 BC) (Sassaman 2001, 2006;
Sassaman et al. 2006). The first to describe the Savannah River stemmed was Claflin, after his work on Stallings Island (Claflin 1931; Coe 1964: 45). Sassaman and colleagues

Figure 2-1. The broad-bladed biface types of Eastern North America and their approximate spatial distribution. This map is not meant to definitively delineate regions in which these biface types were used (as will be discussed below there are always exceptions), but only meant to guide those unfamiliar with the literature. (*The Susquehanna Broad type is distributed throughout a large region from southeastern Pennsylvania to at least as north as the Maine region—not marked on map for clarity.)
(2006: 551) define Savannah River stemmed type of the area as “large metavolcanic bifaces.” Sassaman (2006: 54) explained that the relatively large Mill Branch bifaces, leading to the similar Savannah River forms, developed from smaller, Paris Island points made on quartz that existed from 5350 B.P. to 4700 B.P. (Sassaman 2006: 54). He has taken account of several radiocarbon dates from Mill Branch sites in the area, and found that near the Savannah River, Mill Branch sites tend to date between 4700 and 4600 B.P. (Sassaman 2006: 69). In the uplands, however, sites containing the large Savannah River stemmed date as late as 4200 B.P. (Sassaman 2006: 67). Because no Mill Branch sites in the Savannah River drainage date after 4450 B.P., Sassaman (2006: 76) suggested that some people who used broad-bladed technology began to move from the riverine lowlands to the upland areas. Others, whom he believes participated in “Stallings Island culture,” seem to have moved into the riverine environments around this time, and seem to have adopted the Savannah River stemmed-like biface form of Mill Branch (Sassaman 2006: 123).

2.1.1.2 North Carolina

By 3900 ± 250 B.P., Savannah River stemmed bifaces can be observed on the Gaston site, in the Roanoke River Basin of North Carolina (Coe 1964: 118). A careful excavation of this stratified site revealed a sudden appearance of Savannah River bifaces in an occupation stratum interspersed between two sterile strata; 100% of the stemmed bifaces in that strata were Savannah River stemmed. The Gaston site was one of three deeply stratified sites that Coe (1964) investigated in North Carolina. Another, the Doershuck site, found on the Yadkin River, also had a sudden introduction of Savannah River bifaces, largely replacing the Guilford points that were extremely popular in the previous stratum; Savannah River stemmed points made up 82.7% of assemblage in the post-Guilford occupation (Coe 1964: 34). Based on these sites, Coe was able to construct a biface chronology for the area that became widely adopted by archaeologists that worked there (Sassaman 2006: 52).
2.1.1.3 Virginia and Chesapeake Bay

Savannah River bifaces are found even north of the Roanoke, and they have been reported around the Chesapeake Bay (Dent 1995: 180) and throughout the James River Valley areas of Virginia (Pagoulatos 2010). Though no radiocarbon dates have been provided for the James River Valley sites (Pagoulatos 2010), a radiocarbon date was retrieved from a site south of it. At the Slade site, in Virginia’s Sussex County, the Savannah River stemmed component was dated 4070 ± 80 B.P. (Dent 1995: 181). The Chesapeake Bay is also where we can start to observe other broad-bladed biface types, such as Koens-Crispin (Dent 1995: 180; see Figure 2-1)—a form also seen further north in New Jersey.

2.1.1.4 New Jersey and the Upper Delaware Valley

The archaeological research on broad-bladed bifaces goes back the furthest in time in New Jersey. Charles Abbott was the first to recover large coarse-grained bifaces in 1872, believing them to belong to a pre-glacial occupation (Spier 1918: 175). Years after that, Hawkes and Linton (1916) wrote a paper on an assemblage of artifacts from a site in the Delaware River Valley. They reported on some triangular-shaped “arrow or javeline heads” (Hawkes and Linton 1916: 491), later identified as Koens-Crispin points (Turnbaugh 1975: 51).

In 1972, Kinsey wrote an extensive review of the archaeology of the Upper Delaware Valley which proved to be influential over subsequent research on the broad points of the Northeast. Often, the earliest broad point forms of the area have been cited to be Koens-Crispin and Lehigh. Kraft’s (1972:30) primary way to distinguish the two, though, was based on the material each is made from. Otherwise, they have virtually the same form (see Kraft 1972: Figure 6) and they were found to have virtually identical radiocarbon dates: 3720 ±120 B.P. for a feature containing a Koens-Crispin point at the Miller Field site (Kraft 1972: 30) and 3720 ±100 B.P. for a Lehigh feature at the Peters-Albrecht site (Kinsey 1968). While Koens-Crispin bifaces are observed on argillite in the southern part of the Delaware drainage, Lehigh tends to refer to bifaces that are made from chert or jasper, and they are usually found in the northern part of the Delaware drainage (Kinsey...
Both Kraft (1972: 30) and Kinsey (1972: 349) believed that the only difference between these two “types” was the material on which they were made. It is likely for this reason that researchers often only discuss Koens-Crispin or Lehigh (see Pagoulatos 2010; Ritchie 1965; Witthoft 1953) or refer to them collectively as Lehigh/Koens-Crispin (see Kinsey 1972; Kraft 1972; Turnbaugh 1975).

When the earliest dates for broad-bladed bifaces from Ontario and Maine are considered (ca. 4000-3800 BP; Bourque 1995:101; Eastaugh et al. 2013: 281; Chris Ellis, personal communication 2015), though, the dates recovered for Lehigh/Koens-Crispin bifaces would seem to be too late in time to have been intermediate between northern bifaces and the Savannah River stemmed. Other broad-bladed bifaces have been observed in New Jersey, named “corner-removed” (Mounier 1972) and “Large Blade Broad-Stemmed” (Kenyon 1980a: 22) types, which seem to have been deposited earlier in time. On the Byram site, Kinsey was able to associate his Large Blade Broad-Stemmed types with a date of 3830 B.P. (Kenyon 1980a: 22). Kenyon noted that these bifaces bore “some striking resemblances” to the Genesee bifaces of Ontario (Kenyon 1980a: 22). Mounier (1972: 50-51) was able to recover a date of comparable age for the corner-removed bifaces of the Fralinge site, on the coast of New Jersey, finding them to be approximately 3880±100 years old. Mounier (1972: 50) argued that these bifaces did not suit any previously defined broad-bladed types. However, based on the photographs of the bifaces he recovered, they most resemble Savannah River stemmed forms (see Mounier 1972: Plate 9).

2.1.1.5 Pennsylvania

Southeastern Pennsylvania has been referred to as “the hearth” amidst the distribution of broad points in the Northeast (Ritchie 1965: 149), though this perception may simply be an effect of it being one of the more well-researched areas for this period. Early on, three different, yet similar-looking broad-bladed biface types were identified in the state — Susquehanna, Perkiomen, and Lehigh (Whittoft 1953; see Figure 2-1). While Witthoft (1953) suggested that the Susquehanna type was ancestral to the other two bifaces of Pennsylvania, radiocarbon dates collected later called this proposed sequence into question. Ritchie (1965: 152) was the first to suggest that the Lehigh bifaces preceded the
Perkiomen and Susquehanna bifaces of Pennsylvania, being directly related to the older Savannah River stemmed forms. Kinsey (1968) later confirmed Ritchie’s hypothesis when he reported that he dated a Lehigh biface to be 3720 ± 100 B.P. (see above) — it was a date much older than that (3250 ±100 B.P.) reported for the Susquehanna Broad bifaces of Ritchie’s “Frost Island phase” in New York (Ritchie 1965: 156). It seemed as if the Lehigh/Koens-Crispin was the older type in the Lehigh and Delaware river valleys, followed by Perkiomen (present in the record by 3600 B.P.), and finally Susquehanna Broad bifaces (present in the record by 3500 B.P.; Pagoulatos 2010; Snow 1980). As previously stated, however, some of the very old dates retrieved from sites in the Northeast might suggest that either an earlier manifestation of broad-bladed technology made its way north, or that the Lehigh/Koens-Crispin type is older than the dates amassed to date would suggest.

According to Kinsey (1972: 352), “Perkiomen evolved locally from Lehigh.” The distribution of Perkiomen biface technology concentrates around the Shuylkill Valley (Kinsey 1972: 427; Witthoft 1953: 19), as well as the Delaware and Hudson River Valleys (Kinsey 1972: 427; Ritchie 1971: 43). It also extends into Virginia and North Carolina, having been introduced to these areas around 3100 B.P., and having persisted there until 2800 B.P. (Painter 1988). It would seem though, that in these states Perkiomen bifaces cluster around the Dismal Swamp region on the Virginia-North Carolina border (Painter 1988), and are not often found outside of that area (Dent 1995: 180). Perkiomen bifaces are also observed in other northeastern regions, including New York (Funk 1993; Ritchie 1965: 152), Connecticut, New Hampshire (Snow 1980), and Ontario (Bursey 1994; Ellis et al. 1990a, 2009). In New York, Perkiomen bifaces generally occur in a “thin surface scatter” (Ritchie 1965: 152) and when Perkiomen bifaces were recovered in the Upper Susquehanna Valley they were usually in association with other broad points (see Funk 1993: 149). There seems to be an exception in western New York, however. The Piffard site, of Livingston County, seems to have included a grave (i.e., a short-term event) in which only Perkiomen-typed bifaces were deposited (Ritchie 1965: 152). In Ontario, though the Chaingate site had been identified as a Perkiomen site based on the projectile points recovered there (Bursey 1994), Ellis and colleagues (2009: 815) have since cast doubt on this identification. Otherwise, only very few Perkiomen finds exist in
Ontario, which are mostly located on and around the Niagara Peninsula (Ellis et al. 1990a: 100; Ellis et al. 2009: 815).

2.1.1.6 New York, New England, and the Maritimes

Having done much work on establishing a chronology of archaeological occupations of the Northeast, Ritchie (1965: 134) proposed the existence of another broad-bladed biface type that spanned the coastal states of Connecticut and Massachusetts, as well as more inland in Vermont and eastern New York: Snook Kill (see Figure 2-1). In Martha’s Vineyard Massachusetts, Ritchie (1969) excavated sites such as the Hornblower II, the Vincent site, the Peterson site, and the Howland Number 1 site, where he observed Snook Kill components. Although he was unable to date any of the strata containing the Snook Kill bifaces directly, he was able to date the strata directly below and above them on the Hornblower II site, giving them an age somewhere between 4190±100 B.P. and 3160 ± 80 B.P. (Ritchie 1969: 32-35). Further inland, in New York, he was able to describe three Snook Kill sites all of which occurred near to the eastern border of the state (the Snook Kill site of Saratoga County, the Vedder site of Greene County, and the Weir site of Rensselaer County) as containing a mixture of bifaces with broad stems and those with more slender side-notched stems distributed diffusely over large areas adjacent to rivers (Ritchie 1965: 135). The Snook Kill site was dated to 3470 ± 100 B.P. (Ritchie 1965: 135), though later a possibly even earlier date, albeit statistically identical, of 3670 ±130 B.P. was associated with Snook Kill bifaces in the Upper Susquehanna River Valley (Funk 1993: 149). Kinsey (1972: 349) suggested that Snook Kill should also be considered the same type as the Lehigh/Koens-Crispin bifaces, as it was virtually identical in form to these other two broad-bladed biface types. He argued that, like in the case of Lehigh and Koens-Crispin types, Snook Kill only differed in the kinds of materials it was made from and its geographical distribution. No other researcher seems to share his view, though, and Snook Kill continues to be treated as its own type (see Dincauze 1975; Funk 1976, 1993; Snow 1980: 235-242; Turnbaugh 1975). This disagreement over typological categories may be a result of there being a gradation of biface form over a large area.
To the east of New York, Dincauze (1972) explains that the distribution of Snook Kill comes as far as the Connecticut River, after which a different broad-bladed biface type can be observed, known as the Atlantic point (see Figure 2-1). Dincauze (1972: 42) defined the range of the Atlantic point as spanning from eastern Connecticut, through Rhode Island, Massachusetts, to Maine. She found them to have higher length to width ratios than Snook Kill forms and, impressionistically, found them to be larger (Dincauze 1972: 42). Though she reported no radiocarbon dates associated with this technology, her work on the Atlantic Edges site, located in Hull Massachusetts, found that this Atlantic biface site must have been occupied before 3600 years ago — when the spring tides would have begun to flood the site on a yearly cycle, depositing sterile layers of peat and cobbles (Dincauze 1972: 48-50). She proposed that Snook Kill and Atlantic points were contemporaneous technologies that were very similar in form and likely related (Dincauze 1972: 57). She also noted how common it was to observe these forms in burial contexts, notably cremation cemeteries with burned human remains and stone artifacts — interesting since to the southeast cemeteries or burials are not generally found for this time period (Dincauze 1975: 27).

After Dincauze had investigated the Atlantic Edge site in Massachusetts, Bourque (1975: 43) conducted work on the Turner site of central Maine—the first occupation site in the New England area with a pure broad point component (Occupation 3). He recovered from the habitation site at Turner Farm “large points with straight or expanding stems…” which he related to Dincauze’s (1972) Atlantic points (Bourque 1975:43). Based on the data from his excavations, Bourque was able to report three radiocarbon dates taken from Occupation 3 of the Turner Farm: 3650 ±75 B.P., 3630 ±85 B.P., and 3515 ±80 B.P. (Bourque 1975: 35), which matched Dincauze’s age estimate of the Atlantic Edge site very well. As Bourque continued to investigate the Turner Farm site, he was able to recover even earlier dates, such as 3945± 230 B.P. and 3825± 76 B.P. from a grave associated with Atlantic-phase bifaces (Bourque 1995: 101, 149). Bourque (1995: 166) argued based on his dates that Atlantic bifaces were being used in Maine as early as 3800 B.P. Again, these dates suggest that broad-bladed biface technology may have penetrated the Northeast before the dates of the Leigh/Koens-Crispin type suggests.
The southern parts of New Brunswick and Nova Scotia are said to have a small presence of broad-bladed bifaces as well (Black 2000: 91). In New Brunswick, “large, side-notched points” were said to have been recovered from near the Saint John River (Sanger 1975: 66) and the St. Croix drainage (Black 2000: 91; Deal 2013: 31-32). The Rum Beach site, in the Bliss Islands, New Brunswick, has also provided an example of an Atlantic type biface (Black 2000: 95), though overall the assemblage mostly consisted of later Fishtail bifaces (Black 2000: 98). As for Nova Scotia, some broad bifaces were observed in the collections held by the Nova Scotia Museum (Sanger 1975: 66), and have been recovered from near Yarmouth (Black 2000: 91). Recently, the excavation of the Boswell site (in the Annapolis drainage) has also recovered a broad-bladed biface with a stemmed haft element as well as a large triangular preform (Deal 2013: 24, 31). Though no traces of broad-bladed bifaces are seen in the northern regions of these provinces, there is a single burial in the Gaspé region which seems to be associated with broad points, dated to 3670±90 B.P. (Deal 2013: 31).

The latest broad-bladed biface before the appearance of the narrower-looking Fishtail points seems to have been, as mentioned previously, the Susquehanna Broad. The Susquehanna Broad is an interesting biface type, because it has been identified in a number of places, and is found over a rather large spatial range. It is partially for this reason that the term “Susquehanna Tradition” is sometimes still used as almost synonymous to “Broad Point” in more northern research areas (see Black 2000; Dincauze 1972; Pagoulatos 2010). Susquehanna Broad bifaces seem to be distributed throughout the Susquehanna drainage of Pennsylvania and New York (Withhoff 1953: 8); the northern part of the Upper Delaware drainage (Kinsey 1972: 429); as well as the Hudson River drainage, the Mohawk River drainage, and central New York (Ritchie 1971: 54). Kinsey (1972: 429) also claimed that the Ashtabula bifaces of the Upper Ohio drainage seem to be of the same form as Susquehanna. In the New England area, Dincauze’s (1975: 27) Watertown phase components also contained bifaces that resembled Susquehanna bifaces (known as Wayland Notched). Again, there seems to be an interesting correspondence between biface form and raw material: the majority of Susquehanna Broad bifaces of the Susquehanna River valley seem to have been made on rhyolite (Withhoff 1953: 8; Kinsey 1972: 354; Stewart 1987). Ritchie (1965: 156) dated
the Frost Island Susquehanna Broad bifaces at 3250 ±100 B.P., and radiocarbon dates collected since indicate the technology was perhaps being used as early as 3550 ±100 B.P. in New York (see Funk 1993: 149). Susquehanna does not seem to have come into the Ontario region in any significant way, as Susquehanna Broad bifaces are only recovered occasionally from the Niagara Peninsula (Ellis et al. 1990a: 100).

In 1976, Funk (261) suggested that a known biface of central and western New York, the broad, triangular Genesee, should also be considered a part of the broad point trend after his studies on sites in the Hudson River Valley. Like Atlantic bifaces, Genesee forms seemed very similar to Snook Kill types. Unlike the Atlantic bifaces to the east though, Genesee bifaces seemed to have been a more western variant that extended into Ontario (Ritchie 1971: 24). While Funk believed that Snook Kill and Genesee bifaces were both derived from the Savannah River Biface and seemed superficially related, he did not venture to examine their relationship more closely (Funk 1976: 263).

In reviewing the distribution of different broad point types in Eastern North America, my intention was to demonstrate that from the Savannah River drainage in 4700 B.P. there seems to have been a movement northward of this broad-bladed point technological trend. Savannah River stemmed technology was being used by people by about 4000 B.P. in what is now North Carolina. Between 3900 and 3800 B.P. examples of broad-bladed bifaces are first observed in New Jersey. Though some very early dates have been collected from the Northeast (approximately 3800 B.P. and perhaps earlier at the Davidson site and the Turner Farm site), only later dates have been observed in intermediate areas (3700 for Lehigh/Koens-Crispin and Perkiomen, 3600 for Snook Kill, and 3500 for Susquehanna). Still, since some of the biface forms are so similar to each other, as well as unique from previous technologies, they do seem to be related. What exactly the relationship of these broad-bladed technologies is however, has been interpreted in various ways since Witthoft’s 1953 publication on the Broadspear Tradition.
2.1.2 Broad-bladed bifaces of Ontario

It took some time before researchers realized that the trend of making broad-bladed bifaces had also made its way to the region that is now Ontario. Researchers instead often believed the large bifaces that existed there belonged to earlier time periods. The Ontario record is said to be dominated by two major types of broad point: Genesee and Adder Orchard (Ellis et al. 1990a, 2009; Kenyon 1983). While the Genesee biface fits better stylistically as a manifestation of the more eastern trend of broad-bladed biface production (Ellis et al. 1990a; Fisher 1997; Funk 1976: 261; Kenyon 1980 a, b), Adder Orchard is characterized as having narrower blades, and is thought to have been inspired by practices of comparable large stemmed biface-making to the southwest in areas such as southern Michigan (e.g., Simons 1972) and northwestern Ohio (e.g., Stothers 1983; see Ellis et al. 2009; Fisher 1997). Still, applying the term “broad point” to Adder Orchard bifaces seems to persist due to a combination of their having been included in the “Satchell” classification (Peske 1963; see below), and their temporal closeness to the appearance of Genesee bifaces in the record (Ellis et al. 1990a).

Initially, the Genesee biface type, as defined by Ritchie (1961, reprinted 1971: 24), was considered part of a Middle to Late Archaic period known as the “the Frontenac Island Phase,” which was “where Brewerton and Lamoka cultures interacted,” (Ritchie 1965: 91). Ritchie (1965: 91) had interpreted the Frontenac Island site, central New York, to represent a single culture of people where Brewerton, Lamoka, and Genesee points were all used. He retrieved three radiocarbon dates: 4980 ±260 B.P.; 4013 ±80 B.P.; and 3723 ±250 B.P., preferring the first one for the age of the site (Ritchie 1965: 107). Now that more research has been conducted on these three biface forms, it is clear that the site was multicomponent, and that the later dates are probably more suitable for dating the site’s Genesee component.

The first publication on the Genesee bifaces in Ontario was authored by Emerson and Noble in 1966. They described an assemblage of lithic bifaces recovered from the Surma site in Fort Erie, which they identified to be Genesee based on Ritchie’s (1961) description. Ritchie (1961, reprinted 1971: 24) had previously defined the distribution of the Genesee biface as ranging from central New York to Ontario’s Grand River Valley,
so the discovery of a Genesee occupation on the Niagara Peninsula was not surprising — though Emerson and Noble (1966: 75) believed it to be the largest collection to have been found up to that time. They also excavated five-sided or pentagonal bifaces that Kenyon (1981) later defined as preforms (unfinished broad points), but Emerson and Noble (1966:77) believed them to have been a different kind of finished point type, possibly Snook Kill.

Still, the idea that Genesee technologies might be associated with the broad point trend was not proposed until Kinsey (1972: 345) observed a resemblance. Because he was still making use of Ritchie’s dates, though, he only suggested that it might have been an early “prototype.” Funk (1976: 261) was the researcher who first provided evidence that Genesee bifaces did in fact occur during the time of the “Broadpoint Horizon.” In eastern New York, his work on the Shagabak site found that Genesee bifaces tended to occur in deposits with Snook Kill, Perkiomen, and Susquehanna Broad (1976: 261). In one case, at the Oatman site, a pure Genesee component was uncovered (Funk 1976: 261). This new evidence suggested that Genesee was not a part of the Laurentian tradition, but a tool type that sometimes appeared independently, and that appeared much later in time. Funk (1976: 263) estimated that the Genesee bifaces must have had an age somewhere between 3900 and 3600 B.P. based on the radiocarbon dates from the Frontenac Island site.

While the more easterly broad-bladed bifaces were recognized as being related to the Genesee technology observed in New York, the broad-bladed, and broad-stemmed, bifaces of southwesternmost Ontario, at first, were seen as representing an entirely different, much earlier, time period. Originally named “Satchell,” the Genesee and Adder Orchard bifaces of southwestern Ontario, much of Michigan, and the northern border of Ohio, were classified as belonging to the Early Archaic or Late Paleo-Indian period (Kenyon 1980b; Stothers 1983; also see Peske 1963) of ca. 9000 - 10 000 years ago. The Satchell category encompassed stemmed and unstemmed lanceolate-shaped points now thought of as Adder Orchard forms (Peske’s [1963] Types I and II bifaces respectively), as well as a broad-shouldered triangular form that researchers now recognize as Genesee (Peske’s [1963] Type III). Other than their co-occurrence on the Warner School site, Michigan (Roosa 1966), the major unifying characteristic of Satchell was that the points
were all made from coarse-grained materials. These coarse materials were often erroneously called “argillite” (see Peske 1963), but they are now recognized as including subgreywacke, slate siltstone and other coarse-grained rocks (Kenyon 1980a, b). Some researchers also claimed that these bifaces were “crudely fashioned” (Stothers 1983: 29) but, as Peske (1963: 558) pointed out, this perceived “crudeness” is most likely due to the difficulty in working the coarser materials upon which they were made. These perceptions of crudeness might have influenced researchers to see them as much older than they truly were (on the basis of the misleading assumption that artifact quality might indicate something about its age). That consideration, the overall lanceolate shape, perhaps the fact that they “are often the largest "projectile points" used at any time from Paleo-Indian times onwards” (Ellis et al. 1990a: 102), and the observed parallel flaking on some that seemed reminiscent of western Late Paleo-Indian point types (Stothers 1983), lead many to believe that Satchell was indeed Paleo-Indian and dated to c. 9000-6000 B.P. (Kenyon 1980b: 17; Stothers 1983; also see Peske 1963: 561).

The first to relate the Satchell bifaces to the Late Archaic broad point trend was Roosa (1966), based on the relative depth of the points in the deposits at the Warner School site. Kenyon (1978, 1980a, 1980b: 17) lent support to Roosa’s ideas by noting that a large “Satchell” site in the Ausable River valley in southwestern Ontario, the Davidson site, would have been located in an area that would have found itself two meters below the water levels of Lake Nipissing from more than 10 000 years up until 4000 B.P. He was also able to retrieve a radiocarbon date of 3830 ±85 B.P. from the site (Kenyon 1978, 1980a: 11), making a very strong case that “Satchell” should be considered a Late Archaic technology (when the date is corrected for isotopic fractionation it is closer to 3760 ±90 B.P.; Eastaugh et al. 2013). Since then, radiocarbon dates have further confirmed that technologies that investigators have related to the Broad Point horizon began approximately 4000 B.P. (Fisher 1997) and lasted to about 3400 B.P. in Ontario (Eastaugh et al. 2013; Robertson et al. 1997).

The next insight that aided in our understanding of the broad-stemmed bifaces in Ontario was when Kenyon (1980b) began to question the validity of the Satchell taxon. The typology in place that separated “Satchell” from “Genesee” was similar to the typology
that differentiated “Lehigh” from “Koens-Crispin” in New Jersey. It seemed that all “Satchell” identified was the regional use of locally obtainable coarse-grained materials (Kenyon 1980b: 18). Kenyon (1980b: 18) observed that “there [was] little difference between the chert stemmed points found in the Late Archaic sites of the Niagara Peninsula and New York State and the greywacke points of the Ausable valley Satchell.”

The same problem arose when researchers delineated the distribution of “Satchell” in Michigan: some said that the type did not extend to the southwestern region of the state (see Robertson et al. 1999: 100). However, Peske (1963: 559) like Kenyon, had pointed out that stemmed forms similar to those that existed in the Satchell complex could be observed in southwestern Michigan. These bifaces were simply made from chert instead of coarse-grained materials. The same situation can be observed in Ohio. For example, the northwestern Ohio site, Freeworth, is a classic “Satchell” site with all lithic tools made from a coarse material (Stothers 1983). Conversely, the Burell Orchard site, in northcentral Ohio, contained many bifaces of a narrow-bladed Satchell form, all made on chert (Redmond and Scanlan 2009). The final blow to the Satchell taxon came in 1981, when Ellis and Deller were able to record the existence of another broad point site in the Ausable River area: Adder Orchard (Kenyon 1983: 7). The site assemblage was composed of Peske’s Type II stemmed, narrow-bladed forms, 93% of which were made from chert (see Kenyon 1983: Table 2). Therefore, the “Satchell” classification had lost its usefulness in Ontario literature. Once aware that both broad and narrow-shouldered bifaces existed on both coarse-grained and chert materials in Ontario (Kenyon 1983), researchers began to turn to the “Genesee” (broad-shouldered) and “Adder Orchard” (narrow-shouldered) categories used today (see Ellis et al. 1990a, 2009; Fisher 1997).

Once he made the connection between the broad-stemmed bifaces on chert and those on coarser grained materials, Kenyon began to investigate their distribution. Kenyon (1980b) noted that Broad Point occupations in Ontario are not generally observed north of the Carolinian forest—which he attributed to the fact that the people who used this technology (and maybe the technology itself) were adapted to living in this particular kind of environment. Later though, a collection of broad-bladed bifaces were recovered from the Inderwick site of the Rideau Lakes area (Watson 1981), and the MacFarlane collection was documented in the Trent waterway (Ellis et al. 1990b)—far north of the
delimitation of the Carolinian ecological zone. These observations suggest that there are other Genesee sites to the north, but that they simply have not been recorded because far less survey work has been conducted there.

As Kenyon (1980b) continued to study the spatial distribution of the broad points in Ontario, as well as the distribution of their characteristics, he noticed some trends. First, he noted that the forms in Ontario were generally broad-bladed, compared to a Satchell site, Pinegrove, in Michigan (Kenyon 1980a: 15). Because the two radiocarbon dates taken from the Pinegrove Cemetery site were rather late in time (3010± 110 and 3305± 135 B.P.; Simons 1972), he suggested that the variation in shoulder broadness might reflect changes over time. Kenyon (1980a: 15-16) drew a parallel between the narrowing of Genesee points over time and the replacement of the Lehigh/Koons-Crispin type with the narrower Susquehanna Broad in the Delaware Valley.

Next, Kenyon (1980b) noted that the stem form of broad points also displayed variation. He noted that some stems, such as from the bifaces of the western Davidson, Sadler, and Desjardins sites, were long and rectangular. Other bifaces from the more eastern Hamilton Golf Course and Weir sites tended to be shorter and constricted at the base (Kenyon 1980b: 36-38). Much like shoulder broadness, he proposed that it was possible to seriate bifaces over time based on what kind stem the biface displayed. Because of the relatively early date of the Davidson site bifaces, as well as their resemblance to Savannah River stemmed bifaces, Kenyon proposed that those bifaces with long rectangular stems were the earliest, and later people began to make bifaces with shorter constricting stems (Kenyon 1980b: 36-38). When Kenyon (1981) later conducted a metric study on the bifaces of the Surma site, and Fisher (1987) conducted a study on the bifaces from the Parkhill site, their measurements easily allowed for these collections to be placed into Kenyon’s (1980b) chronology. When Kenyon (1983: 11) added the data he collected from the bifaces of the Adder Orchard site, he was convinced that early broad points resembled the Genesee-type bifaces, with broad shoulders and rectangular stems. Over time, he said, people in the west began to make narrower-bladed forms that retained their rectangular stems (like those seen at Adder Orchard and Pinegrove Cemetery), where in the east they began to make forms that retained their broad shoulders, but that
had shorter, more constricted stems (Snook Kill-like bifaces, like at Weir in New York; Kenyon 1983: 11-12).

Kenyon’s (1980b) hypothesis seemed able to classify most broad point collections in Ontario (save the bifaces from the Brodie site (Fisher 1987: 16), however, that may have been because some Woodland stemmed bifaces were included in that collection, confounding comparison; Chris Ellis, personal communication 2015). And yet, further investigation at the Adder Orchard site seemed to suggest the situation was more complicated than Kenyon (1983: 11) had suggested. The Adder Orchard site was revisited by Fisher in 1989, when she was able to obtain three radiocarbon dates: 3950±130 B.P., 4000±90 B.P., and 4040±100 B.P. (Fisher 1997: 1, 91). Based on these dates, along with the single date retrieved by Kenyon (3900±90 B.P.; 1983: 9), Adder Orchard bifaces actually seemed to be older than the Genesee bifaces in Ontario (Fisher 1997: 91). Kenyon’s chronology was unable to withstand this new evidence. Instead, Fisher suggested that Genesee and Adder Orchard technologies reflected communication with the east and with the west/southwest respectively (Fisher 1997: 94). She believed that Adder Orchard points could be related stylistically to the narrower bladed “broad points” such as Etley points found in Illinois or the Stringtown points of Ohio or the Pinegrove site, Michigan, recoveries — though the exact relationship of Adder Orchard to these western forms was unclear (Fisher 1997: 93).

Another metric study was then conducted on the Genesee bifaces recovered from the Peace Bridge site of Fort Erie from the 1994-1996 excavations, as well as the 1997-2000 excavations. Once the measurements had been collected, their haft element statistics were compared to those collected by Kenyon (1980b) and Fisher (1987; see Austin and Jenkins 2006: 390; McEachen et al. 1997: 333). Upon comparing the standard deviations of each sample to the standard deviations of all the samples taken together, it was determined that there was more intra-sample variability than inter-sample variability (Austin and Jenkins 2006: 390; McEachen et al. 1997: 333). Therefore, they argued that it would be unwise to make a second attempt at creating a seriation for the bifaces (McEachen et al. 1997: 333).
While Fisher is likely correct that Genesee bifaces have their origin, or, at least a closer stylistic relationship, to the east of Ontario, the chronological relationship between Genesee and the neighbouring form, Snook Kill, is still relatively ambiguous. As shown above, Snook Kill components in New York continue to date 200-400 years younger than the earliest dates from the Davidson site in Ontario. It is also true that Genesee components are recovered in New York, including eastern New York (such as the Oatman site; see Funk 1976: 261). Therefore, it is still feasible that the initial broad-bladed biface type in the New York-Ontario region might have been more Genesee-like, as Kenyon (1983) suggested and, as time passed, practices in the New York region diverged towards making Snook Kill-looking bifaces. And certainly, that is the time-line also proposed by Funk (1993:224): “Genesee points probably appeared throughout New York ca. 1900-1800 B.C. and Snook Kills around 1800-1700 B.C.” We need more dated Snook Kill and Genesee components in the New York region in order to further investigate the relationships of these eastern forms, however.

Kenyon’s (1980b) study on Genesee biface form was expanded upon by Burgar in 1985. He conducted a very thorough metric study on a large sample of Genesee bifaces from across Ontario. Unlike Kenyon’s studies, Burgar (1985: 73) focused solely on Genesee bifaces, excluding both Adder Orchard and Snook Kill types from his analyses. Something else that made Burgar’s (1985) study unique was that he prioritized the investigation of spatial relationships over temporal ones (not that Kenyon [1980a, b, 1983] ignored spatial distributions of traits). In his analysis, he derived 10 regions of like Genesee bifaces based on metric comparisons (Burgar 1985: 114). Like Kenyon (1980b), he found that the stem of the biface was the element that varied the most predictably across regional samples. He also determined that different areas had statistically significant variations of Genesee haft element. Burgar (1985: 131) interpreted the loci of different variants as representing different band hunting territories. Finally, he determined that these regions tended to be associated with a certain physiography: low-relief areas in oak forests, near river systems (Burgar 1985: 122-123, 126), confirming many of Kenyon’s (1978, 1980a, b) observations.
Burgar’s (1985) interpretation of Genesee biface variation and its relationship to different communities of people was interesting, but it appears that not all groups were as mobile as he had believed. Years later, when ASI was conducting an archaeological assessment in Fort Erie in preparation for construction at the Peace Bridge, a very large Genesee site was excavated (Williamson 1997: 1). The earliest radiocarbon date recovered from the Genesee component of the Peace Bridge site was 3580 ±60 B.P. (Robertson et al. 1997: 497); some years after the initial Genesee technology use at the Davidson site. The Peace Bridge site seemed to represent, not only a large occupation site, but also an intensive quarry site (Robertson et al. 1997: 505). Those who resided at Peace Bridge seemed to have built a semi-permanent settlement there, an interpretation based on ASI’s identification of certain feature clusters as possible structural living floors (Robertson et al. 1997: 499, 505). ASI was also able to collect evidence demonstrating that the settlement at Peace Bridge would have been very able to support itself with harvestable resources such as nuts and fish, for both walnut shell and netsinkers were recovered from several of the site’s Genesee-associated features (Robertson et al. 1997: 497). In Kenyon’s (1978, 1980a, b) own reports and publications on the Davidson site, he also emphasized how important nut collecting must have been to the people of that time. Additionally, though he did not find fish remains, he did write that the sites of the Ausable River Valley seemed to have been well-placed for fishing (Kenyon 1978: 13). The procurement of nuts and fish would have helped to support larger settlements of people, and perhaps allowed for semi-permanent occupations of sites.

When the Davidson site was revisited in by Chris Ellis for the field seasons between 2006 and 2015, careful excavations revealed a complex distribution of features there as well (Eastaugh et al. 2013). Though no structures were uncovered, a pit hearth, a large bell-shaped storage pit, smaller pits of unknown function, and middens (refuse-filled erosional channels) were recorded (Eastaugh et al. 2013: 282, 288). Again, these features were thought to indicate relatively long, probably seasonal, periods of occupation. Such things as deer, turtle, and fish faunal remains, as well as strawberry, raspberry, pin cherry, grape, butternut, hickory nut, beechnut, oak acorns and black walnut floral remains were recovered from the site (Eastaugh et al. 2013: 293; Kenyon 1978: 10; Chris Ellis, personal communication 2015). These kinds of foods were likely procured during the
months between early summer and fall (Eastaugh et al. 2013: 293). It was also argued that the large storage pit, which was constricted around the top, was a winter storage pit (Eastaugh et al. 2013: 293; Ellis et al. 2015: 56). Their argument was inspired by the description of ethnographic cases where in-ground storage was used to protect surpluses when sites were abandoned. They believed that this storage method suggested that foods might have been left behind, in order to have been reclaimed during return trips to the site in times of scarce resources, such as wintertime or early spring (Eastaugh et al. 2013: 293; Ellis et al. 2015: 56).

Another notable feature is the immense size of the Davidson site. Ellis (2008) commented that he has never seen such a large site as Davidson for this time period. More than size, five statistically significant, evenly-spaced loci of Genesee-aged material were identified over the 1.9 ha site (Eastaugh et al. 2013; Keron 2015). Though these may represent the re-occupation of this site over many years, the fact that they are so distinctly and evenly spaced, and seem to have witnessed the same activities, may suggest that the site was occupied at the same time by socially distinct groups (Keron 2015). Therefore, the kind of settlement-subsistence patterns suggested by the Peace Bridge and Davidson sites have very different implications for information-sharing and social relationships than what was conceptualized by Burgar (1985).

Since researchers first began to investigate Genesee bifaces, this artifact type has challenged many of our assumptions. They went from being perceived as very old, sometimes “crude” tools used by highly mobile hunters, to being perceived as part of a wide-spread technological trend that demonstrates a connection between the semi-sedentary communities of the southern Ontario region to distant places. They have led researchers to investigate the relationship between raw material and constructed typologies, and to question the relationship between a tool’s form and its function.

2.1.3 Manner of Transmission

Because broad points are perceived as being so unique and recognizable, many researchers have used them to study how technological trends can span such large areas. Since a relationship between different broad-bladed biface types was first suggested,
researchers have been investigating the nature of the connection between different forms (see Cook 1976a; Custer 1984; Pagoulatos 2010; Sassaman 2001, 2006; Turnbaugh 1975). Early on, it was debated whether the Broadspear Horizon was the result of migration (the position taken by Turnbaugh [1975]) or the diffusion of technology (Cook’s [1976] stance on the matter). Other researchers have been more hesitant to use this continent-wide classification as a unit of analysis for processes that tend to occur on much smaller scales (see Cross 1990; Pagoulatos 2010; Sanger 1975). These questions are still of importance on these smaller scales, however, and researchers continue to investigate them for specific regions. Of late, large material exchange networks seem to be one of the best explanations in certain regions for the diffusion of technology over large areas.

As researchers were observing relationships between broad-bladed biface forms, and noting the progressively younger dates of the more northern forms, Turnbaugh (1975) proposed his Broadspear migration hypothesis. Based on the research that had been completed up to that point, he observed that many coastal sites between Florida and Maine, especially along the salt water estuaries, had broad points (Turnbaugh 1975: 54). He believed that there was sufficient evidence that the broad point spread fulfilled the five criteria outlined by Rouse in 1958 that were necessary to demonstrate migration (Turnbaugh 1975: 57). He proposed that these coastal sites were all occupied by people belonging to the same marine-adapted “culture,” who had migrated up the coast, relatively rapidly, originating from the Savannah River drainage region (therefore, the “homeland” of broad point-using people was known, fulfilling two of Rouse’s criteria) (Turnbaugh 1975: 54). Turnbaugh thought the sudden presence of broad point using people interrupted the Narrow Point sequences of previous peoples, fulfilling another of Rouse’s criteria (Turnbaugh 1975: 56). Finally, Turnbaugh believed that stone vessels, pottery, and marine exploitation always co-occurred in a culture “package” that spread into the new areas (Turnbaugh 1975: 57) — again suggesting that it was one group of people were expanding instead of a shared material culture.
According to Turnbaugh, the toolkit, namely the broad point, was what supposedly gave these migrating people an adaptive advantage to exploit marine resources, allowing them to undergo population growth, and encouraging them to spread up the coast.

In the 1970s, archaeology mostly operated within a culture-ecological framework (Ritchie 1985), and Turnbaugh’s migration hypothesis was no exception. He tied the proposed migration of broad point-using people to the warm period that occurred at 4000 BP, which he said raised the ocean water levels, creating new, rich environments (salt marshes) to be inhabited by people (Turnbaugh 1975: 59). Not only would the warming event create new productive environments for broad point users, but he also suggested that it would have influenced the time of year when shad—an anadromous fish—would have travelled up-river to spawn (Turnbaugh 1975: 60). He believed that the broad point-using people were greatly dependent on fish, particularly shad (though no evidence except for the distribution of broad point occupations along the coast was given for this interpretation), and with the warming event, the shad would have spawned earlier and earlier in the year. Therefore, Turnbaugh (1975: 64) proposed that for the people to continue to procure shad as a major food source at the same time of year, they would need to move north to intercept them. This explanation fulfills another of Rouse’s criterion—it explains why there might have been a movement of people.

Cook’s response in 1976 criticized Turnbaugh’s migration hypothesis. Though he agreed with Turnbaugh that the broad point represented a “horizon” that could be used as a reliable temporal marker, he believed that the broad point spread had more to do with it being a technological innovation that was adopted by groups already living to the north, and that it did not represent the expansion of one cultural group (Cook 1976a: 350). Cook (1976a) questioned whether or not the “broad point spread” truly met all of Rouse’s criteria for a migration. He considered other aspects of material culture associated with broad points, finding that different artifacts (like pottery and soapstone vessels) did not always co-occur with broad points like Turnbaugh had suggested, or with each other for that matter, so he believed it was more likely that these different kinds of material culture were differentially adopted by local groups (Cook 1976a). He also found that certain activities, like mortuary practices and subsistence activities seemed to differ from place
to place—particularly between the north and the south (Cooke 1976a). This argument cast doubt, not only on Turnbaugh’s migration theory, but the very idea that a “Broad Point Culture” even existed.

Secondly, Cook questioned Turnbaugh’s explanation for why the migration might have taken place. Cook (1976a: 348) did not believe that it would have been likely for people to follow the shad spawning north simply to continue to exploit that resource at a particular time of year. He also questioned the correlation Turnbaugh made between broad point technology and anadromous fishing. Cook countered that occupations along the coast generally seem well-adapted to exploit the natural marine resources, whether or not broad points were used (Cook 1976a: 348). While Cook (1976a: 353) suggested that broad points may have been functionally useful for either procuring or processing maritime resources, which might have explained the rapid spread of broad point use up the coast, he noted that fishing technology was well-developed in certain coastal areas before and after the Broad Point horizon.

Cook proposed what he believed to be a more plausible explanation for the spread of broad point technology. First, he argued that because band societies do not have very rigid boundaries, there would have been much information sharing between people and, as a result, the material culture between groups would overlap (Cook 1976a: 350). Based on this model, he stated that peoples living closer geographically should resemble one another more than the geographically distant, because there would have more contact between them (Cook 1976a: 350). A second way for the broad point to have diffused through the east, Cook (1976a: 348) suggested, would have been through the networks that must have existed to exchange steatite and other lithic materials. Cook’s (1976a) ideas on how exchange networks could have not only facilitated the interpersonal relations for information exchange, but also could have transported the broad points themselves, were expanded upon in later broad-bladed biface studies.

More recently, Pagoulatos (2010) wrote an extensive review of the Broad Point Horizon, suggesting that the technological spread was more complicated than either Turnbaugh or Cook had originally proposed. He argued that, depending on the region, a combination of
migration and technology adoption contributed to the spread of broad-bladed bifaces (Pagoulatos 2010).

Sassaman (2006: 76-77) has argued that there were two migrations from the Savannah River drainage by broad-point using peoples. The first migration event seemed to have been when Mill Branch groups left the area approximately 4450 B.P. — likely because new groups of people had begun to settle in the area (who Sassaman calls “Early Stalling people”) (Sassaman 2006: 76-77). New occupations were established in the uplands of Northern Georgia (Sassaman 2006: 78). Later, Classic Stallings people also abandoned the area by about 3800 B.P. (Sassaman 2006: 154). According to Sassaman, people moved from the area partially because there was a shortage of resources (Sassaman 2006: 155). New settlements seem to have been established up-river and down-river from the Stallings Island site (2006: 169-170). In each case, the movement of these groups into new areas would have meant that new communities would have been exposed to Savannah River stemmed technology, and these broad-bladed bifaces might have been adopted by them.

In the New England region too, the migration of groups is thought to have brought the broad-bladed bifaces to the area. Dincauze (1972: 58) was the first to suggest that Atlantic technology was introduced with the “slow trickle of foraging bands,” brought to the area by “a population expansion of some sort.” Bourque (1975: 43) agreed with this interpretation, explaining that he believed the sudden and drastic change in subsistence strategies and mortuary practices observed at the Turner Farm site, as well as other sites in the area, indicates the arrival of new groups. Bourque suggests that the in-coming groups came from the southern New England area (Bourque 1975: 43). Sanger (1975: 69) added that this migration seems to have brought people even as far as New Brunswick. He also argues that the cause for these migrations was likely environmental change including the northward expansion of oak forests (Sanger 1975: 70).

In other cases, it would seem that broad-bladed forms were introduced through the diffusion of information and the adoption of new technology by local communities. Pagoulatos (2010: 175-176) cited an example of broad points gradually being taken-up by
many local groups in the Delaware River drainage. The site, 28ME100G, seems to have been made up of different loci of artifacts—and while two of those concentrations were predominantly Broad Point, and one concentration was predominantly Narrow Point, the fourth one was made-up of a combination broad points and narrow points (Pagoulatos 2010: 175-176). The site 28ME100G lent evidence to the idea that narrow point-using people slowly began to make and use broad points instead, without a sudden interruption in biface style or lifeways.

As Sanger (1975: 61) argued, in-situ hypotheses, which propose that change took place in local practices without great movements of people, cannot be treated as the default when migrations cannot be demonstrated. He believed that archaeologists should endeavour to explain those hypotheses as they would migration. Many researchers have proposed explanations and models for how exchange might have encouraged broad-bladed technology to have been taken-up by multiple local communities.

In 1984, Custer proposed that the technological trend spread through raw material exchange networks. Many researchers had noted that particular lithic materials were being chosen to make broad-bladed bifaces. For example, Witthoft (1953: 8) pointed out that the majority of Susquehanna Broad bifaces were being made on rhyolite, and Kinsey (1972: 349) noted that many Lehigh bifaces were made on jasper (and Koens-Crispin were made from argillite). Broad-bladed biface typology became so entwined with raw material use that Kinsey (1972: 349), as previously mentioned, argued that raw material became an aspect of a biface’s classification.

When Stewart (1987) conducted a study on the quarry sites around the Blue Mountain rhyolite outcrops of Pennsylvania and Maryland, he found that “artifacts diagnostic of the Late Archaic through Middle Woodland periods [were] extremely well-represented,” including “Broadspear” varieties (Stewart 1987: 53). Stewart (1987:53) proposed that the intensive use of rhyolite in this period was related to its wide-spread exchange. He even went so far as to suggest that the regular-looking biface blanks were produced by “part-time, or perhaps seasonal specialists… as a response to anonymous consumers, or consumers with highly variable needs,” (Stewart 1987: 54). While equating past peoples
with modern-day consumers of a capitalistic system may be problematic, the idea that those people who lived nearer to the raw material outcrops became experts in making blanks that were then exchanged to those who lived further away is interesting. Recent research has found an absence of rhyolite cores and reduction flakes on Susquehanna sites of the Susquehanna drainage (Pagoulatos 2010: 174), supporting that exchange took place, and suggesting that it was the exchange of Susquehanna Broad preforms or completed bifaces.

Based on the wide-spread use of common materials, Custer (1984) outlined the role that exchange likely played in people’s lives. He suggested that as people were forming new relationships with their landscape, they might have redefined their relationships with other communities as well (Custer 1984: 39). Custer (1984) discusses two types of exchange networks that might have existed in Pennsylvania: his “localized” model and his “chain” model (41-42). He argues that while localized exchange systems could have been maintained through social relationships, the same kinds of exchange would have been difficult to maintain over very long distances. According to him, a “chain” of exchange over a long distance, instead, would probably mean that group membership was relatively flexible, and “lithic exchange networks were carried out along the lines of groups using a fusion-fission cycle,” (Custer 1984: 42). He argued that both kinds of exchange existed in the Middle Atlantic (Custer 1984: 43). Not only did these exchange networks provide the means to obtain superior raw materials to accommodate high width to thickness ratios, he argued, but also exchange networks allowed for “symbolic status communication,” (Custer 1984: 40-41). That is, he believed that in encountering new groups it was desirable to signal ones status with the display of “exotic materials” to avoid conflict (Custer 1984: 41). However, he did not explain how this system would have been useful when it seemed as if almost everyone has access to these raw materials, and how this system would have benefited those communities who lived nearest to the raw material outcrops who also decided to make use of it for their own tools.

In his work on the Middle Atlantic region, Stewart (1994) continued to find that “finished artifacts appear to have been traded, as well as early- and middle-stage bifaces,” (Stewart 1994: 79). In addition to the large-scale “down the line” exchange model discussed by
Custer (1984), Stewart (1994) proposed that some groups likely also practiced “focused exchange.” In a down the line model, one would expect that the amount of raw material quarried from a specific source would lessen over greater distances (Stewart 1994: 77). Stewart explained that, in reality, the use of specific materials did not decrease uniformly as distance from the raw material source increased. Rather, bifaces made from specific materials were sometimes distributed in patches (Stewart 1994: 77-79). Focused exchange was described to be when “small groups… travelled outside of the region on sporadic trading missions” (Stewart 1994: 79). Those groups were said to then bring materials back to their communities, leading to higher concentrations in areas that could be relatively distant from the source area (Stewart 1994: 79).

In his own study, Pagoulatos (2010: 167) differentiated between two means of broad-bladed biface adoption: a “material acquisition model” and an “information flow model.” While his material acquisition model was suitable for those cases where communities had incoming complete and near-complete bifaces on raw material from afar, the information flow model was able to describe another situation. The information flow model was described as the exchange of ideas between groups coming in contact with one another (Pagoulatos 2010: 167). Creating these two separate models may be misleading, however, in that it suggests that material exchange did not take place in regions where local raw materials were used. As Cross (1990) demonstrated in his own research, that is not always the case.

Cross’ (1990) work on the Turner Farm, Hirundo, and Young site collections of Maine revealed interesting exchange patterns. Although relatively local materials were used, it seemed as if those who manufactured the preforms were different individuals from those who retouched them later (Cross 1990: 182, 194, 202). He says that those who knapped the preforms were much more skilled, and were able to apply broad and shallow flaking, whereas those who retouched the bifaces caused many step-fractures (Cross 1990: 202). His argument was much like that of Stewart (1987), where it was argued that those who made preforms were skilled specialists. This evidence might suggest that exchange networks might be related to raw material preference in some cases, but in other cases they were driven by more than a functional desire for the highest quality material. It also
might suggest that, though social connections were valued, they seem to have been valued for themselves, rather than as a display of status for the sake of other communities. Cross (1990: 246) argues that “at the local or site level… the production and use of Susquehanna Tradition bifaces establishes a forum for participation in the social relations which define the group, and perhaps creates ties with other groups.” He claims that the exchange of bifaces helped to create interdependence between individuals, and households, therefore creating stronger social connections than would otherwise exist (Cross 1990: 243).

2.1.4 Introduction into Ontario

As previously discussed, the Genesee biface of Ontario seems to exhibit more stylistic ties to the east, making its way into the region by at least 3800 B.P. Ellis and colleagues (1990a: 100) believe that in Ontario the broad point tool was something that was adopted by local groups living in the area, and that in general, the lifeways of people stayed the same. Since the excavation of the Peace Bridge site, it has been proposed that extensive Onondaga chert exchange networks were established on the Niagara Peninsula, which is what facilitated the diffusion of the Genesee technology to the west.

The Peace Bridge site has been interpreted as an intensive quarry site inhabited with semi-permanency, whose inhabitants seem to have manufactured Onondaga products and widely distributed them (Robertson et al. 1997: 505, 507). Williamson and MacDonald (1998: 30-31) have argued that environmental changes on the Niagara Peninsula that took place 3900 years ago might have influenced the Onondaga exchange network. According to Pengelly (1997), two lakes existed within Lake Erie’s drainage throughout both Nipissing phases. The first, Lake Wainfleet, was located on the Niagara Peninsula, and the second, Tonawanda, extended into New York. The water levels of both lakes began to decrease after 3900 years ago, disappearing completely by about 3780 +/-80 B.P. (Pengelly 1997). This date corresponds very closely to the first examples of the Genesee biface in what is now known as Ontario. The environmental change might have caused the people living on the Niagara Peninsula to redefine their relationship with their landscape, both on the western side of Lake Wainfleet, and to the east of it. The disappearance of this large lake might have encouraged people to move into and make
use of areas that had been previously under water, or seasonally flooded. In particular, Williamson and MacDonald (1998: 30) believe that these changes in water levels would have allowed for the settlement around a new outcrop of Onondaga: the Fort Erie outcrop upon which the Peace Bridge site was established.

It is possible that the access to new resources and the loss of old ones was only one of the outcomes of the lakes’ withdrawal. It could have also brought people, who had previously been living on either side of Lake Wainfleet, in closer contact. This contact might have exposed communities living on the western side of the former lake to the broad-shouldered technologies that existed in the east. Alternatively, the disappearance of the lake might have encouraged people living to the east of it to move into the area, bringing their technology with them.

Again, this hypothesis is only a possibility, and it does have some inherent problems. To start, the earliest date retrieved from Peace Bridge is approximately 300-400 years later than the initial occupation of Davidson. Next, other Onondaga outcrops in the Grand River region were also used at this time (Robertson et al. 1997: 495), and Onondaga was being exchanged prior to this time period for the purposes of producing Adder Orchard bifaces (Fisher 1997: 18). (Though Onondaga exchange does seem to have intensified between 4000-3800 years ago: Ellis and colleagues (2009) suggested that Kettle Point chert was used more heavily to make Adder Orchard points than to make Genesee points, while the reverse was true for Onondaga.) Therefore, the Peace Bridge quarry site itself may not have been of great importance to the introduction of Genesee technology to Ontario, though it seemed to have become important for Onondaga exchange by at least 3600-3500 years ago.

Regardless of when the Peace Bridge quarry became important, Williamson and MacDonald (1998) argue that the sizeable quarries uncovered at Peace Bridge are evidence for the exchange of Onondaga material with people of the surrounding region. Similar to observations of rhyolite exchange reported by Custer (1984), Stewart (1987, 1994) and Pagoulatos (2010), Onondaga appears to have been exchanged in the form of worked products such as Genesee bifaces and preforms (Williamson and MacDonald
Kenyon (1981: 5) also noted that more Onondaga Genesee preforms were recovered from the Surma site than the Davidson and Sadler sites—suggesting that the exchange of more complete Genesee bifaces took place more often in places that were further from the outcrop.

Similar to the situation observed by Cross (1990) in Maine, it would seem that material exchange also took place even when both parties had access to Onondaga material. In 2003 Clark completed a study on INAA sourcing of the Onondaga of Genesee bifaces in order to investigate Onondaga exchange. He found that the material for one biface, though found on the Peace Bridge quarry, actually originated from an Onondaga outcrop on the other side of the Niagara River (Clark 2003: 125, 130-131). The results of Clark’s (2003) study may also support the position that the community of Genesee-making practice on the Niagara Peninsula came to be through interactions with groups in New York.

Therefore, though previously there have been debates over whether it was the migration of broad point-using people, or the diffusion of the idea of the broad-bladed biface itself that left such a widespread horizon throughout eastern North America, it would seem that this technological trend is made up of both migration and technology adoption events. For example, arguments have been made that the change in technological systems followed the movements of people in the Savannah River area and the New England area. Elsewhere, assemblages seem to suggest the adoption of the technology by local peoples. The wide-spread adoption of broad-bladed bifaces often seems to be tied to the choice to use specific raw materials, as well as building social relationships through the participation in exchange networks. For example, the exchange of rhyolite preforms seems to have been a factor in the adoption of the Susquehanna Broad biface in Pennsylvania and New York, and the exchange of Onondaga seems to have encouraged the adoption of the Genesee form in Ontario. Additionally, Cross (1990) and Clark (2003) were able to identify material exchange even when local raw materials were in use, suggesting that exchange is not exclusively tied to acquiring desirable materials, and regardless of its purpose, it seems to help to facilitate building and maintaining communities of practice whereby certain technologies can be reproduced and used.
2.2 Broad point function

The unique form of many broad points—namely being remarkably large, broad bladed, and many forms being relatively thin—has elicited much discussion as to their function. Especially in the 1970s, when it was thought that there was a utilitarian reason for its wide-spread diffusion (see Cook 1976a; Kinsey 1972; Turnbaugh 1975), determining the uses of the broad-bladed bifaces was framed as being very important. The Perkiomen form first described by Witthoft, and its proposed function, seems to have had the most attention in the literature of all the broad point forms (Granger 1988; and see Custer 1991; Dunn 1984; Staats 1986; Truncer 1990), though some authors have also discussed the uses of other types, including the Savannah River stemmed (see Sassaman 2006, 2010); Snook Kill (see Funk 1993; Ritchie 1965, 1969); Atlantic broad (Bourque 1975, 1995); and of course Genesee (see Ellis et al. 1990a, b; Snow 1980).

For the most part the debate has revolved around three possible uses for the broad-bladed bifaces: as a fishing spear, a projectile point, or a knife.

2.2.1 Broad points and fishing

Many researchers have noted the tendency of Broad Point occupations to occur on marine coasts and rivers (see Coe 1964; Kenyon 1980a, b; Kinsey 1972; Pagoulatos 2010; Ritchie 1965; Turnbaugh 1975; Witthoft 1953). Researchers of the James River valley area, Virginia, have noticed that the occupations of people when they began to use Savannah River stemmed are found near rivers 96% of the time, when previous occupations were only located near rivers 56% of the time (Pagoulatos 2010: 171). Similarly, in the Connecticut River drainage, there seems to have been a shift from past peoples having occupations both in the uplands and near rivers, to people predominantly occupying riverine environments (Pagoulatos 2010: 177).

In light of these occupation patterns, it is not a surprise that for a long time researchers have searched for a relationship between the broad biface forms and marine and riverine resources. Kinsey (1972) was the first to suggest that broad-bladed bifaces were especially tied to fishing and marine resource collection. He argued that the broad shoulders on these bifaces would have made it more difficult for them to penetrate the
tough hides of deer, but that they might have worked well to spear the “softer flesh of fish” (Kinsey 1972: 346). He went on to say that the wide shoulders might even have been advantageous for spear-fishing, suggesting they might have embedded themselves like barbs (Kinsey 1972: 346). Turnbaugh (1975) expanded upon this idea, suggesting that broad points were specifically developed to spear anadromous fish along the coast. Cook (1976a) agreed that broad points must have been well-suited for a role within a fishing economy for the technology to have spread so quickly (though not necessarily as a fishing spear tip).

Ritchie’s (1969: 43) work on Martha’s Vineyard seemed to suggest that deer hunting was of great importance to Snook Kill-using people of that site, as the assemblages there produced large quantities of deer remains. Bourque (1995: 145) too noted a decrease in the procurement of marine resources with the appearance of the broad-bladed Atlantic bifaces. Sassaman (2010) also disagreed with the idea that there was any special association between broad point technology and marine or riverine exploitation. He said that while remains of anadromous fish have been found at sites along the east coast—such as sturgeon, shad, and salmon—they have only been found in small quantities. There are some sites in Maine (the Sharrow and Brigham sites) from which significant amounts of shad remains have been recovered, but this subsistence activity does not seem to be connected to the appearance of broad points in the region (Sassaman 2010: 159-163). He also pointed out that similar types of fish remains have been recovered from coastal Early Archaic occupations, arguing that coastal fishing did not seem to be especially associated with the Broad Point Horizon.

Sassaman says that though some fish hooks and some line weights were recovered at Stallings Island, it would seem that fish remains in the marine shell middens were relatively rare (2010: 167). He believes that Turnbaugh might have overestimated the importance of fishing at Stallings Island, because initially the great number of cooking stones recovered from the site were interpreted as netsinkers (Sassaman 2010: 167).

Recently, freshwater drum remains have been recovered from the Davidson site (Chris Ellis, personal communication 2015), not surprising as the site finds itself in a place that
would have been ideal for fishing (Kenyon 1978: 13). Kenyon (1980b: 22) had doubts about broad-bladed stone bifaces being used for spear fishing, however. He argued that fishing implements were generally narrower, smaller, and made from organic materials (Kenyon 1980b: 22). Custer’s (1991: 53) views were aligned with Kenyon’s (1980b), and he pointed out that even for large fish species, broad-shouldered spearheads are scarcely ever used. In most known spearfishing scenarios, the preference tends to be for narrow spearheads with barbs (Custer 1991: 53; Ellis 1997: 41-45; Kenyon 1980b: 22).

Additionally, the use of stone tips for spearfishing is extremely rare ethnographically (Ellis 1997: 41-45), and it might have been even more difficult to use them for intensive spear-fishing in the Great Lakes. In “The Walleye War,” the walleye spear-fishing practices of the Anishinaabe community of Lac du Flambeau were described during a time when they faced great pressure from settler-Americans to abandon these traditional practices (Nesper 2002). Using metal-tined spears, the community was very successful in procuring great quantities of walleye during their spawning season. People would fish at night when the fish were settled over the shoals of the lake (Nesper 2002). Nesper (2002: 22) suggested that even the more experienced fishers would miss their desired target one third to one half of the time. It was very likely that once the fish target was missed, the spear would hit stones. These spears would need their metal prongs sharpened often because of the wear that they endured (Nesper 2002). Materials that have more flexibility to them, therefore—such as metal, bone, or wood—may have been better suited to spear fishing over shoals than chert bifaces would have been. Chert (and stone in general) is incredibly brittle (Ellis 1997: 56), which makes it excellent to knap into desired shapes, but would make it especially vulnerable to being crushed whenever it struck stone. Indeed, generally the weapons used in spearfishing are used over and over to take fish in large quantities during spawning runs, and stone tips are too brittle to survive such repeated use very well – this is not as serious as problem with organic tips.

This observation does not preclude stone tips from ever having been used in the past to spear fish (especially if they were speared over muddy or sandy substrates). But, when we consider that there was probably a large part of subsistence technology of Geneseec-
using people that did not preserve, it might be more likely that people were making use of organic fishing spears, fish-traps, or nets to fish (see Cleland 1982).

In fact, I would argue that nets were being used to fish, either by themselves or as part of a larger tool set. At the Peace Bridge site, netsinkers were said to have been “ubiquitous” (Robertson et al. 1997: 497). On the Davidson site too, a fish gorge was recovered that is associated with the Broad Point component suggesting that line fishing took place (Chris Ellis, personal communication 2015). Additionally, another fish gorge, five netsinkers, a copper fish hook, and a bone harpoon were recovered (though none of these could be associated with the Genesee component with certainty). Freshwater drum (*Aplodinotus grunniens*), moves to warm lake shallows (less than 10m) during the warm weather months, while they would have been less available in the spring and fall when they would have shifted to deeper waters (Bur 1984). Finding this species is especially interesting, as the Davidson site was found near to the shore of the Thedford Embayment. Before the water levels decreased, the Thedford Embayment was a shallow bay off Lake Huron (Kenyon 1978). It would have acted as a favourable environment for the freshwater drum during the summer season. It would have been possible to capture this fish species with either nets (see Bur 1984), or by line-fishing methods (Needs-Howarth and Thomas 1998). Using nets to capture large quantities of fish requires the cooperation of large groups of people (Cleland 1982: 775), but that would have hardly been a problem at either the Davidson site or the Peace Bridge site. Of course, it is difficult to say how important freshwater drum was to the diet specifically, as only one specimen has been identified to date (the fauna has not yet been examined in any detail, not to mention the preservation problems which always surround the analysis of delicate fish remains). Still, these lines of evidence taken together suggest that fishing in general was likely an important activity, and fish nets were at least one of the fishing technologies used between 3800 and 3400 years ago.

Some researchers have proposed alternative explanations for the concentration of Broad Point sites along rivers. For example, though Ritchie (1965: 138, 151) believed that Susquehanna-using people procured fish, he did not believe that those communities who used Snook Kill bifaces made any great use of fish. He suggested that finding Snook Kill
sites on rivers had more to do with the choice to use boats for transportation (1965: 135). Kenyon (1980a: 12) suggested that the real relationship was between Broad Point sites and sandy plains that were often associated with rivers. Sandy plains support nut-bearing trees, like the butternut, hickory, beechnut, oak acorns and walnut (found at Davidson), and such a productive mast forest would have been a good habitat for deer (also found at Davidson) (Kenyon 1980a: 12).

While these other benefits might have been a factor in choosing a settlement location, I believe it is still likely that fishing was an important resource based on the evidence above. The Genesee bifaces do not seem to be a good candidate for the fishing technology used at that time, though, and it is more likely that line fishing and nets, and possibly other organic technologies, were used. It is unfortunate that biases in preservation favour mammal hunting technology over fishing technology in archaeological studies, especially in the distant past, as it is well-demonstrated that fishing was a very important resource for people living in the Great Lakes region in more recent times (Cleland 1982; Needs-Howarth and Thomas 1998).

2.2.2 Broad points: Projectiles or knives?

Many collectors and some of his colleagues (namely Henry Deisher) referred to the broad-bladed bifaces that Witthoft described in his 1953 paper as knives (Witthoft 1953). He reported that people generally perceived broad-bladed bifaces as knives “because they were often so broad, large, blunt and asymmetrical,” and it was difficult to envision this form as one that would be effective in penetrating animal hides (Witthoft 1953: 6). Witthoft (1953: 6), however, proposed that these bifaces were in fact projectile points based on three major pieces of evidence: Witthoft argued that there was not enough tip and edge-wear for the bifaces to have been used as knives, he said that basal smoothing that was present on these bifaces suggested that they were hafted spears, and finally other tools were made from broken Perkiomen points—this damage likely having been sustained from projectile use. Since this publication, a debate in the literature has endured for decades over whether broad points were used as projectiles or knives.
Cook (1976a: 353) was unconvinced that broad-bladed bifaces would have been effective for spearfishing or projectile use (though he agreed that the technology was likely an adaptation to more effectively access marine and riverine resources). He drew on Ahler’s (1971) description of cleavers in the Middle Archaic to make the case that Late Archaic broad points would have also been effective in such tasks, “as all have broad blades and wide, sometimes contracting stems-ideal for socketing,” (Cook 1976a: 353). (Later, Staats (1986) opposed using the word “cleaver” instead of “knife” to describe Perkiomen bifaces, saying that their stems were not robust-enough to survive being used as a cleaver). It was Cook’s (1976a) position, then, that the regional variants of broad points were different styles of knives. Custer (1984), similarly, argued that broad-bladed bifaces must have been knives, also using their general shape as evidence. Much like Cook (1976a), Custer (1984: 40) believed that the broad, thin blades made an optimal form for a knife, and would not have been as effective hunting projectiles as the previously-used narrow point technology.

As researchers continued to collect information on the varied types of broad-bladed bifaces throughout the east, they began to narrow their focus on the function of regional types, rather than speculating on the function of all broad points as an indivisible unit of analysis. Different use-wear studies have been conducted on the Savannah River stemmed bifaces of Georgia—where the broad-bladed trend is said to have begun (Pagoulatos 2010; Sassaman 2006; Sassaman et al. 2006). It would seem that these large bifaces of the Savannah River Drainage were only ever used as knives. While no impact fractures have been identified for these bifaces (Pagoulatos 2010: 160-161; Sassaman 2006: 123), laterally-oriented fractures are common (Pagoulatos 2010: 160-161). An additional piece of evidence that also supports this position was recovered at the Ed Marshall site in South Carolina. A Savannah River stemmed biface was found in close association to a deer-antler handle, and when the stem of the biface was placed inside the handle, they were said to have fit together very well (Sassaman 2006: 123). While experimental studies have succeeded in using Savannah River stemmed bifaces as projectiles (Pagoulatos 2010: 161), based on the results of use-wear studies it appears that that task was not what they were meant for. In other words, even though it was possible to use this tool as a projectile, it does not necessarily mean that it was used as a projectile.
The first to conduct a use-wear analysis on broad-bladed bifaces was Kinsey (1972). He conducted a use-wear study on a sample of 37 Perkiomen bifaces of the Delaware Valley, finding that “at least 75.0 per cent have been used as knives or cutting implements,” (Kinsey: 1972: 426), though he did not explain his use-wear analysis methodology.

Dunn (1984) presented a study that followed up on some of the ideas presented by Witthoft (1953) on the function of broad-bladed bifaces in Pennsylvania. In conducting a microscopic use-wear study based on Ahler’s (1971) observations on a sample of 75 broad bifaces (most Perkiomen, some Susquehanna Broad, and some Lehigh), Dunn (1984) came to the conclusion that they were more likely used by past peoples as knives. He often observed wear patterns that were heavier on one blade edge than on the other (Dunn 1984: 16), suggesting that the observed asymmetrical forms might result from knife-use. Finally, after adding a third sample of bifaces from the William Penn Museum, and a fourth from a private collector, he also conducted a macroscopic use-wear analysis. Dunn (1984: 17) found that of his sample of 190 bifaces, 40 displayed “transverse blade features.” Again, these features were said to be related to knife and cleaver use. Finally, he claimed that only a single biface displayed an impact fracture (Dunn 1984: 17). Dunn’s (1984) observation that only one impact fracture could be observed out of a total of 190 apparently strongly refuted Witthoft’s (1953) classification of broad-bladed bifaces in Pennsylvania as projectile points. Dunn’s (1984) study, however, does not seem to have taken into account any impact fractures outside of Ahler’s (1971: 52) definition of an impact fracture: “longitudinally oriented flake scars derived from the distal end of the blade.” Following this definition may have led him to look only for impact flutes, and caused him to greatly underestimate the number fractures actually present in the sample.

Staats (1986) and Truncer (1988, 1990), contrary to other researchers interested in the function of Perkiomen biface at the time, believed that they were sometimes used as projectile tips. Staats (1986) conceded that Perkiomen bifaces were likely used as knives, though he did criticize some of the assumptions that had led people to believe that they could not also have been used as projectile points. He stated that while most consider Perkiomen types to be asymmetrical with blunt tips (as per Witthoft’s (1953)
description), examination of the broad points themselves demonstrates that not all conform to this shape (Staats 1986). He found that many Perkiomen bifaces are symmetrical (though he was skeptical that asymmetry would be problematic for its function as a projectile), and that many have sharp tips (Staats 1986: 38-39).

Truncer (1990: 25) conducted a study on the use-wear of 492 Perkiomen bifaces from New Jersey, Pennsylvania, Delaware, Maryland, and Virginia. He first conducted an experimental study on replica Perkiomen bifaces, using them as knives and as projectiles and recording the kinds of fractures observed on the bifaces after each activity (Truncer 1990: 21-25). He found that contrary to popular belief, “neither the blade symmetry nor width negatively affected the penetration of the projectiles” in his experiment (Truncer 1990: 24). Using a more inclusive definition of “impact fracture” than Dunn (1984) (counting “snap-and-step, hinge, and burination”), he observed that 4 of 10 of his damaged experimental projectiles displayed diagnostic impact fractures (Truncer 1990: 24). When using Perkiomen replicas as knives, bifaces displayed transverse fractures across the mid-blade “when a prying motion was used,” (Truncer 1990: 24). When he conducted a macroscopic use-wear analysis on the archaeological Perkiomen bifaces, using the breakages he observed in his experiment to identify activities, he found that approximately 12% displayed diagnostic impact fractures, and 28% displayed medial transverse fractures (Truncer 1990: 25). He concluded that Perkiomen points were used for both butchery activities and as hunting projectiles (Truncer 1990).

Following Truncer’s (1990) study, Custer decided to compare his results with those of a study Custer had conducted in 1986. Custer and Mellin had conducted a use-wear study, examining 599 broad-bladed bifaces recovered from Delaware (Custer 1991: 54). In their study, they had found that less than 5% of the bifaces had impact fractures, yet between 40% and 70% of bifaces showed signs of use as knives (Custer 1991: 54). Custer (1991: 58) determined that between his own study, and Truncer’s, no more than 11% of a sample ever displayed impact fractures, and no less than 22% of a sample ever displays knife usage fractures. He compared these percentages with the percentage of narrow points and triangular points that display impact fractures. He reported that 45% and 55% percent of his narrow point and triangular point samples had impact fractures respectively.
Custer then compared the measurements of archaeological broad points to the optimal measurements determined for modern bowhunting projectiles. He found that most broad point forms fell outside the “optimal size range,” for the efficient penetration of a bowhead point. He claimed the largest width of a point could be 30 mm before its size greatly increased its risk of “bouncing” off the animal’s hide, and 65% of broad points in his sample exceeded that width. Therefore, though he allowed that some broad points were used as projectiles, he maintained his position that broad-bladed bifaces were primarily knives.

Further north, most researchers, with few exceptions, perceived broad-bladed bifaces as projectiles. Ritchie believed that hunting was the major subsistence strategy of Snook Kill-using people in New York. He interpreted the two existing sizes of Snook Kill points as having different functions, the smaller acting as throwing spears, and the larger as thrusting spears. Funk conducted a use-wear study on the bifaces he recovered on the Upper Susquehanna drainage, including Snook Kill and Susquehanna Broad types. Funk based his use-wear study on Ahler’s research. He found that 20% of Snook Kill bifaces in his sample displayed impact fractures, and a range of 8.7% to 22% of bifaces from his Susquehanna Broad samples displayed impact fractures. This evidence suggests that both biface types were used to tip hunting implements. He also argued that these bifaces were also likely being used as knives, documenting edge rounding in 40% of Snook Kill bifaces and 4.3% to 24% of Susquehanna bifaces. His study supports the idea that broad-bladed bifaces were multifunctional tools in the Northeast.

On sites in the far northeastern states, such as Massachusetts and Maine, faunal assemblages led researchers to believe that hunting had become more important when people incorporated broad-bladed bifaces into their subsistence technology. In strata containing broad-bladed bifaces at the Hornblower II site, the number of deer remains overwhelmed every other species. In Occupation 3, at the Turner Farm site, deer again made up most of the recovered faunal remains, while marine resources
seemed to decrease in importance from the previous occupation (Bourque 1995: 138-145).

However, faunal assemblages were not always taken as evidence that the broad-bladed bifaces were the tools used as projectiles. Faunal remains in the Savannah River drainage also seemed to suggest that people were hunting deer during Stallings Island times (Sassaman 2006: 123). In this region, and elsewhere, though researchers did not believe broad-bladed bifaces were used as a hunting technology, they allowed that people were likely hunting at this time. As a result, those researchers felt they had to look elsewhere for people’s hunting technology. Custer suggested that broad points were simply later add-ons to the Narrow Point tool set: “If broadspears are cutting tools, other projectile points would still be necessary items in tool kits, and the Bare Island/Lackawaxen points [narrow points] provide a possible candidate” (Custer 1984: 79). In Pagoulatos’ (2010) research in the Connecticut River Valley, he says that Narrow Point occupations are generally found in the uplands, and Broad Point occupations are usually found near the river. He reports that some argue that there was a seasonal movement between uplands and lowlands, where subsistence strategies required a different tool set (Pagoulatos 2010). In the absence of any radiocarbon dates associated with these occupations, however, this interpretation is only one possible explanation; another being that people in the area began to make use of new subsistence economies around the time they began to adopt broad-bladed biface technology.

Staats (1986) did not find Custer’s (1984) suggestion that people used narrow point bifaces as projectiles at this time convincing. If that were the case, he questioned why people would use argillite (“an inferior chipping material”) to make their narrow projectile points, and yet use “high-grade jasper for most of their [other] flaked instruments,” (Staats 1986: 40). Kraft (1990: 71) and Truncer (1990: 31) agreed with Staats’ (1986) position, Kraft (1990:71) adding that in the Upper Delaware Valley, Perkiomen components were consistently found above Lackawaxen components stratigraphically, and that they consistently dated later in time.
For the Savannah River drainage, Sassaman (2006: 123) has argued that socketed, conical antler points were used as projectiles during the Stalling Island occupation phase. As discussed, the Savannah River stemmed bifaces have yet to display impact fractures, and so Sassaman suggests that the bone points recovered must have been used for hunting. The suggestion that past peoples could use a hunting technology made from a material other than stone is not unprecedented. A paper written by Waguespack and colleagues (2009) conducted a literature review of ethnographies of contemporary hunter-gatherer groups from all over the world. They discovered that wood is the most frequently used material to make projectile points (Waguespack et al. 2009: 3). They stated that wooden projectiles are just as effective at piercing animal hides as stone projectile points (Waguespack et al. 2009: 1). Despite their assertion that bone and wood projectiles penetrate deeply, Ellis (1997: 46) concluded that the ethnographic literature indicates that stone projectiles are more lethal than organic points for large game. He argued that stone points have sharper edges, and would sometimes break in the wound, causing more tissue damage (Ellis 1997: 51). Wilkins and colleagues (2014) conducted an experimental study, comparing the damage of wood-tipped spears to stone-tipped spears in gelatin targets. They found that depth of penetration was virtually identical for both materials, but that larger and potentially more lethal wound cavities were created by stone-tipped spears (Wilkins et al. 2014: 8). Even though stone projectile points do seem to offer more “killing power,” both Waguespack and colleagues (2009: 3), and Ellis (1997: 41-45) found that sometimes groups still used organic points for larger mammal hunting. Whether or not organic points functioned as projectiles in place of lithic broad-bladed bifaces, however, is another question.

An interesting observation was made by Painter (1988: 21) in comparing archaeological sites around the North Carolina-Virginia border. He found that during the Late Archaic, two seemingly mutually-exclusive technological systems existed in the region. Around the Dismal Swamp lived those who used Perkiomen technology. Based on faunal remains, they procured mammals, birds, and fish that lived inland (Painter 1988: 24). Those who lived on the coast, named “Currituck” by archaeologists, had a very different material culture and made use of bone points for projectiles. The coast-dwellers subsisted on shellfish, fish, game, and birds (Painter 1988: 21). Painter (1988: 30) believed that
those living along the coast shared many similarities in their material culture with the Stallings Island phase of the Savannah River drainage to the south, whereas the people settled around the swamp shared more similarities with the Perkiomen biface users of the north. These sets of occupations are thought to have been penecontemporaneous (Painter 1988: 30), and therefore preservation bias is not thought to be a factor. In this case, antler and bone points do not seem to have occurred with Perkiomen bifaces to act as projectiles (Painter 1988: 24), but rather they occur only where Perkiomen bifaces do not, suggesting that they may play a role similar to that of the Perkiomen biface. Therefore, though Sassaman’s (2006: 123) suggested technological system seems to work for the Stallings’s Island phase in the Savannah River drainage, it cannot necessarily be extrapolated to other broad point-using communities.

2.2.3 Genesee use in Ontario

It has been suggested by Ellis and colleagues (1990a) that like Snook Kill points, Genesee bifaces were likely used as thrusting spears. Ellis and colleagues suggested that the people at Davidson may have participated in deer drives, spearing them with hafted broad points (1990a). As deer remains were recovered from the Davidson site, the people who lived there must have hunted deer at least occasionally (Kenyon 1978, 1980a).

Snow (1980) felt that the tendency for the Genesee bifaces to be larger than the Snook Kill bifaces meant that there was a functional difference between them, saying, “[m]any of the larger Genesee points would have served much better as knives than as projectile points,” (Snow 1980: 236). Stothers (1983: 26) was of a similar mind, suggesting, much like Custer (1984) had for more southern manifestations of the broad point trend, that “the Satchell Complex bifaces may represent a tool kit for the skinning and dressing of large hide animals such as deer, and may be associated with one or more Late Archaic cultures.”

Alternatively, other researchers in Ontario did not share the view that broad-bladed bifaces were contemporaneous with either the earlier narrow point technology or the later small point technology. Ellis and colleagues (2009) explained that, not only are there several examples of pure Broad Point and Small Point components in Ontario, but the
technological systems seem to be completely different (Ellis et al. 2009). Finally, a more recent study of Davidson analyzed the spatial distribution of artifacts over the site. Significant differences were observed between how the Broad Point and Small Point artifacts are distributed, once again suggesting totally different occupation patterns of the site, and possibly even different lifeways during Small Point and Broad Point periods (Eastaugh et al. 2013; Ellis et al. 2015).

Even though much has been learned of the temporal relationships between these biface technologies, papers that mention use-wear on the broad point bifaces of Ontario are very rare, and to my knowledge no study has been conducted that primarily focuses on their use-wear. Impact fractures are said to have been observed on some of the Genesee bifaces of southwestern Ontario (Ellis et al. 1990a). Additionally, two Genesee bifaces from the Macfarlane collection of the Trent River Valley were also said to display impact fractures (Ellis et al. 1990b: 101). However, the type of fracture found on the first biface’s tip was not identified, and the snapped basal corner on the second biface might have been caused by activities other than projectile use (see Fischer et al. 1984).

Based on the difference in use-wear patterns between such broad points as the older Savannah River stemmed of what is now Georgia and the more recent Perkiomen and Snook Kill types of present-day Pennsylvania and New York respectively, it is clear that researchers must approach the function of each broad-bladed biface type in each region separately, and not assume that all “broad points” were used in similar ways. As Custer (1991) states, broad points may have very well been used in different ways in different places, and the functions of broad points may be as variable as the communities who used them. Only with more use-wear studies—conducted on different biface types in different regional and temporal contexts—can we begin to understand how each community adopted and engaged with this technological trend.
Chapter 3

3 Practice theory with chaîne opératoire methodology

It has always been a challenge for researchers to study those archaeological sites with limited preservation. In the past, the study of the North American “Archaic” has often been approached with either a culture-history perspective or a progressivist-evolutionary perspective. Instead, I propose that when investigating the processes operating 3800-3400 years ago, traditions can be investigated in terms of the practices that are represented by the material culture left behind (see Pauketat 2001a, b). Rather than placing these practices in a context of “ethnic identities” or “behavioural adaptations,” they can be said to represent the communities of practice that must have existed in order to facilitate knowledge-sharing and learning (see Lave and Wenger 1991). Practices might have been learned both through interactions with people as well as through interactions with material culture itself (see Knappett 2005; Soafer 2006). While the past practices themselves are impossible for archaeologists to observe, experimental archaeology may offer insights into their material consequences. Once the relationship between the material and the experimental action is observed, an analogy can be drawn between the state of experimental materials, and the state of archaeological materials. From that analogy, we can take account of the sequence of human actions (or chaîne opératoire) that would have had an impact on the material. In this way, human practices can be investigated for the production and use of individual artifacts.

3.1 Past approaches for studying technology

Some archaeologists have asserted that the evidence for interpreting past lifeways is so sparse in the distant past that much of what is written of pre-ceramic time periods is subject to the predominant academic theoretical perspectives of the time (Emerson and McElrath 2009; Sassaman 2008). Past studies of Archaic assemblages do seem to demonstrate the changing ideas of archaeology. The very first definition of the “Archaic pattern” by Ritchie (1932) was very much embedded in a culture-history framework. After enumerating the many artifact types recovered from the Lamoka Lake site in New
York, which he correctly supposed was of considerable age, he decided that the beveled adze was diagnostic of this “culture.” He then argued that the distribution of adzes that spanned Ontario, Ohio, and Pennsylvania was evidence for the “range” of this culture group (Ritchie 1932: 409). This approach can also be identified in Witthoft’s (1953) discussion of Susquehanna, Lehigh, and Perkiomen bifaces. After discussing the relatedness of the three point types, he defined culture groups based on the presence of these point types and soapstone vessels. Then, much like Ritchie (1932) had done earlier, he delineated the areas “Susquehanna people” and “Perkiomen people” must have occupied based on the distribution of their respective lithic technologies (Witthoft 1953). Both of these papers applied a culture-history theoretical perspective, whereby cultures were perceived “as collections of traits that had come together as a result of random patterns of diffusion” (Trigger 2006: 283). The described material culture was not seen as reflecting human behaviour, action, or choice (Trigger 2006: 283).

With the invention of radiocarbon dating in the 1950s there was a shift in the goals of North American archaeologists, and instead of describing assemblages in an attempt to define past cultures, archaeologists began to describe processes over time (Funk 1977; Ritchie 1985). This newfound interest in change over time, however, was not isolated but instead was attached to a progressivist idea of change over time, for the better (Emerson and McElrath 2009; Funk 1977). Though these perspectives were already being taken-up by researchers such as Taylor and Caldwell, Binford was the one who popularized it in the 1960s (Trigger 2006: 393). The processual archaeological approach was based on reducing all change in human behaviour to functional adaptations to the environment and technological improvements, all the while divorcing the behaviours from their historical context (Emerson and McElrath 2009; Pauketat 2001b; Trigger 2006; also see Binford 1965). Material culture, especially technologies, were divided into their “functional” and “stylistic” elements (Stark 1998: 4), with style usually being left unexplained (Pauketat 2001a; Wobst 1977). Additionally, because this framework depended on individuals responding completely rationally to their environment, “they paid little attention to the cultural transmission of knowledge,” as “if such transmissions failed, behavioural patterns could be reinvented” (Trigger 2006: 395).
The influence of processual archaeology is especially present in some of the early debates about the spread of broad point technology. Throughout Turnbaugh (1975) and Cook’s (1976a) debate, the means by which the broad point spread throughout the northeast was challenged, but neither questioned that the adoption of broad point technology was tied to a functional advantage it provided in a changing environment. In the many studies that followed on the form and function of broad points (particularly of the Perkiomen variety), researchers strived to find the task for which their form was most effective (see Cook 1976a; Custer 1984, 1991; Kinsey 1972; Staats 1986). Many of these researchers based their inferences on Ahler’s (1971) study examining the relationship between a tool’s form and its intended function (see Cook 1976a; Dunn 1984; Staats 1986). This way of thinking was predominant in broad point studies, despite Sergei Semenov’s (the first researcher to conduct a systematic use-wear study) assertion (1970: 1-2), that the way a tool functioned should always be determined independently of its form.

In many ways, it is understandable why a processual framework has been so persistent in studies of the Archaic period. When researchers are presented with data sets that include little more than the lithic technologies of the time, the environmental changes that were occurring, and the distribution of sites over the landscape, the processual framework utilizes the available information, without demanding interpretations which researchers might not feel their data can accommodate. However, the dichotomy it created between function and style, and its progressivist thinking are not well-suited to investigate knowledge sharing and past social relationships.

3.2 Practice theory and its applications in archaeology

The post-processual movement brought in new ideas and perspectives on how to study technology and other material culture. Post-processualism emphasized the uniqueness of individual cultures and asserted that culture change did not follow universal laws (Trigger 2006: 444, 453). Finally, post-processualism focused on investigating people’s ideology, through symbolism and iconography present within material culture (Trigger 2006: 453; Watts 2013: 11; also see Hodder 1982). Wiessner (1983) contributed an important ethnographic work on four language groups of hunter-gatherers living in the Kalahari Desert. Her aim was to study the distribution of certain expressions of material culture
across these groups, focusing especially on projectile point form, in the hopes that it might be applied to archaeological investigation (Wiessner 1983: 253). She chose to work within a framework of style, defining it as “a means of transmitting information,” still keeping it separate from the features of the technology that aided in its performance (Wiessner 1983: 256). Here we begin to see the post-processual notions of material culture as text, meant to signify a discourse of ideas and identity consciously accessible, to be “read” by the mind (also see Hodder 1982). She proposed the existence of two style types: emblemic style (meant to symbolize group membership), and assertive style (meant to build individual identity; Wiessner 1983: 257-258). After having collected arrows from different communities in the Kalahari, Wiessner kept her collections for one year before presenting the sets of arrows to members of the !Khung, G/wi, and !Xo language groups (Wiessner 1983: 269). While they could not differentiate their own arrows from those made by others of their communities and their exchange partners, they recognized a great difference between arrows made by members of their own language group, and those made by members of other language groups (Wiessner 1983: 269). Wiessner (1983) used the fact that recognizable projectile point styles existed between language groups to support her concept of emblemic style.

Sackett (1985) criticized Wiessner’s discussion, not seeing evidence that the different projectile forms were the result of manipulations by peoples residing in the Kalahari Desert to express identity or social boundaries. First, the traits Wiessner discussed were less decorative, and more a result of the manufacturing process. Second, there was no uniform identity signifier in Weissner’s (1983) study, but different traits were observed in different inter-group comparisons. Finally, Sackett (1985) argued that using socially expressive style to communicate with other language groups seems unlikely, especially if these language groups had limited contact with one-another. He then proposed an alternative explanation for the patterns Wiessner observed, foreshadowing theoretical perspectives which would later be widely appreciated in archaeology. He advocated for the use of “isochrestic variation”—in other words, crafting within a certain style because that was the style you were taught—instead of straining to explain all artifact variation as socially meaningful. In regard to Wiessner’s study he said, “For it is the socially bounded craft tradition, very much an historical product, that guides the choices a San artisan
makes among the isochrestic options open to him when he manufactures an arrow” (Sackett 1985: 157).

Meanwhile, a separate school of thought arose around this time in European archaeology: *techniques et cultures* (Stark 1998). For the most part, this perspective drew from Mauss’ concept *techniques* and Leroi-Gourhan’s *chaîne opératoire* (Stark 1998). Using this approach, European archaeologists were able to avoid the style-function dichotomy. For example, Lemmonier (1986) attempted to approach material from the perspective of *techniques*, criticizing both the perspective that a certain set of materials defined a culture, and the perspective that material culture was determined by the environment. Instead, he found that groups made “arbitrary choices” in the technologies they engaged in, and how they engaged in them (Lemmonier 1986). He used ethnographic information collected from the Anga, a language-defined group of New Guinea, as a case-study to illustrate his point. He found that material culture did not correspond predictably with ethnic groups, and any given object type tended to be used by more than one ethnic group in the region (Lemmonier 1986). He also found that functionalist explanations did not always work to explain the different technologies. For example, whether the group in question chose to build houses with a single wall, or a double one did not seem to depend on temperature differences (Lemmonier 1986: 166-168). Finally, he found cases where even though a specific technology was known to an ethnic group, it was not adopted (Lemmonier 1986: 165). Lemmonier (1986) interpreted the choice not to adopt known technologies used by one’s neighbours as something like an expression of ethnic identity. Based on his observations, he advocated that the technological choices of all material culture should be taken into account when archaeologists investigate social boundaries of the past (if the investigation should be attempted at all), and ceramic and lithic technologies should not be prioritized (Lemmonier 1986). English papers using the *technologie* approach, such as Lemmonier’s, would come to have a great influence in North American archaeology and its view of technological variation (Bar-Yosef and Van Peer 2009; Dietler and Herbich 1998; Dobres 1995; Dobres and Hoffman 1994; Stark 1998).
Early post-processual perspectives did not seem to resolve all of the issues related to the style-function dichotomy present in the study of material culture. By the 1990s, some North American researchers began to shift towards another theoretical perspective, having become more aware of the advantages of the European frameworks, such as techniques (Stark 1998). Dobres and Hoffman (1994) advocated for the use of practice in studying past technologies, saying that in studying these practices we are able to access the social relationships of the people making and using the technology. Nelson (1997), too, argued that projectile point technology, as much as it helps us to mark temporal horizons in archaeology, is at its core a series of learned practices.

Dietler and Herbich (1998:245), highly influenced by French schools of thought and by Sackett, conducted a study using practice theory (Bourdieu’s habitus) as their primary theoretical perspective, paired with a chaîne opératoire methodology. In their study of the Luo potters of western Kenya, they found that “micro-styles” did indeed exist among potting communities, though the specific traits that made the pots recognizably different could not necessarily be identified by the potters themselves (Dietler and Herbich 1998: 250). They argued that these “micro-styles” simply reflected the different learned practices that were employed (unconsciously) in different pot-making communities (Dietler and Herbich 1998: 253).

Pauketat (2001a, b) is well known for using concepts from Bourdieu and Giddens’ ideas of practice to construct a new theoretical framework for interpreting the archaeological record. Pauketat (2001a: 74) advocates that archaeology as a discipline should be approached from a historical perspective as opposed to a scientific one. While a scientific archaeology would seek to answer why questions, looking for underlying universal and predictable patterns in human behaviour, a historical archaeology asks how things came to be the way they are (Pauketat 2001a: 74). It places observations of the past in their historical context. He proposed that the framework of practice can help archaeologists to access these historical processes (Pauketat 2001a: 74). He defined “practice” as: to perform or act in the way one is inclined to, having one’s inclinations based on one’s past experiences and social learning (Pauketat 2001b: 4). The effects of these acts, as much as they are based on the past, are never perfectly predictable by the actors, as they always
occur in changing contexts. Therefore, while there may or may not be a certain intention behind a practice, the intention does not necessarily determine the effect that the practice will have (Pauketat 2001a: 80).

Based on this concept of practice, Pauketat built his definitions of tradition and constraint. He specifically used tradition to mean, “some practice brought from the past into the present” (Pauketat 2001b: 2). His use of “tradition” differed somewhat from some of its previous uses in archaeology. Tradition, he argued, is the not conservative opposition to change, but the medium through which change can take place (Pauketat 2001a, b). Every time a practice is carried out, that action becomes a negotiation between different social influences from that person’s past experiences. Likewise, the practice itself will change the context within which future practices will be carried out. The context within which practices occur, is termed the “constraint” by Pauketat (2001b: 5). He explained that his use of “constraint” is not meant to be deterministic. Rather, while it does frame the practice, it is also subject to be affected by the practice.

One of the major advantages of using practice as a framework in archaeology is that it does not necessarily place material culture in a position where the “why” must be explained: “practice and tradition are what people do and how they do it, with no strings attached” (Pauketat 2001a: 76). Like post-processualism, using tradition helps to highlight the unique historical context in which material culture of a community was produced. Like technologie, practice allows us to examine all the actions taken in various areas of the technological system, from material making to material using (and even material making through its use). However, unlike technologie, practice does not always depend on there having been a series of conscious choices of the craftsperson (see Bar-Yosef and Van Peer 2009), and unlike in the approaches of post-processual archaeology, it does not treat material culture as if it were a type of text that can be read.

Lave and Wenger (1991) have developed another facet of practice theory, known as communities of practice, which are complementary to many of Pauketat’s ideas. They confront the question of how people learn, and engage with, new practices. Also, using ideas from Bourdieu and Giddens as a base for their own argument, they define a series
of concepts to help explain the process of learning in general. They argue that when a person is inexperienced in a skill they wish to develop, they display legitimate peripheral participation (Lave and Wenger 1991). Legitimate peripheral participation (LPP) is a position that allows someone to learn by participating in a community also containing “full” participants (Lave and Wenger 1991). By being acknowledged as peripheral to the community, it gives the learners permission and freedom to not be experts, to make mistakes, and to be experimental. Full participants, are those who may be considered skilled experts (Lave and Wenger 1991). They avoid the use of “apprentice” and “master,” however, to try to avoid allusion to a very specific system of learning (Lave and Wenger 1991: 31). The concept of LPP also allows for a gradual integration from the periphery into community, as well as for positions which would be seen as “in-between” the classic master-apprentice categories (Lave and Wenger 1991: 56).

These concepts of practice have been adopted and applied by several archaeologists such as Sassaman and Rudolphi (2001), Budden and Soafer (2009), and Roddick (2009) for ceramic studies (just to name a few), Minar (2001) for textile studies, and Carter and colleagues (2013) for lithic studies. Roddick (2009: 63) has argued that when the study of “micro-styles” occurs in the context of learning practices, the researcher can trace practices of the taken for granted way of doing things, as well as intentional choice-making. Based on ethnographic studies that report how flintknapping is learned, the principles of communities of practice would be extremely relevant to its study. Stout (2002) conducted research on lithic axe craftsmen in the village of Langda in Indonesia. He argued that flintknapping, like any other skill, involves both thinking about the skill and actually carrying out the skill, and that the differentiation anthropologists have made in the past between these two “may have been overly rigid,” (Stout 2002: 695). Stout (2002) has also said that gaining skill has to do with being imbedded in a social sphere, where conceiving, talking, and acting are all elements of gaining a knowledge that can be simultaneously described as technical (physical) and social (mental). Using communities of practice to study flintknapping would easily avoid the mind-body, conception-action Cartesian dualism which sometimes complicates anthropological studies of learning.
Lithics specialists have also reported on their own experiences with children, and their accounts lend themselves to Lave and Wenger’s (1991) framework of situated learning and LPP. Högburg (2008: 118) summarized a small study where a six-year-old boy was allowed to observe a flintknapper at work. He was allowed to ask questions, though the flintknapper offered no further instructions to the boy. The boy, meanwhile, was allowed to experiment with some lithic material. He was able to superficially reproduce the kinds of projectile point shapes he had observed in museums, though he did not seem to copy the specific reduction techniques used by the expert, and as a result the child’s products tended to be only unifacially worked (Högburg 2008: 118).

Ferguson (2008) recounted a similar occurrence, this time under unplanned circumstances. His neighbours’ four-year-old daughter would sometimes visit him while he was flintknapping in his garage (Ferguson 2008: 64). Sometimes she would ask him questions, and while he did answer them, he never gave her an in-depth tutorial on flintknapping (Ferguson 2008: 64). He eventually discovered that she had been taking away some of his chert waste materials, and experimenting with them herself. One day, she showed him some of the triangular-shaped “arrowheads” she had made, and upon analyzing the material he was surprised to find that she had developed bipolar reduction herself, though he had never used that technique in front of her (Ferguson 2008: 64). In each of these cases, researchers argued that in the early stages of childhood development, children may not attempt, or be able to, mimic the specific reduction techniques that adults use. Still, it does not stop children from participating in the practice community, engaging with the raw lithic material, and attempting to reproduce the tool forms to which they have been exposed. Högburg (2008: 116) has argued, “play [which imitates adult behaviour] provides a model for society and prepares the individuals for future situations and roles by allowing them to practice different behaviours.”

It appears that LPP could be, in some cases, accessible through material culture. Högburg (2008) described a rare find in the archaeological record, which he interpreted as an unskilled child engaging with lithic technology. At a very small site of lithic debris, he described what seem to be waste reduction flakes left over from a Neolithic Scandinavian square-sectioned axe knapped by a skilled craftsperson (Högburg 2008: 119). Among the
waste flakes was an axe-head, made from a poor-quality material (unlike the waste flakes of the well-made axe), using an un-systematic reduction technique, resulting in a unifacially worked tool (Hogburg 2008: 123-125). Högburg (2008: 126) believed that the material represents a child “playing” in a way that imitated the skilled maker of the square-sectioned axe. Whether it was perceived as play by those past people or not, it seems to represent the material remains of legitimate peripheral participation.

Despite these ethnographic, experimental, and archaeological examples illustrating how well situated learning and practice apply to lithic technology, the concept of communities of practice is rarely applied to lithic studies. A major exception is a study conducted by Carter and colleagues (2013) on obsidian acquisition and tool-making in southeastern Turkey between 10th and 11th centuries B.C.E. They argued that they should be able to identify inter-regional exchange networks through similarities in practices. Based on the varied practices they observed, between both local and regional-level communities, they determined that there were no intensive exchange networks in place (Carter et al. 2013). While ethnic identities are not imposed on the material assemblages, they propose that “these traditions… [are] a fundamental aspect (performance) of what it is to be a member of that social group” (Carter et. al 2013: 568).

I would argue that the study of lithic technology from the archaeological record can benefit from engaging with frameworks such as tradition, as proposed by Pauketat, and communities of practice, as proposed by Lave and Wenger. I find practice to be a very appealing perspective to use for the study of the Genesee broad point bifaces. Both Custer (1984) and Sassaman (2010) have dichotomized the “technic” and “sociotechnic” roles that broad-bladed bifaces have played in the past, proposing that in the latter role they convey more social information than in the former. By using practice-based theories, I can approach the Genesee technology as a whole and avoid using our own biases to divide attributes into functional and stylistic properties. Additionally, I can focus on the historical events surrounding it, and how the Genesee technology came to be used in Ontario, rather than focusing on the question of why it came to be used, to which the answer is much more culturally relative.
3.3 Accessing communities of practice through *chaîne opératoire*

Like many other lithic studies, elements of *chaîne opératoire* are present in this research. *Chaîne opératoire* allows archaeologists to make certain observations about different stages in the life history of the material culture under observation. In the case of lithic tools, it allows the researcher to describe the raw material collection phase, the production of preforms, the production of finished tools, the use of tools, the retouching of tools, and the discarding of tools (Bar-Yosef 2009; Deitler and Herbich 1998; Dobres and Hoffman 1994; Jeffra 2015; also see Leroi-Gourhan 1993). Taking account of all gestures, *chaîne opératoire* allows for the change of the form of the material being examined over time.

According to Conard (2009: 119), *chaîne opératoire*, while a very useful descriptive tool, does not always find itself very well-rooted in an upper-level theory. *Chaîne opératoire* is useful for discussing the “life history” of the objects themselves, and the accumulated gestures of humans, but for making larger-scale interpretations about peoples' lifeways it can fall short (Conard 2009: 119). Pauketat (2001b: 10) has argued that *chaîne opératoire* would pair very well with the study of practice and tradition in archaeology. Like Dobres and Hoffman (1994), as well as Dietler and Herbich (1998), have argued, the gestures which researchers study in a *chaîne opératoire* framework, are really socially-learned practices. While *chaîne opératoire* approaches past gestures from the perspective of the life-history of the material, practice and tradition approach past gestures from the perspective of the people. Therefore, I do believe that the practices, and therefore, the traditions, of past people are accessible by studying their material culture.

Humans learn, negotiate, and interact through social practices, but social practices only exist in the material world. Knappett (2005), in his book “Thinking through Material Culture,” argues that human cognition operates through direct interaction with the material world. He says that when problem solving it is much more natural for one to act “outward” with the objects of the environment for a solution than to think about “internal” representations of objects (this argument is exemplified with the statement that people generally need to manipulate the pieces as they solve a jigsaw puzzle; Knappett
Malafouris and Renfrew (2010) and Soafer (2006) have each made the argument that humans develop their bodies (in both the social and physiological sense) in their outward interactions with objects. Soafer (2006) believes that the learning process can only happen through forming relationships with objects. In her book, “The Body as Material Culture,” she proposes that people learn by doing, their actions involve the material world, and by interacting with it, the knowledge becomes part of the body—learning then, unifies mind, body, and object in her view (Soafer 2006). Coward and Gamble (2010) advocate for the use of what they term relational archaeology, whereby the cognition of hominin ancestors is investigated through the relationships made with the material environment. They argue that since tools preceded language in the sequence of human evolution, that human social relationships were first constructed through the exchange of materials as opposed to language (Coward and Gamble 2010). Relational archaeology has also begun to be adopted by archaeologists who study modern humans, as the importance of highlighting the relationships between humans and animals, and humans and objects becomes acknowledged for its explanatory power in anthropology (Watts 2013: 16).

Latour (1996, 2000) has proposed that social scientists should remove humans from the centre of our frame of analysis. He argues that objects have a set of inherent physical properties to them—or else surely they would bend to the will of people (Latour 2000). And, as those who conduct research in the natural sciences know, this is not the case (Latour 2000). Instead, Latour proposes that social science should be approached from what he calls Actor Network Theory (ANT). This approach focuses on “actor-networks,” defined as “a contingent bundle of interactions between elements, a bundle of connections that is specific to a particular time and place,” instead of people (Elder Vass 2015: 106). That is to say, the focus is on relationships between different actors, which includes non-humans, such as things (see Latour 1996). Because people cannot force their will upon objects (though they might try), it can be said that in a technological system, humans form relationships with materials and objects, they create hybrids with things (Oppenheim 2007; Soafer 2006). Objects, after all, maintain certain properties that would force a person to undergo certain actions if that person wanted to accomplish a certain task (see Dolwick 2009). In crafting material culture people must engage with the
properties of raw materials. In using material culture people come to learn how the properties of an object create both possibilities and limitations for its use. This discussion of material properties is not meant to reflect determinism or functionalism (see Elder-Vass 2015; Dolwick 2009) — functionalism assumes that optimal forms were the goal of every technological development, and that technology gradually became better adapted over time; and determinism reduces people to passive respondents to material conditions. Rather, ANT suggests a two-way negotiation between the members of the hybrid. Elder-Vass (2015: 101) has stated that ANT “[insists] on seeing each event as the outcome of a convergence of multiple interacting influences including those of material objects, all to be taken equally seriously by the investigator.”

Therefore, following the principles of Actor Network Theory, there would have been a symmetry in the interaction between humans and their material culture (Dolwick 2009). As the practices that the objects participated in consequently changed their form, participation in communities of practice shaped the bodies of the craftsperson. Objects, then, were also part of the communities of practice in which people made and used them. Because we cannot observe the practices of 3800 years ago first-hand, we are forced to access these networks through the material objects left behind, using chaîne opératoire. Chaîne opératoire, then, is an access point to the human-object technological communities that existed in the past.

In my study, I take into account stone raw material collection practices, Genesee biface making practices (through the observation of metric and qualitative traits), and Genesee biface using practices (through the observation of macroscopic fractures). In particular, investigating use-practices may pose some difficulty without having an idea of the material consequences of certain gestures. Jeffra (2015) has remarked on the strength of the relationship between chaîne opératoire and experimental archaeology. Additionally, Rots and Plisson have recently criticized many macroscopic use-wear studies for not taking into account the diversity of forms present in different projectile point technologies:
The range of impact features from projectile use, however, depends on the morphology of the point and a single experimental reference to microliths (i.e., Fischer’s experiment) cannot simply be transposed to any archaeological situation (Rots and Plisson 2014: 156).

Based on this criticism I conduct an experimental study in this research in order to form the strongest experimental analogy possible to access the chaîne opératoire of the Genesee bifaces. Experimental archaeology now has a long history in the discipline, and has illuminated many aspects of making and using material culture that would otherwise be inaccessible (Millson 2011). I will assume that the material consequences of the new hybrids my colleagues and I make with replica Genesee bifaces in their use will correspond to the material consequences of past hybrids that were made between past people and archaeological Genesee bifaces. The results of my study will confirm whether or not it is reasonable to make use of the diagnostic impact fracture categories that other researchers have made use of in the past.

I believe that in the investigation of the practices surrounding the making and use of Genesee technology I can access past communities of practice. Through the study of these communities, I should then be able to comment on the nature of the learning and material exchange networks that existed between 3800 and 3400 years ago in what is now southern Ontario.
Chapter 4

4 Materials and Methods

In this study, I am concerned with making observations about the distribution of Genesee making practices, as well as the distribution of Genesee using practices throughout southern Ontario. As argued in the previous chapter, the best way to investigate the material consequences of use-practices is by forming a strong analogy with experimental data. The experiment makes it possible to access past practices by observing the material qualities of the bifaces using a chaîne opératoire approach. Therefore, my methodology is made up of two major parts: first, the measurements and qualitative observations of the archaeological specimens, and second, inspecting the replica biface specimens used in experimental activities. The first part of the study includes making note of the raw materials used to make the archaeological bifaces, observing the variant nominal trait for four elements, taking as many as 10 possible measurements, and finally noting the presence of any of the seven macroscopic fracture types being considered. The second part of the study involves using 19 replica Genesee bifaces made on Onondaga chert in either projectile activities (in which they were launched at a deer carcass target, or into an open environment, with the use of a longbow mounted on a frame) or in butchering activities (in which the same deer carcass was defleshed and disjointed).

4.1 The archaeological samples

The archaeological bifaces came from seven different archaeological sites from across what is now southern Ontario: the Davidson site, the Sadler site, the Desjardins site, the Parkhill site, the Brodie site, the R&K site, and the Hamilton Golf Course site (see Figure 1-1). While portions or all of the biface collections from the Davidson, Brodie, Sadler, Parkhill, Desjardins and Hamilton Golf Course sites have all been examined in previous studies (Kenyon 1980a, 1980b; Fisher 1987), no observations of the R&K site have ever been published (though a site report has been completed). Only Genesee bifaces were taken into consideration for this study. Any specimens that had been
knapped into other forms, such as drills or scrapers, were not considered for either the study of their form or of their macroscopic breakage.

4.1.1 The Davidson site (AhHk-54)

The George Davidson site was originally reported by Ian Kenyon (1978, 1979, 1980a), of the Ontario Ministry of Culture and Recreation. Kenyon led a salvage project over the seasons of 1977 and 1978. The project largely included the excavation of buried cultural materials in an old palesol exposed through erosion along the east bank of the Ausable River, 12 km inland from Lake Huron (Eastaugh et al. 2013; Kenyon 1978). Continuing erosion of the bank led to the excavation of 27 m² of the site “in a narrow, 20 meter long strip along the river’s bank” in 1978 (Kenyon 1980a: 7). Kenyon (1980a: 8) discovered Genesee “projectile points” at the site, describing them as eight “large, straight-stemmed points made from several types of raw material.” (It should also be noted that he encountered at least one Middle Woodland feature in his excavations [Kenyon 1979].)

In 2006, Chris Ellis returned to the site to conduct further research. All excavations outside of the ploughzone were completed through trowelling, and all soil was passed through ¼” (approximately 6mm) screens. Additionally, flotation samples were taken. A total of 84 m² of the site had been excavated as of the 2013 field season in those areas immediately north of the area of Kenyon’s (1978, 1979) earlier work (Ellis 2014b). In the ploughzone, 11 pedestrian surveys have been completed to date (Ellis 2014b). Ellis, through surface collection, excavation, and magnetometer surveys, determined that the site was larger than Kenyon had believed in the late 1970s, estimating it to be about 1.9 ha (Ellis 2011). He also discovered that the northwestern part of the site was multicomponent, having not only a Broad Point component but also a significant subsequent Small Point occupation, dated to ca. 3200-2800 BP (Ellis 2014a).

Although some stemmed and expanding based drills (n=15) and pitted stones (n=9) were recovered from the surface of the southern, inland part of the site (where the Small Point diagnostics do not occur), the formal tool set of Davidson seems rather small (Ellis 2014a), and certainly much more limited than that found at the R&K site described below.
In terms of diagnostic, completed bifaces and biface fragments recovered from Davidson, a total of 38 specimens were included in the present study. A major concern about this sample of Genesee points stems from Davidson being well-known to collectors in the area (Ellis 2008). If collectors were choosing the largest or the most complete bifaces from the surface of the site, it would skew the representativeness of the overall sample. Despite having been recovered through systematic archaeological methods, the bifaces recovered from the surface might be smaller or more fragmented than one would expect.

4.1.2 The Sadler site (AhHk-70)

The Sadler site is located near the east bank of the Ausable, on a farmer’s field only 300m south of Davidson (Kenyon 1980a). It consists of a small surface collection recovered by Ian Kenyon over the 1977-1978 field seasons as part of his general Ausable River valley survey (Kenyon 1980a, b). Kenyon (1980b) studied 12 of the Sadler bifaces in his study on the metrics of the broad points of the Ausable River Valley, excluding the ones without hafting elements. Eighteen bifaces from Sadler were taken into account for this study.

4.1.3 The Desjardins site (AhHk-69)

The Desjardin site is located just east of the Ausable River and the Davidson and Sadler sites. Investigations at the site only included a salvage surface collection recovered by Ian Kenyon (1980b) over the 1977-1978 field seasons (much like Sadler). In Kenyon’s (1980b) publication on the metrics of Genesee broad points, he was also able to include the bifaces recovered by local collector Brian Wolfe, but those bifaces were not available for study for this project. Eleven bifaces from Desjardins were studied here.

4.1.4 The Parkhill site (AhHk-49)

The Parkhill sample was surface collected from a location near Parkhill Creek (Fisher 1987), a tributary of the Ausable River, 3 km east of Davidson (Deller 1980). The site is well-known for its Palaeo-Indian archaeological material, but it also has components of Archaic and Woodland age (Deller 1980). Sixteen bifaces from this surface collection were identified as Genesee (Fisher 1987). Eleven out of the sixteen Parkhill Genesee
bifaces were taken into consideration for this study—four of the bifaces were excluded because they were identified as preforms, three previously by Fisher (1987), and the last by myself. Another biface was excluded for appearing to have been reworked into a scraper. These bifaces had previously been studied by Fisher in 1987.

4.1.5 The Brodie site (AfHi-19)

The Brodie site is located within the Komoka region near Delaware, on the Thames River (Fisher 1987; Kenyon 1980b). Most bifaces were recovered through surface collection, though some examples were excavated in situ underlying a Middle Woodland midden during test excavations under the direction of William Roosa in 1973 (Chris Ellis, personal communication 2015; see also Wilson 1990:103). Fisher (1987) had previously conducted a study on 61 bifaces from the Brodie site, but many of these are now believed to have been misclassified Early and Middle Woodland stemmed points (Chris Ellis, personal communication 2015). Considering only the clear cases of Genesee technology, 17 bifaces and biface fragments could be included in this study.

4.1.6 The R&K site (AgHb-265 & AgHb-266)

The R&K (or the Ruijs and Kirchberger Property) site collection was recovered through a Stage 4 mitigation conducted by Timmins Martelle Heritage Consultants in 2007. R&K is located in Brantford, and is represented by two locations (Location 2, AgHb-265 and Location 5, AgHb-266) of a large Late Archaic site, the predominant diagnostic point type by far being Genesee (Timmins Martelle 2010). At each location, the site was hand excavated by 1 m² units to subsoil, and passed through a 6 mm sized mesh screen. At Location 2, 455 m² of the site were excavated, and the locus extended a maximum of 36 m in the North-South dimension, and 21 m in the East-West dimension. At Location 5, 1550 m² of the site were excavated, and the locus extended a maximum of 75 m in the North-South dimension and 46 m in the East-West dimension. The excavations would continue to radiate outwards from the areas of high concentration as determined by the Stage 3 investigation. When 10 or fewer Aboriginal artifacts were being recovered per unit at Location 2, and when 12 or fewer artifacts were being recovered per unit from Location 5, the excavation ceased in that area (Timmins Martelle 2010).
Besides diagnostic bifaces, other artifact types were recovered from Location 2 including utilized (n=405), retouched (n=123), and notched (n=18) flakes; three knives; five perforators; 38 scrapers; 9 drills; and 12 bifaces. Location 2 was also said to have had a feature full of fire-cracked rock that looked much like a hearth. At Location 5, utilized flakes were recovered (n=1259), as well as retouched (n=9), and notched (n=10) flakes; seven spokeshaves; two strike-a-lights; two knives; one perforator; 214 scrapers; 105 drill fragments; six wedges; and 183 biface fragments. Also recovered at Location 5 were 35 ground-stone fragments (Timmins Martelle 2010). Each location also yielded small amounts of artifacts diagnostic of other time periods, including the Early Archaic, the Middle Archaic, and Early Woodland (Timmins Martellel 2010). Still, the non-diagnostic elements were interpreted to have belonged to the Late Archaic Genesee component, as the other point types occurred in comparatively low numbers over the site (Timmins Martelle 2010). The report interprets evidence recovered from Location 2 and Location 5—such as the great amount of detritus, the small amount of faunal material, and the ubiquity of fire-cracked rock over the site—as indicating short-term fall occupation and Genesee biface production sites (Timmins Martelle 2010).

Recovered from Location 5 were fragments of 65 bifaces identified as Genesee. Because no finished Genesee bifaces were recovered from Location 2, these were excluded from the present study. Additionally, any mending fragments were considered together as representing a single biface.

4.1.7 The Hamilton Golf Course site (AhGx-20)

The most eastern collection used in this study consisted of the surface collected bifaces from what is now known as the Hamilton Golf Course, in Ancaster Township, Westworth County (Howey 1975). In 1974, Howey conducted a survey of the parts of the property that had exposed soil—either from ploughing or other disturbances, or from natural erosion. He plotted the location of all his surface finds, determining that the bank east of the artificial pond had the greatest concentration of artifacts. His survey was completed in 1974, before the land was developed in 1976 (Howey 1975).
Fourteen Genesee bifaces from the Hamilton Golf Course site were used in this study. Based on Howey’s report, the Hamilton Golf Course site was multi-component. He found several artifacts that are usually not associated with Genesee sites—such as ceramics, abraders, pestles, and anvils (1975). The fact that the bifaces were recovered from the surface of a multi-component site causes some sampling biases that should be acknowledged. Though I was unable to choose the sample myself, based on the photographs of the other artifacts included in the report, it would seem as if all of the clear examples of Genesee bifaces were included in the 14 studied. A sampling problem from this collection, however, concerns the few artifacts that are potentially Genesee bifaces, but were not included. These were four distal blades of triangular-shaped bifaces. It would have been difficult to include them in the study, as they are not as diagnostic as those more complete specimens. Even so, this exclusion may have biased the macroscopic wear observations for this sample, as those specimens were excluded precisely because of the way they were broken.

4.2 Analyzing the archaeological material

For this part of the study, qualitative observations as well as measurements were recorded with the goal of describing the variation in form of the Genesee bifaces of southern Ontario. Though breaking down any complete artifact into a series of attributes and measurements will never perfectly describe its form, and the attributes and measurements chosen for observation will always be influenced by the researcher’s own biases, the observation of certain traits can be useful to allow for inter-sample comparisons of biface-making practices.

A problem with the assessment of biface form in this study may come from inherent biases in the typology that is already in use in Ontario archaeology. When the samples of this study were being assembled—as previously discussed—the “Genesee” bifaces were sorted from other bifaces based on a pre-determined projectile point typology (most researchers use Ritchie’s [1971] revised point typology). A type of artifact is meant to describe a trend in time or space that is “culturally relevant” (Bettinger and Eerkens 1999; Kreiger 1944). It allows for the organization of artifacts to make sense of sequences and change and how it might relate to human behaviour. Bettinger and Eerkens
(1999) write that the typologies that continue to “work” are those that continue to be used. It is true that Genesee bifaces have certain distinctive attributes that make them recognizable to archaeologists, and are consistently dated within a 400 radiocarbon year (ca. 800 sidereal year) time period in a region that encompasses parts of Michigan, Ontario, and New York (Ellis et al. 1990a, 2009; Kenyon 1980b; Ritchie 1971). Therefore, even though making use of the Genesee type to define the sample may reaffirm certain biases already held by archaeologists about the form of these bifaces, it has proven to be so useful in describing the technology in the past that the risk was found to be acceptable for this study.

For each biface and biface fragment a variety of nominal traits were observed. The traits chosen for study, as well as the categories used to describe them, were based on those that previous research suggested were useful in understanding broad point variability (e.g. Truncer 1990). These included: the material the biface was made from, the morphology of the base (straight, convex, or concave), the morphology of the stem (straight, expanding-based, narrowed-based), the morphology of each blade/foresection edge (straight, convex, or concave), and whether or not the blades of the biface had a triangular shape. The material used to make each biface was identified with the use of sources such as von Bitter (1991), and by comparing the bifaces of the samples to materials that had been previously identified by Chris Ellis. There were some materials that were not identifiable by sight alone, and the material for these bifaces was recorded as “unidentified.” In order to determine whether the base and edges of the biface were straight, convex, or concave, that element of the biface was held on a flat surface. If light could be observed through any space in the middle of the base or the edge, it was noted as “concave.” If the base or

Figure 4-1. Length and width measurements. Drawn by Ian Kenyon. Reproduced with the permission of the Ontario Archaeology Society Inc., Toronto, Ontario, from Kenyon (1980b). (Dotted lines were added).
the edge could easily be rocked back and forth on the flat surface, the base or edge was noted as “convex.” If the element neither had space in the middle through which light could be seen, nor could be easily rocked back and forth, it was noted as “straight.” The blades of the biface were noted to have a “triangle shape,” regardless of blade outline shape, if the shoulders were the widest part of the blade.

Next, a series of 10 possible measurements were taken for each of the bifaces and biface fragments using a set of electronic calipers (to measure in millimeters), only in the dimensions for which the biface being examined was complete. The continuous measurements used were those employed in previous Ontario Genesee broad point studies, conducted by Kenyon (1980b), Burgar (1985), and Fisher (1987). Kenyon (1980b), the first to publish an extensive study on broad point form in Ontario, originally defined blade length, base width, stem length, base width, stem width, by including a graphic of a Genesee broad point with his measurements drawn onto it (Figure 4-1).

Table 4-1. Measurement definitions

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall length</td>
<td>the measurement from the very tip to the edge of the base</td>
</tr>
<tr>
<td>blade length</td>
<td>the measurement from the biface’s tip to its lowest shoulder</td>
</tr>
<tr>
<td>stem length</td>
<td>the measurement from the base of the biface to where the stem meets the blade</td>
</tr>
<tr>
<td>maximum shoulder height</td>
<td>the measurement from the base of the biface vertically to the point that is in-line with the tip of the higher shoulder</td>
</tr>
<tr>
<td>minimum shoulder height</td>
<td>the measurement from the base of the biface vertically to the point that is in-line with the tip of the lower shoulder</td>
</tr>
<tr>
<td>base width</td>
<td>the measure of the distance between two basal corners</td>
</tr>
<tr>
<td>stem width</td>
<td>the measure of the distance between the two edges of the stem where it meets the blade</td>
</tr>
<tr>
<td>shoulder width</td>
<td>the measure of the distance between the tip of each shoulder</td>
</tr>
<tr>
<td>stem thickness</td>
<td>the maximum distance between the two faces of the biface on the stem</td>
</tr>
<tr>
<td>maximum thickness</td>
<td>the maximum distance between the two faces of the biface on the blade</td>
</tr>
</tbody>
</table>
When Burgar (1985) wrote his thesis on the metrics of the Genesee bifaces of Ontario, he added several measurements that Kenyon had not investigated in his research, only some of which were included in the present study: overall length, maximum stem thickness, and shoulder height. (One small change that I made to his methods was that instead of taking the “right” and “left” shoulder heights, as Burgar did, I took the “maximum” and “minimum” shoulder heights).

Finally, the macroscopic fractures on each of the Genesee bifaces were taken into account, and the presence of any of seven types of macroscopic fractures were noted. The fracture categories included step-terminating impact fractures, spin-off fractures, impact burins, impact flutes, crushing, bending fractures, and cone-initiating fractures (see Table 4-2). Once a fracture was identified, it was examined and then photographed with the use of a Dino Lite digital low-power microscope (between 20 and 50x magnification depending on the size of the fracture) and Dino Capture 2.0 software.

Based on previous experimental research, as well as the results of the experiment conducted in this study (as described in Chapter 5), those macroscopic fractures that were considered diagnostic impact fractures (DIFs) included: step-terminating fractures (Fischer et al. 1984; Lombard et al. 2004, 2005; Odell and Cowan 1986; Villa et al. 2009; Weitzel et al. 2014); spin-off fractures greater than 6 mm (Fischer et al. 1984; Lombard 2004, 2005; Weitzel et al. 2014); impact burins and impact flutes if they are large enough (Barton and Bergman 1982; Fischer et al. 1984; Lombard et al. 2004, 2005; Odell and Cowan 1986; Sano 2009; Titimus and Woods 1986; Villa et al. 2009; Weitzel et al. 2014); and finally, crushing—possibly only occurring when the biface strikes something relatively hard, like rock (Odell and Cowan 1986; Titimus and Woods 1986; Villa et al. 2009; Weitzel et al. 2014) or bone (as demonstrated in this study; see Table 5-5). These fractures could potentially all be simulated by dropping, but the chance of dropping a biface in just the right way to create a fracture like these is so low, that most archaeologists consider it negligible (Sano 2009).
Table 4-2. Macroscopic fracture types

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>step-terminating bending fracture</td>
<td><img src="image1" alt="Image" /></td>
<td>“A bending-initiating fracture which before meeting the opposite surface of the specimen runs parallel to this, and which thereafter...meet[s] the surface at a right angle” (Fischer et al. 1984: 23).</td>
</tr>
<tr>
<td>spin-off fracture</td>
<td><img src="image2" alt="Image" /></td>
<td>“Cone fracture which initiates from a bending fracture and which removes parts of the original surface of the specimen,” (Fischer et al. 1984: 23).</td>
</tr>
<tr>
<td>impact burin</td>
<td><img src="image3" alt="Image" /></td>
<td>Hinge fracture along the lateral edge of biface (Odell and Cowan 1986: 204).</td>
</tr>
<tr>
<td>impact flute</td>
<td><img src="image4" alt="Image" /></td>
<td>A fracture that takes off a narrow tract of material from one of the faces of the point (Odell and Cowan 1986: 204).</td>
</tr>
<tr>
<td>crushing</td>
<td><img src="image5" alt="Image" /></td>
<td>“[T]he force was directed so deeply into the interior of the stone that it dissipated before it could surface and remove a sizeable piece. As a result...the damage remained localized at the tip itself” (Odell and Cowan 1986: 204).</td>
</tr>
<tr>
<td>bending fracture</td>
<td><img src="image6" alt="Image" /></td>
<td>“[I]nitiated from a large area, having a straight or convex profile along its whole area of initiation” (Fischer et al. 1984: 23)</td>
</tr>
<tr>
<td>cone-initiating fracture</td>
<td><img src="image7" alt="Image" /></td>
<td>“[I]nitiated from a point or small, well-defined area, having a concave profile in the area of initiation” (Fischer et al. 1984: 23)</td>
</tr>
</tbody>
</table>

Therefore, it would likely only be a confounding factor in interpretation if such fractures are found to be very rare overall in an assemblage. The fractures recorded that were not necessarily caused by impact, but might have been caused by a number of phenomena.
(including knapping errors, trampling, cutting, or impact), included bending fractures and cone-initiated fractures (based on observations by Fischer et al. 1984; Odell and Cowan 1986; Odell and Odell-Vereeeken 1980; Nielson 1991; Sano 2009; Shea et al. 2002; Sano 2009; Truncer 1988; Weitzel et al. 2014).

4.3 The experimental study

The replica sample included 20 reproduction Genesee bifaces knapped by Dan Long from Onondaga chert (like most of the specimens from the archaeological samples). The replica points were first labelled, catalogued, and photographed. Next, the variant nominal traits (base shape, stem shape, edge shape, and whether it was triangle shaped) and 10 measurements used for the archaeological sample were observed for the replica sample. All of the bifaces were triangular, made of Onondaga chert originating from the geological Clarence Member outcrop near Port Colborne, Ontario (Dan Long, personal communication 2015) and not heat-treated (see Appendix B-8a). They were also mostly within the range of measurements proposed for Genesee bifaces by Ritchie (1971), Kenyon (1980b), Burgar (1985) and Fisher (1987) (see Table 4-3). (There are some cases where the replicas do not match the measurements of those in Fisher’s (1987) study, though considering that there were many non-Genesee bifaces in her sample, these differences were found to be acceptable.) Once the measurements were completed, Dan Long hafted 15 of the replica points onto hardwood dowels 2.5 cm thick and 120 cm long, and another five of the replicas onto sections of cut wooden dowel 2.5 cm thick and 20 cm long, using an adhesive made from pine resin and beeswax, and rawhide lashings (see Appendix B-8b).

The 15 replicas hafted onto dowels 120 cm long were used as projectiles and launched at a deer carcass target. Using a deer carcass was thought to best simulate hunting during the Broad Point period, as it is the only large animal species whose remains have been recovered and identified from the Davidson site (Kenyon 1978, 1980a, b), and as previously discussed, Genesee bifaces were likely used to hunt larger game if used as weapon tips at all. The deer carcass was roadkill, and was frozen for easy storage after collection. The outer tissues (hide, muscle, bone) were thawed by the time of the experiment, though some of the internal organs were still frozen.
Table 4-3. Measurements of the replica sample contextualized among metric studies in the literature

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Measurement ranges in the literature (mm)</th>
<th>Measurement of replicas (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall length</td>
<td>76.2-88.9</td>
<td>-</td>
</tr>
<tr>
<td>blade length</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>maximum shoulder height</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>minimum shoulder height</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>base width</td>
<td>-</td>
<td>18.95</td>
</tr>
<tr>
<td>shoulder width</td>
<td>half as wide as long</td>
<td>35.86</td>
</tr>
<tr>
<td>stem thickness</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>maximum thickness</td>
<td>7.9-14.2</td>
<td>-</td>
</tr>
<tr>
<td>tip angle</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*The mean was calculated from more than one sample discussed in the study.

For the experiment, like those conducted by Shea and colleagues (2001), Hutchings (2011), and Wilkins and colleagues (2014), the manual speeds of hand-thrown spears were simulated with a bow. In order to launch the projectiles consistently at a particular speed that would be within human javelin-throwing range, we used a bow with a 45 pound (20.4 kg) draw force, and a 28 inch (0.71 m) draw length. Based on the law of energy conservation, (see Appendix A) the initial speed of the projectile was determined with the equation: $F = \frac{\text{mass} \cdot \text{(speed)}^2}{\text{draw length}}$ where $F$ is the force of launch, and $\text{mass}$ refers to the mass of the projectile being thrown (the average mass of the spears in this study was 0.279 kg). A bow with these specifications should have launched the spears at an average initial speed of 23.4 m/s. According to a kinesiology study conducted by Mero and colleagues in 1994, the average speed of a hand-thrown lance was 18.7 m/s for a group of 11 women, and 23.9 m/s for a group of 11 men. A spear projected at a speed of 23.4 m/s
is therefore well within human hand-thrown speeds—though it is much closer to the average male throwing speed than the average female throwing speed. Wilkins and colleagues also advocate for a speed range between 17 m/s and 27 m/s for thrown spears (2014), and Hutchings used a speed of 25.1 m/s to simulate javelin use in his projectile experiments (2011). Each of the spears were launched from a distance of 2.3 m as many times as was necessary to noticeably fracture. Some lasted as many as four trials before they had even minimal damage and as a result, a total of 29 shots were made at the deer carcass. Each shot was videoed, and each time the spear met the target, its position was photographed. The spears were taken back to the lab and cleaned with detergent and warm water. The stone tips that were heavily damaged were taken out of their hafts, using acetone to remove the adhesive. They were then analyzed under the Dino Lite microscope. The rest had their blades analyzed, but were left within their haft for further trials.

We planned to relaunch those spears that were not heavily damaged (n=7), into a cleared environment, in the hopes that we might observe the fractures that occur when the bifaces struck different materials (rocks, trees, etc). This stage of the experiment was meant to explore the kind of fractures that would occur when the bifaces missed their animal target. The timing of the experiment was unfortunate, however, and in the middle of February it was difficult to find an area without heavy snow cover. In order to observe any impacts at all, we were forced to conduct the experiments on a paved road and launch the projectiles until they broke or were visibly damaged. We took 14 shots on the road, hoping that it would simulate striking stone. Because it became very difficult to control the distance of our spears with the bow, we decided to throw them by hand. Finally, to investigate how the bifaces would break when they struck wood, one spear was launched at a large tree, and a second spear was thrust at a tree twice (there was a total of three trials). All bifaces were used until they sustained heavy macroscopic damage. They were then taken back to the lab, removed from their hafts, and observed once again under the Dino Lite microscope.

The five bifaces hafted on the 20 cm handles were meant to be used as knives to deflesh the deer carcass (though only four out of five were actually used). This part of the
experiment was taken on by a total of four individuals, with a maximum of two individuals working at once on the carcass. Two of the individuals, Patricia Wells and Ed Eastaugh were faunal specialists with much experience in defleshing a variety of animals. Patricia Wells even had previous experience using lithic tools for this task. The two others involved were less-experienced students—one of which was myself. Throughout the process, at least one expert was working on the specimen. It took approximately 1 hour and 45 minutes to completely deflesh the deer. First, the carcass was skinned, next the organs were removed, after which the flesh was stripped from the bones. Finally, the vertebral column of the animal was disarticulated at two points, in order to make the sections of skeleton more manageable for further processing (as the bones were to become part of a teaching collection). The first hour of the process was filmed, before the camera ran out of batteries. Again, knives that had been used were taken back to the lab, and washed with detergent and warm water. They were then removed from their hafts and analyzed under the Dino Lite microscope.

After the biface making practices were observed by way of qualitative traits, (such as material used, and blade, stem, and base shapes), and metric traits, (such as overall length, stem length, shoulder width, and thickness measurements), their use practices were investigated through the identification of five DIF types. Finally, an experimental study was conducted to confirm that the DIF types that have been used in previous studies would be applicable to Genesee bifaces, as well as to investigate the potential for Genesee bifaces to sustain macroscopic fractures when they are used as knives. In the following chapter I describe how I analyzed the data I collected.
Chapter 5

5 Results

Once the measurements and qualitative observations were completed, I compared the data collected from each sample of archaeological bifaces. While certain characteristics of the Genesee bifaces occurred relatively consistently across the samples, there were many attributes that seemed to be associated only with certain regions. In terms of the metric traits taken into account, none displayed a statistically significant difference between samples, except for stem length and the thickness measurements.

When I examined the replica bifaces used as projectiles, I found that they displayed the same kinds of fractures that can be observed on the archaeological bifaces. I also observed that under the experimental conditions, the Genesee-shaped bifaces did seem to fracture in particular ways depending on the material they struck. The replica bifaces used in defleshing, however, showed no observable macroscopic fractures.

Based on the observed macroscopic impact fractures present on the bifaces of all but the Desjardins sample, it would seem as if past peoples were using Genesee technology as either projectile points or as the tip of a thrusting spear, for at least part of the time. And based on the asymmetrical blades of many of the bifaces, I believe it likely that they were also sometimes used as knives.

5.1 The many forms of the Genesee biface

The form of a Genesee biface consists of many aspects that I have separated into nominal attributes and metric attributes for the purposes of comparing the distribution of these attributes across the archaeological samples. While no trait is thought to have been necessarily meaningful to the people who made and used Genesee bifaces, observing the variability of one specific element over space was useful as a proxy to investigate the distribution of Genesee-making practices, and the communities in which they were learned.
5.1.1 Raw material collection and use

Different materials are used in different proportions at different sites. The two eastern samples, the R&K site and the Hamilton Golf Course site, are made-up entirely of bifaces made from Onondaga chert (see Figure 5-1). Since the excavations conducted at the Peace Bridge site in Fort Erie, it is widely thought that quarries were established on Onondaga outcrops by at least 3400 B.P., if not earlier, for the purpose of intensively procuring this material to produce Genesee bifaces (Austin and Jenkins 2006; Clark 2003; Williamson and MacDonald 1998). Predictably, the majority of the Genesee bifaces recovered from the Peace Bridge site were made on Onondaga—although, four out of 121 finished biface fragments were made from other kinds of material, including Upper Mercer and Selkirk cherts (Austin and Jenkins 2006). The Surma site, also located near the Onondaga outcrop in Fort Erie (Emerson and Noble 1966), seems to have been part of the same occupation represented by Peace Bridge (see Williamson and Austin 2006). Surma also yielded an assemblage of Genesee bifaces entirely made from Onondaga (n=27) (Emerson and Noble 1961; Kenyon 1981). The results of this study continue to support the idea that even the eastern occupations that did not occur directly on the Onondaga outcrop itself used Onondaga to the exclusion of all other lithic raw materials.

![Figure 5-1](image-url)

**Figure 5-1.** The percentages of the bifaces made from Onondaga chert, Kettle Point chert, coarse-grained materials in each collection.
In the Ausable River Valley samples and Brodie, a much greater variety of materials were being used, as noted in previous studies. The materials used in these regions include Kettle Point chert, which outcrops on the shore of Lake Huron (Kenyon 1980a; see Figure 1-1); and grey-coloured, coarse-grained metasedimentary materials—thought to exist in cobbles in the Ausable and Thames river valleys (Fox 1978; see Figure 1-1). Previously, the coarse-grained material use in the Ausable River Valley was observed by Kenyon (1978, 1979, 1980a, b) and even earlier in the middle Thames River drainage, by Chillingworth (1965). Onondaga chert also seems to make-up a substantial proportion of these samples. The Parkhill site collection, a unique case in the region, is almost entirely made of Onondaga, with only one biface made from an unidentified material (see Figure 5-1). I ran a Monte Carlo simulation, at 10 000 iterations, to test whether the distribution of raw material use among the different samples was significant to the ≤0.05 level, then used the adjusted residuals (outside the values ± 1.96 indicate a ≤0.05 significance level) to identify the area(s) of significance. I used the same procedure throughout my analysis of the relationships between nominal attributes of the sample.

The three primary material types had a statistically significant distribution among the collections (Fisher’s Exact value=84.2; p=0.000, see Appendix D, where the justification for using Monte Carlo, and the results of all tests of nominal traits using the simulation can be found). As would be expected, Onondaga was more commonly used at the R&K and Hamilton Golf Course sites, while its use was markedly low at the Davidson, Desjardins, and Brodie sites. Kettle Point chert use was significantly higher at the Davidson site than anywhere else. This might in part have to do with Davidson’s close proximity to the Kettle Point outcrop. Conversely, coarse-grained materials made-up a significantly greater proportion of the sample at the Desjardins and Brodie sites than any others. The test did not find significantly higher or lower distribution of any particular material at the Sadler and Parkhill sites—though in the case of Parkhill the small sample is made almost entirely from Onondaga.

The use of different materials suggests different material collection practices, especially between the western and the eastern sites. In the latter part of August 2014, we investigated the availability of coarse-grained, but knappable, cobbles along a portion of
the Ausable River via canoe, as well as the Thames River in the Komoka region on foot. It was our hope that in trying to collect the material ourselves, we could better comment on the practices involved in gathering coarse-grained cobbles. While absent in the stretch of the lower Ausable River nearest to the Davidson and other sites, we found some cobbles of material exposed at many sets of rapids to the south beginning about 4 km away, seemingly where the river cuts through the Wyoming Moraine till deposits (Chris Ellis, personal communication 2015). We examined the cobbles at each of the rapids we encountered from the beginning of the Moraine edge, following the river south for approximately 15 km. Next, the cobble exposures in the middle Thames River area rapids located near the Brodie site, just south of Komoka, Ontario, were investigated. These rapids were located about 5 km northeast of Kilworth, Ontario, where Fox (1978) had reported finding similar raw materials. Each time a suitable-looking cobble was selected, we broke it open to ensure it resembled the kind of coarse material used to make Genesee bifaces. While we did find cobbles which resembled the material used in Genesee manufacture, they seemed to be rare amongst many examples of cobbles unsuitable for knapping. Other times, even if the cobble was of a suitable material, it was not of a size that could be easily be made into a Genesee-sized biface. Moreover, finding suitable cobbles was a laborious process that consisted of checking several shallows to find only a little appropriate material. Though much of our difficulty in finding a substantial quantity of material can be attributed to our inexperience, the difference between gathering bits of material over a relatively diffuse area and procuring material intensively from a stationary outcrop is still a notable one.

Overall, it would seem that there were three major ways of procuring material on sites occurring in the southwesternmost part of the province—collection from the stationary Kettle Point outcrop, collection over a wide area of coarse-grained material present in the glacial till, and acquiring Onondaga materials from some distance away, likely through exchange networks. In the more eastern samples, it would seem that the intensive procurement and exchange of Onondaga material was the major practice involved in acquiring raw material—though according to Austin and Jenkins (2006), the exchange of other materials would also have played a minimal role.
5.1.2 Blade Morphology

Genesee biface technology has been classically associated with a triangular shape (Ritchie 1971: 24) with wide shoulders. After comparing the forms of the bifaces from sample to sample, it would seem that while most bifaces had triangular blades, not all the bifaces included in this study fell neatly in the “triangular” category.

![Proportion of non-triangular bifaces](image)

**Figure 5-2. The percentage of bifaces displaying triangular and non-triangular forms in each collection.**

I first noted that there were more non-triangular shapes present in the Ausable River Valley and Komoka samples (with the exception of Parkhill) than in the more eastern samples (see Figure 5-2). The Davidson and the Sadler sites in particular have their samples made-up of an elevated 38% of non-triangular bifaces (though the proportion of non-triangular bifaces in these collections was not found to be significant; Fisher’s Exact value=4.42; p=0.660). This observation might be explained by one or more of four possibilities. The first explanation would be long curation times: assuming that shoulders are at risk of being damaged in use, resharpening the blades might result in narrower shoulders over time. Because the communities in the west did not have as easy access to Onondaga chert as the eastern communities, one might assume their Onondaga bifaces underwent longer curation periods. More narrow-shouldered variants in the west might also have to do with the fact that the sole source of local chert, Kettle Point, occurs in small nodules that may not be able to accommodate wide shoulders. This trend might
also have to do with the fact that Adder Orchard technology, with its narrow-shouldered shape, has a higher concentration of finds in the west (Fisher 1997; Kenyon 1983; Peske 1963). It is possible that either Adder Orchard technology influenced the way Genesee bifaces were made in the west, or that some Adder Orchard bifaces are present in some of the western samples. In order to try to eliminate some of these possibilities, I investigated further, as described below.

**Figure 5-3. The percentage of bifaces displaying straight, concave, and convex edge shapes in each collection.**

Blade edge shape was investigated next. In recording edge-shape, I observed that there were bifaces with convex edges in western samples in general, while there were none at all in the eastern samples (see Figure 5-3). When I ran a Monte Carlo simulation on the distribution of edge shapes across the collections, I found that the bifaces with convex edge shapes were significantly associated with the Davidson and the Desjardins sites, while they were significantly absent from the R&K material (Fisher’s Exact value= 39.6; p=0.001). The Davidson sample also seemed to have a lower-than-expected proportion of bifaces with straight blade edges. Additionally, the Parkhill sample was the only assemblage to have a significant proportion of bifaces with concave blade edges (and it also had a significant absence of bifaces with straight blade edges).
When I analyzed the co-occurrence of “non-triangular” with “convex edge shape” for the entire sample (see Table 5-1), I found that they were significantly associated with each other (Fisher’s Exact value= 23.4; p=0.000). It is possible that these bifaces belong to components of the sites that date earlier, or nearer to the time when Adder Orchard technology was predominant (about 4000 B.P.; see Fisher 1997). In order to test this possibility, I conducted two more Monte Carlo analyses—testing the association of the “triangular” and “edge shape” traits with the raw material used. Under the assumption that people did not make as much use of metasedimentary material when Adder Orchard technology was predominant (see Fisher 1997), I expected that if the narrow-shouldered bifaces did represent earlier occupations, they should display a greater association with Kettle Point chert. Even though the simulation did demonstrate a statistically significant association between convex-edged bifaces and Kettle Point chert, non-triangular bifaces did not seem to be significantly associated with that particular raw material (Fisher’s Exact value= 7.6; p= 0.031; adjusted standardized residual for Kettle Point= 1.9). In fact, when I followed-up on the individual cases that could be described by “convex-edged and non-triangular,” and “convex-edged and made from Kettle Point,” it actually led me to different groups of bifaces. Therefore, the three traits do not seem to co-occur for any of the bifaces, with two exceptions.

These two bifaces were recovered from the Davidson site. Davidson of course has a small number of artifacts from other time periods, and the bifaces might represent an earlier

<table>
<thead>
<tr>
<th>Trianguloid (n)</th>
<th>Asymmetrical</th>
<th>Concave</th>
<th>Convex</th>
<th>Straight</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>3</td>
<td>0</td>
<td>10</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Y</td>
<td>12</td>
<td>10</td>
<td>5</td>
<td>28</td>
<td>55</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
<td>10</td>
<td>15</td>
<td>29</td>
<td>69</td>
</tr>
</tbody>
</table>

= significant based on its adjusted standardized residual value

Adder Orchard presence on the site. Upon further investigation, though, it appears that one of the two (AhHk-54-1) was excavated from unit 205N/198E, directly above and perhaps even in, Feature #1 (the large bell-shaped storage feature; Ellis 2007, 2010). Feature #1 also contained another Genesee-looking stem and a drill made from a Genesee biface, and provided two AMS dates on charred wood samples from the very bottom of
the pit: 4020 ±30 B.P. and 3660 ±30 B.P. (Ellis 2010: 20). The older of the two dates is an outlier versus the overall sample of 20 Broad Point related dates from Davidson, and most likely results from the burning of old wood (either from dead trees or the older segments of a long-lived tree [Chris Ellis, personal communication 2015]). When the biface was first recovered, Ellis (2007: 13) remarked on its Adder Orchard-like outline, though because of some of the Genesee-looking bifaces and biface fragments recovered from the same area of the site, he attributed its form to the constraints presented by the Kettle Point material. Therefore, based on the fact that there is little co-occurrence of the three traits “non-triangular,” “convex-edged,” and “made from Kettle Point” in these samples, and the fact that one of the two bifaces that do display this co-occurrence was excavated from a Genesee-dated feature, I am hesitant to remove them from my sample, as they seem to be legitimately part of the technological system of the time period under examination. As will continue to become clear further on, there seems to be a mixture of traits in the west that sometimes make the classic typologies difficult to apply. Even without non-triangular bifaces, there does seem to be a presence of convex blades on other western sites, particularly at Desjardins which had a statistically significant proportion of bifaces which were both triangular-shaped and had convex edges (Fisher’s Exact value= 27.0; p=0.009; adjusted standardized residual=2.5).

The asymmetrical forms that were observed in each sample are also of interest (see Figure 5-3). Small percentages of bifaces in each sample displayed asymmetrical blade edges (as in, one edge was classified as “straight,” and the other was classified as “concave,” for example), save at the Desjardins site. As previously discussed, Dunn (1984) argued that Perkiomen bifaces were used as knives based on the fact that they displayed microscopic use-wear on only one side. If Genesee bifaces were being used as knives in the same way that Dunn’s sample was, then, it would follow that these bifaces are more heavily re-sharpened on one side, leading to a more asymmetrical blade shape. At the same time, I do not think that the asymmetry of the biface would always cause it to be considered inappropriate, or always cause it to malfunction as a projectile. I believe that it would simply be the result of curating a tool used in cutting activities.
5.1.3 Stem Morphology

Across all samples, it would seem that “straight” is the predominant stem shape (see Figure 5-4). Stems that are narrowed at the base also seem to have a small presence in all samples but Parkhill, and a relatively large presence in the Hamilton Golf Course sample.

Despite the Parkhill sample having an unusually high percentage of expanding stems, it is likely that this is simply an effect of Parkhill’s small sample size. A Monte Carlo simulation was run on the distribution of stem shapes, and none of the differences were found to be significant (Fisher’s Exact value = 16.8; p=0.600).

5.1.4 Base shape

At most sites considered, bifaces with concave bases made up at least 50% of the sample. In the eastern samples, though, concave-based bifaces contributed more than 70% of the sample, while in the west (Ausable and Komoka samples) concave-based bifaces only accounted for 47-64% of each sample (see Figure 5-5). At the Davidson and Sadler sites, straight bases seem to make up a significant proportion of their samples (32% and 50% respectively). The Sadler site was, in fact, found to have a significantly greater number of bifaces with straight bases than any other site. The Brodie site sample was found to be
unique in having 47% of its bifaces displaying convex bases. The Brodie site sample, due to its high percentage of convex bases, was found to be significantly different from the rest when a Monte Carlo simulation was performed (Fisher’s Exact value= 31.9; p=0.006), based on its adjusted standardized residual value (4.3).

These results suggest that there is real variation of base-finishing practices, and it does seem to correspond somewhat to where the site is located. There seems to have been a greater variation of base-finishing practices among the western sites. Genesee biface base-finishing was not standardized throughout the area, though the most common base shape was concave.

![Distribution of base shapes](image)

**Figure 5-5. The percentage of bifaces with straight, concave, and convex base shapes.**

### 5.1.5 Co-occurrence of base and edge traits

The co-occurrence of attributes can provide information on how information was shared, and whether one Genesee shape was predominant throughout the area. **Table 5-2** depicts a Monte Carlo simulation on the co-occurrence of the two traits that vary the most from sample to sample: base shape and edge shape. The test did not display any obvious patterns. Even so, 29% of bifaces displayed both straight edges and concave bases. This co-occurrence was not found to be significant, however, because overall, each of these
attributes were the most common expression of their respective element (Fisher’s Exact value=11.8; p=0.161).

Table 5-2. Relationship between edge shape and base shape.

<table>
<thead>
<tr>
<th>Base shape (n)</th>
<th>Concave</th>
<th>Convex</th>
<th>Straight</th>
<th>Asymmetrical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>concave</td>
<td>7</td>
<td>5</td>
<td>18</td>
<td>8</td>
<td>38</td>
</tr>
<tr>
<td>Convex</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Straight</td>
<td>1</td>
<td>3</td>
<td>8</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>13</td>
<td>29</td>
<td>12</td>
<td>63</td>
</tr>
</tbody>
</table>

Straight edges and concave bases are variants more often seen in the eastern samples than in the Ausable River Valley and Brodie sites. The fact that both of these traits are more common overall might suggest that the Genesee form over the whole region was heavily influenced by eastern practices. The exchange of Onondaga material to the west in the form of preforms and completed stemmed bifaces may have meant that the influence on Genesee-making practices flowed one-way. That these traits do not co-occur significantly might suggests that the technology was not adopted by people living in the west as if following a template, but rather each western community engaged with the technology in slightly different ways.

5.1.6 Metrics

As I have previously discussed, metric studies of Genesee bifaces have been conducted by other researchers, and in some ways I have replicated their results. To test for significant differences in the metric data between samples, I conducted a Kruskal-Wallis test on SPSS (my standard for significance was p≤0.05). I chose to make use of the Kruskal-Wallis test because some samples did not display a normal distribution for each of the measurements. If the test returned significant results, a Mann-Whitney test was conducted on each sample pair to further investigate the statistical relationships between the biface sizes of each archaeological site.
Table 5-3. The mean measurements of nine different biface attributes for each collection (maximum and minimum shoulder heights were averaged).

<table>
<thead>
<tr>
<th></th>
<th>OL</th>
<th>BL</th>
<th>StL</th>
<th>ShH</th>
<th>BW</th>
<th>StW</th>
<th>ShW</th>
<th>StT</th>
<th>MTh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Davidson</td>
<td>N</td>
<td></td>
<td></td>
<td>10</td>
<td></td>
<td>10</td>
<td></td>
<td>19</td>
<td></td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>64.91</td>
<td>46.79</td>
<td>14.58</td>
<td>19.87</td>
<td>20.29</td>
<td>21.79</td>
<td>36.30</td>
<td>8.40</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>14.82</td>
<td>10.98</td>
<td>3.71</td>
<td>4.98</td>
<td>2.87</td>
<td>3.11</td>
<td>8.40</td>
<td>0.98</td>
</tr>
<tr>
<td>Sadler</td>
<td>N</td>
<td>6</td>
<td>7</td>
<td>12</td>
<td>18</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>17.26</td>
<td>16.87</td>
<td>3.60</td>
<td>4.78</td>
<td>3.12</td>
<td>0.80</td>
<td>7.93</td>
<td>0.80</td>
</tr>
<tr>
<td>Desjardins</td>
<td>N</td>
<td>6</td>
<td>6</td>
<td>9</td>
<td>14</td>
<td>12</td>
<td>9</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>68.22</td>
<td>47.24</td>
<td>16.82</td>
<td>21.79</td>
<td>20.08</td>
<td>23.16</td>
<td>35.81</td>
<td>9.12</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>11.61</td>
<td>9.83</td>
<td>1.83</td>
<td>3.12</td>
<td>2.57</td>
<td>2.52</td>
<td>5.50</td>
<td>2.08</td>
</tr>
<tr>
<td>Parkhill</td>
<td>N</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>9</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>67.58</td>
<td>45.35</td>
<td>15.53</td>
<td>19.78</td>
<td>17.47</td>
<td>21.60</td>
<td>28.73</td>
<td>9.24</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>--</td>
<td>23.36</td>
<td>1.03</td>
<td>3.80</td>
<td>1.53</td>
<td>2.69</td>
<td>--</td>
<td>3.17</td>
</tr>
<tr>
<td>Brodie</td>
<td>N</td>
<td>6</td>
<td>6</td>
<td>15</td>
<td>27</td>
<td>15</td>
<td>17</td>
<td>14</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>75.66</td>
<td>56.73</td>
<td>15.95</td>
<td>19.43</td>
<td>18.66</td>
<td>21.25</td>
<td>32.42</td>
<td>9.45</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>11.09</td>
<td>10.28</td>
<td>3.65</td>
<td>4.42</td>
<td>2.12</td>
<td>1.91</td>
<td>3.97</td>
<td>1.45</td>
</tr>
<tr>
<td>R&amp;K</td>
<td>N</td>
<td>4</td>
<td>7</td>
<td>16</td>
<td>26</td>
<td>30</td>
<td>21</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>75.91</td>
<td>52.62</td>
<td>15.02</td>
<td>20.02</td>
<td>20.77</td>
<td>21.20</td>
<td>40.91</td>
<td>7.04</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>20.74</td>
<td>14.51</td>
<td>4.42</td>
<td>6.51</td>
<td>3.34</td>
<td>4.71</td>
<td>10.17</td>
<td>0.84</td>
</tr>
<tr>
<td>Hamilton G.C.</td>
<td>N</td>
<td>6</td>
<td>6</td>
<td>13</td>
<td>23</td>
<td>11</td>
<td>12</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>58.78</td>
<td>46.18</td>
<td>11.01</td>
<td>13.77</td>
<td>18.81</td>
<td>21.03</td>
<td>36.86</td>
<td>7.65</td>
</tr>
<tr>
<td></td>
<td>S</td>
<td>12.25</td>
<td>11.47</td>
<td>1.84</td>
<td>2.50</td>
<td>2.77</td>
<td>2.72</td>
<td>5.97</td>
<td>1.20</td>
</tr>
</tbody>
</table>

Many of the recorded measurements displayed no significant differences between the samples. Across the region, people seemed to have been making bifaces with similar stem widths and base widths (see Table 5-3). For the blade elements of the bifaces though, much more variation appeared to have existed within samples than between them. Kenyon (1980b) had also observed the great variation of blade length measurements, suggesting that because the blade was subject to more damage and re-
sharpening than the haft element, it was not a reliable element to use for testing intersample variation. In his investigations of the material from the Ausable River Valley sites, he also found that longer blades could be observed on those bifaces made from coarse-grained materials. He, again, used this evidence to argue that blade measurements were not appropriate to distinguish different Genesee variants (Kenyon 1980b). After comparing the overall length and blade length measures across the samples, I ran a Mann-Whitney test on these measurements grouped by material. For my analysis I tested the measurements of the biface against the materials grouped in two different ways: my first test grouped materials as coarse-grained or chert, and my second by west-originating or east-originating. By conducting each of these tests, I had hoped to reduce the risk of confusing a local practice with a practice associated with a specific material type.

There were significant differences between the lengths observed for the bifaces made from coarse-grained materials and those made from chert (Mann-Whitney U= 53.0; p=0.010 for blade length; and Mann Whitney U=37.0; p=0.006 for overall length), finding the coarse-grained bifaces to be longer. The differences between the bifaces made from western-originating materials to eastern-originating materials was not significant, however (Mann Whitney U=161.0; p=0.710; and p=0.868). These results support Kenyon’s (1980b) assertion that the use of coarser-grained materials facilitated the production of longer Genesee bifaces among the western occupations.

The other measurement that seemed to be influenced by raw material type, but not raw material origin was stem width. Coarse-grained bifaces seem to have wider stems (Mann Whitney U=396.5; p=0.011 based on material type; and Mann Whitney U=611.5; p=0.119 based on material origin), and are thicker overall (p=0.000 based on material type, and p=0.090 based on material origin). Maximum thickness and stem thickness are related to material type (Mann Whitney U=159; p=0.000; and Mann Whitney U=260.5; p=0.000, respectively), and also to material origin (Mann Whitney U=397; p=0.047; Mann Whitney U=506.5; p=0.022, respectively). The relationship between thickness and both of these variables makes it unclear if stem thickness was more subject to local practices or material constraints. It is likely that these differences relate somewhat to the relative difficulty of knapping a coarser grained material. For example, it might have
been more difficult to take off broad, shallow flakes necessary to thin the bifaces (Kenyon 1980b). Kenyon (1980b) did not discuss how material type affected the maximum thickness of the biface, though he did find that it influenced stem thickness. It is very possible that biface thickness was influenced by a combination of material constraints and local practice. If thicker stems became the norm due to certain material influences, then that practice might be applied to other materials. Alternatively, biface-making practices may already have been producing slightly thicker bifaces, and so the material realities of the coarse-grained materials encouraged that practice to be carried forward. Finally, like Kenyon (1980b), I found that shoulder width and base width measurements were completely unrelated to the raw material used.

Other metric attributes of the bifaces seem to display differences across the samples. When I conducted a Kruskal-Wallis test for the stem length measurements (as well as for the elements that directly correlated with stem length, namely shoulder height), I found that the differences were significant (Chi-Square=24.7; df=6; p=0.000).

Using a Mann-Whitney U test comparing each pair of samples, I found that the major outlier was the Hamilton Golf Course sample. All samples had significantly longer stems than those found at the Hamilton Golf Course site. Kenyon (1980b) was the first to study the distribution of Genesee haft element shapes over space in his own metric study. He observed that the stems of the bifaces in eastern Ontario were much more similar in size to those from the Oatman and Weir sites of New York:

The Hamilton Golf Club site, which is outside of the spatial range of Ontario Satchell, has short contracting stems that seem to be transitional between the Genesee points of Oatman and the Snook Kill points of Weir (Kenyon 1980b: 34).

That portrayal of the Hamilton Golf Club bifaces perfectly describes the results of this study. In addition to my observing several “narrowed” stems in the Hamilton collection, there does seem to be a real difference in the stem length of bifaces found to the east in comparison to those found in the west. In considering other eastern Genesee sites in Ontario this pattern holds true. At Surma, the bifaces also display shorter stem lengths more akin to those observed at the Hamilton Golf Course than any of the other samples of
this study, averaged at 12.88 mm (Kenyon 1981). Likewise, at the Peace Bridge site, biface stems had an average length of 12.02 mm (based on Austin and Jenkins; 2006). It would seem that the bifaces at the Hamilton Golf Course site are much more similar to what can be observed on the Niagara Peninsula and in New York than the rest of the samples in this study. It is very interesting that despite the R&K site’s more eastern position, it was found to be more statistically similar to most of the biface samples to the west in terms of stem length.

Haft element variance proved to be significantly associated with geography in Burgar’s (1985) study as well. After taking a series of measurements from the bifaces in his sample, Burgar (1985: 75) conducted a principal component analysis in an attempt “to define a new set of variables or components in terms of coefficients relating to the original variables.” This way, he determined which measures contributed the most to his components, and which of his samples were the most related to each other. He found that the measurements from around the haft element were those that varied most significantly and contributed the most to his component scores.

Figure 5-6. The results for the principal component analysis on the metric traits of the bifaces. The bifaces of the Hamilton G.C. and Sadler sites seem to cluster.
I decided to run a principal component analysis on my own measurements, after ensuring that my samples were large enough (using the Kaiser-Meyer-Olkin measure of sampling adequacy), and that each of the variables displayed at least a slight linear relationship. It did not add any more to my analysis, other than to confirm what I had already observed through the Mann-Whitney tests. The principal components were derived through a Varimax Rotation method using SPSS. After that, the components were ranked based on their Eigenvalue, or their level of variance. The first principal component had a relatively high Eigenvalue of 5.1, and gave shoulder height and stem length measurements the most weight, though it took into account all but the blade length measurements. The second principal component had a much lower Eigenvalue of 1.5. It was made up of all measurements, but it gave the contribution from overall length and blade length measurements more weight. When the cases were plotted based on their principal component 1 and 2 values, the only two samples that seemed to cluster together were the Hamilton Golf Course site sample, and the Sadler site sample (see Figure 5-6). The results of this multivariate test further support the interpretation that the Hamilton Golf Course bifaces have haft elements which are distinctive from the rest in this sample, and that the Sadler bifaces are especially different from the eastern bifaces.

Once again, we can see that the R&K site seems more similar to the bifaces to the west than to the bifaces of the Hamilton Golf Course site. This similarity might suggest that lithic material and information exchange was more prominent between the people residing at the R&K site and the people living to the west who did not have direct access to the Onondaga outcrop, than with people residing around Lake Ontario, to whom Onondaga might have been more accessible. The communities of Genesee-making practices may not necessarily correspond to geography, then, but more to social relationships that were maintained through exchange.

Alternatively we could be observing, as Kenyon (1980b) had originally suggested, variation over time. The R&K site was not statistically similar to all of the Ausable River Valley sites, and the biface stems of the Sadler site were statistically longer. The mean stem length of the bifaces from the R&K site is virtually identical to that of the Davidson site, and similar to that of Parkhill. The mean stem length of the Sadler bifaces was
practically identical to that seen at Brodie, and Desjardins had the highest stem length mean of all the samples (perhaps it was not found significantly different from the R&K bifaces because of its smaller sample size). We know that the first occupations at the Davidson site date very early (3800 B.P.), to a time when it is thought Genesee technology was introduced to the area. It could have been that once the technology was adopted in the west (with its R&K-like stems) the Genesee-making practices diverged in small ways from the practices that could be observed to the east. Much like the convex blade edges, longer stem lengths might have been an influence of past Adder Orchard practices—Fisher’s (1997) stem length measurements from the Adder Orchard site suggest that the average narrow-bladed broad point had a slightly longer stem ($\bar{x} = 16.1$ mm). Meanwhile, practices might have changed slightly over time in the east as well. We know that Peace Bridge dates relatively late in the period (3500-3400 B.P.), as does the Snook Kill type in New York (3600-3500 B.P.). It is possible that the Hamilton Golf Course, with its similarly short stems and its narrowed bases, is also a relatively late site.

### 5.1.7 Width to thickness ratios

Broad-shouldered bifaces are well known for their high width to thickness ratios. In the past, researchers have claimed that their unusually high width to thickness ratio suggested that broad point bifaces had blade edges suitable for use as knives (see Cook 1976a; Custer 1984). To test the distribution of width to thickness ratios across the samples, I ran a Kruskal Wallis test. I expected that the ratio would vary slightly, if for no other reason than because different materials were being used. It does seem that the width to thickness ratio varies from sample to sample (see Table 5-4; Chi-Square=26.8; df=6; p=0.000), with the eastern-made bifaces having much larger ratios than the western-made bifaces (Mann Whitney U=171.5; p=0.002). There was also a significant relationship between the ratio and material type (Mann Whitney U=178; p=0.032).

#### Table 5-4. Mean width to thickness ratios for each collection.

<table>
<thead>
<tr>
<th></th>
<th>Davidson</th>
<th>Sadler</th>
<th>Desjardins</th>
<th>Parkhill</th>
<th>Brodie</th>
<th>R&amp;K</th>
<th>Hamilton G.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>width:thickness</td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ratio</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$N$</td>
<td>16</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>12</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>$X$</td>
<td>2.18</td>
<td>3.34</td>
<td>3.17</td>
<td>2.72</td>
<td>2.81</td>
<td>4.37</td>
<td>4.02</td>
</tr>
<tr>
<td>$S$</td>
<td>0.33</td>
<td>0.85</td>
<td>0.78</td>
<td>--</td>
<td>0.85</td>
<td>0.76</td>
<td>0.55</td>
</tr>
</tbody>
</table>
I believe that in the western communities, most bifaces had lower width to thickness ratios for a combination of reasons. Coarse-grained materials are more difficult to thin, and Kettle Point materials occur in relatively small nodules, usually not able to support the broad-shouldered shape (Kenyon 1980b). The form of the bifaces made from these materials would have been somewhat restricted, encouraging Genesee biface-making practices to accommodate a different set of material realities. Finally, because the Onondaga bifaces were received through exchange or interaction that spanned a great distance, they were presumably curated for long periods of time. I believe that the repair and resharpening of Onondaga bifaces would have eventually worked them down into narrower shapes, again shrinking the width to thickness ratio.

There seemed to be a greater diversity in material use, blade shapes, and base shapes in the western samples. Specifically, traits such as non-triangular blades, convex blade edges, and higher percentages of straight and convex base shapes may be an influence of the technological system previously used in the area, Adder Orchard. Further support for this position is supplied by the significantly different stem lengths between the western collections, which had longer, Adder Orchard-like stems, and the shorter stems of the Hamilton Golf Course site—suggesting that stem-making practices varied over space. The fact that the potentially later Sadler site bifaces and the R&K site bifaces were significantly different while the R&K and the earlier-dated Davidson sites have similar stem lengths might suggest that there was change in practices over time as well. Other differences, such as biface thickness, appear to relate to the properties of the raw material used.

## 5.2 The experimental results: Using Genesee replicas

The 19 replica Genesee bifaces were used in experimental tasks in order to investigate task-related wear. The Genesee bifaces used as projectile tips displayed four of the five types of impact fractures observed in the archaeological collections. There was also some correspondence between the material the biface struck and the resulting impact fracture. Finally, a trend was observed that might suggest that longer replica bifaces fractured more often, giving them shorter use-lives.
When the replicas were used as knives for butchering, our activities did not result in any macroscopic fractures. This observation is somewhat different from that of other studies examining fractures resulting from butchering activities.

5.2.1  Projectiles

The Genesee bifaces hafted to spear shafts were launched at the deer target, resulting in 55% of the breaks being diagnostic of impact. Later, the Genesee spears were hand-thrown in an open environment to investigate how the impact fractures would differ based on the material the biface made contact with. While crushed tips were observed under multiple circumstances, the other fracture types tended to be especially prevalent in certain circumstances.

5.2.1.1  The deer target

In total, we fired 29 shots at the deer target: two of which glanced off the target, and one of which missed the target completely (in this case the stone point was not observably damaged). Out of the 26 times the spears met their target, the bifaces sustained damage only 11 times (42%). Three of the 11 cases were only very slight tip-crushing events that would not have prevented those points from being reused without repair. Another six cases displayed diagnostic impact fractures (DIFs), meaning that diagnostic impact

Plate 5-1. Chert remnants found in the bones of the deer

A.  Deer innominate with impact mark (see imbedded chert fragments).
B.  Deer vertebrae imbedded with biface tip fragments.
fractures made up approximately 55% of all macroscopic impact fractures. This figure is in line with the results of the study by Fischer and colleagues (1984), who found diagnostic impact fractures to occur 55% of the time; Lombard and colleagues’ 2004 study (57% of the time); and Clarkson and Brindley’s 2015 study (60% of the time). Over the course of all trials, the replica projectiles sustained diagnostic impact fractures 21% of the time.

Crushing was the most common impact fracture, occurring a total of 6 times in the deer target experiment (3 of which were not considered diagnostic, as they were so slight; see Table 5-5). For each of the heavy-crushing events, the projectile landed in the upper forequarter, or hind quarter, suggesting that the point made contact with the scapula or the innominate. In fact, after the deer was defleshed, tiny fragments of chert was found imbedded in the innominate (see Plate 5-1). It is likely this was caused by one of the crushing events.

Table 5-5. Observations from launching replica spears at deer target.

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-1</td>
<td>--</td>
<td>--</td>
<td>bending fracture</td>
</tr>
<tr>
<td>DLC-2</td>
<td>spin-off fracture</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-3</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-5</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-6</td>
<td>spin-off fracture</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-7</td>
<td>crushed tip</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-8</td>
<td>crushed (reusable)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-9</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-11</td>
<td>impact burin</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-14</td>
<td>crushing at tip, bending fracture at stem</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-15</td>
<td>--</td>
<td>--</td>
<td>crushed tip</td>
</tr>
<tr>
<td>DLC-17</td>
<td>multiple cone fractures</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-18</td>
<td>--</td>
<td>--</td>
<td>crushed (reusable)</td>
</tr>
<tr>
<td>DLC-19</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>DLC-20</td>
<td>--</td>
<td>--</td>
<td>crushed (reusable)</td>
</tr>
</tbody>
</table>

Spin-off fractures were observed twice: each time, the projectile hit the frontal dorsal region, and may have either struck the scapula, or the vertebral column of the animal. An impact burin was observed once when a biface impacted the mid-trunk, likely making contact with the ribs. I observed multiple cone initiated fractures on DLC-11, which made contact with the dorsal trunk—possibly striking the vertebral column. Once again,
after the deer was defleshed, two vertebrae were found to have point tips embedded in them. These lithic remains might have been left by any of the spin-off or cone-initiated fracture events. Finally, one bending fracture at the tip was observed (although I believe it was sustained when it penetrated the deer’s torso and hit the wooden board supporting the target), and one bending fracture at the stem was observed (the projectile hit the rear of the trunk, possibly striking the innominate).

## 5.2.1.2 Open environment

When we threw the spears into an open environment, we again observed diagnostic impact fractures. A total of 14 throws were made on the paved road, and impact fractures were sustained 36% of the time (diagnostic impacts, again, occurred 21% of the time). When the tip of the point hit the ground, it was common to see crushing paired with an impact flute (see DLC-5, DLC-18, DLC-19; also see Appendix D). In the case of DLC-3, in its fourth trial, its shoulder hit the ground, breaking off in a cone-initiated fracture. Finally, for DLC-20, the face of the Genesee point landed on the ground, breaking the biface in two places.

Interestingly, the only impact flutes observed in this experimental study were observed on bifaces thrown onto the road (DLC-5, DLC-18, and DLC-19), while I observed no examples of this kind of fracture on those bifaces launched at the deer target. It could be that impact flutes occur more frequently when the point tip strikes a hard, rock-like surface. Of course the sample size is so small it is difficult to come to any firm conclusions concerning this fracture pattern.

### Table 5-6. Observations from launching replica spears in an open environment.

<table>
<thead>
<tr>
<th></th>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCL-3</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>crushing and cone fracture on shoulder</td>
</tr>
<tr>
<td>DCL-5</td>
<td>impact flute</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>DLC-18</td>
<td>impact flute</td>
<td>--</td>
<td>--</td>
<td>impact flute</td>
</tr>
<tr>
<td>DLC-19</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>DLC-20</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>two bending fractures</td>
</tr>
</tbody>
</table>
Two of the spears were tested on trees instead of thrown into the open environment. The first, DLC-9, was launched at the tree with the mounted longbow. The stone tip of the spear embedded in the tree and knocked loose from its haft. As we removed the point from the tree, we observed that the tip had snapped off the biface. The second spear, DLC-8, was thrust at the tree by hand. The tip of the stone point snapped off as the spear was thrust at the tree for the second time. Each of these tip-snaps was identical to the bending fracture noted on the tip of the biface (DLC-1) that likely made contact with the wooden board that supported the deer target in the first portion of the projectile experiments.

Although this study was relatively small and exploratory in nature, whenever I observed a single bending fracture on a biface, I could associate it with striking wood. Whether the point was launched with the mounted longbow (as in the case for DLC-1 and DLC-9) or thrust against wooden materials (as in the case for DLC-8), if it hit wood, the biface displayed a single bending snap. The one exception was DLC-14, which also displays a single bending fracture, but which struck mammal bone instead. DLC-14, however, did not display a bending fracture at its tip like the other examples (it had a crushed tip), and the bending fracture was found on its upper-stem (see Appendix C). I believe, therefore, that the snapped stem observed on DLC-14 relates to the force from the moving wooden shaft on the biface after the biface had been halted in its trajectory by the mammal bone.

In each case, the single bending fracture was caused by a longitudinally-oriented force.

The sole case of a biface sustaining two bending fractures at once (one distally at the tip and one mid-blade) was DLC-20. This biface fractured when one of its faces hit the hard road surface. In this case, the bending fractures were associated with a transversely-oriented force, but it may be difficult to differentiate bending fractures which result from longitudinal force from those that result from a transverse force in the archaeological record.
5.2.2 Size and use-life

After the trials were completed, I plotted a graph of the relationship between certain measurements of the projectile point and the length of its use-life (measured by the number of trials it survived). Odell and Cowan (1986) reported that the length of the projectile point made no difference in its longevity in their experimental study, though the length to width ratio did. Even then, they explained that low length to width ratios failed to penetrate the animal’s hide more often, and as a result, did not strike bone as frequently as those with higher length to width ratios (Odell and Cowan 1986). Cheshier and Kelly (2006) also conducted an experimental study on the different breakage frequencies between

**Figure 5-7.** The plotted relationship between the number of trials each biface survived, and its shoulder width.

**Figure 5-8.** The plotted relationship between the number of trials each biface survived and its overall length.
2.5 cm points and 5 cm points. Again, they did not find that absolute length was a significant factor in durability. In this study, the overall length of the projectile point appeared to have been related to the number of trials it survived (see Figure 5-7). When I plotted the results, a negative relationship between the variables was relatively clear.

A Pearson Correlation found that the relationship was very nearly significant at the \( \leq 0.05 \) level (Pearson’s \( r=-0.503; \) \( p=0.056 \)) suggesting there is some structure to these data. Perhaps the only reason it was not significant at the \( \leq 0.05 \) level was that the sample was not large enough to resist the variability of different impact surfaces (that is, soft tissue, bone, pavement, and wood).

I conducted the same analysis on the relation of the longevity to the shoulder width of the projectile point. This relationship was far less defined when plotted (see Figure 5-8), and it was not significant according to its Pearson Correlation (Pearson’s \( r=-0.449; \) \( p=0.093 \)).

Finally, I repeated the same steps once more, this time testing survival rate to the length to width ratio of the projectile point (see Figure 5-9). There was, seemingly, no relationship between the plotted variables, and the lowest Pearson Correlation significance score (Pearson’s \( r=-0.277; \) \( p=0.318 \)). The failure of the length to width ratio to correlate with projectile survival seems contradict the findings of other studies, but it is interesting that the length of the biface appears to have influenced its durability.
5.2.3 Knives

None of the four Genesee knives used to deflesh the deer carcass sustained macroscopic fractures. The greatest change that I observed was a general rounding of the tip and edges. At one point, a stone biface came loose from its haft—though it sustained no observable damage from the event. While Truncer (1990) observed fractures on all the blades of his knives after his butchery experiment using Perkiomen style broad points, we were not able to replicate his results with the Genesee bifaces. Because the four Genesee knives in this study had a larger width to thickness ratio ($\bar{x} = 5.5$) than Truncer’s three replica Perkiomen knives ($\bar{x} = 4.4$), I do not believe that the Perkiomen replica bifaces were easier to break under transverse stress. I believe it is more probable that these differences relate to the experience of the researchers who were involved in the defleshing experiment. The researcher who did most of the defleshing for this study, Patricia Wells, had previous experience using lithic tools for this task, and was aware that using the knife in a twisting or prying motion would break the tool. Ed Eastaugh, the technician who runs the zooarchaeology laboratory at Western University, has also had much experience in defleshing animals. Even when he disjointed the vertebral column in two places, the knives did not break. Truncer (1990) meanwhile claims to have employed a prying technique to disjoint elements in his own experiment, and found that each of his three knives sustained transverse fractures across their blades.

Additionally, those researchers who conducted most of the defleshing in this study were not aware of the kinds of breaks commonly observed on Genesee material, nor were they aware of my own expectations. It is possible that Truncer (1990), in contrast, had some idea of the kinds of fractures present on the archaeological bifaces, leading him to re-create what he had observed (consciously or subconsciously).

If past peoples did use Genesee bifaces as knives, it is more likely that they were well-practiced in their use, and were aware of the consequences of using them in certain gestures. Truncer’s study determined that transverse blade fractures are a possibility when using broad-shouldered, thin-bladed bifaces in butchering activities, but the results of the present study suggest that it was not an unavoidable consequence. Instead, when investigating the use of these bifaces as knives in the future, one must conduct a
microscopic use-wear study—either in lieu of the macroscopic study, or in combination with it.

5.3 Macroscopic fractures on archaeological material

In order to trace the use-practices in which Genesee technology was involved, I investigate the pattern of DIF frequency among the bifaces. The proportion of bifaces with DIFs in the entire sample is relatively high, suggesting that one of the primary roles for Genesee bifaces was as stone tips for a hunting technology. It also appears that the choice to use a biface as a stone tip was not influenced by raw material, nor by the size of the biface.

5.3.1 Use-wear across the samples

The macroscopic use-wear study of the archaeological materials provided information about the way the Genesee bifaces were used across all seven sites. In the overall sample, a relatively high 22% of the biface fragments displayed diagnostic impact fractures. This proportion of materials with impact fractures suggests that these bifaces were used in hunting activities in at least some contexts. Though many researchers (see Fischer et al. 1984; Odell and Cowan 1986; Truncer 1988; Villa et al. 2009; Weitzel et al. 2014) would take these impact fractures as evidence for projectile use, Lombard and colleagues (2004) argue that using a stone-tipped spear in thrusting activities will result in the same kinds of fractures. Even though it may be difficult to distinguish thrusting damage from projectile damage, the presence of impact fractures over a proportion of the sample still suggests that Genesee bifaces were used as part of the hunting technology 3400-3800 radiocarbon years ago.

As I have previously discussed, the experimental portion of this study showed that Genesee bifaces used as projectiles sustained diagnostic impact damage 55% of the time they sustained any damage. Based on the experimental results, then, 22% is a lower percentage than I would expect if the bifaces were being used exclusively as projectile tips to their exhaustion before discard. Because the fracture properties of the coarse-grained material used in the production of some of these bifaces remains unexplored, I decided to investigate the percentage of bifaces with diagnostic impact fractures within a
sample of only those bifaces made on chert. Excluding the coarse-grained bifaces did not make a significant difference, however, as the percentage of biface fragments with diagnostic impact fractures only increased to 23%.

The figure of 22% is more consistent with the frequency of diagnostic impact fractures over their experimental use as projectiles (21%). Considering that some of the bifaces in the sample were not observably fractured, it may be more appropriate to treat the sample as representing bifaces at various stages in their use-life, rather than as bifaces which were all exhausted to the point of discard. Weitzel and colleagues (2014) also observed that 22% of their projectile point sample displayed the classical DIFs. Truncer (1990), too, observed that only 10% of his Perkiomen point sample sustained impact fractures. Clarkson and Brindle (2014: 86) compiled a list of studies from Europe, Africa, and Australia that have used diagnostic impact fractures to identify projectile use in the archaeological record, finding “[t]he highest percentage of DIFs from an archaeological site is just over 40%, whereas experiments typically produce DIFs on 40–60% of points.” In fact, most of the studies they cite have reported that bifaces with DIFs make up less than 20% of their sample, and only three out of 29 samples boasted a proportion of 40% or above. They note that this could be partially attributable to the recovery of relatively complete points from archaeological sites. In contrast, most experimental studies, like this one (see Fischer et al. 1984; Lombard et al 2004; Odell and Cowan 1986; Truncer 1988; Weitzel et al. 2014), will launch the projectiles until they sustain macroscopic fractures, and then calculate the proportion with diagnostic impact fractures from a sample of unusable points. In light of these other reports, it seems that projectile use was one of the primary, if not the primary, function of Genesee bifaces. When the percentages of biface fragments with impact fractures are graphed by site sample, very similar proportions can be observed from site to site (see Figure 5-10). Except for at the Desjardins site, there is at least one biface with a DIF in every site sample, and at sites with bifaces displaying DIFs, they make up 17-40% of the sample. Though there is some variation, the differences are no more than would be expected due to chance based on a Monte Carlo simulation (Fisher’s Exact value=5.5; p=0.468).
The fact that bifaces with DIFs were consistently found across all but one of the site samples, and that a relatively high proportion of bifaces displayed DIFs, suggests that Genesee bifaces were produced so they could function as stone tips, at least some of the time.

Whether Desjardins represents a special activity area is difficult to determine. Unlike the rest of the Ausable River Valley sites, it was not found on a flood plain, but on an upland terrace (Kenyon 1980a), and one coarse-grained biface from Desjardins did have a smooth and polished “rubbed tip.” Other researchers have reported broad-stemmed bifaces with rubbed tips from the Surma site (Kenyon 1981), and the Adder Orchard site (Fisher 1997). In this study, two other Genesee bifaces with rubbed tips were observed from the Brodie site sample, and three other bifaces were observed from the Davidson site (these were not included in the study, as they did not appear to have been worked into Genesee-shaped bifaces).

Besides the biface with the rubbed tip, the bifaces in general at Desjardins seemed to have been kept in very good condition. Very few fractures were noted on the bifaces at all (only three bending fractures on a total of 11 bifaces), and all the bifaces at that site displayed symmetrically-worked blades (see above). Based on the condition of the tools,
I am tempted to suggest that they were used only very lightly, if at all. It might even be possible that some of the bifaces recovered from Desjardins belonged to a plough-disturbed cache.

Another interesting observation is that while the Sadler site had the greatest proportion of bifaces with DIFs, it had a very low proportion of asymmetrical bifaces, suggesting that Sadler might also be a candidate for a specialized activity area. The high percentage of bifaces with DIFs (40%) paired with the low percentage of bifaces that have had their edges unevenly reworked (9%) suggests that more projectile activity than cutting activity might have been taking place there.

5.3.2 Use-wear across materials

It is also useful to be aware of how the biface’s material influenced its use and wear in order to better interpret the use-wear results. I thought that coarse-grained bifaces might display impact fractures less frequently than the chert bifaces. The coarse-grained debitage recovered from Davidson indicates that the material fractures differently and that it is more difficult to remove long flakes in biface thinning activities (Chris Ellis, personal communication 2015). I did not find that there was a significant difference

![Fracture types by material](image)

**Figure 5-11.** The percentage of coarse-grained and chert bifaces with bending fractures, step-terminating fractures, spin-off fractures, cone-initiating fractures, impact burins, impact flutes, and crushing.
between the occurrence of DIFs on chert and their occurrence on metasediments (Chi-Square=0.459; df=1; p= 0.498), based on a Pearson Chi-Square test, but upon graphing the distribution of observed fractures on each of the two materials it appears that there may be a difference in the way each fractures on impact. Crushing was the most common DIF for coarse-grained bifaces (though a single burination fracture was observed), whereas step-terminating bending fractures, spin-off fractures, fluting, and burination were also observed among the chert bifaces. The step-terminating bending fractures, spin-off fractures, and impact flutes seen on the chert projectiles each terminate by removing a thin surface section of the artifact. Observing such terminations more frequently on chert bifaces is consistent with the belief that that material is more amenable to broad, shallow flaking than coarse-grained materials during flint-knapping.

5.3.3 Use-wear and biface size

There did not seem to be a correlation between whether a biface displayed a DIF and its size. I ran a Mann Whitney U on the archaeological sample, and the relationship between the overall length of the biface and whether it displayed a DIF was not significant (Mann Whitney U= 105.0; p= 0.895). The box and whiskers plots (see Figure 5-12) also demonstrate that the mean length of those bifaces with DIFs was only slightly lower than of those bifaces without DIFs. This finding suggests that there was no system whereby all the longer bifaces were used as knives while the smaller bifaces acted as

![Figure 5-12. The mean overall length of bifaces that have diagnostic impact fractures (left), and the mean of those that do not (right).](image-url)
projectiles. Clearly, both long and short projectiles were used in hunting activities. The slight difference in mean length between the two groups possibly relates to the bifaces displaying DIFs being further along in their use-life. These bifaces, therefore, might be more likely to have been curated to shorter lengths.

Next, the relationship between shoulder width and the presence of DIFs was tested, and again, it was not found to be significant (Mann Whitney U=491.0; p=0.668). The box and whiskers plots demonstrate that the mean shoulder width for bifaces with DIFs is virtually the same for those without (see Figure 5-13). Again, this evidence works against any suggestion that the narrower-shoul ered bifaces acted as the stone tips for hunting technologies, while the wider-shoud ered bifaces were relegated to the role of knives.

Finally, the length to width ratio of the bifaces with DIFs versus those without were compared (see Figure 5-14). For the third time, the two groups were not found to be significantly different from one another (Mann Whitney U=63.0; p=0.343). However, the range of length to width ratios for the known projectile points was more restricted, and slightly lower, than the range of ratios for bifaces without DIFs. It is difficult to say what this result might mean, given its lack of statistical significance. Based on Odell and Cowan’s (1986) study, it seems unlikely that bifaces with lower length to width ratios would be more prone to breakage. One possibility is that people were choosing a certain
range of biface forms to act as projectiles. What might be more likely, however, is that because there are so few bifaces with DIFs from which I could take both length and width measurements, there may be a narrower range of sizes in that subset of the sample simply due to chance.

In sum, the macroscopic diagnostic impact fractures observed in the experimental study seem to support the use of the classic fracture types that other studies have employed to infer projectile use. The different fracture types may correlate with different impact surfaces. Longer bifaces may sustain fractures more easily than shorter ones, though it does not seem that past peoples were selectively using shorter bifaces to act as projectiles. Rather, it appears that they used long and short bifaces equally in their hunting technology. Finally, while it does seem that coarse-grained materials and chert have different kinds of impact fractures, one material does not sustain diagnostic fractures more often than the other. Additionally, past peoples seemed to have made use of bifaces made from both materials as projectile points.

Figure 5-14. The mean of the length to width ratio of bifaces that display diagnostic impact fractures (left), and the mean of those that do not (right).
Chapter 6

6 Discussion

People, lithic raw materials, and their products all interacted with one another to make a technological tradition. This tradition was never static, but was always in the making, as it was practiced by a variety of people in a variety of contexts. The fact that people throughout the region of study engaged with Genesee technology at some level, meant that they were all participating in a community of practice, albeit on a very large scale.

The exchange of Onondaga as a raw material resource would have formed the community of practice that facilitated the adoption of Genesee technology over what is now known as parts of Ontario and New York. Yet, when people participated in this macro-scale community, they could have only done so on a micro-scale — as a member of a more locally-oriented community. As each local community would have had its own set of past practices, as well as its own set of constraints with which to interact, local communities engaged with Genesee biface making in slightly varying ways. Even while the engagement with this biface-making technology varied from community to community, Genesee bifaces were used in a seemingly similar set of tasks. The Genesee biface, then, appears to have been adopted in order to perform certain functions (namely being used as projectiles and knives). The past peoples manufacturing Genesee bifaces were not simply making forms in stone, but seemed to hold a specific idea about the role (or possible roles) it would play upon its completion. Therefore, the spread of broad-bladed biface technology into Ontario was not prompted by an appreciation of a form independent of an ascribed function.

6.1 Material use over time

Other researchers have argued that raw material exchange networks were vast during the Broad Point Archaic, and that they might have facilitated the diffusion of specific biface technologies over large areas (see Custer 1984; Pagoulatos 2010; Stewart 1987, 1995). I believe that this explanation also suits the patterns archaeologists have observed between 3800-3400 years ago in southern Ontario. It seems that Genesee biface technology began
in the east and was adopted by communities of people already living in the westernmost part of the province. After its adoption, it appears that each community engaged with biface-making practices in slightly different ways. Micro-traditions in Genesee making grew from people’s interactions with locally-existing constraints, including the raw materials they had to work with.

It appears that through material exchange, the practice of using, and eventually making, Genesee technology expanded west from the Niagara Peninsula to include the Ausable and Komoka regions. As I explained in Chapter 2, even though Onondaga had been exchanged into the area previously, as evidenced by the presence of Onondaga bifaces on the Adder Orchard site (Fisher 1997), its exchange seems to have intensified between 4000-3800 years ago. For example, 48% of all stemmed points at the Adder Orchard site were made from Kettle Point chert (Fisher 1997). Kettle Point, therefore, seems to have been used more heavily at the Adder Orchard site than approximately 200 years later at the Davidson site, where Kettle Point stemmed points make up only 26% of the assemblage (and even that percentage is relatively high amongst the other Genesee sites in this study). In contrast, the use of Onondaga seems to have increased in the area from the time the Adder Orchard site was occupied (36% of stemmed points), to when the Davidson site was occupied (50% of stemmed points).

Based on the evidence from the Adder Orchard and Davidson sites, the introduction of Genesee technology to the Ausable River Valley seems to have corresponded with an increase in Onondaga exchange. There might have been some continued use of Kettle Point chert early on in the area, on which people might have continued to knap narrower, more irregular forms (likely due to the constraints of the material; see Kenyon 1980b), while Onondaga Genesee bifaces were being made use of. Feature #1, as previously discussed, dates to within the time of Genesee use, and it is filled with Kettle Point chert flakes (Chris Ellis, personal communication 2015). Along with the Adder Orchard-like biface found on the surface of the feature, a rectangular stem fragment on Onondaga was recovered. Finally, found in this same feature, was another point, apparently poorly made, on a flake of poor-quality Kettle Point material. Superficially looking like a Genesee biface, it had a generally triangular blade shape and relatively wide shoulders.
Yet, it was very small (smaller than even the Adder Orchard-looking biface of this feature), and mostly unifacially worked around the edge (see Plate 6-1). It is possible that this Genesee-shaped tool was knapped by a novice learner or a peripheral participant (see Ferguson 2008; Högburg 2008) in the early stages of Genesee use on the Davidson site. As Ferguson (2008) and Högburg (2008) have each observed, children do have a tendency to emulate the forms they are exposed to, while seeming to be less concerned with the reduction techniques employed to achieve those forms. It is possible, then, that the peripheral participant meant to emulate the Onondaga Genesee bifaces, even though he or she might not have actually observed any of the full participants in their community knapping Genesee-shaped bifaces. Timmins (1992: 301-302) has argued that children could be those members of the community who initiate changes in style. He found that, on the Calvert site, children’s pots displayed styles that became prominent in adult pots later on (Timmins 1992: 301-302). Perhaps because peripheral participants, such as children, are not yet as familiar with the practices of their own community as the more fully-participating adults, they may be in a better position to adopt new ideas and be experimental with the crafts they are in the midst of learning. The radiocarbon date of Feature #1 (3660 ±30 B.P) might be a little late in time, though, to suggest that it marked the beginning of Genesee-making in the region, and it might be premature to place such importance on the small (yet relatively wide) shoulders of this particular biface. Still, in this particular feature, it appears that a novice flintknapper was attempting to apply Genesee-like forms to local materials.

Plate 6-1. On the left is the expertly-made biface from Davidson displaying an Adder Orchard like form. On the right is the Genesee-like uniface found in a neighbouring unit.
Another interesting change in material use between the Adder Orchard and the Davidson sites is the changing importance of coarse-grained materials. At the Adder Orchard site, Fisher recovered six stemmed bifaces made from coarse materials (11% of the total bifaces recovered). At the Davidson site, coarse grained bifaces make up 21% of all stemmed bifaces. Kenyon (1980a, b) argued, that once the Genesee-making began in the Ausable River area, people began to make use of coarse grained materials. He thought that in using these coarse-grained cobbles over Kettle Point chert, people were choosing local materials that could better accommodate the large blade shape of the Genesee biface (Kenyon 1980b). He also suggested that the increased use of metasediments might relate to changing social relationships and possibly reduced material exchange with the east (Kenyon 1980a). New evidence from the Davidson site, though, suggests that perhaps coarse-grained materials were not the only local materials that people were turning to.

Feature #17 and Feature #18 of the Davidson site, date respectively to 3450±40 B.P. and 3400±40 B.P, relatively late in the Genesee-using period (Ellis 2011). Each feature contained a small assemblage of Kettle Point pentagonal preform fragments (five in #17, and two in #18), as well as many Kettle Point flakes. The finds in each of these features might suggest that, at the Davidson site at least, Kettle Point either continued to be used for point-making all along, or that people returned to it later in time (perhaps amidst the changing exchange relationships, as Kenyon [1980a] suggested).

Unfortunately, no dates are available for the Sadler, Desjardins, Parkhill, or Brodie sites, which makes it more difficult to investigate changes in material use over time in the west. If we assume that the same trends observed at about 3800 B.P. at Davidson continued, however, it might suggest that the Sadler and Brodie sites might date later than the Davidson site. Each site has a similar assemblage of materials, with Kettle Point making up a very small proportion of bifaces (6%), and both Onondaga and coarse-grained materials increasing in importance.

Parkhill and Desjardins do not seem to fit this hypothesized trend. The Parkhill sample is unique in that it is almost entirely made-up of Onondaga bifaces. Material use is not the only way in which the bifaces are different, and overall the bifaces seem to resemble those found in the east (further discussed below). It might be that the Parkhill site
represents an occupation of people who did not learn local flintknapping and material collection practices, and instead travelled to the Ausable River Valley later in life (it is such a small sample that the move might just as easily have been temporary). Parkhill does not appear to be the only site with a preponderance of Onondaga in the region (Chris Ellis, personal communication 2015), though the kinds of biface-making and curating practices at these other sites is still unknown.

The patterns of the Desjardins site are the most difficult to explain. Much like the Parkhill site, it differs from the other three western sites in various ways. Scarcely any Kettle Point chert was used, and yet Onondaga use is only 21%. In Kenyon’s (1980b) study, he was able to supplement his own surface collection from Desjardins with that of a local collector. With both together, the number of bifaces made on Onondaga and the number of bifaces made on metasediments were nearly equal (Kenyon 1980b). It is possible that Onondaga is more attractive to, or more detectable by, collectors, leaving a disproportionate number of coarse-grained bifaces on sites that have been looted to a great degree, such as Desjardins. Alternatively, the greater proportion of coarse-grained materials might be attributable to shifts in stone source-use over time; with earlier sites having bifaces mainly on Onondaga and Kettle Point, with metasediments gaining more importance later in time, as mentioned above.

According to Custer (1984: 42), a “chain model” of exchange occurred over long distances that involved “lithic exchange networks…carried out along the lines of groups using a fusion-fission cycle.” While I am not sure how applicable the image of “lines of groups” is to the situation during the Broad Point period, Stothers and colleagues (2002) have proposed a similar, and much more fitting, idea of how exchange networks operated in the Late Archaic through to the Early Woodland. From their observations of the Williams Cemetery site on the Maumee River in northwestern Ohio, they proposed that the exchange of material goods could have occurred in a “trade fair” type of environment. They argue that people came together in a large group, perhaps even on an annual basis, at the Williams Cemetery between 3000 and 2600 years ago. This larger group probably needed to make use of a resource that occurs in large, harvestable quantities in order to feed the entire gathering (in this case, spring-spawning fish) (Stothers et al. 2002). At the
same time, people renewed social relationships through material exchange (Stothers et. al 2002). It was proposed that these kinds of gatherings might have taken place during the Late Archaic of Ontario (Ellis et al. 1990a), but that it was difficult to affirm without finding archaeological evidence (Ellis et al. 2009).

There is much about the Davidson site to suggest that it is such a gathering site. Ellis (2007) commented that he has never seen such a large site as Davidson for this time period. In addition, five statistically significant, evenly-spaced, similarly-sized loci of Genesee-aged material were identified over the 1.9 ha site (Eastaugh et al. 2013; Keron 2015). Though these may represent the re-occupation of this site over many years, the fact that they are so distinctly and evenly spaced may suggest that the site was occupied at the same time by several different social groups — possibly repeatedly. The artifact distribution at Davidson bears a resemblance to a description of the Williams Cemetery: “The floodplains surrounding the Williams Cemetery are littered with clusters of lithic debris, including chert debitage and fire-cracked rocks, occasionally associated with various Late Archaic… bifaces…” (Stothers et al. 2002: 302). Perhaps, then, the loci at Davidson do represent the occupation of the site by different groups.

Secondly, as argued in Chapter 2, Davidson was located in an environment thought to be very rich in resources, including nuts and fish. The mast forests would have provided a variety of nuts (Eastaugh et al. 2013; Kenyon 1980a), and cooperative fishing might have taken place at the nearby Ausable River, or the Thedford Embayment (Kenyon 1978: 13). Additionally, it is thought that deer that would have been attracted to the area (Kenyon 1980a).

Granted, the Williams Cemetery differs from the Davidson site in many ways: Davidson has no known human burials, let alone a massive cemetery, and it was occupied approximately 900 years before the first radiocarbon dates of the Williams Cemetery. These differences may disqualify any comparison made between the sites, yet it is difficult to deny that they share some interesting similarities.

The people living in what is now Ontario were likely being introduced to the new Genesee technology through contact and material exchange. As they learned new
practices in order to engage with this technology, they formed a different relationship with the raw materials of their landscape. In the east, different sources of familiar raw material were explored at the Peace Bridge site and its products were exchanged with other communities. In the west, there was a greater use of the non-local Onondaga, then a shift in local material use in the west from Kettle Point to metasediments.

6.2 Genesee making practices

As different communities took up Genesee point-making, their respective histories and landscapes led to slight variations in the expression of Genesee form. In this case, blade edges and haft elements seem to best inform us of the micro-traditions that existed within the larger community of practice. Characteristics such as stem length, blade edge shape, and base shape are not necessarily differences that would have been meaningful to the people making and using Genesee bifaces. Especially in the case of base shape and stem length, the fact that they were hidden within a shaft implies that there was no intention to display group identity during use (see Hodder 1982: 187; Wobst 1977: 328-329). Nor do these changes seem at all relevant to function—people were using the bifaces in similar ways across the region. Just because these Genesee attribute varieties may not have meaning or purpose, does not make them any less real, however, and I believe they can be used to investigate past social networks and patterns of learning.

The earliest cases of broad point bifaces observed in New York occur at about 3670 +/- 90 years ago (Funk 1993). Based on stem length and shape, the Genesee forms that we can observe in the east at the Hamilton Golf Course site appear to be more related to the Genesee and Snook Kill forms in New York than the other Genesee forms seen in Ontario (see Kenyon 1980b). The bifaces of the Hamilton Golf Course also display stem lengths that are very similar to those seen at Peace Bridge, on the Niagara Peninsula. Whether through contact or the movements of people (or a combination of the two), a community of new Genesee-making practices seems to have emerged over the area of the Niagara Peninsula and up the Lake Ontario shoreline sometime after 3800 B.P.

The technology made its way west, as previously discussed, probably through material exchange and idea sharing. The fact that the stem lengths of the bifaces at the R&K site
are more similar to the bifaces of the western sites might demonstrate that there were
stronger exchange relationships between the western sites and the R&K site than between
the western sites and the Hamilton Golf Course site. In this case, the people of the R&K
site would have maintained a different set of exchange relationships than those at the
Hamilton Golf Course site, which would have led to the differences in their biface
morphology. It is also possible that the stem morphology of the bifaces at the R&K site
might reflect temporal as well as geographical trends, perhaps indicating that the R&K
site was occupied earlier than the Hamilton Golf Course and Peace Bridge sites. Still, the
bifaces of the R&K site share many similarities with the Hamilton Golf Course bifaces:
both samples are dominated by straight blade edges and concave bases, and have a
similar presence of concave blade edges and straight bases. The two biface samples also
have similar width to thickness ratios; probably because of the easy access to an
abundance of fine-grained material at each of these sites. Therefore, it looks as if the
R&K bifaces are somewhat intermediate in their form. Overall, the bifaces there look
most like the other eastern sample, however its stem lengths suggest that it is either a
marginal member of the more western community of practice, or, that it represents an
occupation that preceded the time when eastern practices diverged to make their bifaces
more Snook Kill-like.

There might have been some continuity between Adder Orchard-using people and
Genesee-using people in the Ausable River Valley. The persistence of convex edges (a
classically Adder Orchard trait) on otherwise Genesee-looking bifaces at many western
sites lends even greater support to this position. Even bifaces made from coarse-grained
metasediments (argued to have been used later in time) display convex blade edges
(especially at Desjardins). No biface blades in the eastern samples were ever identified as
having convex edges. Therefore, it seems very likely that convex blades were the
influence of local people, and their traditions, on the adopted Genesee form. Similar
processes might have affected the haft elements of the bifaces. Like at the R&K site, stem
lengths appear longer in these western sites than in the east. Because it seems that the
Adder Orchard site contained bifaces with long stems, it could be that stem length, much
like edge shape, represented a 200-year learned practice in the west that survived the
conversion to Genesee bifaces.
Another interesting observation is how much more variation there is among the western bifaces compared to those in the east. As Genesee bifaces were adopted by many local communities, many different combinations of traits emerged. This phenomenon can be seen particularly in the distribution of base shapes. The Brodie sample includes several bifaces with convex bases, something that is unusual at the other sites. Meanwhile, the Davidson and Sadler bifaces are nearly evenly distributed between having straight and concave bases, suggesting that either form was acceptable in those communities. Finally, among the Desjardins and Parkhill bifaces, concave bases were predominant. The material available on Adder Orchard base types would suggest that they were somewhat variable. Peske (1963) discussed the variability among the coarse-grained bifaces of Michigan, some of which were Adder Orchard-like, and some of which looked more like Genesee bifaces. He noted that some unstemmed lanceolate bifaces tended to have convex bases, while the stemmed narrow-shouldered bifaces usually displayed straight bases. The variability among the Adder Orchard forms, then, might explain some base-shape variation of the western Genesee bifaces. Base-finishing practices of western Genesee bifaces seem to reflect the variability of Adder Orchard bases that once existed.

Kenyon (1983) once proposed that there was a gradation of forms, where the Genesee-like traits were the oldest “ancestral” form, and to the west of its introduction it diverged into a narrow-shouldered, straight-stemmed Adder Orchard form. Once Fisher (1997) was able to determine that the Adder Orchard site was older than any known Genesee presence in Ontario, Kenyon’s ideas about the broad point time-sequence were discarded. Based on the findings of this study, however, the biface forms that he observed as intermediate between Adder Orchard and Genesee were very real, but instead of representing a directional change over time, they could represent the coalescence of two different forms.

It was not a passive acceptance of a new technology in the west river valleys, but an active adoption, as people took inspiration from the Onondaga products they received through exchange, as well as through other forms of social interaction, and began to produce their own Genesee forms on local materials. People seem to have moved away from using Kettle Point chert to make their bifaces, making greater use of imported
Onondaga chert products, and eventually returning to local materials once more, this time giving greater importance to coarse-grained cobbles, found in the till. As the form was applied to new materials, practices changed again. Working metasediments into Genesee forms is thought to have its own inherent challenges. In producing Genesee bifaces themselves, the people of the lower Ausable and middle Thames River valleys engaged with the technology slightly differently. Bifaces made on this material had lower width to thickness ratios with wider stems, likely because of the constraints of the material. One change in biface form that took place seemingly in spite of material constraints instead of because of it, was blade length. In shifting to make greater use of these coarse-grained materials, the blade length of the biface appeared to become even longer than what was observed on most Onondaga bifaces. The exaggerated blade lengths of the west might reflect changing values on what was considered a proper tool form.

As I have already mentioned, there might also have been some movement of people at this time. At the Parkhill site, we see no convex forms whatsoever, and instead we see an above average proportion of bifaces with concave blades. Whenever blade shapes other than “straight” were observed in the east, they were also concave. It is possible that concave edges developed through blade resharpening. As only concave blades are observed on the Parkhill bifaces, they may have been highly curated bifaces, perhaps used by those unfamiliar with locally accessible cherts. Whether the people had settled in the valley permanently, or the move was temporary, different groups of people seemed to have been coming into closer contact. The situation may not be just representative of a coalescence of biface forms, but of different groups of people coming together.

People’s technological practices are not determined by their geographical closeness to other groups, or the raw material resources they have access to, nor are their future practices bound by their past practices. And yet, technological practices are influenced by all of these things to a certain degree—social relationships with others, the properties of the materials they have to work with, and the practices which they are taught. Technology, and indeed all traditions, is always a negotiation between past experiences and present circumstances, and the constraints within which those practices can be carried-out.
6.3 Genesee using practices

It seems that amidst the small variations in Genesee shape throughout the area, Genesee bifaces were used as projectiles relatively consistently. This use-pattern might indicate that either the bifaces were part of a projectile technology, or that (more likely) they acted as multifunctional tools.

The consistent use of these broad bifaces as stone tips for projectiles is especially interesting, because nothing about their form would have prevented them from being used solely as knives. Based on the experimental study, the Genesee-shaped bifaces performed very well at defleshing the deer. In fact, based on the presence of asymmetrical blade forms in almost all samples (the exception being Desjardins), it appears that Genesee bifaces were used as knives for part of the time. The Genesee biface could have been adopted as a knife technology in the Ausable River valley, while Adder Orchard bifaces continued to act as projectiles. Instead, the people of the Ausable River decided to adopt the entire technological system represented by the Genesee point, not only replacing Adder Orchard, but eventually shifting to coarse-grained materials in order to accommodate its form. Form, in this case, was not divorced from function, but rather the knowledge of how the biface was meant to be used was wrapped up with its appearance. When people adopted Genesee products, they did not seem to have been viewed as blank slates onto which they could project their own intended function.

Engaging with Genesee products meant participating in certain making and using practices. This kind of adoption—of both the technology’s form and its function—might not have held true for every introduction of broad-shouldered forms throughout Eastern North America, however.

It is interesting to note that the shape that is thought to have been the first manifestation of the broad-bladed biface of this time period, the Savannah River stemmed biface of the southeastern USA, does not seem to have been used as a projectile at all. Sassaman (2006) has not observed impact fractures on any of these artifacts recovered from Stallings Island. Strengthening his interpretation of Savannah River bifaces as knives, he also recovered a Savannah River biface closely associated with a bone handle within which the stone tip fits well (Sassaman 2006). Conversely, a later manifestation of the
broad point, Perkiomen points, as previously mentioned, do display impact fractures (Truncer 1990). Similarly, Funk (1993) found that two of the forms found in New York, Snook Kill and Susquehanna Broad, also display impact fractures. Pagoulatos (2010) outlines two groups of bifaces that have been classically considered part of the broad point trend: those earlier forms found in the Southeast, and those found later in the Northeast. While a broad-bladed biface technology existed in the Savannah River Drainage from 4700 B.P., Sassaman (2006) suggested that a dispersal event from the Savannah River Drainage took place approximately 3800 years ago. Pagoulatos (2010) also noted that the earliest occurrences of the broad-bladed biface in the north seems to occur between 3800-3600 B.P. It could be that, before this biface technology reached the Northeast, they were not considered projectiles, but in their new context, they took on a new role. People appear to have continued to use them as knives, as suggested by some of the asymmetrical forms seen in this sample (and also see Dunn 1984), but added a task to its repertoire. Of course, more use-wear studies must be conducted on the many varieties of broad points that exist, and in their many contexts, before we can reach any firm conclusions about where broad-shouldered bifaces were considered a projectile, and where they were not. However, based on the data collected to date, in the Ontario-New York region broad-bladed bifaces seem to be consistently used as stone tips for hunting implements.

It is very difficult to determine why the relatively large Genesee projectile form might have been adopted so readily, and why after its adoption people of the Ausable River Valley had the desire to make even larger forms. In the experiment portion of this study, the longer Genesee points seemed to have broken after fewer trials than the shorter ones. It is tempting to assert based on this evidence that Genesee technology was not adopted for functional reasons. However, based on the experimental study, until the bifaces broke, they worked well as projectiles and certainly could have produced lethal wounds. Even as they conduct experimental use-wear studies, archaeologists are confronted with the fact that each projectile form comes with its own benefits and detriments (Christenson 1986). Based on the evidence archaeologists have to work with, it would be near impossible to know what people valued about the Genesee technological system. Perhaps the form lent itself more easily to being used as a multifunctional tool, and would have been more
easily reworked into different tool types (such as drills and rubbed tips). Perhaps the stone tips were designed to break more easily, leading to a “shrapnel effect” that would more effectively kill prey (see Ellis 1997). It is just as possible that those who used the technology were not as concerned with the “optimal” projectile form as are researchers. Regardless, because the form was adopted with a certain set of functions in mind, it stands to reason that its effectiveness in carrying out its function was something socially informed and not necessarily accessible to present-day archaeologists.

It appears that Genesee technology was adopted to perform similar tasks across multiple communities. It also seems that people living in the west made a conscious decision to adopt Genesee technology, and even altered their material collection practices in order to accommodate this form. While people made the conscious decision to engage with large-scale practices, Adder Orchard-making practices were perpetuated due to the fact that people were situated in more locally-existing communities.
Chapter 7

7 Conclusion

Researchers studying broad points have noted the paucity of use-wear studies conducted on samples from Northeastern North America since at least the 1980s (see Snow 1980). Especially for Genesee bifaces, their large size has always cast some doubt on their potential role as stone tips for either thrusting spears or projectiles. Additionally, since Fisher (1997) reported that the Adder Orchard site was older than the Davidson site, Kenyon’s (1983) original proposal that Adder Orchard technology came out of Genesee technology in the west of the province was no longer viable. The relationship between the two technologies, as well as the means by which Genesee technology entered the southwesternmost region of the province, were once again ambiguous. The findings of this study suggest that Genesee technology has been used in similar hunting, and likely cutting, activities all across the region that is now southern Ontario. The results of this study also suggest that local people of the western communities likely adopted Genesee technology. Even though they made the decision to adopt many of the characteristic Genesee traits for their lithic technology, many other traits persisted from when Adder Orchard points were produced, leading to the forms intermediate between Adder Orchard and Genesee that Kenyon observed in 1983.

7.1 Research and findings

In this study, I have tried to employ a specific theoretical perspective and methodology in order to best investigate how past people engaged with Genesee technology. Approaching this project from the perspective of learned practices, while seeking to describe historical events as opposed to finding universal explanations, has been very useful. I believe that the conceptual tools of communities of practice and historical processualism offer an attractive alternative to the progressivist and functionalist perspectives that sometimes exist in archaeological fields that must make do with limited datasets. After all, approaching archaeology from a historical perspective does not demand answers to why questions, but only asks how (Pauketat 2001a).
My methodology was heavily based in *chaîne opératoire*, as I investigated the material collection and exchange practices, the biface making practices, and the biface using practices within the Genesee technological system. The distribution of biface-making practices was observed through examining the variation of traits within and across samples. These traits include blade and haft element shapes, as well as a variety of metric attributes. In order to investigate the variation of Genesee using practices, I used diagnostic impact fractures (DIFs) to identify projectile use, and edge shape symmetry to identify knife use. In conducting an experimental study where Genesee bifaces were used as projectiles and knives, I became more familiar with their inherent material properties, and how those might constrain, and also create possibilities for, their use in the past (according to Actor-Network Theory). I was also able to observe the material effects of using the bifaces in certain gestures.

First, like previous studies have indicated, I noticed a greater diversity of raw material in the western biface samples, including Kettle Point, coarse-grained materials, and Onondaga; whereas the eastern samples had bifaces made exclusively from Onondaga. I also found that certain blade and base shapes existed in the west of the study area that did not exist, or only occurred in low proportions, in the east. While the eastern samples had only bifaces with straight or concave blade edges, the western samples also included bifaces with convex edges. The bases in the west, too, displayed a greater variation of forms, such as straight, concave, and convex, where the bifaces from the more eastern samples displayed predominantly concave bases, with only some straight bases. Finally, the stem lengths of the western collections were significantly different from the stem lengths of the bifaces from the Hamilton Golf Course site, suggesting that stem-making practices varied over space, and possibly changed over time. All of these observations suggest that some practices that had been employed in making Adder Orchard technology persisted when people in the west adopted Genesee technology.

Use-wear seemed to be relatively consistent throughout the samples, suggesting that Genesee technology was adopted for similar task-sets by most communities. These bifaces were used as projectiles, and were likely also used as knives. Additionally, people
did not seem to discriminate between material types or biface size when choosing stone tips for their hunting technology.

It seems likely that material exchange not only spread material information by way of complete or near-complete Onondaga products, but it also facilitated the maintenance of social relationships whereby the practices of others could be observed. Finally, it is possible that children, found at the periphery of their own practice communities, and likely having more freedom for experimentation, might have played a special role in adopting the Genesee technology in the western communities.

7.2 The limitations of this study and future research

While these are interesting conclusions, the research in this study has certain limitations. First of all, it is well known that experimental studies can only act as approximations of past events, and that they are never perfect simulations. Because the experiment was performed in February, in the midst of Canadian winter, the bow was set up relatively close to the deer target—and likely closer than what would be observed in the average hunting scenario—in order to perform the test inside a garage. For the same reason, for the open-environment trials, the projectiles were thrown onto a paved road instead of an open field, or a wooded environment. While the resulting correlation between specific impact fractures and surfaces of impact is interesting, it does need further study. I recommend that before these observations can be used to investigate the archaeological record, more trials using a larger sample, and a greater variation of launch speeds and distances is conducted.

Moreover, as this study was my introduction to diagnostic impact fractures, it is not surprising that my level of experience and comfort with DIFs improved over time. I did revisit the Dino Lite photographs of some of my early identifications, reassessing when necessary, however it is possible that some inconsistencies remained. Additionally, my interpretation of asymmetrical blade forms as evidence of their use as cutting implements should be treated as a starting point for further study instead of a firm conclusion. It is obvious that a microscopic use-wear study on Genesee bifaces would help to investigate the uses for these bifaces outside of hunting activities.
Another word of caution concerns the proposed sequence of Genesee adoption in the west. There is limited information on the temporal context of all sites in this study but Davidson. While I tried to be mindful of temporal and spatial change, there is a risk that this study might conflate variation over time with variation over space. The only remedy to this situation is the collection of more radiocarbon dates, as well as the controlled excavation of more Broad Point sites in Ontario (always easier said than done).

7.3 Concluding remarks

In looking at the technological system as a whole, from a perspective of learning and practice, this study was able to answer some questions concerning the use of Genesee bifaces, as well as how they were adopted across Ontario. The results confirmed that the Genesee bifaces of Ontario were used to tip hunting implements. Whether they might have been thrown as projectiles, or thrust is more difficult to say, but based on our experimental study, I found no reason why they could not have been projectiles. Additionally, material exchange networks played a large role in introducing the technology to new areas, such as the Ausable and Komoka River Valleys where people had previously made use of Adder Orchard technologies. Even though the people of what is now southwesternmost Ontario consciously emulated the broad-bladed technologies of the east, their adoption of these forms occurred within their unique circumstances. As a result, local micro-traditions of biface making were formed. Not only did it combine practices from both the Genesee and Adder Orchard technological traditions, but it encouraged people to explore new practices, such as collecting and knapping coarse-grained materials.
References Cited

Ahler, Stanley A.
1971 Projectile point form and function at Rodgers Shelter, Missouri. Missouri Archaeological Society, Columbia.

Austin, Shaun J. and Tara D. Jenkins

Barton, and Bergman

Bar-Yosef, Ofer and Philip Van Peer

Bettinger, Robert L., and Jelmer Eerkens

Black, David W.

Binford, Lewis, R.

Bourque, Bruce


Budden, Sandy, and Joanna Sofaer
Bur, Michael T.

Burgar, Robert W.

Bursey, Jeffery A.

Brindley, Jared, and Chris Clarkson

Carter, Tristan, Sarah Grant, Metin Kartal, Aytan Coskun, Vecihi Ozkaya

Cheshier, Joseph and Robert L. Kelly

Chillingworth, Joe:

Christenson, Andrew L.

Claflin, William H.
1931   The Stalling’s Island Mound Columbia County, Georgia. Plimpton Press, Norwood.

Clark, George R.

Cleland, Charles
Coe, J. L.

Cook, Thomas


Conard, Nicholas J.

Cross, John R.
1990  *Specialized Production in Non-Stratified Society: An Example from the Late Archaic in the Northeast*. Ph.D. dissertation, Department of Anthropology, University of Massachusetts, Worcester.

Custer, Jay


Deal, Michael

Deller, D. Brian

Dent, Richard Jr.

Dietler, Michael and Ingrid Herbich
Dincauze, Dena, F.
1972 The Atlantic Phase: A Late Archaic Culture in Massachusetts. Man in the Northeast 4: 40-61.


Dobres, Marcia-Anne

Dobres, Marcia-Anne and Christopher R. Hoffman

Dockall, John E.

Dolwick, Jim.

Dunn, Robert, A.

Eastaugh, Edward, Christopher Ellis, Lisa Hodgetts, and Jim Keron.
2013 Problem-Based Magnetometer Survey at the Late Archaic Davidson Site (AhHk-54) in Southwestern Ontario. *Canadian Journal of Archaeology* 37(2): 274-301.

Elder-Vass, Dave

Ellis, Chris


Emerson, J.N. and W.C. Noble

Ferguson, Jeffery

Fischer, Anders, Peter Vemming Hansen, and Peter Rasmussen.

Fisher, Jacqueline A.
1987 Brodie and Parkhill: An Analysis of Two Late Archaic Broadpoint Samples from Southwestern Ontario. KEWA 87(8): 3-21.


Fox, William A.
1978 Sub-greywacke in Southwestern Ontario Prehistory. KEWA 78(1): 4-7

Funk, Robert E.
1976 Recent Contributions to Hudson Valley Prehistory. University of the State of New York, State Education Department, Albany.


Gnecco, Cristobal and Carl Langebaek

Granger, Joseph E.
Hawkes, Earnest and Ralph Linton

Hodder, Ian

Högberg, Anders

Howey, Arthur F.

Hutchings, Karl W.

Jeffra, Caroline D.
2015 Experimental approaches to archaeological ceramics: unifying disparate methodologies with the chaîne opératoire. *Archaeological and Anthropological Sciences* 7 (1): 141-149.

Kenyon, Ian


Late Archaic Stemmed Points from the Adder Orchard Site. *KEWA* 83(2): 7-14

Keron, James

Kinsey, Fred W.


Knapett, Carl

Kraft, Herbert C.


Kreiger, Alex D.

Latour, Bruno


Lave, Jean and Etienne Wenger
Lemmonier, Pierre

Leroi-Gourhan

Lombard, M., I. Parsons, M.M. van der Ryst
2004 Middle Stone Age lithic point experimentation for macro-fracture and residue analyses: the process and preliminary results with reference to Sibdu Cave points. *South African Journal of Science* 100: 159-166.

Lombard, Marlize

Malafouris, Lambros and Colin Renfrew

McEachen, Paul, Robert I. MacDonald, and Ronald F. Williamson

Mero, Antti, Paavo V. Komi, Tapio Korjus, Enrique Navarro, and Robert J. Gregor

Millson, Dana C.E.

Minar, Jill C.

Mounier, R. Alan
1972 *Archaeological Investigations in the Maurice River Tidewater Area, New Jersey*. M.A. thesis, Department of Anthropology, Memorial University, St. John’s.
Needs-Howarth, Suzanne and Stephen C. Thomas
1998  Seasonal Variation in Fishing Strategies at Two Iroquoian Village Sites

Nelson, Margaret C.

Nesper, Larry

Nielsen, Axel E.

Odell, George H.
1981  The Morphological Express at Function Junction: Searching for Meaning

Odell, George H. and Frank Cowan

Odell, George H. and Frieda Odell-Vereecken

Oppenheim, Robert.

Pagoulatos, Peter
2010  Late Archaic Modes of Broad-Bladed Biface Transmission Across

Painter, Floyd
1988  Two Terminal Archaic Cultures of S.E. Virginia and N.E. North Carolina.
*Journal of Middle Atlantic Archaeology* 4: 21-31.

Pauketat, Timothy R.

2001b  A New Tradition in Archaeology. In *The Archaeology of Traditions*,
Pengelly, James W.
1997  12 600 years of lake level changes, changing sills, ephemeral lakes and
Niagara Gorge erosion in the Niagara Peninsula and Eastern Lake Erie basin.
*Journal of Paleolimnology* 17: 377-402.

Peske, Richard G.
1963  Argillite of Michigan: A Preliminary Projectile Point Classification and
Temporal Placement from Surface Materials. In Papers of the Michigan Academy
of Science, Arts, and Letters vol. 48: 557-566.

Read, Dwight W.
1974  Some Comments on Typologies in Archaeology and an Outline of a

Ritchie, William A.
406-414.

York State Museum, Albany.

1965  *The Archaeology of New York State*. The Natural History Press, New
York.

1969  *The Archaeology of Martha's Vineyard*. Natural History Press, Garden
City.

1985  Fifty Years of Archaeology in the Northeastern United States: A

Redmond, Brian G. and Brian L. Scanlan
2009  Archaeological Investigations at the Burrell Orchard Site (33Ln15): 2008
History, Cleveland.

Robertson, David A., Ronald F. Williamson, Robert I. MacDonald, Robert H. Pihl, and
Martin S. Cooper
1997  Interpretations and Conclusions. In *In the Shadow of the Bridge: The
Archaeology of the Peace Bridge Site (AjGf-9) 1994-1996 Investigations*, edited
by Ronald F. Williamson and Robert I. MacDonald, pp. 493-509, Archaeological
Services Inc., Toronto.

Robertson, James A., William A Lovis, and John R. Halsey
1999  The Late Archaic: hunter-gatherers in an uncertain environment. In
*Retrieving Michigan's Buried Past*, edited by John R. Halsey, Cranbrook Institute
of Science, Bloomfield Hills.
Roddick, Andrew P.
2009  *Communities of Pottery Production and Consumption on the Taraco Peninsula, Bolivia, 200 BC – 300 AD* Department of Anthropology, Ph.D. dissertation, University of California, Berkley.

Roosa, William B.

Rots, Veerle and Hugues Plisson

Sackett, James R.

Sanger, David

Sassaman, Kenneth E.


Sassaman, Kenneth E., Megan E. Blessings, and Asa R. Randall

Sassaman, Kenneth E. and Wictoria Rudolphi

Sano, Katsuhirio
Semenov, Sergei A.  

Shea, John  

Shea, John J., Kyle S. Brown, and Zachary J. Davis  

Snow, Dean  

Sofaer, Joanna.  

Spier, Leslie  

Staats, Dayton F.  

Stark, Mariam T.  

Stewart, Michael  


Stout, Dietrich  
Stothers, David M.  

Timmins, Peter A.  

Timmins Martelle Heritage Consultants Inc.  
2010  *Stage 4 Archaeological Assessment Ruijs and Kirchberger Property Location 2 (AgHb-265) & Location 5 (AgHb-266) City of Brandtford, Brant County, Ontario*. Submitted to the Ontario Ministry of Culture, Archaeological Licence Number: P064, London.

Titimus, Gene L., and James C. Woods  

Trigger, Bruce G.  

Truncer, James J.  
1988  Perkiomen Points: A Functional Analysis of a Terminal Archaic Point Type in the Middle Atlantic Region. *Journal of Middle Atlantic Archaeology* 4: 55-64.


Turnbaugh, William  

Villa, Paola, Paolo Boscatto, Filomena Ranaldo, Annamaria Ronchitelli  
2009  Stone tools for the hunt: points with impact scars from a Middle Paleolithic site in southern Italy. *Journal of Archaeological Science* 36: 850-859.

Von Bitter, Peter H.  

Waguespack, Nicole M, Todd A. Surovell, Allen Denoyer, Alice Dallow, Adam Savage, Jamie Hyneman, and Dan Tapster  
Watson, Gordon D.

Watts, Christopher

Wiessner, Polly

Weitzel, Celeste, Nora Flegenheimer, and Mariano Colombo
2014 Breakage Patterns on Fishtail Projectile Points: Experimental and Archaeological Cases. Ethnoarchaeology 6(2): 81-102

Willey, Gordon R. and Philip Phillips

Williamson, Ronald F.

Williamson, Ronald F., and Shaun J. Austin

Williamson, Ronald F. and Robert I. MacDonald

Wilkins, Jayne, Benjamin J. Shoville, and Kyle S. Brown

Wilson, Jim
1990 The Boresma Site: A Middle Woodland Base Camp in the Thames River Valley. MA thesis, Department of Anthropology, McMaster University, Hamilton.
Witthoft, John

Wobst, H. Martin
Appendices

Appendix A: Speed calculations

\[ F = \text{draw force} \ (20.4\text{kg}) \]

Potential energy storage \((PE)\) of the crossbow can be plotted force \((F)\) over distance \((x)\):
\[ k = \text{spring constant of the bow limbs} \ (\text{or the slope, } m) \]
\[ F = kx \] (equation of the line)

Energy is area under the curve:
\[ PE = \frac{F \cdot x}{2} \]

Energy Conservation Law:
\[ u = \text{speed} \]
\[ PE = KE \]
\[ \frac{F \cdot x}{2} = \frac{mu^2}{2} \]
\[ F = \frac{mu^2}{x} \quad \text{or} \quad \text{Force} = \frac{\text{mass (initial speed}^2)}{\text{draw length}} \]
Appendix B: Collections

1. The Davidson collection. A) coarse-grained materials; B, C) Onondaga chert material; D, E) Kettle Point material; F) unidentified material.
2. The Sadler collection. A, B, C) Onondaga chert material; D) coarse-grained materials; E) Kettle Point Materials.
3. The Desjardins collection. A) Onondaga chert material; B) coarse-grained material; C) Kettle Point material; D) unidentified material.
4. The Brodie Collection. A, B) Onondaga chert material; C) coarse-grained materials; D) unidentified material.
5. The R&K collection (Location 5). A-I) Onondaga chert material.
7. The Parkhill collection. A, B) Onondaga chert material; C) unidentified material
8. a) Four examples from the replica collection (before use).

b) Replica biface hafted with adhesive and rawhide lashings on 20cm dowel knife handle.
Appendix C: Diagnostic impact fractures (archaeological collections)

1. Davidson Collection

A. AhHk-54-5500 Face 2 – spin-off fracture

B. AhHk-54-11009 Face 1 – spin-off fracture

C. AhHk-54-1205 Face 1 – crushing

D. AhHk-54-6708 Face 2 – crushing

E. AhHk-54-11473 Face 1 – spin-off fracture

F. AhHk-54-Fea. 1-4 Face 2 – crushing

G. AhHk-54- Face 2 – step-terminating bending fracture

H. AhHk-54-6738 Face 1 – step-terminating bending fracture

I. AhHk-54-238 Face 2 – spin-off fracture
2. Sadler Collection

A. AhHk-70-9 Face 1 – step-terminating bending fracture

B. AhHk-70-18 Face 1 – crushing

C. AhHk-70-5 Face 1 – impact burin

D. AhHk-70-32 Face 1 – impact flute

E. AhHk-70-27 Face 1 – impact burin

F. AhHk-70-11 Face 1 – crushing

3. Desjardins Collection

None.

4. Brodie Collection

A. M1D1B1-1-255 Face 1 – impact flute

B. M1D1B1-1-208 Face 2 – crushing

C. M1D1B1-1-200 Face 2 – crushing

D. M1D1B1-1-203 Face 1 – step-terminating bending fracture

E. M1D1B1-1-228 – step-terminating bending fracture
5. R&K Collection

A. AgHb-266-3711 Face 1 – impact flute

B. AgHb-266-2038 Face 1 – impact flute

C. AgHb-266-332 Face 1 – crushing

D. AgHb-266-775 Face 1 – crushing

E. AgHb-266-2318&2331 Face 2 – crushing

F. AgHb-266-2568&2905 Face 2 – crushing

G. AgHb-266-1161 Face 2 – step-terminating bending fracture

H. AgHb-266-1371 Face 2 – spin-off fracture

I. AgHb-266-1338 Face 2 – spin-off fracture

J. AgHb-266-385 Face 2 – crushing

K. AbHb-266-2052 Face 2 – crushing
6. Hamilton Golf Course Collection

A. AhGx-20-31 Face 2 – impact flute
B. AhGx-20-33 Face 2 – step-terminating bending fracture
C. AhGx-20-1 Face 2 – spin-off fracture
D. AhGx-34 Face 1 – spin-off fracture

7. Parkhill Collection

A. M1M1B1-1-1241 Face 2 – crushing and spin-off fracture
B. M1M1B1-1-1196 Face 1 – impact burin
Appendix D: Projectile experiment photographs and videos

Long bow mounted on the guiding-frame.
Deer Target

<table>
<thead>
<tr>
<th>DLC-1 Trial 1</th>
<th>video link: <a href="https://www.youtube.com/watch?v=Ci7C18OQA9M">https://www.youtube.com/watch?v=Ci7C18OQA9M</a></th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-1 Trial 2</td>
<td>video link: <a href="https://www.youtube.com/watch?v=jll5pD0EiNU">https://www.youtube.com/watch?v=jll5pD0EiNU</a></td>
<td>No observable damage</td>
</tr>
<tr>
<td>DLC-1 Trial 3 (hit wooden plank behind deer)</td>
<td>video link: <a href="https://www.youtube.com/watch?v=Rk6VkJ8RF6Q">https://www.youtube.com/watch?v=Rk6VkJ8RF6Q</a></td>
<td>DLC-1 Face 1 – bending fracture</td>
</tr>
<tr>
<td>Trial</td>
<td>Description</td>
<td>Video Link</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>------------</td>
</tr>
<tr>
<td>DLC-2 Trial 1</td>
<td>video link: <a href="https://www.youtube.com/watch?v=bfX7ERDgjUQ">https://www.youtube.com/watch?v=bfX7ERDgjUQ</a></td>
<td></td>
</tr>
<tr>
<td>DLC-2 Face 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLC-2 Face 2 – spin-off fracture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DLC-3 Trial 1</td>
<td>video link: N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No observed damage</td>
<td></td>
</tr>
<tr>
<td>DLC-5 Trial 1</td>
<td>video link: <a href="https://www.youtube.com/watch?v=yEQBJFO-Nnk">https://www.youtube.com/watch?v=yEQBJFO-Nnk</a></td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Missed target and struck the ground. The stone point came out of the haft.</td>
<td>No observed damage</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-5 Trial 2</th>
<th>video link: N/A</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DLC-6 Trial 1</th>
<th>video link: <a href="https://www.youtube.com/watch?v=JgtuQlbTVN8">https://www.youtube.com/watch?v=JgtuQlbTVN8</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-6 Face 1 – spin-off fracture</td>
<td></td>
</tr>
</tbody>
</table>

No observed damage
<table>
<thead>
<tr>
<th>Trial</th>
<th>Video Link</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-7 Trial 1</td>
<td><a href="https://www.youtube.com/watch?v=csTrZqh6KHo">https://www.youtube.com/watch?v=csTrZqh6KHo</a></td>
<td>Crushing</td>
</tr>
<tr>
<td>DLC-8 Trial 1</td>
<td><a href="https://www.youtube.com/watch?v=g3rsPcT9S_M">https://www.youtube.com/watch?v=g3rsPcT9S_M</a></td>
<td>Slight crushing</td>
</tr>
<tr>
<td>DLC-9 Trial 1</td>
<td><a href="https://www.youtube.com/watch?v=VZqxE3CU3q4">https://www.youtube.com/watch?v=VZqxE3CU3q4</a></td>
<td>No observed damage</td>
</tr>
<tr>
<td>DLC-9 Trial 2</td>
<td>video link: <a href="https://www.youtube.com/watch?v=hMYu1RqoC4M">https://www.youtube.com/watch?v=hMYu1RqoC4M</a></td>
<td>No observable damage</td>
</tr>
<tr>
<td>DLC-9 Trial 3</td>
<td>video link: <a href="https://www.youtube.com/watch?v=jOS8ANcWUG8">https://www.youtube.com/watch?v=jOS8ANcWUG8</a></td>
<td>No observable damage</td>
</tr>
<tr>
<td>DLC-9 Trial 4</td>
<td>video link: <a href="https://www.youtube.com/watch?v=6N6Vn47wuhQ">https://www.youtube.com/watch?v=6N6Vn47wuhQ</a></td>
<td>No observable damage</td>
</tr>
</tbody>
</table>
DLC-11 Trial 1
video link: https://www.youtube.com/watch?v=N60MecnDAxs

DLC-11 Face 1 - impact burin

DLC-14 Trial 1
video link: https://www.youtube.com/watch?v=lsi27ATAxpg

DLC-14 Face 2 – crushing

DLC-14 Face 2 – bending fracture

DLC-15 Trial 1
video link: https://www.youtube.com/watch?v=KDCmw6hMImk

No observable damage
DLC-15 Trial 2
video link: https://www.youtube.com/watch?v=U547tmYFJS0

DLC-17 Trial 1
video link: https://www.youtube.com/watch?v=IAxwbWrtpoU

DLC-15 Face 2 – crushing

DLC-17 Face 1, tip – cone initiating fracture

DLC-17 Face 2, right edge – cone initiating fracture
DLC-18 Trial 1
video link: https://www.youtube.com/watch?v=hlsf2f2yANc

No observable damage

DLC-18 Trial 2
video link: https://www.youtube.com/watch?v=Z-ICXtskdPM

No observable damage

DLC-18 Trial 3
video link: https://www.youtube.com/watch?v=mRjO6im609k

DLC-18 Face 1 – slight crushing
<table>
<thead>
<tr>
<th>Trial</th>
<th>Video Link</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-19 Trial 1</td>
<td><a href="https://www.youtube.com/watch?v=ANh9YMMtCDg">https://www.youtube.com/watch?v=ANh9YMMtCDg</a></td>
<td>No observable damage</td>
</tr>
<tr>
<td>DLC-19 Trial 2</td>
<td><a href="https://www.youtube.com/watch?v=f4VAkyTwOV4">https://www.youtube.com/watch?v=f4VAkyTwOV4</a></td>
<td>No observable damage</td>
</tr>
<tr>
<td>DLC-19 Trial 3</td>
<td><a href="https://www.youtube.com/watch?v=xW0hpTmqvYc">https://www.youtube.com/watch?v=xW0hpTmqvYc</a></td>
<td>At the time there was thought to have been damage, but it was not observable in the lab.</td>
</tr>
</tbody>
</table>

Glanced off the carcass, struck the wood backing.
DLC-20 Trial 1
video link: https://www.youtube.com/watch?v=hvBLH1r9J_I

No observable damage

DLC-20 Trial 2
video link: https://www.youtube.com/watch?v=Uot-zhklp0

No observable damage

The projectile glanced off the carcass, and the stone tip sustained slight damage.

DLC-20 Trial 3
video link: https://www.youtube.com/watch?v=229JhgnDIQ4

DLC-20 Face 1 - crushing
Open environment

<table>
<thead>
<tr>
<th>DLC-3 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand on road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-3 Field Trial 2</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand on road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-3 Field Trial 3</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand on road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-3 Field Trial 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand on road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> <a href="https://youtu.be/lt_i6Ma-u48">https://youtu.be/lt_i6Ma-u48</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-5 Field Trial 1</th>
<th>DLC-3 Face 2 – right shoulder – crushing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand on road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> <a href="https://youtu.be/MxFl-lKZf3c">https://youtu.be/MxFl-lKZf3c</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-5 Face 1 – impact flute</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DLC-8 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrust by hand at tree</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-8 Field Trial 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrust by hand at tree</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> <a href="https://youtu.be/NMlQwzV1oA">https://youtu.be/NMlQwzV1oA</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-8 Face 1</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>DLC-8 Face 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DLC-8 Face 3</td>
<td></td>
</tr>
<tr>
<td>DLC-9 Field Trial 1</td>
<td>DLC-8 Face 1</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>Description:</strong> launched at tree with bow</td>
<td></td>
</tr>
<tr>
<td>video link: <a href="https://youtu.be/g5v8IDKiJ5c">https://youtu.be/g5v8IDKiJ5c</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-18 Field Trial 1</th>
<th>DLC-9 Face 1</th>
<th>bending fracture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand onto road. Damaged pavement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>video link: <a href="https://youtu.be/vz3KTG1ngmY">https://youtu.be/vz3KTG1ngmY</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-19 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand onto road.</td>
<td></td>
</tr>
<tr>
<td>video link: N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-19 Field Trial 2</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand onto road.</td>
<td></td>
</tr>
<tr>
<td>video link: N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-19 Field Trial 3</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand onto road.</td>
<td></td>
</tr>
<tr>
<td>video link: N/A</td>
<td></td>
</tr>
<tr>
<td>DLC-19 Field Trial 4</td>
<td>[Image] DLC-19 Face 1 – crushing</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td><strong>Description:</strong> thrown by hand onto road.</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> <a href="https://youtu.be/axAUTDKYr1s">https://youtu.be/axAUTDKYr1s</a></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-20 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> launched with bow onto road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-20 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> launched with bow onto road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-20 Field Trial 1</th>
<th>No observable damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> launched with bow onto road</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> N/A</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DLC-20 Field Trial 1</th>
<th>[Image] DLC-20 Face 2 – two bending fractures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong> thrown by hand onto road. Hit the road on its face as opposed to its tip.</td>
<td></td>
</tr>
<tr>
<td><strong>video link:</strong> <a href="https://youtu.be/GLMhgMCdCqc">https://youtu.be/GLMhgMCdCqc</a></td>
<td></td>
</tr>
</tbody>
</table>
Appendix E: Statistics

See additional documents.
Curriculum Vitae

Name: Kaitlyn Malleau

Post-secondary Education and Degrees:
Laurentian University
Sudbury, Ontario, Canada
2008-2013 B.Sc.

The University of Western Ontario
London, Ontario, Canada
2013-2015 M.A.

Honours and Awards:
Social Science and Humanities Research Council (SSHRC)
Joseph-Armand Bombardier Master’s Scholarship
2013-2014

Andrew Hunter Award
2014

Related Work Experience
Teaching Assistant
The University of Western Ontario
2013-2015

Teaching Assistant
Laurentian University
2011-2013

Publications:
Browne, Robert, Amanda Colles, Nicole Gagnon, Kaitlyn Malleau, Leslie Thoms, and Nelly Zakhari