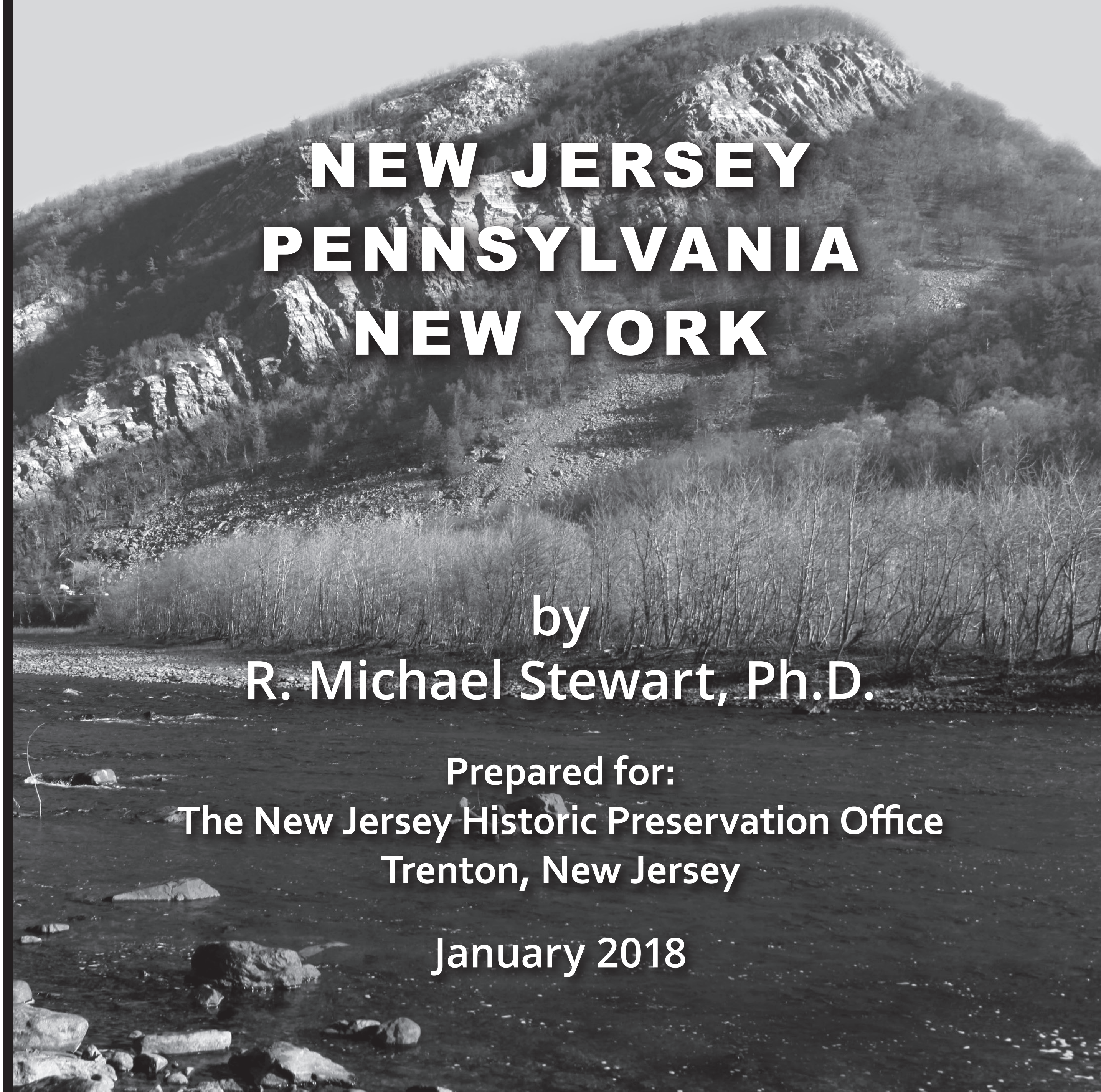
A Radiocarbon Foundation for Archaeological Research in the Upper Delaware Valley



NEW JERSEY
PENNSYLVANIA
NEW YORK

by

R. Michael Stewart, Ph.D.

Prepared for:
The New Jersey Historic Preservation Office
Trenton, New Jersey

January 2018

State of New Jersey
Governor Philip D. Murphy
Lt. Governor Sheila Oliver

Department of Environmental Protection
Catherine R. McCabe, Commissioner

Natural and Historic Resources Group
Historic Preservation Office
Mail Code 501-04B
P.O. Box 420
Trenton, New Jersey 08625-0420

Cover photograph courtesy of Dewberry Engineering, Parsippany, New Jersey.

This material was produced with assistance from the Historic Preservation Fund, administered by the National Park Service, Department of the Interior Any opinions findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of the Interior.

A RADIOCARBON FOUNDATION FOR ARCHAEOLOGICAL RESEARCH IN THE UPPER DELAWARE VALLEY

NEW JERSEY, PENNSYLVANIA, NEW YORK

by
R. Michael Stewart

Prepared for:
The New Jersey Historic Preservation Office, Trenton, New Jersey

January 2018

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES

ACKNOWLEDGEMENTS

Many thanks to Kate Marcopul, State Historic Preservation Officer and Administrator, who initially envisioned the overall project of which this volume is a part and made it a reality. Thanks also to Vincent Maresca, Senior Historic Preservation Specialist at the New Jersey Historic Preservation Office, for providing information that I missed during my initial review of cultural resource management (CRM) reports.

I am grateful to Philip Perazio, archaeologist with the New York State Office of Parks, Recreation and Historic Preservation, who provided access to CRM reports that were not available online through the state's Cultural Resource Information System. Nina Versaggi of the Anthropology Department at Binghamton University, New York, is thanked for providing information about the radiocarbon date from the Beaver Lodge Paleoindian site. I thank Jonathan Lothrop, Curator of Archaeology at the New York State Museum for providing information about Paleoindian studies in New York and the Northeast.

For years the Laboratory of Anthropology at Temple University, Philadelphia, in cooperation with the Pennsylvania State Historic Preservation Office, has been a repository for CRM reports completed in eastern Pennsylvania. I thank Temple lab staff for my continued access to this resource. I gratefully acknowledge the assistance of Doug McLearen, Noel Strattan, Mark Shaffer, and Alison Oskam at the Pennsylvania State Historic Preservation Office in Harrisburg. Kurt Carr, curator at the State Museum of Pennsylvania, was invaluable in providing access to select manuscripts in the museum's files and discussing ongoing research in the region. He and Elizabeth Wagner, also a curator at the museum, Wagner provided photos of artifacts from select sites in Pennsylvania that have enhanced the report.

Staff of the Department of Archaeology and Ethnology at the New Jersey State Museum are thanked for their consistent aid in providing access to collections and documents. My ongoing collaborations with museum curator, Gregory Lattanzi, have been especially fruitful. Greg also contributed a variety of photos of artifacts used in this volume. Our mutual efforts to understand Delaware Valley pottery, along with colleagues Roger Moeller (Archaeological Services, Bethlehem, Connecticut) and George Pevarnik (Latrobe, Pennsylvania) have been rewarding. I thank Roger and George for freely sharing their data, publications, and photographs.

Mike Owens and Lori Rohrer, archaeologists with the National Park Service at the Delaware Water Gap National Recreation Area, enabled access to the report and manuscript holdings at the Bushkill, Pennsylvania archaeology facility. They also graciously accommodated me and colleagues during our work with collections held at the Bushkill curation facility. Their help was invaluable and is gratefully acknowledged.

Jay Custer (University of Delaware), Greg Lattanzi (New Jersey State Museum), Richard Hunter (Hunter Research, Inc.), Matt Tomaso (PS&S), Keith Bastianini (Michael Baker Jr., Inc.), Mike Clem (Virginia Department of Historic Resources), Rich Veit (Monmouth University), Peter N. Chletsos (Sussex County Historical Society), and Don Kline (Mt. Bethel, PA) also shared copies of needed reports, manuscripts, and publications. Their assistance is greatly appreciated.

Photos of fluted points from more recent excavations at the Shawnee Minisink site were kindly provided by Joseph A.M. Gingerich (Ohio State University) and Donald Kline. Kline also made available photos of other biface types and data from his excavations at the stratified Sibum site, and allowed me to record and analyze the stratigraphy of open excavations. Edwin Struve (Chatham, NJ) freely shared his extensive knowledge of area collections and his explorations of the Delaware Valley along with photos. Andy Dillman (Trenton, NJ), Leonard Ziegler (Belvidere, NJ), Don Troxell (Harmony Township, NJ), and Walt Padpora (Milford, NJ) have done likewise, for which they have my thanks. I'm grateful to John Parks (Bordentown, NJ) for allowing his collection from the Delaware Valley to be photographed during a visit to the New Jersey State Museum. My former colleague at Louis Berger Associates, Inc., Rob Tucher, provided a photograph of Archaic triangles from site 28Me1D. Work at 36Cr142 referenced in this report would not have been possible without the herculean efforts of Jeremy Koch (AECOM, NJ), Del Beck (Sugarloaf, PA) and Tommy Davies (Palmerton, PA).

I. INTRODUCTION AND RADIOCARBON BASELINE

Archaeology has been called the science of context. Beyond what we can learn from the physical nature of artifacts and features, we ascribe additional meaning to them by considering the context in which they were found. Context has a spatial component, an associational component, a behavioral component, and of course, a chronological component. Being able to establish the age of deposits as precisely as possible is fundamental to the practice of archaeology and the investigation of cultural histories, processes, and change.

This report represents the most recent and most extensive compilation of radiocarbon dates associated with archaeological sites of the Upper Delaware River Basin and nearby areas. This compilation and associated commentary is part of an alternative mitigation project supported by the New Jersey Historic Preservation Office. The overarching goal of the mitigation is to craft reports and essays that update and synthesize aspects of the archaeological record of Pre-Contact and Contact Native American life in the Upper Delaware Valley, and the degree to which these lifeways mirror trends in the broader region. These documents will provide contexts and highlight research issues to aid future academic and cultural resource investigations that involve this portion of the greater Delaware Valley.

An extensive series of radiocarbon dated archaeological deposits provides more precise contexts for examining any number of issues dealing with the Native American past and sidesteps problems inherent in using cultural historical periods as frames of reference for analysis and interpretation (see discussion in Custer 1996:18-27). As our knowledge about the past increases, the cultural diversity and area-specific historic trajectories that are revealed continue to make problematic the use of a single synthetic framework for all geographic areas.

The use of cultural historical periods requires a unilinear chronological logic that makes it impossible to deal with contemporaneous variability that might exist in a region (e.g., Krause 2016:68-69). Especially troublesome are phenomena and/or diagnostic artifacts that are considered intrinsic to the way in which existing cultural historical periods have been defined, but whose history can be shown to clearly crosscut the chronological boundaries used in defining periods. Examples that spring to mind include: bifurcate, fishtail, and triangular projectile points or bifaces; early pottery; burial practices; and the presence and importance of domesticated plants. The situation is problematic regardless of whether a cultural period is considered simply as a chronological frame or unit, or as an era of common trends in lifeways.

Synthetic frameworks that more closely mirror patterning through time in the archaeological record of Native Americans have been formulated (e.g., Custer 1984a, 1996) but must always be reviewed, refined, or abandoned as critical masses of new data accumulate, or as a framework's fit with a specific geographic area becomes untenable. Variability and change can accrue over variable scales of time but are ever-present aspects of socio-cultural life. The units that we employ in analysis and synthesis should reflect the chronological resolution that we can bring to bear on the archaeological record.

Nonetheless, summary discussions of archaeological data typically are organized by cultural historical periods that initially were meant to reflect general trends in lifeways and are associated with approximate, and often varying (by author) beginning and end dates. In what follows I use the following scheme as a general referent for intervals of time when not citing a specific range of radiocarbon dates: Paleoindian (10,000 BC-8000 BC), Early Archaic (8000 BC - 6500 BC), Middle Archaic (6500 BC – 3000 BC), Late Archaic and Transitional Archaic (3000 BC – 1000 BC), Early Woodland (1000 BC – 500 BC), Middle Woodland (500 BC – AD 800/900), and Late Woodland (AD 800/900 to contact with Europeans).

For the purposes of this project the Upper Delaware Valley is defined by portions of the drainage basin that exist in the following states and counties (Figure 1):

New Jersey:	Warren and Sussex counties
New York:	Orange, Sullivan, Delaware, and Broome counties
Pennsylvania:	Monroe, Pike, and Wayne counties

The defined area is much larger than what has often been considered as the Upper Delaware by archaeologists in the past who have used this designation to refer to an area wherein the spatial distribution of stone tool and pottery types, trends in the use of lithic materials, and settlement patterns reveal common themes. For example, past definitions of the Upper Delaware have bounded it by the Delaware Water Gap on the south and Port Jervis to the north (cf. Custer 1996, Kinsey 1972; Kraft 2001). The Pennsylvania State Historic Preservation Office includes Northampton County in what it considers to be the Upper Delaware Valley, which extends the geographic boundary well south of the Water Gap. The degree to which all, or portions of the larger area used in this project corresponds with cultural or group territories is addressed in the contextual reports and essays to be produced. Evaluating data from a broader geographic context is necessary to examine existing assumptions and to better understand patterns of social interaction and cultural change.

Fundamental to achieving the goals of the larger project and compiling the radiocarbon database was a review of technical reports resulting from cultural resource management (CRM) investigations, in addition to the published literature. Compiled and selectively reviewed were published works focused strictly upon, or referencing some aspect of the archaeology of the Upper Delaware Valley. Included were regional syntheses and major works from adjacent areas that provide a broader context in which to better understand the nature and development of the native cultures of the Upper Delaware.

All CRM reports on file for Warren and Sussex counties, New Jersey were examined. Approximately 361 volumes were examined in addition to an estimated 12 significant Phase II and Phase III reports for New Jersey areas adjacent to the Upper Delaware Valley. Select Phase I and all Phase II and Phase III CRM reports for New York and Pennsylvania portions of the Upper Delaware Valley were reviewed, including significant Phase II and Phase III reports for Pennsylvania and New York areas adjacent to the Upper Delaware Valley. For New York areas it is estimated that 138 volumes were examined; for Pennsylvania 70 volumes are estimated to have been examined.

FIGURE 1. Upper Delaware Valley project area showing relevant counties of New Jersey, Pennsylvania, and New York. Not labelled is Otsego County situated to the north of Delaware County, New York. The boundary of the Delaware River Basin is shown in red (modified from a map available from the Delaware River Basin Commission at http://www.state.nj.us/drbc/library/documents/maps/counties.pdf).

Previous compilations of radiocarbon dates were helpful as a base on which to build, along with the early work of Kinsey and colleagues in the area of the proposed Tocks Island Dam that now comprises the Delaware Water Gap National Recreation Area (e.g., Kinsey 1968, 1972, 1975, 1991; Kraft 1970a, b, 1975a,b). Herbstritt (1988) listed radiocarbon dates for Pennsylvania which included portions of the current project area.

Cultural resource management projects carried out since the 1970s often contain references to existing dates as part of background information in addition to newly generated assays. Numerous development-related projects sponsored by the National Park Service in the Delaware Water Gap National Recreation Area (DEWA) generated many new dates and collated them with existing ones (e.g., Fischler 1990; Fischler and French 1991; Fischler and Mueller 1988, 1991; Hennessy 1992; Stewart et al 2015). Academically-based investigations at the Shawnee Minisink site resulted in an impressive collection of dates anchoring early Paleoindian occupations in the region (Dent 2002; Gingerich 2007, 2011, 2013a; McNett 1985a).

A recent regional synthesis of data related to what is traditionally known as the Transitional Archaic period includes compendiums of radiocarbon dates relevant to research in the Upper Delaware Valley (Blondino 2015; Carr 2015; Moeller 2015). Compilations focused on Virginia sites include numerous references to sites and dates in the Upper Delaware and adjacent areas (Inashima 2008, 2011).

An impressive number of radiocarbon dates have resulted from CRM investigations in New York portions of the Upper Delaware (including the East and West branches of the river) and nearby portions of the Upper Susquehanna drainage (e.g., Hartgen Associates 1988a, b, 1989; Knapp 2009; Knapp and Versaggi 2002; Pretola and Freedman 2009). Funk (1993, 1998) collates radiocarbon dates for the Upper Susquehanna and nearby portions of the Delaware Basin in New York.

Radiocarbon dates also are included for areas adjacent to the Upper Delaware as defined here. How far afield to extend the collection of dates was an arbitrary decision on my part. I have included what I feel to be significant dated sites from Northampton County, Pennsylvania. Northampton county brackets the southern end of the Upper Delaware. Assays from sites in more downriver portions of the drainage basin in Pennsylvania and New Jersey are employed as-needed in the commentary that addresses issues raised by radiocarbon database. For New York I have included dates from sites in Chenango and Otsego counties that occur generally within 20-30 miles of the Delaware Basin. I have done this to capitalize on the wealth of available information and the contextual background they provide. In my review of the regional literature for the greater Delaware Valley it struck me that these data are not widely known and certainly underused.

What follows is a series of tables that organize radiocarbon dates for the study area in a variety of ways. A master list of dates (Table 1) is organized by state, county, and site. For New Jersey and Pennsylvania the site listings proceed by sequential site numbers using the Smithsonian trinomial system (state number, county abbreviation, site number). In this system the state of New Jersey is represented by the number “28”, and Pennsylvania by the number “36”. Smithsonian trinomials generally were not reported for the New York sites included in this study so I have used the site designations employed in CRM reports or the published literature, followed by the county in which they occur.

Subsequent tables are focused on bifaces, pottery, distinctive materials, faunal remains, and botanical remains. The listings in each of these tables is organized chronologically beginning with the earliest. Contextual associations with radiocarbon/AMS dates in these tables are variable and include:

1. artifacts/remains found in dated features;
2. artifacts/remains spatially associated with dated features;
3. artifacts/remains spatially associated with dated organic material but with no feature association;
4. artifacts/remains considered as part of a dated deposit or component with no close spatial association with features or dated material;
5. artifacts with AMS dated residue; and
6. AMS dated botanical remains.

Obviously some of these associations are more compelling and reliable than others. Numerous dates and associations would be rejected were a rigorous chronometric hygiene employed in their evaluation (e.g., Tache and Hart 2013), leaving little for the basis of discussion or generation of hypotheses to be tested. As more reliable dates become available in the future we will be in a better position to employ chronometric hygiene in the analysis of various data sets. A number of the dates and artifact, faunal, or botanical associations listed in the tables will strike the reader as unusual. I comment on a number of these but do not consistently offer the opinions of the original investigators as to their validity. The references provided can be consulted for this purpose. For each artifact class I discuss some of the insights provided by the radiocarbon dates and how they might impact future research in the region, and be used to address the grander challenges for archaeology (Kintigh et al 2014).

Radiocarbon dates resulting from environmental studies, although useful for archaeological research, are not compiled here. Herbstritt includes dates from environmental investigations in Monroe County, Pennsylvania in his 1988 lists. Partial compilations relevant to area and regional glacial history, climate, geomorphology, flora, fauna, stratigraphy, and paleopedology can be found in a variety of studies (Bitting 2013; Boulanger et al 2015; Cotter et al 1986; Dent 1985a; Li et al 2014; Parris 1983; Parris and Case 1980; Ridge 2003; Steadman et al 1997; Stinchcomb et al 2012, 2013, 2014; Vento 1994, 2015; Vento and Stinchcomb 2013; Witte 2001, 2012).

Table 1 lists 401 radiocarbon dates. All presumably are corrected for isotopic fractionation with the possible exception of an 1170+/-60 BP date from Smithfield Beach (36Mr5). The date is listed as uncorrected in one report but not in another (cf. Fischler and French 1991:Table 6-1; Hennessy 1992:139, 171). A small number of dates based on assays of mussel shells derived from archaeological features are included in the listings of Table 1. The samples were collected and paired with AMS dated maize from the same features as part of a small project aimed at deriving climate data from the a study of the stable oxygen isotopes of the shell (Stewart 2008; Stewart and Bitting n.d.). There is no pattern in the expected discrepancies between the shell and maize dates with which they are paired (cf. dates for 36Pi13A, 36Pi33, 36Mr45).

With the exception of Pre-Clovis times, dates exist for portions of all traditional cultural historical periods: Paleoindian; Early, Middle, Late and Transitional Archaic; Early, Middle and Late Woodland. Assays (uncalibrated) predating 3000 BC account for 13% of the total in contrast to those postdating 900 AD which comprise over 38% of the total. Dates for what is traditionally considered as the Late and Transitional Archaic account for 26% of total dates. Over 51% of radiocarbon dates fall within what would be considered the late Middle Woodland and Late Woodland periods. These trends reflect to a general degree the extent and depth of our knowledge of the regional archaeological record as viewed through the lens of cultural historical periods.

Any opportunity to increase the chronological resolution of deposits predating 3000 BC should be embraced. In western Pennsylvania (Adovasio et al 1990; Carr and Adovasio 2002), the DelMarVa Peninsula (Lowery 2009, 2015; Lowery et al 2012), and coastal Virginia (McAvoy and McAvoy 1997) Pre-Clovis artifacts have been recovered from what appear to be secure and dated deposits. No such deposits have yet to be identified in the Upper Delaware Valley but future site survey and testing programs should tailor field strategies to take their possible existence into account.

TABLE 1
RADIOCARBON DATES ORGANIZED BY STATE, COUNTY, AND SITE

Site	Date BP	Context	Reference
28Sx2, Rosenkrans	2560+/-120 Y-1384	Burial 9	Kraft 1976a:23, 31
28Sx2, Rosenkrans	2400+/-60 DIC-407	Burial 5	Kraft 1976a:23
28Sx5, Medwin North	680+/-50 DIC-1372	Feature 14	Williams et al 1982:23, Tables 2, 7
28Sx5, Medwin North	670+/-60 DIC-1353 670+/-90 DIC-1354	Stratum II	Williams et al 1982:20, Tables 2, 7
28Sx5, Medwin North	630+/-105 DIC-1355 550+/-135 DIC-1356	Feature 1	Williams et al 1982: 20, Tables 2,7
28Sx14, Rockelein	7520+/-120 I-8315	Locus 2 fire pit	Dumont and Dumont 1979:46; Kraft 1975b:Table 11
28Sx14, Rockelein	5280+/-110 I-7748	context not specified	Dumont and Dumont 1979:51; Kraft 1975b:Table 11
28Sx19, Bell Browning	520+/-50 DIC-1152 560+/-95 DIC-1153	Feature 2	Williams et al 1982:Table 7; Puniello 1980:Table 2
28Sx19, Bell Browning	510+/-55 DIC-1150 450+/-50 DIC-1151	Feature 1	Williams et al 1982:Table 7; Puniello 1980:Table 2
28Sx29, Bell Philhower/Ahaloking	790+/-80 Beta 266108	Ahaloking infant burial pit	Stewart and Bitting n.d.; New Jersey State Museum collections
28Sx48, Minisink	730+/-60 DIC-383	Feature R-F48	Kraft 1978:89
28Sx48, Minisink	570+/-55 DIC-384	Feature R-F183	Kraft 1978:89
28Sx48, Minisink	460+/-50 DIC- no number reported	Feature R-F485	Kraft 1978:90
28Sx266, Medwin Knoll	770+/-50 DIC-1154	Feature 25	Williams et al 1982
28Sx266, Medwin Knoll	720+/-50 DIC-1157	Feature 22	Williams et al 1982
28Sx266, Medwin Knoll	420+/-45 DIC-1214	Feature 9	Williams et al 1982:40, Tables 5, 7; Puniello 1980:Table 2
28Sx266, Medwin Knoll	370+/-60 DIC-1156	Feature 12	Puniello 1980:150, Table 2
28Sx297	2250+/-80 Beta 80915	Feature 1	Santone et al 1997
28Sx324, Van Etten	70+/-60 Beta 62431	Catalog No.238, context not specified	Wall and Botwick 1995b:Appendix VI
28Sx429, Dark Moon	570+/-55 DIC-2412	occupation level	Hartzell and Staats 1983:11; Staats and Hartzell 1986:28; Staats et al 1986
28Wa2, Harry's Farm	7380+/-120 I-6133	Zone 8, Feature J-F171	Kraft 1975b:6-7, 9, Table 11
28Wa2, Harry's Farm	7320+/-125 I-6600	Zone 6, Feature J-F163	Kraft 1975b:6, 15, Table 11
28Wa2, Harry's Farm	4980+/-110 I-6599	Zone 4, Feature J-F137	Kraft 1975b:23, Table 11

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
28Wa2, Harry's Farm	3920+/-95 I-6598	Zone 3, Feature J-F136	Kraft 1975b:29, Table 11
28Wa2, Harry's Farm	1660+/-95 I-4748	Zone 2, Feature G-F58	Fischler and Mueller 1991:Table 3.5; Kraft 1970b:98, Kraft 1975b:49-50, 52, Table 11
28Wa2, Harry's Farm	550+/-90 I-4749	Zone 1, Pit F-H1	Kraft 1975a:121, 1975b:75, 136, Table 11
28Wa2, Harry's Farm	240+/-120 I-4748	Feature G-F25	Kraft 1975a:133-134, 1975b:147-148, Table 11
28Wa16, Miller Field	3670+/-120 Y-2587	Pit 4-Feature C-F42	Kraft 1970a:31, 1972:10-11, 1975b:Table 11
28Wa16, Miller Field	3590+/-100 Y-2588	Pit 5-Feature C-F60	Kraft 1970a:33, 1972:11, 1975b:Table 11
28Wa16, Miller Field	3170+/-120 Y-2589	Hearth 9-Feature C-F61	Kraft 1970a:43-44, 1972:12
28Wa16, Miller Field	2430+/-80 Y-2590	Hearth 5-Feature C-F38	Fischler and Mueller 1991:Table 3.5; Kraft 1970a:42, 1972:38
28Wa16, Miller Field	760+/-100 Y-2591	Assayed charcoal from within collapsed pot	Kraft 1970b:39-40, 1972:45, 1975b:Table 11
28Wa278, Shoemakers Ferry	1040+/-40 Beta 212295	Feature 911, residue on pottery	Barse 2006; Harbison 2008:78-79, Table 5.1; Messner et al 2008
28Wa278, Shoemakers Ferry	540+/-40 Beta 234911	Feature 718, residue on pottery	Harbison 2008:82-83, Table 5.1
28Wa278, Shoemakers Ferry	300+/-40 No lab # listed	Feature 1700	Harbison 2008:119, Table 6.1
28Wa290	7920+/-50 Beta 266912	Area 2, Context 10	Lee et al 2010:5-15, Appendix C
28Wa290	7420+/-50 Beta 266913	Area 2, Context 10	Lee et al 2010:5-15, Appendix C
28Wa290	5980+/-110 Beta 266914	Unit 204, Context 5	Lee et al 2010:5-15, Appendix C
28Wa290	4510+/-40 Beta 266910	Unit 108, Context 20	Lee et al 2010:4-41 to 4-42, Appendix C
28Wa290	4470+/-40 Beta 266911	Unit 115-121, Context 80	Lee et al 2010:4-42, Appendix C
28Wa290	4460+/-40 Beta 266916	Area 4, Unit 410	Lee et al 2010:Appendix C
28Wa290	3900+/-40 Beta 266915	Area 3	Lee et al 2010:6-9, 6-14, Appendix C
28Wa290	3600+/-40 Beta 266909	Unit 110, Context 30	Lee et al 2010: 4-41, Appendix C
28Wa528	4770 +/-50 PITT 1157	charcoal stained area, yellow sand stratum, 30 cm below surface	Adams and Adams 1993:5
28Wa528	1485 +/-30 PITT 0678	hearth	Adams and Adams 1991:2-3
28Wa580, Gray	690+/-50 DIC-2782	Pit 11-83	Staats 1986a:28
28Wa610	1090+/-120 Beta-61263	Feature 2	Stevens et al 1993
28Mr8, Miele	3940+/-100 I-5412	Pit 1	Hall 1977:11-12
28Mr8, Miele	3840+/-100 I-5413	Pit 3	Hall 1977:11-12
36Pi4, Manna	4550+/-180 Beta 62432	Unit 1, Level 16	Wall and Botwick 1995a:155, 1995b:Appendix VI

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Pi4, Manna	4500+/-40 GX-28162	Raymondskill Creek bank, section A, roughly 450 cm below surface	Witte 2012; Witte and Wright 2001; Stewart et al 2015 et al:Table 11, Figure 20
36Pi4, Manna	4410+/-40 Beta 280872	Raymondskill Creek bank, MAN 2, 362 cm below surface	Stinchcomb, Driese, Nordt and Allen 2012
36Pi4, Manna	3230+/-40 GX-28163	Raymondskill Creek bank, section A, roughly 325 cm below surface	Witte 2012; Witte and Wright 2001; Stewart et al 2015:Table 11, Figure 20
36Pi4, Manna	2420+/-40 Beta 280271	Raymondskill Creek bank, MAN 2, 159 cm below surface	Stinchcomb, Driese, Nordt and Allen 2012; Stewart et al 2015:Table 11
36Pi4, Manna	2070+/-40 Beta 257433	Raymondskill Creek bank, MAN 1, 342 cm below surface	Stinchcomb et al 2011; Stinchcomb, Driese, Nordt and Allen 2012; Stewart et al 2015
36Pi4, Manna	1900+/-40 Beta 25885	Raymondskill Creek bank, MAN 1, 270 cm below surface	Stinchcomb et al 2011; Stinchcomb, Driese, Nordt and Allen 2012; Stewart et al 2015
36Pi4, Manna	1440+/-30 Beta 355783	Block 2, Feature 10 as exposed and excavated on Raymondskill Creek bank	Stewart et al 2015:Table 17
36Pi4, Manna	970+/-120 Beta 62433	Unit 1, Level 2, Feature 1D	Wall and Botwick 1995a:150-151, 1995b:Appendix VI
36Pi4, Manna	840+/-70 Beta 227482	Block 6, Unit 34, Feature 89	Stinchcomb et al 2011; Stewart et al 2015:Table 17
36Pi4, Manna	550+/-40 Beta 227479	Block 2, Unit 51, Feature 49	Stewart et al 2015:Table 17
36Pi4, Manna	550+/-40 Beta 227478	Block 6, Unit 31, Stratum 5	Stinchcomb et al 2011; Stewart et al 2015:Table 17
36Pi4, Manna	530+/-40 Beta 227481	Block 2, Units 48E, 47E, Feature 10, feature stratum 8, level 3	Stewart et al 2015:Table 17
36Pi4, Manna	390+/-40 Beta 227480	Block 6, Unit 34, Stratum 3	Stinchcomb et al 2011; Stewart et al 2015:Table 17
36Pi4, Manna	270+/-40 Beta 227477	Block 6, Unit 31, Stratum 4	Stinchcomb et al 2011; Stewart et al 2015:Table 17
36Pi7, Brodhead-Heller	3660+/-120 Y-2342	Feature 18	Kinsey and McNett 1972:220, Table 12
36Pi7, Brodhead-Heller	3570+/-100 Y-2340	Level III platform hearth	Kinsey and McNett 1972:217, 221-222
36Pi7, Brodhead-Heller	3390+/-100 Y-2341	Feature 26	Kinsey and McNett 1972:222
36Pi7, Brodhead-Heller	3120±120 Y-2339	Level IIa hearth	Kinsey and McNett 1972:218, 222
36Pi13A, Faucett	6170+/-135 I-5238	Feature 188	Kinsey 1972, 1975:62, Table 32
36Pi13A, Faucett	5570+/-200 I-5237	Feature 158	Kinsey 1972, 1975:61, Table 32
36Pi13A, Faucett	5180+/-200 Y-2479	N120E20, occupation floor 72-78 inches below datum	Kinsey 1972:186, 339
36Pi13A, Faucett	4560+/-110 I-5234	Feature 165	Kinsey 1972, 1975:60, Table 32
36Pi13A, Faucett	4445+/-130 I-5411	Feature 181	Kinsey 1972, 1975:59-60, Table 32
36Pi13A, Faucett	4130+/-180 I-5236	Feature 171	Kinsey 1972, 1975:59, Table 32
36Pi13A, Faucett	3450+/-120 Y-2478	Feature 99	Kinsey 1975:51, Table 32

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Pi13A, Faucett	2760+/-100 Y-2477	Feature 89	Kinsey 1972:190, 1975:44, 47
36Pi13A, Faucett	2700+/-100 Y-2476	N110E0, occupation floor 30 inches (76 cm) below datum	Kinsey 1972:191, 1975:44
36Pi13A, Faucett	2350+/-95 I-5233	Feature 161	Kinsey 1975:40, Table 32
36Pi13A, Faucett	2050+/-135 I-5542	Feature 68	Fischler and Mueller 1991:Table 3.5; Kinsey 1975:39
36Pi13A, Faucett	1380+/-40 Beta 266401 assay based on mussel shell	Feature 207	Stewart and Bitting n.d
36Pi13A, Faucett	1160+/-120 Y-2475	N130E40, 12 inches below datum	Kinsey 1972:192, 1975:28
36Pi13A, Faucett	640+/-120 Y-2474	Feature 117	Kinsey 1972:194, 464, 1975:28
36Pi13A, Faucett	540+/-100 Y-2473	Feature 52	Kinsey 1972:195, 1975:28
36Pi13A, Faucett	370+/- 40 Beta 265508	Feature 207	Stewart and Bitting n.d.; Stinchcomb et al 2011; Moeller 1992
36Pi14, Zimmerman	3600+/-80 Y-2344	Hearth 59-Feature 226	Werner 1972:63, 65
36Pi14, Zimmerman	3230+/-120 Y-2343	Hearth 4-Feature 44	Werner 1972:118
36Pi14, Zimmerman	2850+/-20 ISGS-A2012	organic residue on pottery identified as Vinette I	Tache and Hart 2013:Table 1, Appendix 1
36Pi14, Zimmerman	2440+/-20 ISGS-A2011	organic residue on pottery identified as Vinette I	Tache and Hart 2013:Table 1, Appendix 1
36Pi14, Zimmerman	2435+/-20 ISGS-A2010	organic residue on pottery identified as Vinette I	Tache and Hart 2013:Table 1, Appendix 1
36Pi21, Peters-Albrecht	520+/-80 Beta 62436	Feature 4, Catalog No.43	Wall and Botwick 1995a:163, 168, 1995b:Appendix VI
36Pi21, Peters-Albrecht	430+/-110 Beta 62435	Feature 2	Parker 1995:Table 4; Wall and Botwick 1995a:161, 168, 1995b:Appendix VI
36Pi21, Peters-Albrecht	330+/-70 Beta-62434	Feature 1	Parker 1995:Table 4; Wall and Botwick 1995a:159, 167-168, 1995b:Appendix VI
36Pi22, Peters-Albrecht	3670+/-100 Y-1826	Pit 6	Kinsey 1968:246, 1972:318, 394-398; Carr 2015:Table 3.2
36Pi25, Kutay	550+/-80 Y-2338	Feature 75	Kinsey 1972:255
36 Pi33, McCann #1&2	740+/-40 Beta 265506 assay based on mussel shell	Pit 19	Stewart and Bitting n.d
36 Pi33, McCann #1&2	440+/-40 Beta 265507	Pit 19	Stewart and Bitting n.d.; Stinchcomb et al 2011
36Pi135, Milford Beach	590+/-80 Beta 21552 400+/-140 Beta 21551	Feature 20	Fischler and Mueller 1988, 1991:131-132, Table 3.6
36Pi135, Milford Beach	260+/-80 Beta 15569	Feature 1	Fischler and Mueller 1988, 1991: 86-87; French 1988
36Pi136, Dingmans Launch Lower Boat Ramp	3890+/-110 Beta 37464	charcoal concentration, potential hearth	Alterman and Koldehoff 1991:35, Appendix 1
36Pi136, Dingmans Launch Lower Boat Ramp	3230+/-60 Beta 57130	Feature 4	Alterman 1993:Table 1, 22-25

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Pi136, Dingmans Launch Lower Boat Ramp	2740+/-140 Beta 15577	rock filled pit	Fischler 1990:32; Alterman 1993:11; Fischler and Mueller 1988:Table 3.5
36Pi136, Dingmans Launch	2710+/-90 Beta 37465 2390+/-70 Beta 45960	Feature 1	Alterman 1993:12; Alterman and Koldehoff 1991:35-36, 39, Appendix 1
36Pi136, Dingmans Launch Lower Boat Ramp	2450+/-60 Beta 37771	charcoal lens	Alterman 1993:12; Alterman and Koldehoff 1991:Appendix 1
36Pi136, Dingmans Launch Lower Boat Ramp	2370+/-80 Beta 37463	Feature 3	Alterman and Koldehoff 1991:Appendix 1; Alterman 1993:12
36Pi136, Dingmans Launch Lower Boat Ramp	780+/-110 Beta 57129	Feature 2	Alterman 1993:Table 1
36Pi136, Dingmans Launch Lower Boat Ramp	740+/-80 Beta 57128	Feature 1	Alterman 1993:21
36Pi148, Stoehr	1270+/-110 Beta-7558	Feature 3	Wright 1997:35
36Pi148, Boat Launch /Stoehr	400+/-100 Beta 55831	Unit B, Level 5	Inashima 1993:36; Wright 1997
36Pi148 vicinity	4105+/-90 GX-22942	Excavation monitoring, 20 feet below surface	Wright 1997:35
36Pi169, Shohola Flats	4460+/-130 Beta 127251 4370+/-140 Beta 127250	Feature 36	Trachtenberg et al 2008:72-73, Appendix L
36Pi169, Shohola Flats	3960+/-110 Beta 127247	Feature 35/37	Trachtenberg et al 2008:72-73, Appendix L
36Pi169, Shohola Flats	3350+/-110 Beta 127248	Feature 2/26/28/31	Trachtenberg et al 2008:70 Appendix L
36Pi169, Shohola Flats	3150+/-70 Beta 127260 3100+/-70 Beta 86420 3090+/-150 Beta 127257 3030+/-60 Beta 127258 3010+/-150 Beta 127259 2810+/-150 Beta 123478	Feature 58	Trachtenberg et al 2008:74-75, 133-134, 137, 162-163, Appendix L
36Pi169, Shohola Flats	400+/-60 Beta 123476 190+/-60 Beta 123477	Feature 50	Trachtenberg et al 2008:74, Appendix L
36Pi172, Kidney	450+/-70 Beta 123480 410+/-60 Beta 123483 320+/-60 Beta 123481 290+/-60 Beta 123482	Feature 6	Brown et al 2000:i, 41-44, Table 5
Ventura Tract, Pike County, PA	830+/-50 Beta 219495	Feature 4	Messner et al 2006; Messner 2011:91
36Mr5, Smithfield Beach/Pardee	3770+/-90 Beta 41370	Feature 126	Hennessy 1992:146, 255-258

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Mr5, Smithfield Beach/Pardee	3460+/-100 Beta 15570	Unit 4, Stratum E	Fischler and Mueller 1988:Volume I, Chapter 5, Table 1; Fischler and Mueller 1991:Table 3.3
36Mr5, Smithfield Beach/Pardee	3180+/-80 Beta 42907	Feature 134	Hennessy 1992:148
36Mr5, Smithfield Beach/Pardee	3100+/-80 Beta 41371	Feature 135	Hennessy 1992:148
36Mr5, Smithfield Beach/Pardee	2710+/-150 Beta 15568	Feature 2	Fischler and Mueller 1988:Table 3.5
36Mr5, Smithfield Beach/Pardee	1970+/-90 Beta 41246	Feature 117	Hennessy 1992:116, 145-146, 175, Appendix A
36Mr5, Smithfield Beach/Pardee	1720+/-60 Beta 42905	Feature 132	Hennessy 1992:147, 179
36Mr5, Smithfield Beach/Pardee	1640+/-190 Beta 34807	Stratum VII	Fischler and French 1991:Table 6-1; Hennessy 1992:139
36Mr5, Smithfield Beach/Pardee	1200+/-90 Beta 41369	Feature 130	Hennessy 1992:146-147, 171
36Mr5, Smithfield Beach/Pardee	1180+/-70 Beta 42906	Feature 128	Hennessy 1992:311
36Mr5, Smithfield Beach/Pardee	1170+/-60 (uncorrected) Beta 34215	Feature 80	Fischler and French 1991:Table 6-1; Hennessy 1992:139, 171
36Mr5, Smithfield Beach/Pardee	1110+/-100 Beta 41248	Feature 136	Hennessy 1992:148-149, 174
36Mr5, Smithfield Beach/Pardee	1100+/-50 Beta 42908	Feature 133	Hennessy 1992:148, 174
36Mr5, Smithfield Beach/Pardee	1020+/-80 Beta 15576	Feature 13 base	Fischler and Mueller 1988; French 1988
36Mr5, Smithfield Beach/Pardee	930+/-80 Beta 21548	Feature 13	Fischler and Mueller 1991:Table 3.6; Hennessy 1992:68
36Mr5, Smithfield Beach/Pardee	910+/-70 Beta 42904	Feature 123	Hennessy 1992:308-309
36Mr5, Smithfield Beach/Pardee	890+/-60 Beta 15573	Feature 10	Fischler and French 1991:160; Fischler and Mueller 1988; French 1988; Hennessy 1992
36Mr5, Smithfield Beach/Pardee	760+/-60 Beta 15575	Feature 13 top	Fischler and Mueller 1988; French 1988
36Mr5, Smithfield Beach/Pardee	750+/-60 Beta 15574	Feature 11	Fischler and Mueller 1988; French 1988
36Mr5, Smithfield Beach/Pardee	670+/-70 Beta 15572	Feature 7	Fischler and Mueller 1988; French 1988
36Mr5, Smithfield Beach/Pardee	640+/-70 Beta 42902	Feature 122, Level B1	Hennessy 1992:306, 308
36Mr5, Smithfield Beach/Pardee	260+/-60 Beta 42903	Feature 122, Level C7	Hennessy 1992:306, 308
36Mr5, Smithfield Beach/Pardee	400+/-70 Beta 15571	Feature 6	Fischler and Mueller 1988; French 1988
36Mr5, Smithfield Beach/Pardee	350+/-60 Beta 42910	Feature 114	Hennessy 1992:145, 151
36Mr5, Smithfield Beach/Pardee	330+/-60 Beta 21549	context not specified	Fischler and Mueller 1991:Table 3.6
36Mr5, Smithfield Beach/Pardee	150+/-60 Beta 42909	Feature 121	Hennessy 1992:303
36Mr43, Shawnee Minisink	11,050+/-1000 W-3391	soil matrix	McNett et al 1985:6-7; Gingerich 2013a:Table 9.8

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Mr43, Shawnee Minisink	11,020+/-30 UCIAMS 24866 10,915+/-25 UCIAMS 24865 10,820+/-50 Beta 203865	Unit 2, Hearth 1	Gingerich 2013a:Table 9.8
36Mr43, Shawnee Minisink	10,970+/-50 OxA-1731	Unit 4/4E, Hearth 2	Gingerich 2013a:Table 9.8
36Mr43, Shawnee Minisink	10,940+/-90 Beta 101935 10,900+/-40 Beta 127162 10,590+/-300 W-2994	Kline hearth, southwestern portion of site	Kraft 1975b:Table 11; McNett et al 1985:3, 6; Dent 2002:Table 1; Dent 2007:Table 7.1, Figure 7.2; Gingerich 2013a:Table 9.8
36Mr43, Shawnee Minisink	10,750+/-600 W-3134	hearth	McNett et al 1985:6-7; Gingerich 2013a:Table 9.8
36Mr43, Shawnee Minisink	9310+/-1000 W-3388	soil matrix	McNett et al 1985:6-7; Gingerich 2013a:Table 9.8
36Mr43, Shawnee Minisink	1640+/-200 W-3135	Feature 26	McNett et al 1985:9; Fischler and Mueller 1991:Table 3.5; McNett 1985b:115, 117
36Mr43, Shawnee Minisink	1565+/-95 W- no lab # reported	pooled sample of charcoal from base of ill-defined pits, Squares 8, 13	McNett et al 1985:9; Fischler and Mueller 1991:Table 3.5; McNett 1985b:115, 117
36Mr45, Depue Island/Upper Shawnee Island	9330+/-545 Uga-5488	Unit 12/12A, hearth feature, 4.3 meters below surface	Stewart et al 1991:173; Stewart 2014
36Mr45, Depue Island/Upper Shawnee Island	9330+/-40 Beta 348685	Test trench 3, south end hearth feature	Stewart 2014
36Mr45, Depue Island/Upper Shawnee Island	3515+/-55 Uga-5549	Unit 12/12A, hearth feature, 1.8 meters below surface	Stewart et al 1991:176
36Mr45, Depue Island/Upper Shawnee Island	1170+/-40 Beta 265509 assay based on mussel shell	Kline pit feature	Stewart and Bitting n.d
36Mr45, Depue Island/Upper Shawnee Island	500+/-40 Beta 265509	Kline pit feature	Stewart and Bitting n.d.; Stinchcomb et al 2011
36Mr180, Camelback Rockshelter	430+/-40 Beta 249028	presumed Archaic-age deposits	Burns 2009:207
36Mr180, Camelback Rockshelter	400+/-40 Beta 249027	presumed Archaic-age deposits	Burns 2009:207
36Mr180, Camelback Rockshelter	320+/-40 Beta 218501	presumed Archaic-age deposits	Burns 2009:207
36Nm4	3350+/-70 no lab # reported	Locus A, Feature 10-01	Hornum et al 2002:144
36Nm4	2080+/-40 no lab # reported	Locus A, "pot break"	Hornum et al 2002:iv, 138
36Nm12, Sandts Eddy	10,150+/-180 Beta 61413	Stratum XVIII	Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	10,050+/-280 Beta 61744	Stratum XIX	Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	9420+/-90 Beta 51501 9300+/-130 Beta 53142	Stratum XI	Bergman et al 1994:166; Doershuk and Bergman 1996:Figure 14.1; Bergman 1996:Table 15.2

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Nm12, Sandts Eddy	8450+/-130 Beta 61332	Stratum IX	Doershuk and Bergman 1996:Figure 14.1; Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	7500+/-170 Beta 51733	Stratum VII	Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	7330+60 Beta 61582 CAMS 5834	Stratum IX	Bergman et al 1994:164; Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	7080+/-70 Beta 51500	Stratum IX, Feature 9	Doershuk and Bergman 1996:Figure 14.1; Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	4910+/-60 Sample No. 3051 (no lab # reported)	Feature 1A	Weed et al 1990:152
36Nm12, Sandts Eddy	3970+/-80 Sample No. 28857 (no lab # reported)	hearth	Weed et al 1990:91
36Nm12, Sandts Eddy	3450+/-70 Beta 59730	Stratum III/IV interface	Bergman 1996:Table 15.2
36Nm12, Sandts Eddy	3200 ± 90 Beta 28856	hearth	Weed et al 1990; Bergman et al 1994
36Nm12, Sandts Eddy	340+/-50 Beta 28855	Feature 12	Doershuk and Bergman 1996:321; Weed et al 1990:99
36Nm15, Padula	5470+/-80 Beta 47084	Geo Stratum 7, 3Ab horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	5430+/-80 Beta 47969	Geo Stratum 6, 3Ab horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	4910+/-80 Sample 3051	Feature 1A/2	Doershuk 1994:Figure 14.17; Weed et al 1990:152
36Nm15, Padula	2580+/-80 Beta 52248	Feature 6	Doershuk 1994:Figure 14.17
36Nm15, Padula	1300+/-110 Beta 50977	Feature 5	Doershuk 1994:Figure 14.17
36Nm15, Padula	930+/-80 Beta 52247	upper disturbed portion of Feature 6	Doershuk 1994:Figure 14.17
36Nm15, Padula	880+/-70 Sample 961, no lab # reported	Feature 1B	Doershuk 1994:Figure 14.17; Weed et al 1990:152
36Nm15, Padula	640+/-120 Beta 50979	Feature 7	Doershuk 1994:Figure 14.17
36Nm15, Padula	530+/-70 Beta 46855	Geo Stratum 5, 2Ab horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	510+/-60 Beta 47967	Geo Stratum 13, C1 horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	500+/-50 Beta 46856	Geo Stratum 7, 2Ab horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	450+/-70 Beta 47968	Geo Stratum 2, 2Ab horizon	Schuldenrein 1994:Table 6.3
36Nm15, Padula	430+/-60 Beta 47085	Geo Stratum 10, 2Ab horizon	Schuldenrein 1994:Table 6.3
36Nm80, Bachman	3800+/-100 Beta 10657	Feature 6	Anthony and Roberts 1987:81-82, 103-104
36Nm80, Bachman	3630+/-210 Beta 10656	Feature 5	Anthony and Roberts 1987:80-81, 103-104
36Nm80, Bachman	2080+/-90 Beta 10655	Feature 4	Anthony and Roberts 1987:79

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
36Nm80, Bachman	1360+/-120 No lab # reported	Feature 2	Anthony and Roberts 1987:83
36Nm140, Oberly Island	6340+/-70 Beta 105802	Unit 171, 60.05 meters amsl	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	4460+/-60 Beta 105803	Unit 217, 60.39 meters amsl	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	2950+/-100 Beta 108183	Feature 20	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	2010+/-70 Beta 105331	Feature 24	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	1920+/-100 Beta 105330	Unit 188, 60.64 meters amsl, E/BE horizon	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	1680+/-70 Beta 105799	Feature 22	Siegel et al 1999:Table 4; 2001:Table 1
36Nm140, Oberly Island	900+/-60 Beta 105328	Unit 131, 60.72 meters amsl, upper E/BE horizon	Siegel et al 1999:Table 4; 2001:Table 1
36Nm142, Treichlers Bridge	8160+/-70 Teledyne I-18,951	level 2 of Stratum III (upper)	Anderson et al 2000:x, 7-7, 6-397, Table 6.7-1, Appendix VIII
36Nm142, Treichlers Bridge	8030+/-110 Teledyne I-18, 950	Feature 3, level 2 of Stratum III (upper)	Anderson et al 2000: Tables 6.2-1. 6.2-2; 6–107, 6-109, 6-397, 7-7, Appendix VIII
36Nm142, Treichlers Bridge	3160+/-75 Teledyne I-18, 913	Feature 9	Anderson et al 2000:6-121, 6-397, Table 6.7-1, Appendix VIII; Ericksen 1999:Feature 62
36Nm204	210+/-40 Beta 216050	Feature 1-07	Hornum et al 2009:46; Appendix III
36Nm212/229	1190+/-40 Beta 93148	Feature 1	Lattanzi 1996:Appendix F; Puseman 1996
36Nm244, Driftstone	3740+/-70 Beta 131311	Unit 14, hearth at 94” below surface	Kline 1999 (personal communication); Blondino 2008:Table 1, 2015:Table 5.1
36Nm244, Driftstone	3270+/-80 UGAMS-02949	Block 4, ~5’ below surface	Blondino 2008:170, Table 1, 2015:Table 5.1
36Nm244, Driftstone	3070+/-80 Beta 43899	Unit 1, 4’ below surface	Kline 1999 (personal communication); Blondino 2008:167, Table 1, 2015:Table 5.1
36Nm244, Driftstone	2920+/-30 UGAMS-02948	cambic B horizon, Fishtail component	Blondino 2008:Table 1, 2015:Table 5.1
36Nm262	690+/-40 Beta 186301	Feature 80-3	Hornum et al 2005:96-97
36Cr142, Nesquehoning Creek	10,480+/-30 Beta 379217	N10E0, Stratum 17, Level 3	Stewart et al 2018
36Cr142, Nesquehoning Creek	10,340+/-40 Beta 379729	N5E0, Stratum 17, Level 1	Stewart et al 2018
36Cr142, Nesquehoning Creek	9940+/-50 Beta 278334	Unit 2, Stratum 16, Level 4	Stewart et al 2018
Otego Yard Site (NYSM 121), Otsego County, NY	5320+/-120 Beta-no lab # reported	abandoned stream channel deposit	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3870+/-100 Beta-no lab # reported	Feature 188D	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3800+/-80 Beta-no lab # reported	Feature 22D	Hartgen Associates 1988b:101-102, Table 32

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Otego Yard Site (NYSM 121), Otsego County, NY	3640+/-170 Beta-no lab # reported	Feature 182	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3500+/-80 Beta-no lab # reported	Feature 204	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3440+/-90 Beta-no lab # reported	Feature 188B	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3210+/-70 Beta-no lab # reported	Feature 67A	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	3030+/-100 Beta-no lab # reported	Feature 52	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	2100+/-90 Beta-no lab # reported	Feature 42A	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	1800+/-90 Beta-no lab # reported	Feature 183A	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	1750+/-90 Beta-no lab # reported	Feature 58	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	1180+/-90 Beta-no lab # reported	Feature 152	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	1020+/-110 Beta-no lab # reported	Feature 210	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	810+/-80 Beta-no lab # reported	Feature 79	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	570+/-60 Beta-no lab # reported	Feature 22C	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	510+/-60 Beta-no lab # reported	Feature 158	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	280+/-80 Beta-no lab # reported	Feature 99	Hartgen Associates 1988b:101-102, Table 32
Otego Yard Site (NYSM 121), Otsego County, NY	260+/-60 Beta-no lab # reported	Feature 21	Hartgen Associates 1988b:101-102, Table 32
Russ (Una 19-4), Otsego County, NY	8220+/-420 8220+/-470 DIC-475	Feature 21, Section W6S39	cf. Funk 1991:11; Funk 1993:Tables 16, 17; 1998:462; Funk and Wellman 1984:Table 1
Russ (Una 19-4), Otsego County, NY	7960+/-215 DIC-473	Feature 3, Section W6S42	Funk 1993:Table 16, 1998:461
Russ (Una 19-4), Otsego County, NY	7880+/-145 DIC-474	Feature 27, Section W6S39	Funk 1993:Table 17; 1998:464; Funk and Wellman 1984:Table 1
Russ (Una 19-4), Otsego County, NY	6960+/-215 DIC-752	Feature 67, Section E0S36	Funk 1993:Table 16, 1998:461
Russ (Una 19-4), Otsego County, NY	4350+/-170 QC-176	Locus 2, Feature 30, Section W3S42	Funk 1998:451
Russ (Una 19-4), Otsego County, NY	270+/-70 GX-11930	Locus 2, Feature 89, Section W15S45	Funk 1993:Table 16, 1998:451

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Johnsen No.3 (Una 20-4), Otsego County, NY	9140+/-260 GX-8204 8830+/-210 GX-8223	Occupation Zone E	Funk and Wellman 1984:Table 1
Johnsen No.3 (Una 20-4), Otsego County, NY	8880+/-255 GX-8205 8585+/-190 GX-8225	Occupation Zone D	Funk 1993:Table 16; Funk and Wellman 1984:Table 1
Street, Otsego County, NY	1043+/-40 (ISGS A0229)	Pottery residue	Funk 1993:Table 17; 1998:123-143; Hart and Brumbach 2005:Table 1; Hart et al 2007:Table 1
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	4420+/-40 Beta 206644	Feature 1	Kudrle 2005:Table 14, Appendix 6
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	4380+/-40 Beta 206649	Feature 37	Kudrle 2005:Table 14, Appendix 6
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	4370+/-40 Beta 206646	Feature 6	Kudrle 2005:Table 14, Appendix 6
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	3180+/-100 Beta 206648	Feature 36	Kudrle 2005:Table 14, Appendix 6
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	1030+/-50 Beta 206647	Feature 23	Kudrle 2005:Table 14, Appendix 6
Sidney Hangar Site (SUBi-2073), Chenango and Delaware counties, NY	370+/-80 Beta 206645	Feature 3	Kudrle 2005:Table 14, Appendix 6
BRO-212 Site, Broome County, NY	4010+/-50 Beta 253258	Feature 2 Block 6	Kelly 2009a:70, Appendix H
BRO-212 Site, Broome County, NY	2030+/-40 Beta 253257	Feature 1 Block 6	Kelly 2009a:68, Appendix H
BRO-117 Site, Broome County, NY	1350/-50 Beta 256723	Block 3, Feature 9	Kelly 2009b:196, Appendix I
BRO-117 Site, Broome County, NY	730+/-40 Beta 256727	Feature 99	Kelly 2009b:145, Appendix I
BRO-117 Site, Broome County, NY	690+/-40 Beta 256724	Feature 35	Kelly 2009b:108, Appendix I
BRO-117 Site, Broome County, NY	520+/-40 Beta 256733	Feature 126	Kelly 2009b:155, Appendix I
BRO-117 Site, Broome County, NY	310+/-40 Beta 256728 450+/-40 Beta 256730 560+/-40 Beta 256731 580+/-40 Beta 256725 590+/-40 Beta 256726	Feature 13/14, sheet midden	Kelley 2009b:64, Table 17, Appendix I
Chenango Point (SUBi-1274), Broome County, NY	4710+/-40 Beta 265477	Feature 168	Knapp 2011:Table 4.3, Appendix 3
Chenango Point (SUBi-1274), Broome County, NY	3370+/-60 Beta 46949	Feature 18	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	1370+/-60 Beta 46950	Feature 53	Knapp 2011: Table 4.3; Appendix 3, Table A3-17
Chenango Point (SUBi-1274), Broome County, NY	1270+/-70 Beta 35557	Feature 1.4	Knapp 2011: Table 4.3

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Chenango Point (SUBi-1274), Broome County, NY	1000+/-70 Beta 46948	Feature 54	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	920+/-40 Beta 265480	Feature 383	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	860+/-40 Beta 265476	Feature 119	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	760+/-40 Beta 265475	Feature 118	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	740+/-40 Beta 265473	Feature 102	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	740+/-40 Beta 265474	Feature 105	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	700+/-40 Beta 265479	Feature 401	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	680+/-50 Beta 46947	Feature 45	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	660+/-40 Beta 265478	Feature 348	Knapp 2011: Table 4.3
Chenango Point (SUBi-1274), Broome County, NY	530+/-50 Beta 46946	Feature 4	Knapp 2011: Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	1230+/-100 Beta 35558	Feature 1/101	Miroff 2012:Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	600+/-30 Beta 309043	Feature 180	Miroff 2012:Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	550+/-30 Beta 309044	Feature 275	Miroff 2012:Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	540+/-30 Beta 332933 300+/-30 Beta 309042	Feature 176	Miroff 2012:Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	300+/-30 Beta 309040	Feature 46	Miroff 2012:Table 4.3
Chenango Point South (SUBi-2776), Broome County, NY	270+/-30 Beta 309041	Feature 90	Miroff 2012:Table 4.3
Park Creek I (Subi-1464, NYSM #10222), Broome County, NY	4170+/-40 Beta 142040	hickory nutshell AMS date	Miroff 2002:41, 44, Table 4
Park Creek I (Subi-1464, NYSM #10222), Broome County, NY	4020+/-80 Beta 142039	Feature 12/13	Miroff 2002:41, 44, Table 4
Park Creek II (Subi-1464, NYSM #10222), Broome County, NY	2170+/-60 Beta 140974	Feature 4	Miroff 2002:94, Table 34
Park Creek II (Subi-1464, NYSM #10222), Broome County, NY	650+/-40 Beta 140973	Feature 3	Miroff 2002:Table 34
Park Creek II (Subi-1464, NYSM #10222), Broome County, NY	560+/-40 Beta 140975	Feature 2	Miroff 2002:Table 34
Park Creek II (Subi-1464, NYSM #10222), Broome County, NY	480+/-40 Beta 140976	Feature 5	Miroff 2002:Table 34
Raish Site (Subi-1465, NYSM #10223), Broome County, NY	1530+/-120 Beta 142036	Feature 2	Miroff 2002:Table 77
Raish Site (Subi-1465, NYSM #10223), Broome County, NY	560+/-60 Beta 142037	Feature 3	Miroff 2002:Table 77
Otsiningo Market Site (SUBi-3041), Broome County, NY	690+/-30 Beta 378840	Feature 10C	Miroff 2014:Table 8

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Otsiningo Market Site (SUBi-3041), Broome County, NY	670+/-30 Beta 379672	Feature 1	Miroff 2014:Table 8
Otsiningo Market Site (SUBi-3041), Broome County, NY	600+/-30 Beta 378839	Feature 5	Miroff 2014:Table 8
Broome Tech Site (SUBi-1005) , Broome County, NY	2680+/-80 Beta 129347	midden	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
Broome Tech Site (SUBi-1005) , Broome County, NY	2560+/-70 Beta 129344	Context not specified	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
Broome Tech Site (SUBi-1005) , Broome County, NY	2490+/-40 Beta 129343	midden	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
Broome Tech Site (SUBi-1005) , Broome County, NY	2400+/-60 Beta 129346	feature	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
Broome Tech Site (SUBi-1005) , Broome County, NY	2180+/-70 Beta 129345	feature	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
Broome Tech Site (SUBi-1005) , Broome County, NY	920+/-80 Beta 121977	midden	Knapp 2002:Table 9.1
Broome Tech Site (SUBi-1005) , Broome County, NY	820+/-40 AA31006	midden	Knapp 2002:Table 9.1
Broome Tech Site (SUBi-1005) , Broome County, NY	705+/-40 AA31005	Feature 7	Miroff 2014:Table 9; Knapp 2002:Table 9.1
Broome Tech Site (SUBi-1005), Broome County, NY	640+/-40 Beta 196043	Feature 58	Miroff 2014:Table 9
Deposit Airport I (SUBi-2048), Delaware County, NY	1850+/-40 Beta 168304	Feature 18	Knapp and Versaggi 2002:79-80, Tables 7, 8
Deposit Airport I (SUBi-2048), Delaware County, NY	1380+/-60 Beta 160180	Feature 7	Knapp and Versaggi 2002:61, Tables 7, 8
Deposit Airport I (SUBi-2048), Delaware County, NY	1220+/-40 Beta 168305	Feature 27	Knapp and Versaggi 2002:93-94, Tables 7, 8
Deposit Airport I (SUBi-2048), Delaware County, NY	1210+/-40 lab sample # not reported	Context not reported	Knapp 2009:104
Deposit Airport I (SUBi-2048), Delaware County, NY	930+/-60 Beta 168303	Feature 6	Knapp and Versaggi 2002:59,Tables 7, 8
Deposit Airport I (SUBi-2048), Delaware County, NY	920+/-40 Beta 168307	Feature 34	Knapp and Versaggi 2002:107, Tables 7, 8
Deposit Airport I (SUBi-2048), Delaware County, NY	850+/-40 Beta 168306	Feature 29	Knapp and Versaggi 2002:44, 99, Tables 7, 8
Gardepe (Una 16-4), Delaware County, NY	9380+/-100 DIC-261	Locus 1, Zone 6, Feature 23, SectionW40N0	Funk 1979:26; 1993:Table 16, 1998:406
Gardepe (Una 16-4), Delaware County, NY	1820+/-55 DIC-263	Locus 1, Zone 4 Feature 4	Funk 1993:199, Table 17
Gardepe (Una 16-4), Delaware County, NY	1660+/-100 DIC-249	Locus 1, Zone 3, Feature 1, SectionW50N0	Funk 1993:Table 16, 1998:402
Gardepe (Una 16-4), Delaware County, NY	1400+/-55 DIC-262	Locus 1, Zone 3, Feature 30, Section W70N10	Funk 1998:402
Mt. Laurel Gardens-3 (SUBi-2523), Delaware County, NY	3680+/-40 Beta 216699	Feature 2	Carroll et al 2007:Table 8

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Mt. Laurel Gardens-1 (SUBi-2523), Delaware County, NY	2970+/-40 Beta 216698	Feature 1	Carroll et al 2007:Table 8
Delhi Holding Pond Site (SUBi-2673), Delaware County, NY	3490+/-40 Beta 292478	Feature 1	Kudrle 2011:50
Peake Site, Delaware County, NY	5120+/-130 Beta-no lab # reported	Feature 31A	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	4600+/-90 Beta-no lab # reported	Feature 27/32A	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	4310+/-90 Beta-no lab # reported	Feature 12B	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	4290+/-90 Beta-no lab # reported	Feature 25B	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	4270+/-70 Beta-no lab # reported	Feature 25, III	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	3960+/-170 Beta-no lab # reported	Feature 12C	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	3820+/-170 Beta-no lab # reported	Feature 36A	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	3390+/-100 Beta-no lab # reported	Feature 36, II	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	3370+/-80 Beta-no lab # reported	Feature 18	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	3180+/-90 Beta-no lab # reported	Feature 26B	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	1790+/-180 Beta-no lab # reported	Feature 37/39A	Hartgen Associates 1988:Table 18
Peake Site, Delaware County, NY	1380+/-80 Beta-no lab # reported	Feature 13	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	1280+/-60 Beta-no lab # reported	Feature 12A	Hartgen Associates 1988a:Table 18
Peake Site, Delaware County, NY	1220+/-80 Beta-no lab # reported	Feature 30A	Hartgen Associates 1988a:Table 18
Ouleout Site (8W-32-7), Delaware County, NY	1630+/-80 Beta 19934	Feature 23	Hartgen Associates 1989:26, 35-36
Ouleout Site (8W-32-7), Delaware County, NY	1470+/-30 Beta 20233	Feature 10	Hartgen Associates 1989:26, 31
Ouleout Site (8W-32-7), Delaware County, NY	1180+/-80 1160+/-80 1150+/-80 1020+/-80 1000+/-70 990+/-60 Beta-no lab # reported	Feature 18	Hartgen Associates 1989:26, 32-34

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Ouleout Site (8W-32-7), Delaware County, NY	990+/-120 Beta 19676	Feature 19	Hartgen Associates 1989:26, 34
Ouleout Site (8W-32-7), Delaware County, NY	970+/-60 Beta 19682 840+/-90 Beta 19666	Feature 7	Hartgen Associates 1989:26, 30
Ouleout Site (8W-32-7), Delaware County, NY	960+/-80 Beta 19933	Feature 20	Hartgen Associates 1989:26, 34
Herrick Hollow II, Delaware County, NY	1760+/-40 Beta 198655	Locus 2, Feature 3	Hohman et al 2005:97-98, Table 40, Appendix II; Asch-Sidell 2005:Table 6
Herrick Hollow II, Delaware County, NY	890+/-40 Beta 198656	Locus 5, Feature 4	Hohman et al 2005:76, Table 40, Appendix II; Asch-Sidell 2005:Table 6
Herrick Hollow II, Delaware County, NY	880+/-40 Beta 198654	Locus 1, Feature 1	Hohman et al 2005:76, 97, Table 40
Herrick Hollow V, Delaware County, NY	1060+/-40 Beta 198657	Locus 1, Feature 5	Hohman et al 2005:186, 205, Appendix II
Herrick Hollow VII, Delaware County, NY	2400+/- 40 Beta 198658	Feature 1	Hohman et al 2005:239
Beaver Lodge (SUBi-2298, NYSM#11302), Delaware County, NY	6160+/-40 Beta 222395	Feature 1, Horizon 2	Rudler 2006:98-103, 107; Versaggi 2017 personal communication
Fortin Locus 1, Delaware County, NY	4185+/-120 I-7098	Occupation zone 7, Feature 112	Funk 1993:Table 17
Fortin Locus 1, Delaware County, NY	3970+/-100 I-6568	Occupation zone 1, Feature 29	Funk 1993:Table 17; 1998:47
Fortin Locus 1, Delaware County, NY	3840+/-100 I-6567	Occupation zone 4, Feature 24	Funk 1993:Table 17; 1998:50
Fortin Locus 1, Delaware County, NY	3820+/-95 Dic 207	Occupation zone 5, Feature 39	Funk 1993:Table 17; 1998:53
Fortin Locus 1, Delaware County, NY	3775+/-115 I-6351	Occupation zone 5, Feature 28	Funk 1993:Table 17; 1998:53
Fortin Locus 1, Delaware County, NY	3750+/-95 I-6369	Occupation zone 4, Feature 25	Funk 1993:Table 17; 1998:52
Fortin Locus 1, Delaware County, NY	3685+/-100 I-6739	Occupation zone 5, Feature 14	Funk 1993:Table 17; 1998:54
Fortin Locus 1, Delaware County, NY	3610+/-95 I-6368	Occupation zone 5, Feature 7	Funk 1993:Table 17; 1998:54
Fortin Locus 1, Delaware County, NY	3280+/-90 I-7097	Occupation zone 6, Feature 92	Funk 1993:Table 17; 1998:57
Fortin Locus 1, Delaware County, NY	3180+/-95 Dic 177	Occupation zone 7, Feature 74	Funk 1993:Table 17; 1998:58
Fortin Locus 2, Delaware County, NY	1995+/-35 ISGS A0410	Pottery residue, Occupation zone 3	Funk 1993:Table 17; 1998:68-78; Thompson et al 2004:28-29, Tables 2, 4
Fortin Locus 2, Delaware County, NY	1525+/-35 ISGS A0406	Pottery residue, Occupation zone 3	Funk 1993:Table 17; 1998:68-78; Thompson et al 2004:28-29, Tables 2, 4
Fortin Locus 2, Delaware County, NY	1505+/-35 ISGS A0407	Pottery residue, Occupation zone 3	Funk 1993:Table 17; 1998:68-78; Thompson et al 2004:28-29, Tables 2, 4
Fortin Locus 2, Delaware County, NY	1390+/-55 Dic 177	Occupation zone 3, Feature 48	Funk 1993:Table 17; 1998:75
Fortin Locus 2, Delaware County, NY	870+/-75 Dic-166	Occupation zone 4, Feature 30	Funk 1993:Table 17
McCulley No.1, Delaware County, NY	5730+/-110 I-5524	Combined charcoal from Features 2, 6	Funk 1991:11; Funk and Hoagland 1972:13-14, 20; Funk and Wellman 1984:Table 1

Table 1 Continued			
Site	**Date BP**	**Context**	**Reference**
Egli (Una7-3), Delaware County, NY	1320+/-150 GX-11932	Feature 5, Zone 4	Funk 1993:Table 17, 1998:539
Egli (Una7-3), Delaware County, NY	585+/-140 GX-11931	Feature 1	Funk 1993:Table 17
10 Mile River Rockshelter, Sullivan County, NY	4450+/-130 I-4837	basal artifact deposit	Funk 1989:47, Figure 6, Table 5
Site ORA-9936, Orange County, NY	3670+/-40 Beta 247744	Feature 5	Pretola and Freedman 2009:Table 23
Site ORA-9936, Orange County, NY	900+/-40 Beta 247746	Feature 1-DD	Pretola and Freedman 2009:Tables 23-24
Site ORA-9936, Orange County, NY	260+/-40 Beta 250830	Feature 1-U	Pretola and Freedman 2009:Tables 23-24
Site ORA-9936, Orange County, NY	230+/-40 Beta 247745	Feature 4	Pretola and Freedman 2009: Tables 23-24, 120
Site ORA-9931, Orange County, NY	2520+/-40 Beta 251451	Feature 47	Pretola and Freedman 2009:Table 51
Site ORA-9931, Orange County, NY	1150+/-40 Beta 25152	Feature 58	Pretola and Freedman 2009:Table 51
Site ORA-0550, Orange County, NY	1100+/-40 Beta 251443	Feature 37	Pretola and Freedman 2009:Table 84
Site ORA-0550, Orange County, NY	430+/-40 Beta 251444	Feature 42	Pretola and Freedman 2009:233, Table 84
Site ORA-0550, Orange County, NY	400+/-40 Beta 251447	Feature 120	Pretola and Freedman 2009:239-240, Table 84
Site ORA-0550, Orange County, NY	400+/-40 Beta 251449	Feature 152	Pretola and Freedman 2009:240-241, Table 84
Site ORA-0550, Orange County, NY	380+/-40 Beta 251448	Feature 132	Pretola and Freedman 2009:235, Table 84
Site ORA-0550, Orange County, NY	370+/-40 Beta 251446	Feature 74	Pretola and Freedman 2009:234, Table 84
Site ORA-0550, Orange County, NY	370+/-40 Beta 251442	Feature 26	Pretola and Freedman 2009:232-233; Table 84
Site ORA-0550, Orange County, NY	370+/-40 Beta 251445	Feature 68	Pretola and Freedman 2009:234; Table 84
Site ORA-0550, Orange County, NY	340+/-40 Beta 251450	Feature 106	Pretola and Freedman 2009:241-242, Table 84
Site ORA-0550, Orange County, NY	310+/-40 Beta 251441	Feature 7	Pretola and Freedman 2009:Table 84
Site AO71-06-0077, Orange County, NY	1360+/-70 Beta-32599	Feature 9, Layer 3	Hunter Research 1989b:6-5 to 6-15
Site AO71-06-0077, Orange County, NY	1230+/-60 Beta-32600	Feature 9, Layer 4	Hunter Research 1989b:6-5 to 6-15
Dutchess Quarry Cave No.8, Orange County, NY	5880+/-340 DIC-1447	possible hearth, Stratum 3	Kopper et al 1980:132-133, Figure 3, Plate 4; Steadman et al 1997:Table 1, Figure 3

II. BIFACES

Bifaces considered to be "diagnostic" of a particular time period figure prominently in archaeological practice and interpretation. This chapter collates dates for named biface types considered to be diagnostic from sites in the Upper Delaware Valley and select adjacent areas. The correspondence of the range of dates attributed to a specific type with existing chronological typologies is addressed, as are problematic issues associated with these schemes and their relevance to cultural historical periods in use in the region. A variety of studies have provided evidence that traditional typological chronologies used for bifaces in the region require revision (e.g., Bergman et al 1994:31). Suggestions for descriptive protocols and future research are made.

The biface types discussed here often are generically referred to as projectile points, or simply points, in the regional literature. The function that this nomenclature implies is something that needs to be demonstrated on a case by case basis; any number of studies have addressed the multifunctional nature of bifaces (e.g., Custer 1991; Katz 2000; Kraft 1990; Truncer 1990). It is my understanding that most archaeologists working in the region recognize the problem inherent in using the terms projectile or point but continue to use them as shorthand for named biface types. In what follows, comments are only occasionally provided on the probable function of a dated biface type at a given site and I will use the term, point(s), as a convention without strict functional connotations.

From a historical perspective the early work of Kinsey and colleagues resulting in the 1972 compilation, *Archaeology in the Upper Delaware Valley*, in addition to monographs produced by Kraft (1970a, 1975b), generated descriptive data for biface types and a modest number of associated radiocarbon dates subsequently used in interpretative efforts throughout the Delaware Valley and beyond. They, in turn, drew from the work of others (e.g., Leslie 1963) including far flung areas of the Middle Atlantic, Southeast, New England, and the Ohio Valley (e.g., Broyles 1966; Coe 1964; Dincauze 1968; Dragoo 1959; Funk 1965; Ritchie 1961, 1965) in order to identify and estimate the age of bifaces recovered in the Upper Delaware. While casting a wide net is necessary when relevant data are not substantial in a project area, doing so comes with problems that hopefully are recognized and addressed as the radiocarbon database increases (e.g., Sassaman 1998:140-143). Considering local chronologies in ever-broadening geospatial contexts provides comparative contexts which may reveal conformity to broad regional trends or the existence of unique local use histories (e.g., Fogelman 2016). As noted, one goal of the current analysis is to assess the relationship between trends seen in the Upper Delaware with those of the broader region and what may be implied about social interactions and unique use histories.

The history of national and regional archaeology is rife with debates concerning typology (e.g., Evans and Custer 1990; Granger 1988; Lyman et al 1997; Thurman 1985), and whether or not the types that archaeologists create have any relationship to an ethnographic reality, or the way in which a native person might classify or characterize a material thing. Types and typology are heuristic devices that serve to organize ranges of variability into useful units for study; it is a generalizing exercise during which some degree of variability is set aside. The presumption is that the theoretically endless variability of individual objects (e.g., Dunnell 1971:47) is something with which we cannot effectively deal. The analyst chooses a subset of attributes upon which to focus depending upon what is deemed to be important for the analysis of a given phenomenon. Types and typologies are constructed for different purposes (e.g., Andrefsky 1998:64-83). The adequacy of any typology depends upon the analytical purposes that it serves and the degree to which its use or categories are replicable by other researchers (Adams and Adams 1991:278-284).

In the construction of types that reflect units of time (historical types), and their arrangement into chronological typologies, we typically focus upon morphological attributes that appear to be time transgressive. Assigning a biface to a historical type is complicated by the degree to which its original form has been altered during its unique use life. The effects of resharpening or retooling a biface following breakage, or the results of a novice versus an experienced knapper (e.g., Shelley 1990) lead to transformations and variability that bedevils crafting standards for the definition and identification of types.

Assigning a biface to a type also is affected by the mental templates that the individual typologist brings to the procedure (Evans and Custer 1990:32). In completing the background research for this project there were a number of times when I found myself disagreeing with how an analyst chose to assign a biface to a historical type based on my personal understanding and experiences, and not on the metrical attributes previously published for the type or similar bifaces from dated and secure contexts. I am sure that others have had the same experience, borne out by Evan's type identification experiments involving participants of the Middle Atlantic Archaeological Conference (Evans and Custer 1990:31). Carr (2017 personal communication) cautions that researchers need to re-examine collections from significant sites when performing analyses in which typological assessments are a fundamental component. It is partially for this reason that illustrations of dated materials are included in this and other chapters, although the original type assignments have been retained.

All of the above results in an increasing amount of variability accumulating for a specific type, essentially extending its original definition. What becomes even more problematic in this extension is when a specific example or examples are associated with radiometric dates that extend the period of time over which a type appears to have been in use. Even where classic forms of a type are in evidence their association with radiocarbon dates extending the temporal range of their use history can become so great as to negate their usefulness as a chronologically diagnostic artifact. For example, the Lackawaxen series of biface types extends over 1000+ years of the Late Archaic and Early Woodland periods and grades into the morphology of the Piney Island, Bare Island, Pequa, and Poplar Island types (Custer 1996:171, Figure 57; 2001:62; Kent 1996:24; Stewart 1995:181). The situation is even more extreme for triangular points, generally ascribed to the Late Woodland period. Middle Archaic, Late Archaic, and Early Woodland examples are often indistinguishable from those of the Late Woodland (cf. Custer 2001:48, 84-88; Katz 2000; Luckenbach et al 2010; Miller 1998:115-116; Ritchie 1971:31-34, 121, 127-128 ; Stewart 1998a; Stewart and Cavallo 1991:23, 25-27).

Andrefsky (1983:64-122) summarizes the prospects and pit falls of inspectional projectile point types and how types might be quantitatively defined. Using a sample of typed bifaces

(Late Archaic and Early Woodland) from 7 excavated sites in the Upper Delaware Valley, he recorded a variety of morphological attributes for each and used them to statistically define types. He concluded that "formal variation within some of the inspectional types is great enough for the recognition of two or three separate types where originally only one existed (Andrefsky 1983:118-119). Overall, however, the analytic types tended to cluster with the inspectional types. In other words, the analysis produced types very similar to some traditionally defined types but divided others into discrete types. These experiments re-emphasize the observation that traditional types embody a good deal of morphological variation.

Describing a biface and assigning it to a pre-existing historical type should not be the same operation. In recognition of the utility and problems associated with the use of typology in the Middle Atlantic Region, Evans and Custer (1990:38) recommend guidelines for describing biface morphology (also see Andrefsky 1998:172-188). In conjunction with descriptions of the dated contexts with which described bifaces are associated problems with sorting out regional typologies can begin to be addressed.

Sole reliance on chronologically sensitive types as they are now defined lock archaeologists into the use of segments or units or time that may not be appropriate for the examination of the cultural processes that we seek to understand and explain using the archaeological record. The examples of Lackawaxen and triangular point types noted above make this clear. Given their very nature, it is unreasonable to assume that chronological types can automatically be used as fingerprints of specific groups or communities (contra Fiedel 2014).

The contemporaneous use of multiple types within a geographic area or in a single component also has been the subject of study (e.g., Carr 2015:60; Custer and Bachman 1984, 1986; Custer et al 1996; Miller 1998). Assumptions made about contemporaneity and its meaning can confound the modelling of settlement patterns and the exploration of a variety of other issues. In summarizing ethnographic data from around the world related to projectile points, Sedig (2007:61-73) notes that variation in the forms in use within a group could be the result of: attributes distinctive to the maker (ease of identification); attributes deemed significant by a given group (identity symbols); the activity for which the point was intended to be used (what was being hunted, war versus hunting in general, games); trade with other groups; linguistic group affiliation; use in birth, death and other rituals; use in medicinal practices; use as protective talismans/charms; mythical objects. To this list could be added the age, gender, or skill level of the maker.

Table 2 organizes dates for biface types chronologically. The type designations or descriptions used follow those of the investigators cited in the reference portion of the table. It is not possible here to assess individual type assignments based upon the illustrations or metrical data provided in the works cited. A future analysis of these data following the guidelines promoted by Evans and Custer (1990) would be a major contribution to regional archaeology.

TABLE 2
RADIOCARBON DATES ASSOCIATED WITH BIFACE TYPES

Biface Type	Date BP	Calibrated* 2 Sigma Age BC/AD	Calibrated* Median Age BC/AD	Site & Context	Reference
Clovis	11,050+/-1000 W-3391	13760-8258 BC	10905 BC	36Mr43, Shawnee Minisink, associated with dated deposit	McNett et al 1985:6-7; Marshall 1985:Figure 8.1; McNett 1985b:88-89, Figure 6.4; Dent 2002:Table 1, Figure 2; Gingerich 2013a:Table 9.8, Figure 9.4
	11,020+/-30 UCIAMS 24866	11,056-10,823 BC	10,932 BC		
	10,970+/-50 OxA-1731	11,030-10,772 BC	10,872 BC		
	10,940+/-90 Beta 101935	11,068-10,750 BC	10,877 BC		
	10,915+/-25 UCIAMS 24865	10,866-10,761 BC	10,814 BC		
	10,900+/-40 Beta 127162	10,877-10,752 BC	10,810 BC		
	10,820+/-50 Beta 203865	10,841-10,722 BC	10,771 BC		
	10,750+/-600 W-3134	11,838-8789 BC	10,509 BC		
	10, 590+/-300 W-2994	11,112-9646 BC	10,427 BC		
	9310+/-1000 W-3388	11,117-6357 BC	8701 BC		
Crowfield	10,480+/-30 Beta 379217	10,612-10,431 BC	10,518 BC	36CR142, Nesquehoning Creek, associated with dated deposit	Stewart et al 2018
	10,340+/-40 Beta 379729	10,439-10,309 BC 10,304-10,059 BC	10,240 BC		
	9940+/-50 Beta 278334	9658-9573 BC 9554-9289 BC	9406 BC		
Lecroy	9420+/-90 Beta 51501	8941-8453 BC	8718 BC	36Nm12, Sandts Eddy, associated with dated Stratum XI	Bergman et al 1994:164,166; Doershuk and Bergman 1996:Figure 14.1; Bergman 1996:416-417, Table 15.2
	9300+/-130 Beta 53142	8849-8261 BC	8555 BC		
Bifurcate, untyped corner notched	9380+/-100 DIC-261	8873-8325 BC	8660 BC	Gardepe (Una 16-4), associated with dated Zone 6, Delaware County, NY	Funk 1979:26, Plate 3; 1993:Table 16, 1998:406, Plate 135, figs 23, 24; Funk and Wellman 1984

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Kirk Stemmed	9140+/-260 GX-8204 8830+/-210 GX-8223	8929-7628 BC 8475-7516 BC	8368 BC 7956 BC	Johnsen No.3 (Una 20-4), associated with Occupation Zone E, Otsego County, NY	Funk and Wellman 1984:Table 1
Kirk Stemmed	8880+/-255 GX-8205 8585+/-190 GX-8225	8657-7466 BC 8226-7283 BC	8015 BC 7676 BC	Johnsen No.3 (Una 20-4), associated with Occupation Zone D, Otsego County, NY	Funk 1993:Table 16; Funk and Wellman 1984
Kanawha/Neville, Kanawha-like, Neville-like, untyped side notched, untyped corner notched	8220+/-420 8220+/-470 DIC-475	8253-6341 BC 8310-6201 BC	7208 BC 7217 BC	Russ (Una 19-4), associated with dated level (30-40 cm), Otsego County, NY	cf. Funk 1991:11; Funk 1993:Tables 16, 17; 1998:462; Funk and Wellman 1984:Table 1
Kirk Corner Notched, Lecroy	8160+/-70 Teledyne I-18,951	7373-7032 BC	7170 BC	36Nm142, Treichlers Bridge, in proximity to dated sample	Anderson et al 2000: Tables 6.2-1. 6.2-2; 6–107, 6-109, 6-397, 7-7, Appendix VIII
Kirk-like/Kirk Stemmed/side notched and broad stemmed	7880+/-145 DIC-474	7087-6450 BC	6789 BC	Russ (Una 19-4), associated with dated level (50-60 cm), Otsego County, NY	Funk 1991:11; 1993:Table 17; 1998:463-464; Funk and Wellman 1984:Table 1
Kirk-like, Neville-like, Kanawha-like, Wells Bridge Corner Notched	7960+/-215 DIC-473 6960+/-215 DIC-752	7382-6442 BC 6247-5480 BC	6893 BC 5857 BC	Russ (Una 19-4), associated with dated level (20-30 cm), Otsego County, NY	Funk 1993:Tables 16, 17; 1998:460-464, Plate 159 No.25; Funk and Wellman 1984:Table 1
Kirk-like (corner notched)	7520+/-120 I-8315	6597-6201 BC	6373 BC	28Sx14, Rockelein, associated with dated fire pit	Dumont and Dumont 1979:46, Plate 3a, b; Kraft 1975b:Table 11
Kirk-like (stemmed)	7380+/-120 I-6133	6445-6026 BC	6250 BC	28Wa2, Harry's Farm, Zone 8, Feature J-F171	Kraft 1975b:6-7, 9, Table 11, Figure 5
Archaic Triangle	6340+/-70 Beta 105802	5477-5207 BC	5326 BC	36Nm140, Oberly Island, associated with dated charcoal sample	Siegel et al 1999:40; Siegel et al 2001:27, 31, Table 1
Quad, Dalton Hardaway	6160+/-40 Beta 222395	5217-5000 BC	5119 BC	Beaver Lodge (SUBi-2298), associated with dated horizon, Delaware County, NY	Rudler 2006:98-103, 107; Versaggi 2017 personal communication; cf. Lothrop and Bradley 2012:Table 2.5
Cumberland, untyped fluted point	5880+/-340 DIC-1447	5481-4041 BC	4775 BC	Dutchess Quarry Cave No.8, possible hearth, Stratum 3, Orange County, NY	Kopper et al 1980:132-133, Figure 3, Plate 4; Steadman et al 1997:Table 1, Figure 3
Otter Creek, Brewerton Side Notched	5730+/-110 I-5524	4800-4352 BC	4584 BC	McCulley No.1, in or on edge of dated Feature 2, Delaware County, NY	Funk 1991:11; Funk and Hoagland 1972:13-14, 20; Funk and Wellman 1984:Table 1

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Vosburg	5570+/-200 I-5237	4848-3966 BC	4420 BC	36Pi13A, Faucett, associated with component dated by Feature 158	Kinsey 1972, 1975:61, Figure 23
Morrow Mountain I/II or Stark	5280+/-110 I-7748	4344-3934 BC	4120 BC	28Sx14, Rockelein, context not specified	Dumont and Dumont 1979:51, Figure 3; Kraft 1975b:Table 11; Fischler and Mueller 1991:Table 3.3
Brewerton Eared Notched	5180+/-200 Y-2479	4404-3631 BC	3999 BC	36Pi13A, Faucett, associated with dated charcoal sample	Kinsey 1972:186, 339
Snook Kill, Normanskill	5120+/-130 Beta-no lab # reported	4233-3657 BC	3920 BC	Peake Site, Delaware County, NY, associated with dated Feature 31A	Hartgen Associates 1988a:58, Table 18, Plate 5
Kittatinny	4980+/-110 I-6599	3992-3626 BC	3782 BC	28Wa2, Harry's Farm, in proximity to dated feature	Kraft 1975b:23-25, Figure 18, Table 11
Triangular points (unacknowledged in original report))	4980+/-110 I-6599	3992-3626 BC	3782 BC	28Wa2, Harry's Farm, part of dated Zone 4	Kraft 1975b:23-25, Figure 18, Table 11; Stewart and Cavallo 1991:24-25
Poplar Island	4770 +/-50 PITT 1157	3650-3498 BC	3562 BC	28Wa528, associated with dated charcoal stained area	Adams and Adams 1993:5
Brewerton Eared, Brewerton Side Notched, Meadowood, Vestal, untyped corner notched, possible Kirk Corner Notched	4710+/-40 Beta 265477	3632-3557 BC 3538-3489 BC 3471-3372 BC	3495 BC	Chenango Point (SUBi-1274), Feature 168, Broome County, NY	Knapp 2011:Tables 4.3, 4.4, Appendix 3
Lackawaxen Straight Stem, Lackawaxen Expanded Stem	4560+/-110 I-5234	3528-3002 BC	3262 BC	36Pi13A, Faucett, associated with area dated by Feature 165	Kinsey 1972, 1975:60, Figure 23, Table 32
Lamoka, Brewerton, Beekman Triangle, Kittatinny	4510+/-40 Beta 266910	3361-3090 BC	3214 BC	28Wa290, associated with dated deposit	Lee et al 2010:4-41 to 4-42, 6-9, 6-14, Appendix C
Otter Creek	4470+/-40 Beta 266911	3344-3023 BC	3197 BC	28Wa290, associated with dated deposit	Lee et al 2010:4-42, 6-9, 6-14, Appendix C
Vestal Notched, Brewerton Side Notched, Vosburg, Beekman and other Triangles	4450+/-130 I-4837	3520-2868 BC	3147 BC	10 Mile River Rockshelter, part of dated basal artifact deposit, Sullivan County, NY	Funk 1989:47, Figure 6, Table 5; Funk et al 1971
Lackawaxen	4445+/-130 I-5411	3519-2866 BC	3141 BC	36Pi13A, Faucett, associated with area dated by Feature 181	Kinsey 1972, 1975:59-60, Table 32
Lamoka/Dustin, Vestal	4420+/-40 Beta 206644	3328-3218 BC 3122-2918 BC	3058 BC	Sidney Hangar Site (SUBi-2073), associated with dated Locus 2 component, Chenango and Delaware counties, NY	Kudrle 2005:45, Table 14, Appendix 6

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Lamoka/Dustin, Vestal	4370+/-40 Beta 206646	3092-2904 BC	2985 BC	Sidney Hangar Site (SUBi-2073), Feature 6, Chenango and Delaware counties, NY	Kudrle 2005:45, Table 14, Appendix 6
Vestal Notched	4350+/-170 QC-176	3381-2564 BC	3016 BC	Russ (Una 19-4), Locus 2, Feature 30, SectionW3S42Otsego County, NY	Funk 1998:451, Plate 157; Funk and Wellman 1984
Lamoka	4185+/-120 I-7098	3096-2461 BC	2755 BC	Fortin Locus 1, Delaware County, NY, associated with level dated by Feature 112	Funk 1993:Table 17
Lackawaxen	4130+/-180 I-5236	3120-2198 BC	2694 BC	36Pi13A, Faucett, associated with area dated by Feature 171	Kinsey 1972, 1975:59, Table 32
Snook Kill, Genesee	4020+/-80 Beta 142039	2778-2336 BC	2561 BC	Park Creek I (Subi-1464, NYSM #10222), associated with Feature 12/13, Broome County, NY	Miroff 2002:38, 41, 44-45, Table 4, Photo 5
Lamoka	3970+/-100 I-6568	2761-2199 BC	2483 BC	Fortin Locus 1, Delaware County, NY, Occupation zone 1, near dated Feature 29	Funk 1993:Table 17; 1998:47
Bare Island-like	3940+/-100 I-5412	2698-2140 BC	2431 BC	28Mr8, Miele, in close association with dated feature	Hall 1977:11-12
Lackawaxen Expanded Stem	3920+/-95 I-6598	2673-2134 BC	2400 BC	28Wa2, Harry's Farm, Zone 3, Feature J-F136	Kraft 1975b:29-30, Figure 20, Table 11
Poplar Island, Macpherson, Lamoka-like, Beekman Triangle, Koens-Crispin/Snook Kill	3920+/-95 I-6598	2673-2134 BC	2400 BC	28Wa2, Harry's Farm, part of Zone 3 dated component	Kraft 1975b:29, 33, 36, 38-39, Figures 20, 22, Table 11
Lamoka	3840+/-100 I-6567	2504-2022 BC	2298 BC	Fortin Locus 1, Delaware County, NY Occupation zone 4, near dated Feature 24	Funk 1993:Table 17; 1998:50
Vestal Notched	3820+/-95 Dic 207	2493-2016 BC	2272 BC	Fortin Locus 1, Delaware County, NY Occupation zone 5, near dated Feature 39	Funk 1993:Table 17; 1998:53
Lackawaxen Straight Stem, Lackawaxen Expanded Stem, Poplar Island	3800+/-100 Beta 10657 3630+/-210 Beta 10656 2080+/-90 Beta 10655	2488-1952 BC 2575-1497 BC 361 BC – AD 77	2244 BC 2020 BC 111 BC	36Nm80, Bachman, associated with dated Archaic surface	Anthony and Roberts 1987:79-82, 103-104, 158, Plates 19, 27-29

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Vestal Notched	3775+/-115 I-6351	2491-1891 BC	2208 BC	Fortin Locus 1, Delaware County, NY Occupation zone 5, Feature 28	Funk 1993:Table 17; 1998:53
Lehigh	3770+/-90 Beta 41370	2464-1963 BC	2200 BC	36Mr5, Smithfield Beach/Pardee, Feature 126	Hennessy 1992: 146, 255-258, Appendix A
Lamoka	3750+/-95 I-6369	2463-1934 BC	2171 BC	Fortin Locus 1, Delaware County, NY Occupation zone 4, near dated Feature 25	Funk 1993:Table 17; 1998:52
Snook Kill/Lehigh	3740+/-70 Beta 131311	2348-1943 BC	2151 BC	36Nm244, Driftstone Unit 14, hearth at 94" level	Kline 1999 (personal communication); cf. Blondino 2008:Table 1, 2015:Table 5.1; Carr 2015:Table 3.2
Normanskill	3685+/-100 I-6739	2349-1864 BC	2081 BC	Fortin Locus 1, Delaware County, NY Occupation zone 5, Feature 14	Funk 1993:Table 17; 1998:54
Perkiomen, Koens-Crispin	3670+/-120 Y-2587	2351-1746 BC	2063 BC	28Wa16, Miller Field, Pit 4, Feature C-F42	Kraft 1970a:31, 1972:10-11, 1975b:Table 11; Carr 2015:Table 3.2
Lehigh, Perkiomen	3670+/-100 Y-1826	2344-1755 BC	2060 BC	36Pi22, Peters-Albrecht, Pit 6	Kinsey 1968:246, 1972:318, 394-398; Carr 2015:Table 3.2
Lackawaxen Expanded Stem, Egypt Mills, Macpherson	3660+/-120 Y-2342	2350-1740 BC	2048 BC	36Pi7, Brodhead-Heller, part of dated deposit	Kinsey and McNett 1972:220-221, Table 12
Lackawaxen Straight Stem	3630+/-210 Beta 10656	2575-1497 BC	2020 BC	36Nm80, Bachman, associated with dated component	Anthony and Roberts 1987:80-81, Plates 14, 22, 23, 27
Normanskill	3610+/-95 I-6368	2209-1734 BC	1976 BC	Fortin Locus 1, Delaware County, NY Occupation zone 5, near dated Feature 7	Funk 1993:Table 17; 1998:54
Susquehanna, Lackawaxen Stemmed	3600+/-80 Y-2344	2149-1744 BC	1961 BC	36Pi14, Zimmerman, nearby dated hearth feature and in dated component	Werner 1972:53, 65, 69; Carr 2015:Table 3.2
Perkiomen, Susquehanna, Fishtail	3590+/-100 Y-2588	2207-1683 BC	1948 BC	28Wa16, Miller Field, comparable level in units surrounding dated pit feature	Kraft 1970a:33, 1972:11, 1975b:Table 11
Perkiomen, Lehigh/Koens-Crispin, Susquehanna	3570+/-100 Y-2340	2152-1663 BC	1921 BC	36Pi7, Brodhead-Heller, associated with dated component	Kinsey and McNett 1972: 217, 221-222; Carr 2015:Table 3.2
Perkiomen	3450+/-120 Y-2478	2043-1496 BC	1772 BC	36Pi13A, Faucett, associated with dated Feature 99	Kinsey 1975:51, Table 32; Carr 2015:Table 3.2

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Normanskill-like	3390+/-100 Y-2341	1937-1492 BC	1695 BC	36Pi7, Brodhead-Heller, associated with dated component	Kinsey and McNett 1972:222
Susquehanna	3280+/-90 I-7097	1773-1385 BC	1566 BC	Fortin Locus 1, Delaware County, NY Occupation zone 6, near dated Feature 92	Funk 1993:Table 17; 1998:57
Meadowood	3180+/-95 I-6740	1667-1215 BC	1451 BC	Fortin Locus 1, Delaware County, NY Occupation zone 7, Feature 74	Funk 1993:Table 17; 1998:58
Fishtail/Dry Brook	3230+/-120 Y-2343	1777-1209 BC	1510 BC	36Pi14, Zimmerman, part of dated component	Werner 1972:118; Carr 2015:Table 3.2; Blondino 2015:Table 5.1
Orient/Susquehanna Broadspear	3210+/-70 Beta-no lab # reported	1643-1372 BC	1488 BC	Otego Yard Site (NYSM 121), Feature 67A, Otsego County, NY	Hartgen 1988b:70, 101-102,Table 32
Fishtail/Orient	3170+/-120 Y-2589	1697-1116 BC	1435 BC	28Wa16, Miller Field, vicinity of dated feature	Kraft 1970a:43-44, 1972:12; Carr 2015:Table 3.2; Blondino 2015:Table 5.1
Eshback	3160+/-75 Teledyne I-18, 913	1613-1259 BC	1430 BC	36Nm142, Treichlers Bridge, in proximity to dated Feature 9	Anderson et al 2000:6-121, 6-224, 6-397, Table 6.7-1, Appendix VIII
Orient/Dry Brook	3120±120 Y-2339	1645-1044 BC	1367 BC	36Pi7, Brodhead-Heller, associated with dated component	Kinsey and McNett 1972:218, 222; Carr 2015:Table 3.2
Fishtail/Orient	3070+/-80 Beta 43899	1503-1108 BC	1318 BC	36Nm244, Driftstone, associated with dated component	Kline 1999 (personal communication); Blondino 2008:167, Table 1, 2015:Table 5.1
Orient/Snook Kill	3030+/-100 Beta-no lab # reported	1500-1002 BC	1263 BC	Otego Yard Site (NYSM 121), Feature 52, Otsego County, NY	Hartgen Associates 1988b:79, 101-102, Table 32
Fishtail/Orient	2920+/-30 UGAMS-02948	1211-1020 BC	1115 BC	36Nm244, Driftstone, associated with dated component	Blondino 2008:Table 1, 2015:Table 5.1
Fishtail/Orient	2760+/-100 Y-2477	1210-780 BC	936 BC	36Pi13A, Faucett, part of dated component	Kinsey 1972:190, Table 6, 1975:44, 47; Blondino 2015:Table 5.1
Meadowood	2700+/-100 Y-2476	1127-730 BC	877 BC	36Pi13A, Faucett, associated with dated occupation floor	Kinsey 1972:190-191, 1975:44, Table 32
Jacks Reef Pentagonal, Levanna	2580+/-80 Beta 52248	899-476 BC	689 BC	36Nm15, Padula, Feature 6	Doershuk 1994:313, 323, Figure 14.17
untyped corner notched	2560+/-120 Y-1384	930-397 BC	665 BC	28Sx2, Rosenkrans, Burial 9	Kraft 1976a:23, 31-32, Figure 13

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Cresap, Cresap-like, Kittatinny, untyped corner and side notched, Lackawaxen Straight Stem, Susquehanna Broadspear	2560+/-120 Y-1384 2400+/-60 DIC-407	930-397 BC 756-679 BC 671-603 BC 600-390 BC	665 BC 515 BC	28Sx2, Rosenkrans, associated with dated burial cluster	Kraft 1976a:16-18, 23, Figure 3
Rossville	2430+/-80 Y-2590	778-394 BC	567 BC	28Wa16, Miller Field, part of dated component	Fischler and Mueller 1991:Table 3.5; Kraft 1970a:42, 1972:38
Orient, Meadowood, untyped straight stemmed, untyped corner notched	2350+/-95 I-5233	767-341 BC 327-204 BC	467 BC	36Pi13A, Faucett, found around the perimeter of dated Feature 161	Kinsey 1975:40, Table 32
Rossville	2250+/-80 Beta 80915	490-89 BC	290 BC	28Sx297, same unit and level as dated feature	Santone et al 1997:136, Plate 8d
Lackawaxen variant	2080+/-90 Beta 10655	361 BC – 77 AD	111 BC	36Nm80, Bachman, associated with dated Feature 4	Anthony and Roberts 1987: 79-80, Plate 28
Rossville, Lagoon	2050+/-135 I-5542	389 BC-232 AD	79 BC	36Pi13A, Faucett, Feature 68	Fischler and Mueller 1991:Table 3.5; Kinsey 1975:39, Table 32
Sand Hill Stemmed	1820+/-55 DIC-263	73-337 AD	196 AD	Gardepe (Una 16-4), Locus 1, Zone 4 Feature 4, Delaware County, NY	Funk 1993:199, Table 17, 1998:405
Sand Hill Stemmed	1750+/-90 Beta-no lab # reported	70-433 AD	280 AD	Otego Yard Site (NYSM 121), Feature 58, Otsego County, NY	Hartgen Associates 1988b:79, 101-102, Table 32
Levanna, Jacks Reef Corner-notched, Jacks Reef Pentagonal	1660+/-100 DIC-249 1400+/-55 DIC-262	205-592 AD 545-695 AD	383 AD 633 AD	Gardepe (Una 16-4), associated with dated Zone 3 in Locus 1, Delaware County, NY	Funk 1993:Table 16, 1998:395, 399, 402
Sand Hill Stemmed	1660+/-100 DIC-249	205-592 AD	383 AD	Gardepe (Una 16-4), Locus 1, Zone 3, Feature 1, Delaware County, NY	Funk 1993:Table 16, 1998:399, 402
Tocks Island	1660+/-95 I-4748	207-588 AD	383 AD	28Wa2, Harry's Farm, Feature G-F58	Fischler and Mueller 1991:Table 3.5, Kraft 1975b:49-52, Table 11
Tocks Island	1485 +/-30 PITT 0678	536-645 AD	582 AD	28Wa528, associated with dated hearth	Adams and Adams 1991:2-3, Figure 1
Fox Creek	1485 +/-30 PITT 0678	536-645 AD	582 AD	28Wa528, part of dated component	Adams and Adams 1991:2-3
Lamoka	1400+/-55 DIC-262	545-695 AD	633 AD	Gardepe (Una 16-4), Locus 1, Zone 3, Feature 30, Section W70N10, Delaware County, NY	Funk 1993:Table 16, 1998:402, Plate 133, fig. 8
Jacks Reef	1390+/-55 Dic 177	555-717 AD	641 AD	Fortin Locus 2, Delaware County, NY, in same level as dated Feature 48	Funk 1993:Table 17; 1998:75

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Meadowood, Kanawha	1380+/-80 Beta-no lab # reported	533-778 AD	651 AD	Peake Site, Delaware County, NY	Hartgen Associates 1988a:61, Table 18
Eshback, Otter Creek	1360+/-120 no lab # reported	424-900 AD	678 AD	36Nm80, Bachman, vicinity of dated feature	Anthony and Roberts 1987:83, Plate 11
Rossville	1360+/-70 Beta-32599 1230+/-60 Beta-32600	546-778 AD 664-900 AD	669 AD 792 AD	Site AO71-06-0077, Feature 9, Layers 3 and 4, Orange County, NY	Hunter Research 1989:6-5 to 6-15, Figure 6.1
Fox Creek	1320+/-150 GX-11932	425-1013 AD	725 AD	Egli (Una7-3), part of dated Zone 4, Delaware County, NY	Funk 1993:Table 17, 1998:539
Vestal, Susquehanna, Triangle	1180+/-90 Beta-no lab # reported	672-999 AD	842 AD	Otego Yard Site (NYSM 121), Feature 152/153, Otsego County, NY	Hartgen Associates 1988b:48, 79, 101-102, Table 32
Levanna	1180+/-80 1160+/-80 1150+/-80 1020+/-80 1000+/-70 990+/-60 Beta-no lab # reported	675-994 AD 758-1016 AD 759-1020 AD 863-1211 AD 892-1190 AD 948-1186 AD	842 AD 862 AD 872 AD 1016 AD 1042 AD 1058 AD	Ouleout Site (8W-32-7), Feature 18, Delaware County, NY	Hartgen Associates 1989:26, 32-34, Plates 2-4, Appendix II
Jacks Reef Corner Notched	1160+/-120 Y-2475	650-1050 AD	863 AD	36Pi13A, Faucett, N130E40, 12 inches below datum	Kinsey 1972:192, 1975:28
Levanna	1060+/-40 Beta 198657	893-1027 AD	980 AD	Herrick Hollow V, Locus 1, Feature 5, Delaware County, NY	Hohman et al 2005:186, 205, Appendix II
Triangle	970+/-120 Beta 62433	859-1272 AD	1067 AD	36Pi4, Unit 1, Level 2, Feature 1D	Wall and Botwick 1995a:150-151
Vestal	920+/-40 Beta 265480	1026-1192 AD	1105 AD	Chenango Point (SUBi-1274), Feature 383, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Levanna	870+/-75 Dic-166	1026-1268 AD	1155 AD	Fortin Locus 2, Delaware County, NY, in same level as dated Feature 30	Funk 1993:Table 17
Lamoka	860+/-40 Beta 265476	1044-1098 AD 1146-1260 AD	1180 AD	Chenango Point (SUBi-1274), Feature 119, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Vestal, Vestal/Normanskill, untyped side notched	810+/-80 Beta-no lab # reported	1030-1298 AD	1203 AD	Otego Yard Site (NYSM 121), Feature 79, Otsego County, NY	Hartgen Associates 1988b:54, 78, 101-102, Table 32
untyped triangular blade with corner notches, untyped lanceolate blade with side notches	790+/-80 Beta 266108	1038-1306 AD	1220 AD	28Sx29, Bell Philhower/Ahaloking, infant burial pit	Stewart and Bitting n.d.; New Jersey State Museum collections

Table 2 Continued					
Biface Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Bare Island, Lackawaxen	690+/-40 Beta 186301	1258-1323 AD 1346-1393 AD	1296 AD	36Nm262, Feature 80-3	Hornum et al 2005:96-97
Triangle	680+/-50 DIC-1372	1259-1399 AD	1311 AD	28Sx5, Medwin North, Feature 14	Williams et al 1982:23, Tables 2, 7
Fox Creek	640+/-120 Beta 50979	1151-1493 AD	1333 AD	36Nm15, Padula, Feature 7	Doershuk 1994:323, Figure 14.17
Triangular	640+/-120 Y-2474	1151-1493 AD	1333 AD	36Pi13A, Faucett, part of dated component	Kinsey 1972:194, 197, 464, 1975:28
Levanna	600+/-30 Beta 378839	1297-1373 AD 1377-1408 AD	1346 AD	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY	Miroff 2014:Table 8
Triangular	550+/-80 Y-2338	1276-1483 AD	1375 AD	36Pi25, Kutay, Feature 75	Kinsey 1972:253, 255, Table 9, Figure 73g, h; Figure 75
Madison	540+/-30 Beta 332933 300+/-30 Beta 309042	1316-1354 AD 1389-1436 AD 1490-1602 AD 1612-1654 AD	1403 AD 1563 AD	Chenango Point South (SUBi-2776), Feature 176, Broome County, NY	Miroff 2012:Table 4.3
Triangular	420+/-45 DIC-1214	1418-1524 AD 1558- 1631 AD	1474 AD	28Sx266, Medwin Knoll, Feature 9	Williams et al 1982:40, Tables 5, 7; Puniello 1980:Table 2
Lamoka	370+/-80 Beta 206645	1415-1665 AD	1541 AD	Sidney Hangar Site (SUBi-2073), Feature 3, Chenango and Delaware counties, NY	Kudrle 2005:50, Tables 14, 19, Appendix 6
Brewerton Side Notched	280+/-80 Beta-no lab # reported	1444-1695 AD 1726-1814 AD	1609 AD	Otego Yard Site (NYSM 121), Feature 99, Otsego County, NY	Hartgen Associates 1988b:48, 78, 101-102, Table 32
Triangle, Otter Creek-like	210+/-40 Beta 216050	1635-1696 AD 1725-1814 AD 1917-1950 AD	1766 AD	36Nm204, Feature 1-07	Hornum et al 2009:46; Appendix III
Triangle	150+/-60 Beta 42909	1663-1895 AD 1903-1950 AD	1798 AD	36Mr5, Smithfield Beach/Pardee, Feature 121	Hennessy 1992:303, Appendix A

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

For the Paleoindian period, when fluted bifaces are easily recognized, multiple schemes exist that organize stylistic differences with chronological implications for the Middle Atlantic and Northeastern regions (Bradley et al 2008; Gardner and Verrey 1979; Gingerich 2013b; Gramly 2009: Table 3.3; Lothrop and Bradley 2012:Table 2.1; Lothrop et al 2016:204-210, Table 2; Stewart and Rankin 2018). Few of these types have been found in dated contexts in the Delaware Valley or Middle Atlantic Region. Dates for the Paleoindian occupation of the Nesquehoning Creek site (36Cr142) are included here for that reason. Although the locality does not fall within the project area it is situated in the Delaware River basin to the west of the Upper Delaware.

Dates for Clovis (Early Paleoindian period) from the Shawnee Minisink site are the earliest in the Delaware Valley and Middle Atlantic region (Gingerich 2013a:218; Miller and Gingerich 2013:13, Appendix) in addition to making it "the most securely dated early Paleoindian site in the Northeast" (Lothrop et al 2016:206, Table 3). The reliability of the dates on either end of the range shown in Table 2 is questionable. The two dates are derived from a single charcoal sample, one on the diluted charcoal and the other on the alkali fraction remaining after purification (McNett et al 1985:7). Using six more recent AMS dates Gingerich (2013a:240) calculated the mean age for the Clovis occupation at 10,937+/-15 BP. Fluted points from the site are shown in Figure 2.

The chronology of the Crowfield type remains in question but is considered part of the Middle Paleoindian period (Bradley et al 2008:141-152; Lothrop and Bradley 2012:Table 2.1; Lothrop et al 2016:207-208, Table 2) Considering standard deviations and calibration, the dates associated with Crowfield at the Nesquehoning Creek site fit the range ascribed to the Middle Paleoindian, 12,200–11,600 calibrated years BP (cf. Koch 2017:133; Lothrop et al 2016:207-208, Table 2; Stewart et al 2018). At the stratified Wallis site in the Susquehanna River Basin of Pennsylvania, Miller, Marine and Vento (2007) identify two Crowfield bases and a complete Crowfield point found in an alluvial stratum, the top of which is dated to 9890+/-40 BP. The radiocarbon sample is situated stratigraphically above the fluted points and falls, with calibration, just beyond the latest expected age for the Crowfield type.

The Beaver Lodge site is located in the floodplain of the narrow valley of the West Branch of the Delaware River near Hale Eddy, New York. Artifacts (n=933) exhibiting a near total reliance on exotic, high quality lithic material form an activity area centered on a dense charcoal feature (Grills and Versaggi 2007:5, 7-8; Knapp et al 2006; Rudler 2006). The shallowly buried site is interpreted as a single, short term Paleoindian component (Rudler 2006). A date of 6160+/-40 BP on charcoal from the burn feature is inconsistent with the Quad and Hardaway Dalton biface fragments in association (Figure 3). Lothrop questions the original identification of the artifacts as related to the Quad and Hardaway Dalton types. As a result of his examination of the point fragments he feels that the Michaud Neponset type is represented (2016 personal communication). He and Bradley (2012:Table 2.5) suggest an early or middle Paleoindian age for the locality.

The 5880+/-340 BP date associated with fluted points from Dutchess Quarry Cave No.8 also is anomalous. The artifacts likely relate to the Middle Paleoindian Michaud/Neponset point form (Lothrop and Bradley 2012:16, Table 2.2) rather than the Cumberland identification shown in Table 2. Site formation processes and associations are a complicating issue at this multicomponent site. Faunal remains initially thought to be associated with Paleoindian artifacts have provided AMS dates pre-dating Paleoindian times (Steadman et al 1997).

The use of caves/rockshelters is unusual for Paleoindians in the region (Lothrop and Bradley 2012:23). Lothrop and Bradley (2012:24) suggest that this under-representation may relate to natural transformations over time that obscure or degrade a shelter or cave opening hindering their discovery during archaeological survey. The multicomponent Fairy Hole Rockshelter (28Wa25) in the Upper Delaware represents another unique occurrence involving a fluted point (Figure 4; site files, New Jersey State Museum). The remains of giant beaver from

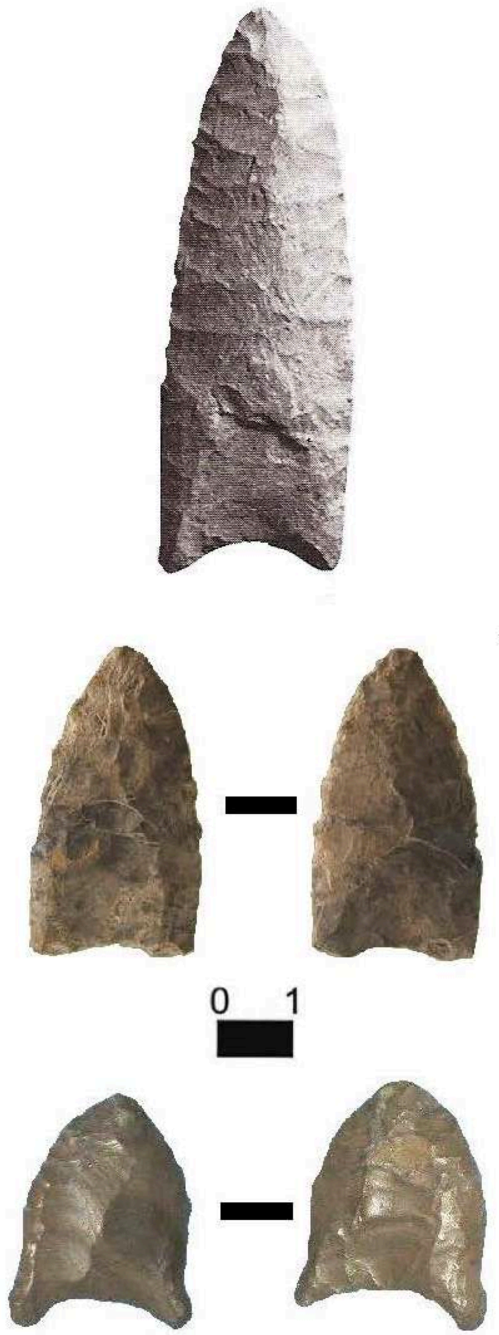


FIGURE 2. Clovis points from the Shawnee Minisink site. Top: Clovis from the original excavations of the site (modified from McNett 1985b:Figure 6.4). Middle: reworked Clovis associated with 10,970+/-50 BP date (see Table 2; Gingerich 2013a:Table 9.8; photo courtesy of Joe Gingerich). Lower: reworked point found out of context at 44” below surface, well above Paleoindian deposits (photo courtesy of Donald Kline). Scale is in centimeters.

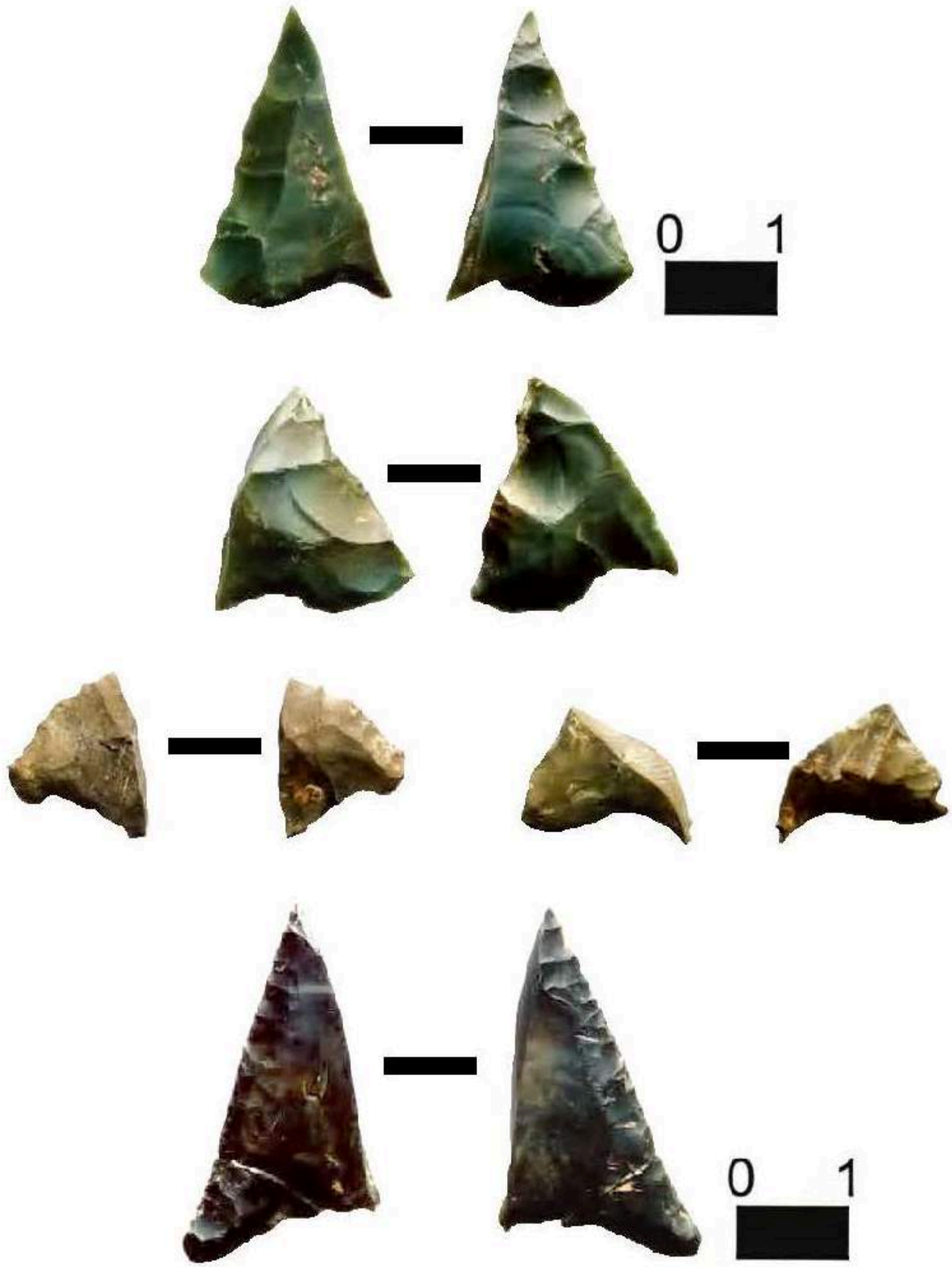


FIGURE 3. Paleoindian point fragments from the Beaver Lodge site. Top: Quad-like. 2nd Row: Quad. 3rd Row: Paleoindian point tines/ears. 4th Row: Hardaway Dalton. Modified from Rudler (2006:Photos 8.7, 8.8). Scale in centimeters.

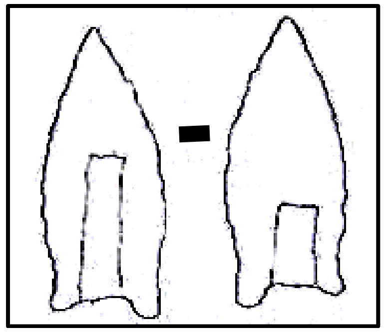


FIGURE 4. Tracing (not to scale) of a jasper fluted point recovered from the Fairy Hole Rockshelter (28Wa25) circa 1981. Length is approximately 5 cm, width 2.1 cm. Source: site files of the New Jersey State Museum, Trenton.

Cross's (1941:143-152) original excavations in the shelter are AMS dated to 11,140+/-30 BP (Boulanger et al 2015:191). While no direct association between the point and the faunal remains can be demonstrated, it is interesting to note that the two sigma, calibrated date (12,934-13,095 BP) overlaps an Early Paleoindian time frame. The point form is somewhat comparable to the Bull Brook-West Athens Hill (Early Paleoindian) and Michaud-Neponset (Middle Paleoindian) point forms. This is shear speculation, of course, since the evaluation is based only on a tracing.

In conjunction with other data researchers have used Paleoindian chronological typologies, or trends in biface modal forms, to address issues of technology, subsistence, mobility, and settlement patterns (e.g., Anderson 1995, 1996; Anderson et al. 2010; Burke 2006:84; Ellis 2011; Gingerich 2012; Harrington 2017a, b; Koch 2017:185-20; Lothrop et al 2016:221-238; Meltzer 2009). A somewhat common observation is that Late Paleoindian complexes in eastern North America tend to exhibit a reduction in residential mobility and annual range territory relative to Early Paleoindian complexes. Generating many more radiometric dates for specific biface forms is a priority for future Paleoindian research (Lothrop et al 2016:239). This is especially true for the Delaware Valley where point variability does not always fit easily into defined modal forms in use elsewhere (see discussion in Gingerich 2013b; Stewart and Rankin 2018).

A range of point types are typically assigned to the Early Archaic period in the Middle Atlantic Region (cf. Carr 1998a:Figure 1; Barber 2003; Broyles 1971; Coe 1964; Custer 2001; Dent 1995:156-159; Egloff and McAvoy 1990; Funk 1993:141-188; Maryland Archaeological Conservation Laboratory 2012; Pagoulatos 2003; Ritchie 1971). Relatively few of these are associated with radiocarbon dates in the Upper Delaware project area: Kirk Corner Notched, Kirk-like Corner Notched, Kirk Stemmed, and Kirk-like Stemmed. There are sites in the project area, however, where other forms attributable to the time are found on surface sites and in buried contexts that have yet to be dated (e.g., Anderson et al 2000:6-202 to 6-207; McNett 1985b). Deeply buried deposits at 36Mr45 have produced two consistent Early Archaic dates (see Table 1) associated with features and an extensive lithic assemblage. Unfortunately no diagnostic bifaces have been recovered.

In regional sequences Kirk Corner Notched bifaces have a relatively lengthy use history and tend to appear prior to Kirk Stemmed forms, although their chronological ranges overlap (c.f. Anderson et al 2000:6-202 to 6-207; Carr 1998a:46-48, 51-55; Dent 1995:156-157, Table 5.1; Egloff and McAvoy 1990:69-71; Inashima 2008:219-222; 2011:107-108). In turn, use histories of bifurcate biface types and Kirk Stemmed bifaces also overlap (c.f. Carr 1998a; Custer et al 1994, 1996; Egloff and McAvoy 1990:71). Kirk Side Notched and Lecroy bifaces co-occur at the Fifty site (44Wr50) in Virginia, although dates for the types rarely overlap (Carr et al 2013:196).

The dated examples from the Upper Delaware and adjacent areas do not neatly conform to the trends noted for the greater Middle Atlantic region. The 9140+/-260 BP date for Kirk Stemmed at Johnsen No. 3 in the adjacent Upper Susquehanna Valley remains somewhat problematic in terms of trends, but with calibration it overlaps a number of other regional dates for the type. Two dates from Treichlers Bridge (36Nm142) may relate to the Kirk Corner Notched type (cf. Tables 1, 2). The earliest (8160+/-70 BP) is most closely associated with a single Kirk specimen and what was typed as a Lecroy bifurcate. The second date (8030+/-110 BP) relates to a similar stratum (III upper) and soil horizon (Bwb2) but a different excavation level (Anderson et al 2000:6-397). The same stratum and soil horizon contains a mixture of Kirk, Decatur and bifurcate points suggesting that individual components are mixed.

The Treichlers Bridge dates are comparable to the single date, 8280+/-40 BP (Beta 300158), from 36Hu18 in the Middle Delaware Valley (White 2013:1-1). The date is from a feature correlated with a BW4 horizon at the site which included a Kirk Corner Notched point in its lower portion (cf. Vento and Stinchcomb 2013: 78, 89; White 2013:5-41, 5-42, 5-84). However, the photo of the Kirk point seems more akin to the Kirk Stemmed type (see White 2013:Figure 5.40). Dates from the Rockelein (28Sx14) and Harry's Farm (28Wa2) sites are fairly late for Kirk Corner Notched and stemmed forms, as noted long ago by Andrefsky (1983:15). Even with the subsequent accumulation of more dated occurrences in the region the age estimates for the Rockelein and Harry's Farm bifaces remain somewhat unusual.

A spatially discrete excavation area (Locus 2) at the Rockelein site included two notched Kirk-like points (Figure 5) associated with a small fire pit that was the source of a 7520+/-120 BP date (Dumont and Dumont 1979:46, 50, Plate 3a, 3b). McNett (1985b:106-107) favorably compares the Rockelein bifaces with the Early Archaic Abbott type defined at the Shawnee Minisink site, also noting a superficial resemblance to Kirk Corner Notched points. The Rockelein biface also resembles an untyped corner notched point from an early dated context at the Gardepe site in New York (see below; Funk 1998:406, Plate 135, no.24). Considered in conjunction with the relatively late date from Harry's Farm, Dumont and Dumont (1979:59) suggest that Kirk bifaces in the Northeast developed in a way that is distinctive from the sequence based on data from southern sites.

Kraft's (1975b:9) identification of a Kirk Stemmed biface in a dated context at Harry's Farm was bolstered by the evaluation of several regional scholars with extensive experience with Early Archaic forms. A date of 7320+/-125 BP is from a feature originating at a higher excavation level separated from the Kirk-related deposit by what appears to be a B Horizon, as indicated by the presence of lamellae bands – Kraft's "reddish brown seepage bands" (Kraft 1975b:Table 2). No diagnostic bifaces are associated with this higher deposit.

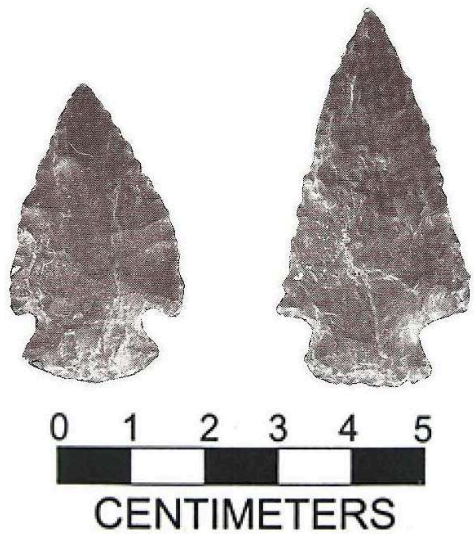


FIGURE 5. Kirk-like bifaces associated with Locus 2 fire pit at 28Sx14, the Rockelein site. Modified from Dumont and Dumont (1979:Plate 3).

The earliest date from the Russ site (Otsego County, NY) has been reported over the years with two different standard deviations (see Tables 1, 2; cf. Funk 1991:11; 1993:Table 17; 1998:462; Funk and Wellman 1984:Table 1). The variety of biface types associated with the dated levels of this site seems problematic for Kirk points when Neville or Neville-like forms are part of the mix. Dates from the broader region associated with Neville points, or its morphological cognate, Stanly Stemmed (cf. Custer 2001:45, 57, Figure 11; Dent 1995:Table 5.2; Inashima 2008:256; Justice 1995:97-99), typically postdate the other biface forms listed for the contexts at Russ that also include Kirk-like points.

The Wells Bridge Corner Notched type was defined on the basis of data from the Russ site (Funk 1998:37-38). Other corner and side-notched points in the excavation levels associated with the 8220, 7960, and 6960 BP dates did not neatly fit into existing typologies and a possible affiliation with Brewerton forms was raised (Funk 1998:460-461). Funk (1993:181) considered the Kanawha-like and Neville-like forms transitional between the better defined types, which might account to some degree for the differences in associated dates when compared with chronological sequences elsewhere. Funk (1993:182) had this to say about the stratigraphy and biface variability at the site:

> Despite the obviously stratified, undisturbed condition of the sub-plowzone sediments in the central area of locus 2 there was no consistent pattern in vertical distribution of point types. This was at variance with expectations based on the southeastern data where the various types occurred in a definite sequence.

Setting aside caveats related to site formation processes, notched points with varying morphologies are in use throughout what is considered the Early Archaic period in the Upper Delaware and adjacent areas. Stemmed, but un-notched forms seem to have a nearly parallel use history. Undated Early Archaic deposits at Shawnee Minisink (McNett 1985b:101-107) are another case in point regarding variability in notched forms during the period. More dates from secure contexts certainly are needed to confirm the distinctiveness of local Early Archaic sequences. Data are sufficient, however, to indicate that typological variability in an Early Archaic deposit should not automatically be taken as evidence of disturbance or lack of integrity.

Use wear analysis of Kirk Corner Notched points from Treichlers Bridge (36Nm142) indicates that at least some Early Archaic bifaces did not function strictly as projectiles. Two of three such forms found in excavations retained evidence of use in hide scraping (Church 2000:16, 18).

The few dated bifaces with bifurcated bases from the project area are somewhat controversial warranting a discussion of related typologies, themselves a topic of debate. Bifurcate points have been used in different ways to affiliate sites with a cultural historical period. Following Gardner (1974, 1987, 1989) many archaeologists see them as both a chronological and cultural signature of the onset of the Middle Archaic period (e.g., Carr 1998b; Carr and Moeller 2015:79; Custer 1990, 1996:133-162; Stewart and Cavallo 1991). Others see bifurcate-related deposits as representing a continuation of Early Archaic lifeways and extend the chronological boundaries of this period to accommodate dates linked with the points (e.g., Dent 1995:157-159; Dumont and Dumont 1979; Egloff and McAvoy 1990; Funk 1991:8;1993; Kraft 2001:95,104; Kraft and Mounier 1982a:64; McMillan 1985). Custer (1996:18-27, 134-135) notes the large errors that are associated with Middle Archaic radiocarbon dates and their calibration relative to later times, and the general lack of correspondence of radiocarbon dates with the chronological boundaries used in defining cultural historical periods.

Anderson (1991), Carr (1998b:78-79) and Anderson et al (2000:6-207 to 6-214) provide summaries of bifurcate types and associated dates from the Southeast and Middle Atlantic Region. Justice (1995:86-96) considers data from the greater Eastern Woodlands. Struve (2014) provides an interesting history of bifurcate related research with an emphasis on the Northeast. The overarching type sequence begins with MacCorkle, proceeds through St. Albans and Lecroy, and ends with the Kanawha type. The primary foundation for the typological scheme is based on the work of Kneberg (1956), Broyles (1971) and Chapman (1975, 1977) in Tennessee and West Virginia. Chapman (1975:235-248) synthesized previous research, noted related types that had been named elsewhere in the Eastern Woodlands, and compared them with the sequence noted above. He affirmed the chronology of the sequence based on the stratigraphy and radiocarbon dates from the St. Albans (West Virginia), Rose Island and Icehouse Bottom (Tennessee) sites. At Rose Island Chapman (1975:110-114, Plate XXVIII) also identified six variants of the bifurcate form that did not neatly fit into the four defined types. He related these variants stratigraphically to the MacCorkle and St. Albans phases.

Prior to the studies noted above, Leslie (1963:73-74) tentatively identified two types of bifurcated base points that he recognized on sites of the Upper Delaware Valley: Archaic Bifurcated Long and Archaic Bifurcated Stubby (Figure 6). In doing so he was reacting to Ritchie's (1961:115) illustration in his New York typology of untyped bifurcates. Leslie (1983:73) claimed that the "stubby bifurcated point is almost certainly a product of the Middle Archaic in my area – and, I believe in central New York and southeastern Pennsylvania." He notes that the long form is rare in the Upper Delaware Valley.

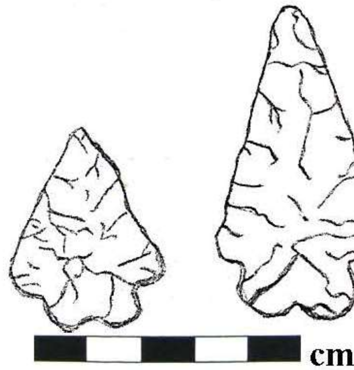


FIGURE 6. Leslie's Stubby and Long types of bifurcates from the Upper Delaware Valley. Modified from Leslie (1963:73).

Dates associated with all of the bifurcate types overlap considerably. The range of time they represent roughly encompasses 900 years, beginning circa 8900 BP and ending circa 8000/7700 BP (cf. Anderson et al 2000: 6-207 to 6-214; Carr 1998b:79; Dent 1995:Table 5.1; Inashima 2008:198-199, 224-225, 227, 256; Justice 1995:86-96). Bifurcates have appeared in later dated contexts (see discussion in Fogelman 2016; Struve 2014). Mounier (2003:202) reports a radiocarbon assay that placed a bifurcate point cluster at 28Bu226 in the Lower Delaware Valley around 6500 BP. He does not comment on the lateness of the date but seems to accept it at face value.

Bifurcated base points occur in buried deposits ranging from 37" to 58" below surface at the Rockelein site, 28Sx14 (Dumont and Dumont 1979:Figure 3). Figure 7 depicts examples of the recovered bifurcates. Unfortunately it is not possible to relate individual specimens with a specific context given the generalized discussion of the site's stratigraphy in the published report. The MacCorkle, St. Albans and Lecroy types are suggested by the variation depicted. At least three bifurcated base points occur at a slightly greater depth than the excavation level that produced the dated pit feature (7520+/-120 BP) and Kirk-like points discussed earlier. The remainder of the bifurcates occur above this level. Such relative associations may not be out of line with the range of dates associated with bifurcate point types.

FIGURE 7. Bifurcate points from the Rockelein site, 28Sx14. Modified from Dumont and Dumont (1979:Plate 1).

At Treichlers Bridge (36Nm142), also in the current project area, bifaces identified as MacCorkle and St. Albans occur in the same undated excavation stratum and soil horizon as Decatur and Kirk Corner Notched points (Anderson et al 2000:Table 6.3.1-6). These recoveries relate to the upper portion of Stratum III and a soil described as a 2Bwb horizon (Vento 2000:6-22 to 6-23). In contrast, MacCorkle, St. Albans, and Lecroy points are found in overlying sediments representing a short duration flood event – Stratum IV, C7 horizon (Anderson et al 2000:Table 6.3.1-8; Vento 2000:6-24 to 6-25). Examples are shown in Figure 8. Some of the typological assessments of the Kirk and bifurcate forms from the site are questionable, as Carr (2017 personal communication) has observed as a result of handling the collection. One of the MacCorkles shown in Figure 8 (top row, center) may not be a bifurcate at all but a notched point with a recent nick in the base.

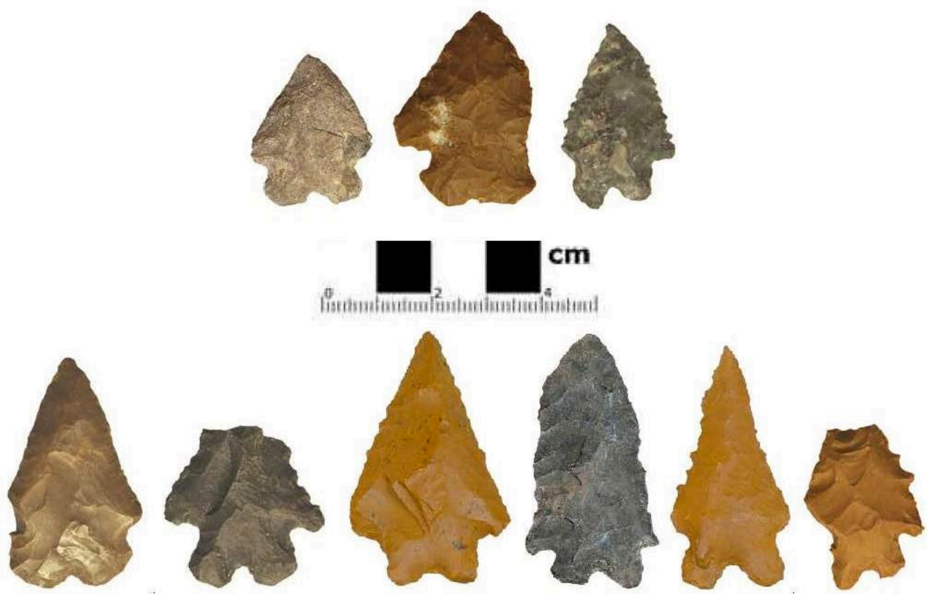


FIGURE 8. Examples of bifurcate points from Treichlers Bridge, 36Nm142. Top: MacCorkle (2), Lecroy, from Stratum IV, C7 horizon. Photo courtesy of Kurt Carr and Elizabeth Wagner. Bottom, left to right: MacCorkle (2), St. Albans (3), Lecroy, from Stratum III, Bwb2 horizon. Modified from Carr and Moeller (2015:94, cf. Anderson et al (2000:Table 6.3.1-4, Plates 6.3.1-2 to 6.3.1-4).

Figure 9 depicts a Lecroy point found in proximity to an AMS-dated carbon sample (8160+/-70 BP) and a Kirk Corner Notched point also in proximity at Treichlers Bridge (Anderson et al 2000:6-397). Earlier than expected given the traditional typological sequence, this assay nonetheless overlaps other dates for the bifurcate type reported from the Eastern Woodlands (Inashima 2008:224-225). Carr (2017 personal communication) believes that the Kirk point is, at best, classified as the Kirk stemmed type given the fragmented nature of the artifact. Remnants of the base are not ground and the serrations may be a result of the heat-related spall of the blade margin.

FIGURE 9. Lecroy point (left) and Kirk Corner Notched point fragment found in proximity to dated carbon sample at Treichlers Bridge, 36Nm142. Lecroy photo modified from Carr and Moeller (2015:94). Kirk photo courtesy of Kurt Carr and Elizabeth Wagner, State Museum of Pennsylvania (cf. Anderson et al 2000:6-387, Plates 6.3.1-1, 6.3.1-4).

Farther afield in the Lehigh River Gorge section of the Delaware basin, bifurcate points are in a buried and well developed B horizon (Stratum 13) up to 41 cm thick at 36Cr142 (Stewart et al 2018:Tables 4.1, 4.3). Soil weathering has masked what appear to be two different alluvial deposits. The deposits are currently undated. Bifurcates from the basal half of Stratum 13 are shown in Figure 10. A Stanly Stemmed point is tentatively associated with this stratigraphic context. Bilobate points derive from the upper portion of the stratum along with stemmed points.

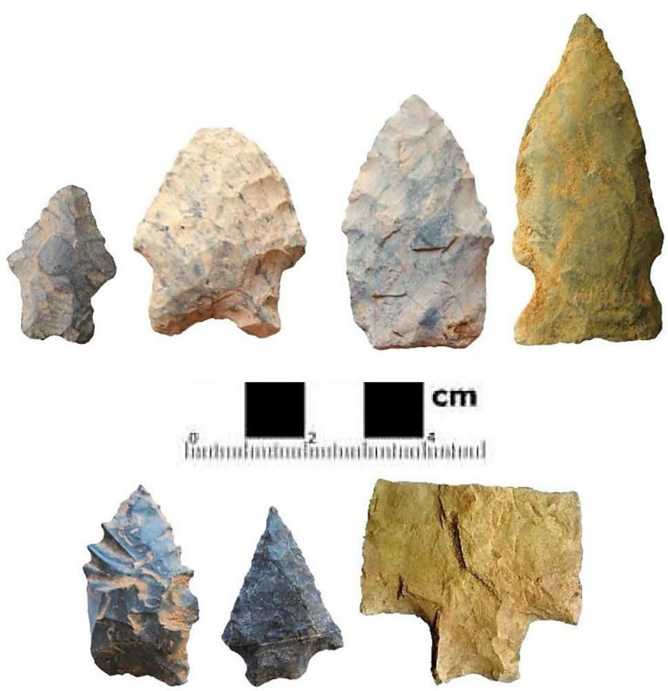


FIGURE 10. Bifurcate and other points from Stratum 13 at 36Cr142. Top: points from upper half of stratum. Bottom: points from lower half of stratum.

Morphological variability within a given bifurcate type is very apparent in viewing examples from the southern sites and relevant metrical data (e.g., Chapman 1975:105-114, 240, 242-243). Chapman (1975:255-256) recognized all of the major bifurcate types in reviewing collections from the Middle Atlantic Region. In hindsight, the variability that Leslie (1963:73; 1973:Plate II) illustrates from the Upper Delaware Valley is encompassed by the MacCorkle to Kanawha sequence and the variants from Chapman's Rose Island excavations. Kinsey (1972:Figure 121c) illustrates additional examples found in the Bushkill, Pennsylvania area of the Upper Delaware. Struve (2014) associates these with the Susquehanna and Taunton River bifurcate types defined by Fogelman (see below). Additional examples of bifurcates from the Upper Delaware are depicted in Figure 11.

FIGURE 11. Additional examples of bifurcate points from the project area. Top row: 28Wa528, New Jersey State Museum and Andrew Dillman collection; 2nd row: Carpentersville to Phillipsburg sample, John Parks collection. 3rd row, left to right: Sibum site – Minisink Hills, PA; Marshalls Creek, PA; Portland, PA; Great Meadows, NJ (Donald Kline collection); Stroudsburg to Port Jervis area (Lee Richardson collection). Bottom row: far right, 28Wa11; all others Martins Creek, PA (Edwin Struve collection, photos courtesy of Edwin Struve).

The assemblage of bifurcates from 28Sa119 in the Lower Delaware Valley provides some indication of the variability that can characterize a single, short term occupation (Figure 12). In the fourth of three excavation zones at the site a cluster of six bifurcates surrounded what is described as a workshop area (Morris 1982:23-25). Zone 4 (2-5" thick) and the bifurcate component is stratigraphically separated from higher Late Archaic, Transitional Archaic, and Woodland period deposits and features by a few inches of sand and pebbles representing gradually accumulated slope wash. A radiocarbon date of 3160+/-290 BP (Teledyne I-II 390) is associated with a feature in Zone 2 (Morris 1982:27).

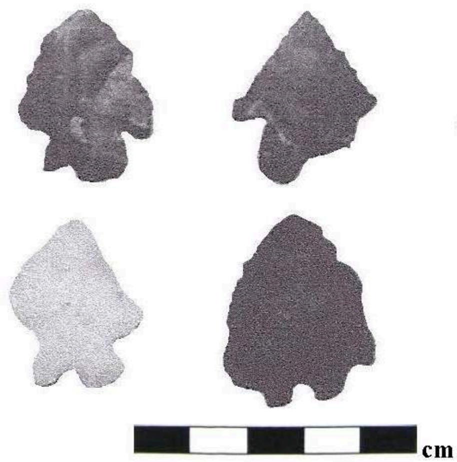


FIGURE 12. Bifurcates from an isolated component at the Osborn site, 28Sa119. Modified from Morris (1982:Figure 1).

Variability in bifurcate forms, and deviations from the classic types represented at sites in Pennsylvania and the Northeast, led Fogelman (1988, 2016) to define additional types (see related discussion in Struve 2014). In addition to MacCorkle, St. Albans, Lecroy, and Kanawha, Fogelman recognizes examples of what he defines as the Sandts Eddy (2016:17-20), Gardepe (2016:21, 23-24), Penns Creek (2016:26-27), Susquehanna (2016:29-31), and Taunton River (2016:34) types in collections derived from the Upper Delaware project area. Summary statistics are provided for individual types but the extreme variability represented by the described ranges and illustrations provided do not seem to be supportive of a type's coherence. Statistical comparisons with previously defined types would be useful. In large collections the gradation between some of the proposed types (e.g., Penns Creek and Susquehanna) is so subtle that assigning specimens to one or the other is problematic (Struve 2014). There is no question that documented variability in the region, or the Upper Delaware, is not readily captured by the four classic bifurcate types as Fogelman (2016:4, 6) and Struve (2014) maintain. However, metrical data and comparative analyses are needed to clearly document similarities and perceived differences. More importantly, clearly stratified and dated deposits are needed where this variability can be examined in a more controlled fashion.

The use history of bifurcates or a particular form/type need not be synchronous over the extensive region in which these bifaces are found. Assuming that the dated sequences from Tennessee and West Virginia are a pan-regional standard has led on occasion to researchers dismissing assays that appear too early or too late without considering alternative explanations (see summary in Struve 2014). The two dated examples from the project area are a case in point and belie the moderate frequencies with which bifurcates appear on area sites. The initially untyped biface from the Gardepe site in Delaware County, New York is associated with the earliest date (9380+/-100 BP) for any bifurcate in the region (see Table 2, Figure 13). Funk (1979:26; 1993:Table 16) considered the date unacceptable in comparison with the standard, southern-oriented chronology for bifurcates. The corner notched point derived from the same dated zone of the Gardepe site that produced the bifurcate is comparable to the Kirk-like biface from the dated context (7520+/-120 BP) at the Rockelein site (see Figure 5).

FIGURE 13. Bifaces associated with dated Zone 6 at the Gardepe site, Delaware County, New York. Modified from Funk (1998:Plate 135, nos. 23, 24).

Fogelman (2016:12-13, 21-24) uses the Gardepe bifurcate to define a new type. Summary statistics for the Gardepe type are: length 1 $1/4$ to 3 $5/8$ inches; width $7/8$ to 1$1/2$ inches; thickness $1/4$ to $3/8$ inch. The type has well-formed basal tangs that are slightly angled and rectangular, and may be squared off or slightly rounded. Corner notches create shoulder barbs that can be oriented at right angles on resharpened specimens. Basal notches are medium deep and blade edges are straight (Fogelman 2016:21). At least one point typed as MacCorkle at Treichlers Bridge would conform to these criteria, as well as an untyped bifurcate from 28Wa528 (see Figures 8, 11). Additional examples could be cited using Fogelman's illustrations for comparison.

Equally early dates (9420+/-90 BP, 9300+/-130 BP) associated with the Sandts Eddy bifurcate (Figure 14) might also be viewed as controversial. Identified as a Lecroy point, it is large for the type (cf. Chapman1975:240) but otherwise seems to conform to its morphological range. Fogelman (2016:11-12, 17-20) uses the Sandts Eddy bifurcate as the foundation for his Sandts Eddy type offering the following summary statistics: length 1 $1/4$ to 2 $1/4$ inches; width $3/4$ to 1 $1/2$ inches; thickness $3/16$ to $3/8$ inch.

In qualifying the morphology of the Sandts Eddy type Fogelman (2016:17) notes:

> Corner notches are deep and bold, creating prominent barbs. The stem is slightly angled outward. Each side flares a little before contracting into mostly rounded, or pointed, basal tangs. The tangs are usually symmetrical and the basal notch 1/8" (3-5mm) deep. Basal and stem grinding noted on a third of the specimens examined. Blade edges quite variable from convex to straight to concave and usually serrated, from incipient to bold. As the point goes through reshapening (sic) episodes, the blade edges become incurvate and the barbs more exagerrated (sic), as on the type specimen.

Fogelman (2016:12, 17) identifies a bifurcate associated with a dated fire pit (8730+/-130 BP) at 36Da12 (Carr and Moeller 2015:98, 100) as an example of the Sandts Eddy type. The comparison, he argues, indicates the form's persistence through time. The comparison seems strained (see Figure 14).

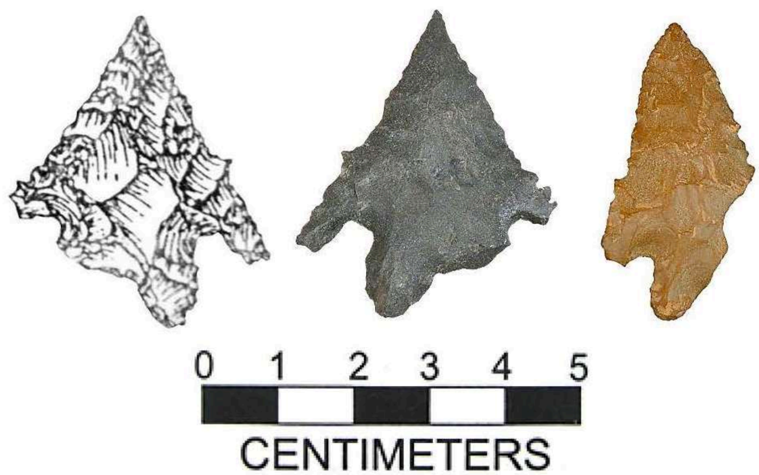


FIGURE 14. Lecroy point from dated Stratum XI at the Sandts Eddy Site, 36Nm12, and bifurcate associated with dated feature at 36Da12. Left and middle: Sandts Eddy Lecroy point, modified from Bergman, Russell, Duerksen and Miller (1996:Figure 11.1), Kimball (1996:Figure 12.1), and Carr and Moeller (2015:94). Right: 36Da12 bifurcate, modified from Carr and Moeller (2015:100).

In summary, a wide range of associated dates and the apparent long term co-existence of variable forms of bifurcates, along with other stemmed and notched bifaces, suggests that the use of the standard chronological typology should be employed with caution in dealing with surface sites or buried deposits lacking radiocarbon assays. Until additional excavations of stratified and dated deposits occurs we must consider that there are distinctive micro-regional histories of bifurcates, and that other explanations for observed variability in the biface form exist. While I do not totally agree with recent typological efforts (Fogelman 2016; Struve 2014), they do attempt to deal with patterning in the geographic distribution of bifurcate forms. These geographic distributions might be construed as reflecting micro-regional histories and the interaction of native groups employing similar approaches to production.

Evidence exists that indicates that bifurcate points were multi-purpose tools. At Treichlers Bridge immunological analysis associated St. Albans and Lecroy points with a variety of mammals suggesting the points' probable role in hunting or the processing of prey. In particular the dated Lecroy point from the site (artifact #1558.8, see Figure 9) reacted to deer antiserum during immunological analysis. Deer antiserum could relate to all species of deer, elk, moose, caribou, or pronghorn antelope (Newman 2000:Tables 3, 4). Use wear analysis implicated MacCorkle, St. Albans, and Lecroy points in hide processing (Church 2000:10-14, 16, 18). Lecroy points also may have been employed in wood working (Church 2000:12-13) and a MacCorkle specimen in graving bone (Church 2000:14). In a sample of 38 bifurcates in the collections of the New York State Museum examined by Fogelman and Struve only one exhibited an impact fracture generally associated with a biface's use as a projectile. They observed that impact fractures were more frequent among LeCroys, St. Albans and Kanawhas from New Jersey and Pennsylvania, which tend to be small and perhaps more likely to be used as projectile points than the larger forms of bifurcates (Struve 2014). The analysis of a collection of 21 bifurcates from sites in several eastern states led Giotta (2015) to conclude that all functioned as knives and were manufactured with that purpose in mind. The degree to which variations in bifurcate form and size reflect function should continue to be explored with a variety of approaches.

Bifurcate history could be explored further at the Shawnee Minisink site where relevant deposits are known to exist and substantial portions of the site remain. Southern portions of the Manna site (36Pi4) contain deeply buried deposits that are likely Middle Archaic or earlier in age (Stewart et al 2015:Table 7; Wall and Botwick 1995a). Excavation Level 16 at 5.75' to 6.2' below datum produced a radiocarbon date of 4550+/-180 BP (Wall and Botwick 1995a:155; 1995b:Appendix VI). Artifacts continued to be found to depths of 11.2 feet below datum. The Sibum site is currently being excavated by Donald Kline in the Delaware Water Gap not far from the Shawnee Minisink site. Situated on a terrace of the Delaware River, alluvial deposits ranging in depth from roughly 31" to 43" below surface have produced a bifurcate (see Figure 11) and notched points of probable Middle to Early Archaic age. Sufficient charcoal samples exist to form the basis of a project that would firmly establish the chronology of the stratigraphic sequence. The Treichlers Bridge site produced one of the most, if not *the* most substantial assemblage of bifurcates in the region. Portions of the site may still exist although the locality has been subjected to substantial mitigation excavations prior to bridge construction.

Sites in the Delaware Valley, Middle Atlantic and Northeast regions provide evidence that triangular points are not limited to assemblages post-dating 600 AD. They also are known to be part of Middle Archaic, Late Archaic, and Early Woodland assemblages. Without a clear understanding of these earlier triangles, we run the risk of misusing surface and plowzone sites in our archaeological analysis of the Native American past.

Early-on in the Upper Delaware Valley, Leslie (1963:71, 74) discussed what he termed Archaic Triangles in his analysis of biface types in Wayne County, Pennsylvania and Sullivan County, New York. He gives as the basic criteria for identifying Archaic triangles their relative thickness and cruder chipping relative to Late Woodland specimens. He notes that some are morphologically similar to the Levanna and Madison types of Late Woodland times, but "there is less intergrading between the Madison points and the Archaic Triangles than in the case of the

Levanna type" (Leslie 1963:82). In turn, Ritchie's (1961, 1971) metrics and illustrations of Levanna and Madison points show considerable overlap between these Late Woodland types.

Leslie assumes that the Archaic Triangles relate to the Middle and Late Archaic periods but provides no contextual data for his interpretation. His Archaic Triangle type grades into what he provisionally named the Damascus Triangle (Leslie 1963:78). These are described as characteristically long but of triangular shape, and relatively rare. He speculated, conceding a lack of evidence, that they might be of Middle Archaic age. In his assignment of age Leslie seems to be drawing partially on Ritchie's (1961) initial typology for New York projectile points, which included the Brewerton Eared Triangle, and the potential relationship of triangular forms with Laurentian or Brewerton assemblages. Figure 15 depicts Leslie's examples of early triangular types.

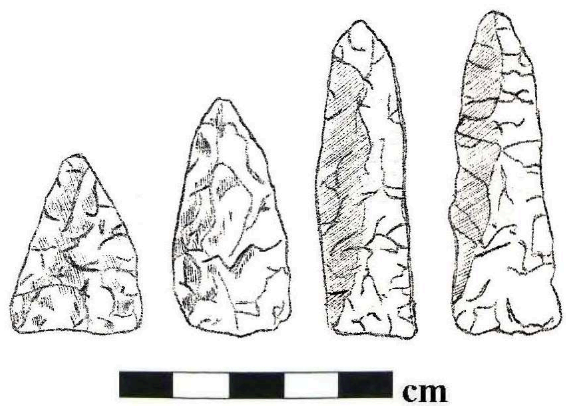


FIGURE 15. Archaic Triangles (left two) and Damascus Triangles (right two) from the Upper Delaware Valley. Modified from Leslie (1963:74, 78).

By 1971 Ritchie (1971:121, 127) had added the Late Archaic Beekman and Squibnocket triangle types to his New York typology. Kinsey (1972:439-443) acknowledges that some triangles may be Late Archaic in age but presumes that most from the Upper Delaware Valley sites that he examined are affiliated with Late Woodland components. His description (Kinsey 1972:443) of what he labelled as Elongate Triangular points, considered to be Late Woodland in age, would subsume Leslie's Damascus Triangles. Kraft (1975b:Figure 18) includes un-notched triangular forms as part of late Middle Archaic Kittatinny Complex dated to 4980+/-110 BP at Harrys Farm (28Wa2) in the Upper Delaware (Kraft 1975b:24, Figure 18; Stewart and Cavallo 1991:24-25). Funk (1975:xiii) notes that some variants of Kraft's Kittatinny point type grade into Brewerton Eared triangle and Beekman triangle points. Both Leslie (1963:76) and Kinsey (1972:406) recognized Brewerton Eared triangles on area sites but commented on their rarity.

In 1976 Hunterbrook triangles were defined on the basis of two specimens found in an Archaic context at the Hunter Brook Rockshelter in the Hudson Valley of New York (Wingerson and Wingerson 1976). In excavations they occurred at 27" below surface and beneath what were identified as Beekman triangles, Kittatinny, Vosburg, Brewerton, Lecroy, and Palmer-like points. No radiocarbon dates are available for the deposit. On the basis of the shelters stratigraphy and a comparative analysis involving other sites with triangles in stratigraphic contexts, the Wingersons interpreted the Hunterbrook triangle as a Middle Archaic form with technological or cultural links to Late Archaic types of triangles.

The two examples from the Hunter Brook rockshelter are medium sized, nearly equilateral points with excurvate sides. Bases are ground and the points are noticeably bifacially thinned up to one third of the length of the point (Wingerson and Wingerson 1976:25). The points are about 2 cm long with widths of 2.0 and 2.5 cm (Wingerson and Wingerson 1976:Figure 1). Drawing on triangles found in other Archaic contexts in the region, the Wingersons (1976:26) defined the type on the basis of 24 specimens as: a medium sized, equilateral (80%) triangle with a concave base; bases moderately to heavily ground with bifacial thinning about 1/3 the length of the point on all specimens; 67% are 1" to 1 1/4" (2.54 - 3.175 cm) in length, 25% are 3/4" to 1" (1.9 – 2.54 cm), and 8% are 1 5/16" (3.33 cm) in length.

In size range and general shape the Hunterbrook triangles overlap descriptive data for the Late Woodland Levanna type which lacks basal grinding (Ritchie 1971:31). Morphological similarities with Late Archaic Beekman triangles, which often exhibit slight to moderate basal grinding, can also be noted (Ritchie 1971:121). Late Archaic Squibnocket triangles also share morphological similarities (Ritchie 1971:127). It is difficult to compare any of the forms with Leslie's proposed Archaic forms from the Upper Delaware Valley.

Attention was refocused on the antiquity of triangular points in the Delaware Valley with the excavation of the deeply stratified Area D site (28Me1-D) within the Abbott Farm National Historical Landmark (AFNHL). A collection of 49 triangular points/fragments from these deposits are clearly Archaic in age and used over a period potentially as early as 4000/4500 BC (Stewart 1990a, b, 1998a; Stewart and Cavallo 1991:25-26, Figure 2; Wall, Stewart and Cavallo 1996:9-10, Table 2; Wall, Stewart, Cavallo and Busby1996). The triangle assemblage is derived from at least 10 different occupation levels that include artifact clusters on charcoal stained living floors, and shallow, basin-shaped hearth pits. A summary of the site's stratigraphy and the bifaces recovered are fundamental to an understanding of triangular points found in pre-Late Woodland contexts in the Upper Delaware and broader region.

Area D is one of several lowland sites located within the AFNHL at the Piedmont to Coastal Plain transition. Prior to highway construction, the site was flanked on three sides by fresh water, tidal marsh. Table 3 organizes radiocarbon dates from the site and Figure 16 depicts an idealized profile of the deposits (compiled from Stewart 1998a; Wall, Stewart, Cavallo and Busby1996:Table 1, Figure 8). Figure 16 retains the original labelling of horizons. The IIIC, IVC, VC, VIIC, VIIIC and IXC horizons all include variable expressions of lamellae. In some cases the lamellae may be the result of pedogenesis and thus should be considered as B/C horizons. However, the possibility remains that some lamellae are depositional given their position below the current water table and the likelihood that the water table has fluctuated over the millennia as a result of sea level rise.

Alluvial sediments and artifact deposits post-dating 4310+/-290 BP are found in the upper 4 to 6 feet of the profile. The 4310+/-290 BP date is derived from the base of the IIC horizon. A date of 4410+/-110 BP is from the top of the IIIC horizon. The IVC horizon is associated with an assay of 5450+/-200 BP. These three dates appear reasonable given their stratigraphic positions. The latest point of overlap between the calibrated dates from the IIC and IIIC horizons is 2866 BC; statistically the two dates could represent the same relative point in

TABLE 3
RADIOCARBON DATES ASSOCIATED WITH ARCHAIC TRIANGULAR POINTS
AT AREA D (28ME1-D)

Context	Date BP	Calibrated* 2 Sigma Age BC	Calibrated* Median Age BC
Base of IIC horizon, level 15	4310+/-290 Beta 15186	3651-2192	2943
Top of IIIC horizon, level 17	4410+/-110 Beta 15187	3373-2866	3093
IVC horizon, level 22	5450+/-200 Beta 15185	4719-3907	4279
4' below top of IIIC: Feature 55-2; Sample Cat No.277	5120+/-120 Beta 37995	4177-3661	3916
	5040+/-290 Beta 34007	4177-3626	3839
6' below top of IIIC, Feature 79	5320+/-170 Beta 37996	4491-3765	4145

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

time. There is no overlap with the date from the IVC horizon with the latest portion of its calibrated range at 3907 BC.

Radiocarbon dates from successively deeper excavation levels, siturtaed well below the water table, seem problematic at first glance. The two dates derived from Feature 55-2 and Sample No.277 are statistically alike. Although their probability ranges overlap that of the date from the IVC horizon, their considerable stratigraphic separation from the IVC horizon indicate that they represent distinctive ages. The calibrated date from Feature 79 also overlaps that of the three dates situated stratigraphically above it. But again, its relative position indicates that it represents a distinctive time, as it can considering the assay's calibrated range.

Recognizing that a single assay is a probability statement representing what was once a single moment in time (i.e., the death of the organic sample being tested), points within the calibrated range of each of the dates could be selected to create a coherent sequence that becomes increasingly older with depth. Of course, this would assume that the dated samples themselves are without problems which may not be the case given their provenience in a waterlogged matrix. Accepting such assumptions one could argue that the level at which Feature 79 occurs pre-dates 4000 BC.

Select attributes for the Area D triangles are summarized in Table 4. More detailed compilations of attributes are found in Katz (2000) and Stewart (1998a). Examples are depicted in Figure 17. Traits common to Archaic triangles at Area D include: a preference for isosceles shapes, although other forms are represented; a preference for chert as a raw material; absence of grinding on any lateral margins; lateral margins that are typically straight to slightly excurvate; bases which are often straight but range from slightly convex to slightly concave. There are fairly common ranges and trends in length, width, and other metrical attributes. Attributes do not appear to change significantly though time although basal width seems to increase slightly with depth/age. The morphology of the triangles from the Late Woodland deposits on-site is readily

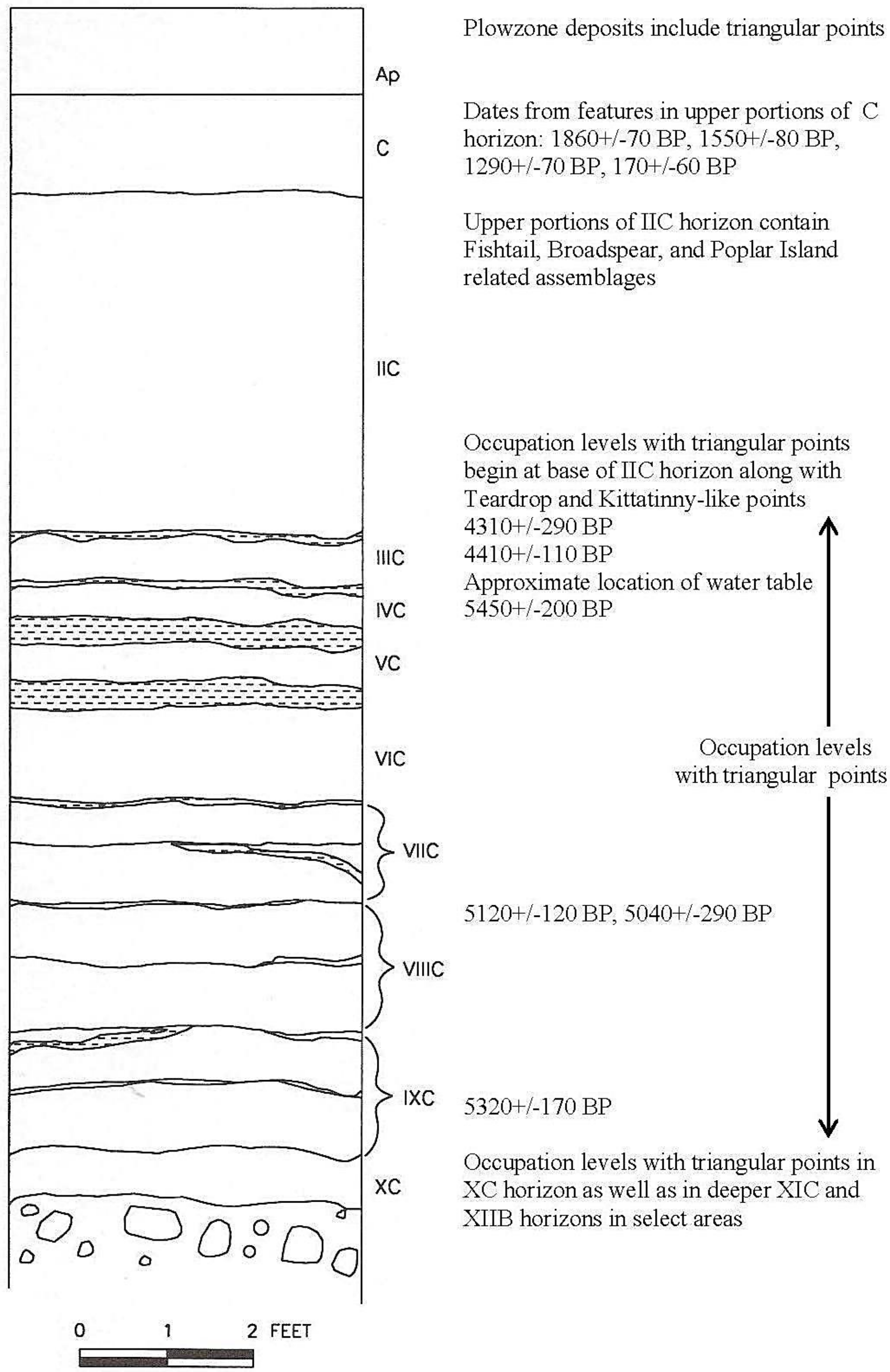


FIGURE 16. Idealized profile of deposits at the Area D site, 28Me-1D. Modified from Stewart (1998a) and Wall, Stewart, Cavallo and Busby (1996:Figure 8).

TABLE 4
SELECT ATTRIBUTES OF ARCHAIC TRIANGLES, 28ME1-D

Context	Sample Size	Axial Length cm Range Average	Basal Width cm Range Average	Maximum Thickness cm Range Average	Comments
IIC base	5, 4 generally whole	2.09- 3.74 2.54	1.8 - 2.32 1.9	0.4 - 0.88 0.55	Sample includes isosceles and equilateral forms. 50% reveal patterned treatment of base - short, steep pressure flakes that are continuous along one face of the base, and long, deep pressure flakes centrally focused on the opposing face of the base. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are predominantly straight but range from slightly convex to slightly concave.
IIIC	8, 7 generally whole	1.8 - 4.73 3.14	1.69 - 3.1 2.09	0.4 - 0.87 0.56	75% are isosceles triangles, remainder are equilateral and pentagonal. 63% reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are predominantly straight but range from slightly convex to slightly concave.
IVC	6, 5 generally whole	1.8 - 2.7 2.38	1.7 - 2.0 1.8	0.3 - 0.75 0.33	80% are isosceles triangles, remainder are equilateral. 20% reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are straight to slightly convex.
VC	10, 7 generally whole	1.8 - 2.9 2.5	1.72 - 2.6 1.98	0.31 - 0.8 0.44	90% are isosceles triangles, remainder are equilateral. 77% reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are predominantly straight but range from slightly convex to slightly concave.
VIC	7, 6 generally whole	2.1 - 3.8 2.82	1.78 - 2.95 2.35	0.4 - 0.64 0.49	66% are isosceles triangles, remainder are equilateral. 50% reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are predominantly straight to slightly concave.
VIIC	1 fragment	NA	NA	NA	NA
IXC	2, 1 generally whole	2.2- 3.02 2.61	2.44	0.43 - 0.45 0.44	100% are isosceles triangles. 50% reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are slightly excurvate; bases are slightly convex to slightly concave.
XC	4, 1 generally whole	3.0	2.6	0.32 - 0.6 0.45	Whole specimen is an isosceles triangle. Whole specimen reveals patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are slightly excurvate. Base is concave.
XIC	3, all generally whole	2.6 - 2.92 2.97	2.01 - 2.65 2.34	0.4 - 0.51 0.47	100% are isosceles triangles. None reveal patterned treatment of base as described above. No grinding apparent on any margin. Lateral margins are straight to slightly excurvate; bases are slightly concave.
XIIB	1 fragment	NA	NA	NA	NA
N.B. Two additional whole triangles were found in deep deposits but lack exact provenience.					

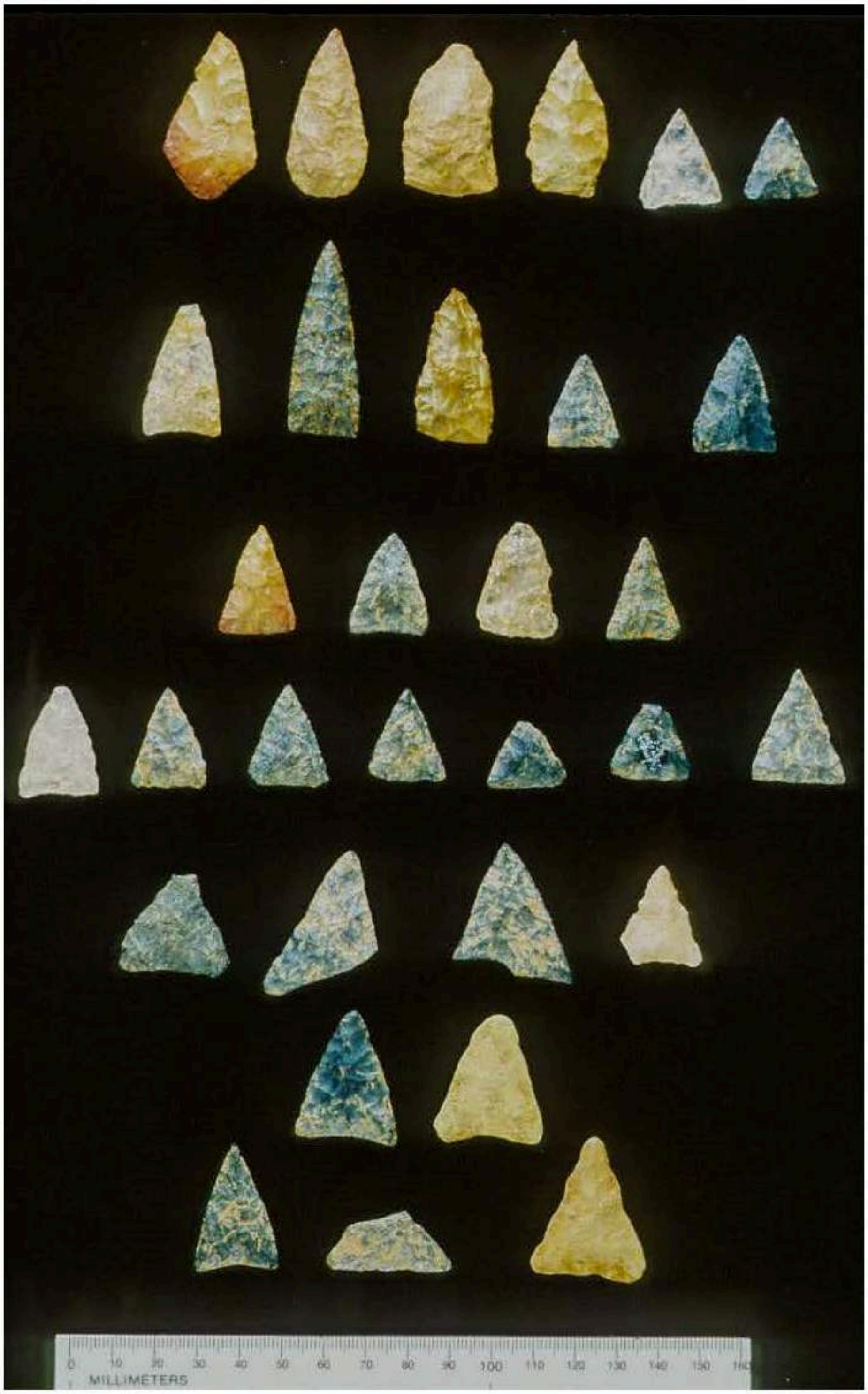


FIGURE 17. Examples of Archaic Triangles from 28Me1-D. Top row from base of IIC horizon with Teardrop and Kittatinny points; 2nd row from IIIC horizon; 3rd row from IVC horizon; 4th row from VC horizon; 5th row from VIC horizon; 6th row left-IXC horizon, right-XC horizon; 7th row from XIC horizon. Photo courtesy of Rob Tucher.

encompassed by the variation evident in the assemblage of Archaic forms (Wall, Stewart and Cavallo 1996:Table 2).

In what I originally believed was a distinctive basal treatment, short, steep pressure flakes are continuously removed along one face of the basal margin. On the opposite face, longer and deeper pressure flakes are removed, and clustered on central portions of the margin (i.e., they are not continuous across the entire margin). This strategy results in one face of the basal margin having a steeper angle than the other. In some cases, this asymmetrical quality of the angle of the basal margin is achieved using only short pressure flakes, which is why I believed that the asymmetry is a distinctive trait that can be considered on its own, as well as in combination with the patterned removal of pressure flakes.

Katz (2000) analyzed and compared assemblages of Archaic triangles from Area D with those of Archaic age from three sites in the vicinity of Liverpool, Pennsylvania in the Susquehanna Valley: 36Pe16, 36Pe60 and 36Pe61. On the Susquehanna Valley sites the triangles were part of Broadspear/Transitional Archaic components (Miller et al 2009). The Archaic point assemblages were then compared with an assemblage of Late Woodland triangles from the Gropp's Lake site located adjacent to the AFNHL. Katz concludes that the metric and morphological attributes that are commonly encountered in type descriptions (i.e., length, width, thickness, and edge curvature) show notable overlap between Archaic and Late Woodland triangles, with basal width being a possible exception (Katz 2000:81). Earlier, Kotcho (1998) used length, width and thickness in a discriminant analysis attempting to distinguish Area D Archaic triangles from Late Woodland specimens. The samples were metrically quite similar and could not be statistically differentiated.

Katz's (2000) analysis of Archaic triangles and comparisons with Late Woodland triangles from Gropp's Lake and other published Late Woodland data (e.g., Custer 1983) does not support the basal treatment described above as a potentially unique feature of Archaic triangles. Katz's study, however, did identify some characteristics of the Archaic triangles that set them apart statistically from those of the Late Woodland period. In comparison with the Late Woodland triangles from Gropp's Lake Archaic triangles have (Katz 2000:80-81):

-a greater proportion of straight-based forms;
-a smaller mean basal depth;
-smaller mean basal widths;
-a smaller proportion of bases exhibiting basal grinding;
-a smaller mean edge angle; and
-a greater proportion of excurvate lateral margins.

While the above distinctions are significant they are not presence/absence criteria that can definitively allow an analyst to identify any individual specimen as Archaic versus Woodland, especially when dealing with surface assemblages of artifacts. In conjunction with other data, the noted attributes increase the likelihood of identifying early triangles from buried but undated contexts.

The results of Katz's functional analysis (breakage patterns, edge damage, use wear) of Archaic and Late Woodland triangular points is summarized in Table 5. Both populations functioned as projectiles and cutting implements. Although Late Woodland points provided more evidence of use as projectiles the differences were not statistically significant (Katz 2000:89).

TABLE 5
FUNCTIONAL COMPARISON OF LATE WOODLAND TRIANGULAR POINTS WITH ARCHAIC ASSEMBLAGES FROM 28ME1-D, 36PE16, 36PE60, AND 36PE61
(Source: Katz 2000:Table 6.1)

Functions:	Gropp's Lake:		Area D:		Liverpool:	
	No.	%	No.	%	No.	%
Knife function only	17	39.5	11	55.0	9	50.0
Projectile function only	13	30.2	5	25.0	2	11.1
Knife & Projectile uses	9	20.9	1	5.0	5	27.8
Drill or Perforator only	4	9.3	2	10.0	1	5.6
Drill and Knife	0	0.0	1	5.0	1	5.6
Knife total	26	60.5	12	60.0	15	83.3
Projectile total	22	51.2	6	30.0	7	38.9
Drill total	4	9.3	3	15.0	2	11.1

Archaic triangles are known from other sites in adjacent areas. At the Gropp's Lake site (28Me100G) triangular points, found in lower excavations levels of stratified deposits, were dismissed originally as probable intrusions from higher strata (Stewart 1987:Figure 5.7). The deep triangles occur stratigraphically just above Stanly/Neville and Brewerton Notched points (Stewart 1987:Plate 6.25). The deep triangles, Stanly/Neville, and Brewerton points are found in a soil horizon which pre-dates 2420+/-100 BC, a radiocarbon assay from the base of the overlying stratum (Stewart 1987:V-4).

At the White Horse West site, 28Me119, also adjacent to the AFNHL, triangular points identical to those from Area D occur in the deepest Archaic context along with Kanawha, Stanly/Neville, and contracting stemmed points which could represent variants of the Stark or Morrow Mountain types (McLearen and Fokken 1986:Plate 6.2). These artifacts are mixed with items more typical of the Late Archaic period. The context has not been radiocarbon dated.

Approximately 22 miles (36 km) to the east of the AFNHL, five radiocarbon dates (Cavallo 1981:8) and trianguloid bifaces/points assigned to the late Paleoindian period from the Turkey Swamp site, 28Mo305, represent an equivocal situation. The earliest assay, 8739±165 BP, when calibrated at two sigmas (Calib 7.0; Reimer et al. 2013) could feasibly indicate a very late Paleoindian occupation circa 8258 BC. However, the calibrated ranges of all of the dates crosscut the chronological boundaries typically associated with the Early and Middle Archaic periods. The radiocarbon dates and stratigraphic context could represent a Middle Archaic context. Lithic preferences, the use of cobble and pebble sources of chert, and lithic reduction strategies mimic those evident in the Archaic triangle assemblages at Area D (*contra* Stewart and Cavallo 1991:24).

Triangular points morphologically similar to the Area D assemblages have been excavated from the deepest levels of 28GL210, another coastal locality situated about 36 miles (58 km) to the southwest of the AFNHL (Louis Berger and Associates, Inc. 1992:Plates 9.2, 9.3; Lothrop and Koldehof 1994:107-113). They are minimally Late Archaic in age being situated stratigraphically below a Lackawaxen/Poplar Island component. The deposits have not been dated. Also located in Gloucester County, four triangles were found in a level with a variety of stemmed points attributable to the Late Archaic period at 28GL228. A thin sterile layer of sand separated the Late Archaic deposit from an overlying Jacks Reef component at the site (Bello et al 1998). In buried deposits at Locus 5 of 28Sa214 a small triangular point was positioned stratigraphy below a Bare Island point, which in turn was located below a Poplar Island point (Heinrich and Hinshaw 2017). Farther afield in the Coastal Plain of Maryland, triangular points occur in stratified deposits at the Pig Point site, 18An50, and are attributed to both the Late Archaic and Early Woodland periods (Luckenbach et al 2010).

The size range of Late Archaic Beekman triangular points is replicated in the Area D collection. Equilateral forms predominate, and the morphology of lateral and basal margins encompasses the variability seen in the Area D specimens. However, Beekman triangles typically reveal ground bases, something not seen in the Area D artifacts. Basal grinding also distinguishes Hunter Brook triangles from those at Area D, although morphologies are comparable. The basic Hunter Brook, Beekman, and Squibnocket morphologies overlap entirely with the Archaic triangles from Area D and the Susquehanna Valley sites (Katz 2000:98).

Beekman triangles from New York and New England range in date from approximately 2500 BC to 2800 BC, and are considered to be a part of the Vosburg Complex (Ritchie 1971:121; Ritchie and Funk 1973:341). Squibnocket triangles are associated with later phases of the Late Archaic in eastern New York and southern New England, and seem to be a well established type by 2200 BC (Ritchie 1971:127-128; Ritchie and Funk 1973:341-342; Snow 1980:223-228). As noted by Johnson et al (1984:27), "The morphological overlap of Late Archaic Beekman and Squibnocket Triangles is so great that they have been grouped together under the new type name - Small Triangle". Small Triangles range in age between roughly 3000 BC and 1000 BC in New England (Johnson et al 1984:98-99). Doucette (2005:26-27, Figure 5) defined a new type of triangular point (Snappit) on the basis of 37 specimens from excavations at Annasnappet Pond in Massachusetts. Most (over 62%) have a concave ground base and slightly serrated edges. They are not as short and equilateral as the Squibnocket type and are not as wide and with as straight lateral margins as the Levanna type of Late Woodland times. Possible similarities with Beekman triangles are noted. The triangles are associated with three features with dates of 5100+/-40 BP, 5810+/-40 BP, and 7210+/-70 BP (Doucette 2005:27, Table 1). In general morphology they are similar to the Archaic triangles at Area D but are distinguished by the incidence of basal grinding and the slight serration of some lateral margins.

Additional evidence exists for Archaic triangles in the Susquehanna Valley of Pennsylvania supplementing the assemblages from the sites involved in Katz's (2000) analysis. On Calver Island (236Da89) triangles are associated with deposits dated to circa 4300 BP (Miller et al 2010:94-95). At the Skvarek site (36Lu132) a triangular point with straight base and basal grinding is associated with a date of 4160+/-70 BP (Miller 1994; 1998:116). General similarities with the Hunter Brook type were noted. With the exception of basal grinding the point's morphology falls within the variation represented by the Area D assemblages. The triangle occurs in the same stratum as a Lackawaxen point (Miller 1998:107). A single basally thinned triangle is associated with three bifurcated-base points and a date of 7390+/-110 BP in Segment A of the Middle Archaic deposits at the West Water Street site, 36Cn175 (Custer 2001:84; Custer et al 1994, 1996:30, 33, Figure 22, 23).

Component IV at the nearby Memorial Park site (36Cn164) included Brewerton Side Notched, Brewerton Eared Notched, Brewerton Corner Notched, Chillesqueque Triangle, and Vosburg point types (Cremeens and Hart 2009:58). Dates of 6355+/-155 BP and 6115+/-265 BP are associated. Beekman triangles are part of Component V, along with Otter Creek, Brewerton Side Notched, and Brewerton Eared points. Dates of 5830+/-130 BP and 5790+/-240 BP are associated with the deposit (Cremeens and Hart 2009:58, 60). In their review of the work of East et al (2002) at the East Bank site, Bergman et al (in press) note that Archaic triangles are found between 6260+/-40 BP and 3620+/-60 BP.

About 15 miles to the north of the Delaware Basin in Otsego County, New York, isosceles triangular points from the Camelot No.2 site are associated with a date of 4795+/-230 BP (Funk 1993:Figure 1; 1998:216, Plate 64-figures 33, 34). The points were originally described as trianguloid resembling the Brewerton Eared Triangle type (Funk 1988:27). In later publications they are simply identified as Brewerton Eared Triangles.

Triangles associated with Archaic-aged dates (see Table 2) are known for the project area and mimic those reported for the broader region. From earliest to latest they are: 6340+/-70 BP, 4510+/-40 BP, 4980+/-110, 4450+/-130 BP, 3920+/-95 BP. Calibrated medians range from 5326 BC to 2400 BC. The earliest date, 6340+/-70 BP, relates to deposits at Oberly Island (36Nm140) with dated material in close association with one of three Archaic triangles found in the lower portions of the upper Bt horizon in the stratigraphic sequence (Figure 18; Siegel et al 2001:31). No type designation was assigned. Length, width and thickness metrics include a mean length of 2.54 cm, mean width of 1.85 cm, and a mean thickness of 0.45 cm (Siegel et al 2001:Tables 5, 11); they fall within the ranges of the Area D assemblage.

FIGURE 18. Archaic triangles from Oberly Island, 36Nm140. Modified from Siegel et al (1999:Plate 63b, c, d).

In other cases triangles are described as the Beekman type and co-occur with a number of other point types that chronologically straddle the Middle and Late Archaic periods. At 28Wa290 and Harry's Farm (28Wa2) they are found with Kittatinny points, an association seen late in the Archaic sequence at Area D. Although illustrated as part of Kraft's (1975b:Figure 18) Kittatinny Complex at the site, triangles are not directly acknowledged and metrical data are not provided. The most obvious example (Kraft 1975b:Figure 18m) is an isosceles form approximately 3.2 cm in length with a width of 2.5 cm (scaled measurements from photograph). Funk (1975:xiii) points out that some Kittatinny specimens grade into the Brewerton Eared Triangle and Beekman Triangle types. Leslie's (1963:76) illustration of a Brewerton Eared Triangle from the Upper Delaware resembles the morphology of the Kittatinny point type described later by Kraft. A triangular biface could be transformed with minimal effort into a Kittatinny point.

Comments made concerning the triangles found in the dated basal levels of Stratum 3 of the Ten Mile Rockshelter, Sullivan County, New York (see Tabler 2) reiterate the difficulties in clearly distinguishing Late Woodland forms from those of Archaic age.

> Of great interest in this context (basal levels of Stratum 3) are three triangular points. A thin, well-chipped, nearly equilateral specimen with straight sides and base (Figure 29) could easily pass for a Levanna point, except for the lightly but evenly rubbed base. A thin isosceles triangle (Figure 30) which lacks rubbing seems indistinguishable from the Madison type, a Late Woodland form. The third point (Figure 31) is convex-sided and concave-based and lacks basal rubbing, but matches very well the form of the Beekman Triangle type (Funk et al 1971:36).

These comments again make clear that the attributes of all triangles in a single context both overlap and vary from those employed in existing typological descriptions of Archaic and Late Woodland forms. Figure 19 depicts the early triangles from the rockshelter.

FIGURE 19. Triangular points from the base of Stratum 3 at the Ten Mile Rockshelter, Sullivan County, New York. Modified from Funk (1989:Figure 6) and Funk et al (1971:Plate VIII).

Triangles appear in a number of suggestive, but not directly dated, early contexts. At 36Pi239 situated in small floodplain along the Lackawaxen River, what is described as an Egypt Mills point was found in a buried A horizon (Stratum IV) which also included historic period artifacts. A triangular point which the investigators typed as a Late Woodland Madison form was found in the associated B horizon, Stratum V (Snyder and Petyk 2010:95, Plate C4). If the stratigraphy is intact the triangle likely pre-dates the Late Woodland period.

In excavations on the southern end of the Manna site (36Pi4) the base of a triangular biface derives from Level 12 at 4.85’- 5.05’ (147-153 cm) below datum. Level 16, at 5.75’- 6.2’ (175-188 cm) below datum, is associated with a radiocarbon date of 4550+/-180 BP (Stewart et al 2015:69-71; Wall and Botwick 1995a:155). A Late Woodland feature occurs at the base of the plowzone in Level 2 (1.85’- 2.0’; 45-60 cm) and is dated at 970+/-120 BP and a triangular point was found in Level 3 at 2.15’- 2.2’ or 65-67 cm below datum (Stewart et al 2015:68, Table 7; Wall and Botwick 1995a:150-151).

A large isosceles triangle with an approximate length of 5 cm and width of 2.8 cm was found at the Rosenkrans site in Burial 10 attributed to the Middlesex Complex of the Early Woodland period (Kraft 1976a:Figure 15). The point is not identified in the key to the illustration of Burial 10 artifacts or in the narrative text. In the case of other burials Kraft (1976a:16, 25, 29, Figure 2, 10, 12) identifies associated points whose original date of manufacture and use predate the internments. Dates for related burials on-site are 2560+/-120 BP and 2400+/-60 BP (see Table 1).

The deepest 6” level (#5) of the Friedman II site (28Sx16) contained Beekman triangles with an extensive array of other point types generally associated with the Middle Archaic, Late and Transitional Archaic periods. Higher in the stratigraphic sequence, Level 3 also included Beekman triangles along with Late and Transitional Archaic point types (Kinsey 1972:334-335).

Farther south, a triangle occurs in Stratum VIII, Level 9 at Smithfield Beach (36Mr5) in a deposit attributed to a late Transitional Archaic/Early Woodland context (Hennessy 1992). What is described as a Levanna triangular point was found in Stratum IV at Sandts Eddy (36NM12) and presumed to be Late Woodland in age (Bergman et al 1996:58). However, the context appears to relate primarily to the Transitional Archaic and Early to Middle Woodland periods. Feature 6 at the Padula Site (36Nm15) is a dump of fire cracked rock. Mixed in with the fire cracked rock were points identified as a Jacks Reef pentagonal and a Levanna triangle. In contrast a radiocarbon date of 2580+/-80 BP associated with the feature (Doershuk 1994:313, 323, Figure 14.17) would date the context to the Early Woodland period.

Current excavations at the Sibum site by Donald Kline in the Delaware Water Gap (Monroe County, Pennsylvania) have recovered triangular points in a stratified sequence (Figure 20) involving what appear to be four distinct soil sequa. Analysis of the recoveries from two, 10’x10’ blocks is ongoing and no radiocarbon dates have yet been obtained. For perspective in evaluating the sequence pottery, triangles, Fox Creek and other stemmed points occur in the plowzone. Fishtail points are recognized in the 16-19” and 19-22” levels. Fishtail and Normanskill points are found in the 22-25” level, and Poplar Island, Lamoka-like, stemmed and notched points in the level from 25-28”. Lecroy and notched points are in the 28-31” excavation level, and corner and side notched points are found at 31-34”. What seem to be the most recognizable Early/Middle Archaic biface types are depicted in Figure 21 for comparison with the sequence of triangular points.

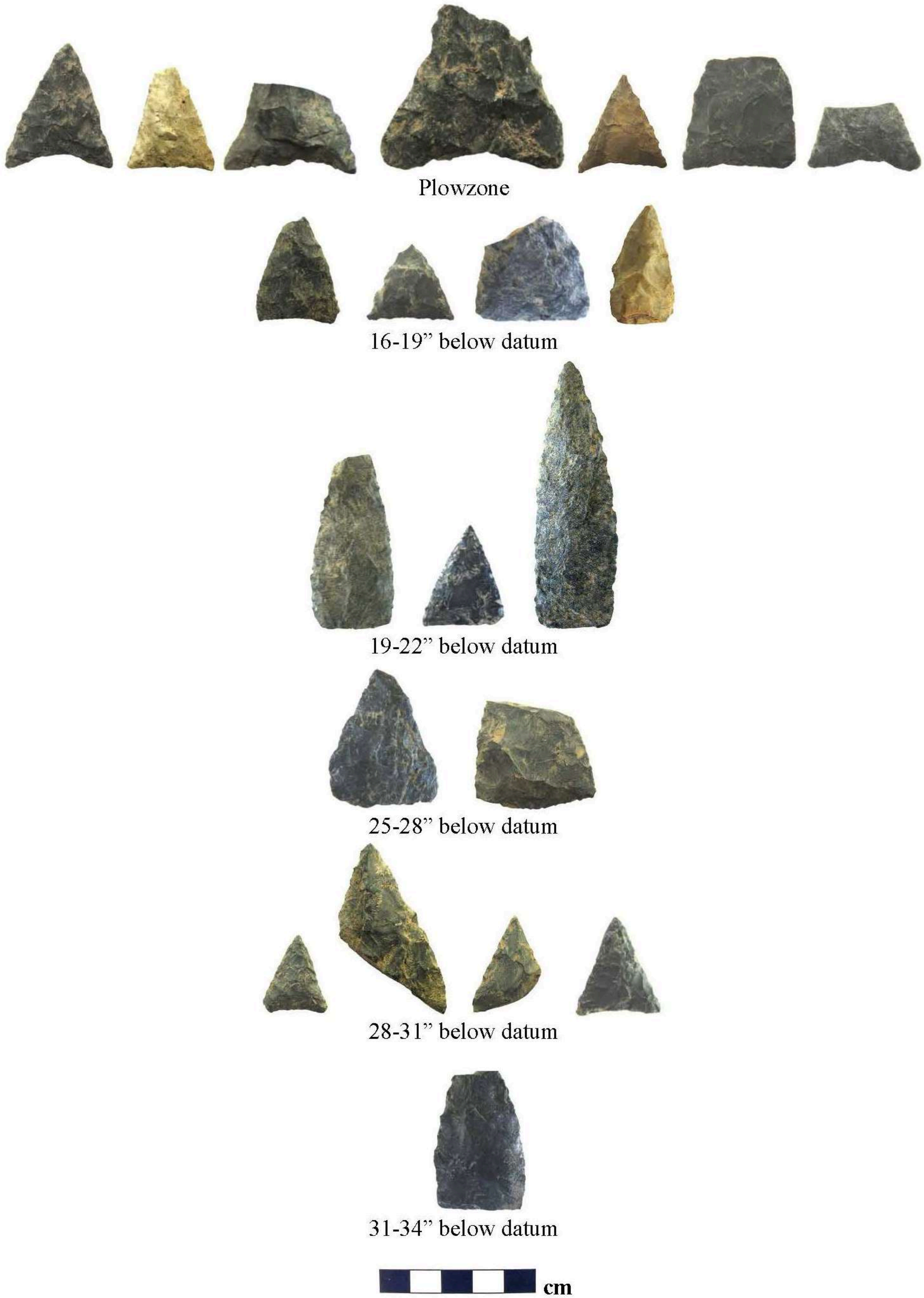


FIGURE 20. Triangular points from the stratified deposits at the Sibum site, Delaware Water Gap, Pennsylvania.

FIGURE 21. Probable Early/Middle Archaic points from the Sibum site with below datum depths. Left to right: Lecroy, Kanawha Stemmed, untyped bifurcate-like, Kirk Corner-Notched, MacCorkle, Abbott.

Defining occupation surfaces and discrete chrono-stratigraphic units at the site has not been completed so it is premature to speculate about how long a particular occupation surface was stable, or the amount of time represented by individual chrono-stratigraphic units. Therefore the contemporaneity of biface types in a given excavation level cannot be assumed. Nonetheless, the vertical distribution of biface types and gross correlations of excavation units with depositional episodes and soil horizons suggests that triangles minimally relate to the Late and Transitional Archaic periods with some of potential Middle Archaic age.

Descriptive measurements and observations for the Sibum triangles are tabulated in Table 6. Asymmetrical thinning refers to a series of short shallow pressure flakes on one face of the biface's base with deeper and longer pressure flakes on the opposite face, the treatment once thought to be a distinctive features of early triangles. The only noticeable difference between the bifaces in the plowzone and those of lower levels are the basal concavities of the plowzone finds. There is considerable overlap in all other features replicating the conclusions of Katz's (2000) controlled study. The elongate, isosceles forms at 19-22" and 31-34" resemble those seen in the Area D assemblage.

Given the variability and overlap of triangular points of Archaic origin from the Delaware Valley and broader region, it does not seem useful to continue to use existing type names (i.e., Beekman, Squibnocket, and Hunter Brook) to characterize future finds. Continuing to compare and contrast the attributes of new finds with standard typological descriptions is useful but such endeavors should also reflect on the additional data and comparative samples discussed here.

The morphological and functional similarity of Archaic and Late Woodland triangles raises the issue of whether bow and arrow technology existed in the region earlier than typically presumed since Late Woodland triangles are typically considered to be arrowheads (Custer 2001:87; Katz 2000:101). In studies that have used ethnographic examples of arrowheads as a baseline for determining relevant attributes of projectile points, weight and width are important in proposed discriminant functions (Katz 2000:101 citing Shott 1997 and Thomas 1978). The attributes of Archaic and Late Woodland triangles from the Delaware Valley exhibit an overlap with those associated with arrow heads.

TABLE 6
DESCRIPTIVE DATA FOR TRIANGULAR POINTS FROM THE SIBUM SITE
MINISINK HILLS, MONROE COUNTY, PENNSYLVANIA

Context	Sample Size	Axial Length cm	Basal Width cm	Maximum Thickness cm	Comments
Plowzone	7, 4 relatively whole	4.5 3.6 3.0 2.7	5.1 3.1 2.6 2.5	1.3 0.6 0.6 0.6	The largest specimen appears to be a manufacturing failure. Basal grinding on 2nd specimen listed. Base of 3rd and 4th specimens listed asymmetrically thinned. All equilateral.
16-19" below datum	4 relatively whole	3.45 3.0 2.9 2.0	1.9 3.2 2.3 2.2	0.8 0.8 0.4 0.45	Largest specimen an unfinished, late manufacturing stage. Base of 4th specimen listed asymmetrically thinned. Three equilateral, one isosceles.
19-22" below datum	3 relatively whole	8.1 5.1 3.0	2.5 2.4 2.5	0.9 0.6 0.4	Basal grinding on 3rd specimen listed. One equilateral, two isosceles.
25-28" below datum	2, 1 relatively whole	3.9	3.0	0.95	Both appear to be unfinished, late manufacturing stages. Whole specimen nearly equilateral.
28-31" below datum	4, 2 whole	2.6 2.1	2.3 1.8	0.4 0.4	Base of 2nd specimen listed asymmetrically thinned. All equilateral.
31-34" below datum	1 relatively whole	4.0	2.5	0.9	Basal grinding. Isosceles.

Reductions in projectile size, shoulder or basal width, and thickness remain key variables in the indirect argument for the presence of bow and arrow technology (Blitz and Porth 2013:89-91). Projectiles with greater mass, such as those that might be used on a spear, provide the greatest penetration and wounding potential while the light weight and greater velocity typical of the bow and arrow produces a flatter trajectory and better accuracy (Yu 2006:207). Custer (1991:58-63; 2001:87) provides a comparative discussion of the "stopping power" or kinetic energy of spear and spearthrower versus bow and arrow, noting that kinetic energy is a product of the projectile's weight and the square of its velocity. Increasing a projectile's velocity while holding its mass constant, something made possible by the use of the bow, dramatically magnifies the kinetic energy of a projectile. "Because of the higher velocity of arrows, a smaller point could be used; and a smaller, lighter projectile would increase velocity and resultant kinetic energy" (Custer 2001:87). While wounding and penetration are important, the ability to accurately target a specific area of an animal's body may be more so (Custer 1991:58) and is a benefit of bow and arrow technology.

Debate concerning the origins of bow and arrow technology in North America is ongoing, including the possibility that it appears millennia before 300-600 AD, the time typically associated with the technology in the Eastern Woodlands (Blitz and Porth 2013; see summary in Toner 2015). In the Delaware Valley a Middle Woodland origin, circa 500/600 AD, is presumed as represented by Jacks Reef points (Kraft 2001:194). The use of the bow and arrow, regardless of its antiquity, does not preclude the continued use of the demonstrably more ancient spearthrower or atlatl, as is seen ethnographically in the Southwestern United States and Central America (Toner 2015; Yu 2006:201).

Exploring the possible adoption of the bow and arrow prior to 500/600 AD in the Upper Delaware and broader region is important given the attendant implications. Individual rather than cooperative hunting may have been favored, impacting the sharing of prey and the social contexts involved (Grund 2017; Toner 2015). To the degree that the bow and arrow contributed to greater household autonomy the size and structure of residential camps may have changed, as well as the nature of archaeological sites construed as hunting stations or hunting camps (Blitz and Porth 2013; Toner 2015). The potential for increased violence or coercion and related social impacts has been linked with the adoption of the bow (Blitz and Porth 2013). Future research also needs to consider that pointed fragments of debitage as well as bone and antler can be effective arrow points (e.g., Knecht 1997; Odell 1988; Odell and Cowan 1986; Waguespack et al 2009).

Table 7 presents general age ranges for select biface types associated with the Middle Archaic through Late Woodland periods as represented by named types listed in Table 2.The purpose of the table is to provide a macro-regional context for evaluating the radiocarbon dates associated with the myriad biface types found in the Upper Delaware and surrounding area. It does not presume that the chronological ranges for biface types be accepted uncritically for the Upper Delaware. Of course, much of the earlier research completed in the project area by Funk, Kinsey, Kraft, and their colleagues was instrumental in establishing what are considered to be acceptable chronological ranges for a number of these types. Entrees in Table 2 reflect these efforts. References in Table 7 focus on compilations of dates and discussions of biface types, and less frequently on original sources or site-specific radiocarbon assays. Macro- and inter-regional data and references to original sources found in Anderson et al (2000), Custer (2001), Inashima (2008, 2011), and Johnson (2002) were particularly useful in this compilation.

TABLE 7
GENERAL AGE RANGES FOR SELECT BIFACE TYPES
MIDDLE ARCHAIC THROUGH LATE WOODLAND PERIODS

Biface Type	Date Range* BP	References
Morrow Mountain I/II or Stark	7255+/-165 to 4430+/-50	Custer 2001:Figure 11; Egloff and McAvoy 1990:72-73; Inashima 2008:237-238, 2011:115; Justice 1995:105
Otter Creek	6560+/-100 to 4220+/-160	Custer 2001:Figure 11; Funk 1976:235-238, Funk 1993:Table 17; Inashima 2008:240-241
Vosburg	6115+/-265 to 3965+/-155	Custer 2001:Figure 11; Funk 1976:243; Inashima 2011:127-128; Justice 1995:116
Brewerton Side Notched	6115+/-265 to 3960+/-100	Anderson et al 2000:6-218 to 6-219; Custer 2001:Figure 11; Inashima 2008:201; 2011:97; Johnson 2002:2-41
Brewerton Corner Notched	6115+/-265 to 4300+/-180	Anderson et al 2000:6-217; Custer 2001:Figure 11; Inashima 2008:200; 2011:96
Lamoka	5383+/-250 to 2650+/-150	Custer 2001:Figure 11; Funk 1993:Table 17; Inashima 2008:222-223; 2011:108-109; Johnson 2002:2-44 to 2-45; Justice 1995:129; Ritchie 1965:Figure 1; Ritchie and Funk 1973:Figure 1; Stewart 1987:170, Plates 21-23, Appendix 1; Wall 2015:40-47

Table 7 continued		
Biface Type	**Date Range* BP**	**References**
Brewerton Eared Triangle	5180+/-200 to 4220+/-160	Custer 2001:Figure 11;Funk 1993:Table 17; Inashima 2008:201; Justice 1995:123
Genesee	4930+/-260 to 3673+/-250	Justice 1995:159; Ritchie 1971:24
Lackawaxen Straight/ Expanded Stem	4560+/-110 to 2260+/-40	Anderson et al 2000:6-225 to 6-226; Custer 1996:Figure 57, 2001:9-113; Inashima 2008:222; Lothrop and Koldehoff 1994:115; Miller 1998:107
Vestal	4450+/-130 to 3770+/-125	Funk 1993:Table 17; Funk et al 1971:43-44; Ritchie 1971:130
Poplar Island	3920+/-95 to 2470+/-50	Custer 1996:139-145, 2001:43, 90-113; Inashima 2008:245; Miller et al 2010:93,Table 1
Snook Kill	4020+/-115 to 2460+/-60	Funk 1993:Table 17; Inashima 2008:253; Justice 1995:160; Miller et al 2010:93,Table 1
Bare Island	4920+/-90 to 3600+/-70	Custer 2001:90-113; Inashima 2008:196, 2011:94; Miller et al 2010:94,Table 1
Normanskill/Normanskill-like	3980+/-160 to 3390+/-100	Funk 1993:Table 17; Inashima 2011:116
Macpherson	4160+/-140 to 3660+/-120	Funk 1965:137; Kinsey 1972:413; Kraft 1975b:36-40
Eshback	post 5180+/-200; 3870+/-230 to 3160+/-75; 1480+/-170 to 850+/-80; Late or Transitional Archaic and/or late Middle Woodland	Anderson et al 2000:6-223 to 6-224; Johnson 2002:2-45 to 2-46; Kinsey 1972:417-419; 1975:72, 77, Figure 28aaa; Stewart 1987:64, 80, 352, Figures17, 19, Plate 5
Koens-Crispin/Lehigh	4416+/-57 to 3300+/-40	Carr 2015:Table 3.2; Inashima 2008:222, 225, 2011:110; Johnson 2002:2-47 to 2-48, 2-50; Miller et al 2010:93,Table 1
Perkiomen	3670+/-120 to 3320+/-40	Carr 2015:Table 3.2; Inashima 2008:243; Wall et al 2003:190, 293
Susquehanna	4140+/-260 to 2030+/-160	Carr 2015:Table 3.2; Funk 1976:264, 1993:Table 17; Inashima 2008:260-262; Johnson 2002:2-50 to 2-52
Fishtail (Dry Brook/ Orient)	3230+/-120 to 2670+/-105	Blondino 2015:Table 5.1; Carr 2015:Table 3.2; Funk 1976:264; Johnson 2002:2-55; Ritchie 1965:Figure 1; Ritchie and Funk 1973:Figure 1
Meadowood	3180+/-95 to 2130+/-115	Funk 1993:Table 17; Inashima 2011:113-114; Johnson 2002:2-55 to 2-56
Cresap/Cresap-like	2506+/-175 to 1900+/-70	cf. Dragoo 1963:47-51, 109-110, 118, 290-291,Plates 22, 38, 42; McConaughy 2003, in press; Tippins et al 2015
Rossville	3100+/-70 to 1310+/-155	Anderson et al 2000:6-232 to 6-233; Custer 2001:90-113; Dent 1995:Table 6.3; Inashima 2008:248; Johnson 2002:2-58
Lagoon	2470+/-120 to 2050+/-170	Anderson et al 2000:6-232 to 6-233
Sand Hill Stemmed	1820+/-55 to 1660+/-100	Funk 1993:Table 17
Tocks Island	1660+/-95 to 1485 +/-30	Table 2, this report
Fox Creek/Selby Bay	2020+/-130 to 1075+/-90	Anderson et al 2000:6-234 to 6-238; Dent 1995:Table 6.7; Funk 1993:Table 17; Inashima 2008:210-211, 2011:104; Johnson 2002:2-58 to 2-59
Jacks Reef Pentagonal	1840+/-90 to 1000+/-45	Custer et al 1990:161, Table 2; Funk 1993:Table 17, 1998:Plate 43; Inashima 2008:217; Johnson 2002:2-60 to 2-61; Lowery 2013; McConaughy 2013; Rieth 2013:Table 1; Walker 2013
Jacks Reef Corner Notched	1660+/-100 to 1020+/-100	Anderson et al 2000:6-239 to 6-241; Custer et al 1990; Funk 1993:Table 17; Inashima 2008:216-217, 2011:107; Johnson 2002:2-60 to 2-61; Lowery 2013; McConaughy 2013; Walker 2013
Levanna	1680+/-125 to 200+/-205	Funk 1993:Table 17; Inashima 2008:225-227
Madison	1180+/-80 to 210+/-60	Anderson et al 2000:6-242; Funk 1993:Table 17; Inashima 2008:228

*Ranges shown consist of the earliest and latest radiocarbon dates not clearly discounted by the investigators.

A comparison of Tables 2 and 7 indicates substantial overlap between biface types once thought to have more distinctive chronological ranges. The ranges shown in Table 7 also are at odds with the chronological sequences portrayed in many typologies. The long term persistence of some stemmed and notched biface morphologies is one theme of the discussions that follow. Taken together, these observations will make it even more difficult to employ data from surface and shallowly buried sites dated on the basis of diagnostic biface types in settlement pattern and other studies.

In the Upper Delaware, a single date (5280+/-110 BP) for a biface form described as Morrow Mountain I/II or Stark derives from 28Sx14, the Rockelein site. It falls on the very late end of the age range currently ascribed to the type, usually associated with the Middle Archaic. The morphology of this type falls within the variability of forms that arguably persist in Late Archaic and later chronological contexts (see discussions below).

Kittatinny points are presumed to be a late Middle Archaic form but have only been dated twice in the Upper Delaware Valley (see Table 2). The single date from 28Wa2 (4980+/-110 BP) where the type was defined remains the earliest. A date from 28Wa290 (4510+/-40 BP) overlaps the two dates from Area D where the type is associated with Archaic triangles (see Figures 16, 17). A Beekman Triangle also occurs in the same dated context as the Kittatinny point at 28Wa290. At 28Sx404 a Kittatinny point was found above a context in the same excavation unit that produced straight stemmed (Bare Island?) and Vosburg points (Hunter et al 2001:Plate 6.12).

Kittatinny points occur in three different Middlesex Complex/Early Woodland burials at the Rosenkrans site (Kraft 1976a:16, 25, 29, Figure 2, 10, 12). In one case they co-occur with Vosburg, Lackawaxen, and Lehigh/Susquehanna Broadspear points (Kraft 1976a:25, Figure 10; see Table 2 this report). Kraft believes that these older points were collected by mourners and deliberately included as grave goods along with caches of Early Woodland biface types that are contemporaneous with the internments. Kittatinny points are not well recognized beyond the project area, perhaps given the similarity of some variants with types in the Brewerton series and the Vosburg form (cf. Funk 1975:xiii; Kraft 1975b:Figure 18; Ritchie 1971:Plate 32).

A number of point types are considered grounded in the Middle Archaic or Late Archaic periods (or both), depending on the bracketing dates used to define a cultural historical period by a researcher. These types include: Otter Creek, Vosburg, Brewerton (side notched, corner notched, eared triangle). In the most reasonable scheme promoted for eastern New York, including the Hudson and Susquehanna valleys, Otter Creek and other broad, side notched forms have the greatest antiquity followed by Vosburg and Brewerton types, all exhibiting some degree of overlap in their chronological ranges (Funk 1993:188-191). The same appears true of eastern Pennsylvania (cf. Custer 2001:Figures 38, 57).

Of the four radiocarbon assays recorded for the Otter Creek type in the project area, two are extremely late (1360+/-120 BP, 210+/-40 BP) and considered to be bad dates by the investigators. The remainder fall squarely within the range deemed acceptable in the broader region, but are hundreds of years removed from the earliest dates associated with the type. At McCulley No.1 (Delaware County, New York) Otter Creek co-occurs with Brewerton Side

Notched at 5710+/-110 BP. While radiocarbon and stratigraphic data indicate that Otter Creek appears prior to the types in the Brewerton series, there is substantial overlap in their chronological ranges and they co-occur on a number of sites (Funk 1993:188-190; Johnson 2002:2-41 to 2-42).

There are only two dates for Vosburg (5570+/-200 BP, 4450+/-130 BP). The earliest derives from the Faucett site (36Pi13a) and at the time (Kinsey 1975:61) was the earliest date for the type in the entire Northeast. At the Faucett site Vosburg is found stratigraphically below the majority of levels associated with the Lackawaxen component, although there is slight overlap when depths below datum are considered (Kinsey 1975:52-61). Depths below datum are more comparable for the Brewerton and Vosburg components (Kinsey 1975:60-61). The co-occurrence of Vosburg with Brewerton, Beekman, and Vestal points in the basal deposits at the 10 Mile Rockshelter is considered to be an acceptable association (Funk et al 1971:43-44). Brewerton Side Notched points co-occur with Vosburg at other dated sites in the region (e.g., Cremeens and Hart 2009:58-59; GAI Consultants 1995; Johnson 2002:2-41 to 2-42).

One gets the impression from reading CRM reports that the Brewerton Side and Corner Notched types are the default forms used to characterize any moderately-sized biface found on surface sites and in contexts that might be Late Archaic in age (Custer 2001:66). Illustrations of points ascribed to Brewerton assemblages certainly include a wide range of forms (e.g., Ritchie 1970:Plates 4, 7). While acknowledging that the Brewerton Phase is not well understood in the Upper Susquehanna and Upper Delaware valleys, Hohman and Versaggi (2003:7) suggest that the points in Brewerton series may simply be a variant of generic bifaces found on Late Archaic sites.

Seven radiocarbon assays from the project area relate to types in the Brewerton series, the six deemed reliable ranging from 5730+/-110 BP to 4450+/-130 BP. They fall within the mid-range of dates known for the broader region (see Table 7). A seventh date of 280+/-80 BP for the Brewerton Side Notched type at the Otego Yard site (Otsego County, NY) is clearly unacceptable. At the Peake site (Delaware County, NY) a Brewerton Eared Triangle occurs in an excavation level immediately below a context dated to 4310+/-90 BP (see Table 1; Hartgen Associates 1988a:52, Table 18). In the Middle Delaware Valley a Brewerton Side Notched point is associated with a component dated to 2970+/-40 BP at site 28Hu18 (White 2013:3-21), an assay much later than the expected range for the type.

At the Chenango Point site (Broome County, NY) Brewerton points are associated with Vestal, Meadowood, a possible Kirk Corner Notched, and untyped corner notched forms (see Table 2). It is possible that the side notched biface identified as Meadowood is a variant of the Otter Creek type or some other Late Archaic form (Knapp 2011:133) which would be more in line with the date assigned to the context. The association of a possible Kirk and two untyped notched points of possible Early/Middle Archaic age with a dated Late Archaic feature could be incidental. However, Knapp (2011:130) notes that the spatial concentration of these points "belies a random mixing". He feels that a more likely explanation is that the bifaces are actually Late Archaic in age, or represent old artifacts that were retrieved and recycled during the Late Archaic.

Residue (protein) and use wear analysis of Brewerton points from sites in the project area could reflect their use both as projectiles and tools used for other purposes. At 36Mr133 a Brewerton Side Notched point (FS#5018) tested positive for guinea pig anti-sera which could represent beaver, porcupine or squirrel. An additional specimen (FS#1037) tested positive for chicken which could be indicative of quail, turkey, grouse, and all gallinaceous fowl. It also tested positive for guinea pig which could be beaver, porcupine or squirrel; grasses-Poaceae (Hornum et al 2009:76-79; Parr 2006). The relevant points are shown in Figure 22. At Treichlers Bridge (36Nm142) use wear analysis resulted in the following: Brewerton Side Notched (Item 3427.1) scraping fresh hide (Church 2000:11); Brewerton Side Notched (Item 3226.3), working of meat or bone (Church 2000:15); and Brewerton Eared Notched (Item 3213.11),sawing softwood, scraping fresh hide (Church 2000:16).

FIGURE 22. Point types tested positive for protein residues at 36Mr133 and 36Mr119. Left to right, 36Mr133: Lackawaxen (FS 438), Normanskill (FS 226), Brewerton Side Notched (FS 5018), Brewerton Eared-Notched (FS 1037); 36Mr119: Lackawaxen/Lamoka points (FS 78, 106, 467). Modified from Hornum et al (2009:76-79, Figures 28, 45)

As Custer (1996:164) notes, "some stemmed projectile points usually thought to date to the Late Archaic, Early Woodland, and Middle Woodland periods were probably being used during much of the Middle Archaic as well." This statement is substantiated by the analysis of biface assemblages from secure and dated contexts (Custer 1996:134, 139-145, 164-180, 227-231, 2001:90-113). Custer identifies five biface forms (Pequea, Piney Island, Bare Island, Poplar Island, and generalized side notched) that occur in various combinations in assemblages from the beginning of the Late Archaic through the Middle Woodland period (Custer 2001:90). The morphology of the Piney Island type intergrades with what could be typed as variants of Lackawaxen and Bare Island (cf. Custer 2001:25, 42, Figures 16, 17, 24; Kent 1996:Figure 16; Kinsey 1972:Figure 116; Ritchie 1971:Plates 2, 3, 24). In addition to Bare Island, variants of the Lackawaxen form intergrade into the variability presumed to represent the Poplar Island type, and Poplar Island can intergrade into Bare Island form (cf. Ritchie 1971:14, 44, Plate 24). Admitting that sample sizes from controlled contexts need to be larger, Custer (2001:90-111, Figures 34, 35) has a developed a sequence of type combinations that permit assessing the age of a deposit or site with more precision than what reference to an individual types use history might permit.

Kinsey (1972:367, 436-437) previously commented on the similarity of the Lackawaxen Stemmed and Lagoon types, as well as what he describes as a stronger resemblance between

Lackawaxen Converging Stem and the Rossville type. In his review of traditional biface types employed in the Upper Delaware Valley, Andrefsky (1983:20-23) notes the morphological blending between specimens typed as Lackawaxen, Poplar Island and Bare Island. Anthony and Roberts (1987:166-167) observe that a number of sites roughly dating between 2000-1700 BC reveal the contemporaneous use of a variety of stemmed biface styles including: contracting stemmed, straight stemmed, expanding stemmed (Poplar Island and Lackawaxen related), and Macpherson-like side notched bifaces. “These sites might represent a distinct phase within the middle/upper Delaware Valley, defined not by a single artifact type” (Anthony and Roberts 1987:167, Plates 19, 27-30). On the basis of data from Piedmont of Pennsylvania Snethkamp (1981:213, 217) concluded that a stemmed point tradition persisted throughout the Late Archaic and Early Woodland periods. Custer’s (2001) analysis reaffirms these earlier observations. Data from the Upper Delaware and adjacent areas provides additional, although not comprehensive, support of these observations.

Table 8 compares dates for the variety of narrow-bladed stemmed points found in the project area. A single assay for Poplar Island points at 28Wa528 extends the early range of time typically associated with the type (cf. Tables 7, 8). The latest date shown (2080+/-90 BP) also goes beyond the expected range for the type and is one of three assays derived from what was defined as an Archaic surface at the Bachman site, 36Nm80. The two earlier dates (3800+/-100 BP, 3630+/-210 BP) were felt to be appropriate for the context; the latest one was rejected by the investigators. While the site’s stratigraphy provides support for rejecting the later date (Anthony and Roberts 1987), Custer’s (2001:Figures 34, 35) master sequence includes Poplar Island points in Early and Middle Woodland assemblages. Lackawaxen points are found in the same contexts dated by this suite of assays. Poplar Island and Lackawaxen are found in the same component elsewhere in the Delaware Valley (e.g., Lothrop and Koldehoff 1994). The co-occurrence of Poplar Island with the Beekman, Lamoka, Macpherson, and Snook Kill/Koens-Crispin types at 28Wa2 (Kraft 1975b:29-40) is not unexpected given the observations discussed above and the date ranges assigned to each in the broader region.

In the Delaware Valley Lackawaxen points have an especially long history of use. Dates from the project area encompass the Late and Transitional Archaic, Early and Middle Woodland periods and generally fall within what might be anticipated. The feature related 2080+/-90 BP assay discussed above from the Bachman site has a Lackawaxen point in close association. The 690+/-40 BP date from 36Nm262 is very late and unprecedented, even in light of the type’s long use history in the greater Delaware Valley. This same context included a Bare Island point. The co-occurrence of the Bare Island and Lackawaxen types would be considered typical except for the anomalous radiocarbon date. The only other date for Bare Island (3940+/-100 BP) is from 28Mr8 and is considered to be well within the types anticipated range.

There is a close temporal and spatial relationship between Lackawaxen and Broadspear points at the Lower Black’s Eddy site in the Middle Delaware Valley, with dates ranging between 4020+/-180 BP and 3520+/-100 BP (Schuldenrein et al 1991:Table 2, 64). Broadspear, Fishtail, Lackawaxen-like, and Hellgrammite forms dated circa 1300-900 BC co-occur at the nearby Williamson site associated with early pottery (Hummer 1991:Plate 12,1994:146-147, 2005:Figures 1-3).

TABLE 8
COMPARISON OF DATES* FOR NARROW STEMMED POINTS
UPPER DELAWARE AND ADJACENT AREAS**

Poplar Island	Lackawaxen	Lamoka	Macpherson	Normanskill	Bare Island	Rossville
4770+/-50						
	4560+/-110					
		4510+/-40				
	4445+/-130					
		4420+/-40				
		4370+/-40				
		4185+/-120				
	4130+/-180					
		3970+/-100				
					3940+/-100	
3920+/-95	3920+/-95	3920+/-95	3920+/-95			
		3840+/-100				
3800+/-100	3800+/-100					
		3750+/-95				
				3685+/-100		
	3660+/-120		3660+/-120			
3630+/-210	3630+/-210					
				3610+/-95		
	3600+/-80					
				3390+/-100		
	2560+/-120					
	2400+/-60					
						2250+/-80
2080+/-90	2080+/-90					
						2050+/-135
		1400+/-55				
						1360+/-70
						1230+/-60
		860+/-40				
				810+/-80		
	690+/-40				690+/-40	

*Dates are shown BP and derived from Tables 1 and 2.
** See Introduction for details regarding adjacent areas.

Downriver at the transition to the Coastal Plain a Lackawaxen Straight Stemmed point occurs at 28Me20 near a feature dated to 2840+/-120 BP (Stewart 1986:133, 237, Plates 8,9). Examples of the Lackawaxen Expanding Stem, Rossville, and Lamoka types are found near a feature dated to 2650+/-150 BP at 28Me100G (Stewart 1987:170, Plates 21-23). Farther into the Coastal Plain of the Lower Delaware Valley Lackawaxen points are represented at the Jughandle Site (28Bu273) in a series of closely related components that also contain a significant amount of early pottery (Marcey Creek, Ware Plain, Williamson Flat Bottomed, Vinette I) and fragments of steatite vessels (Fokken et al 1987). Thermoluminescence (TL) dates on sherds of Marcey Creek and Ware Plain pottery are respectively 2500+/-250 BP and 3060+/-400 BP (Fokken et al 1987:V-39). At the Worrell site (28Bu252) Lackawaxen points are part of a component that includes steatite tempered pottery (Payne 1990:Figure 2). A TL date of 2700+/-270 BP is associated with steatite tempered, flat bottomed pottery and Lackawaxen-like points at 28Bu165 (Mounier 1985:4-5, 20, 22-23, Plates 3, 4). A date of 3830+/-90 BP is associated with a Lackawaxen/Poplar Island component at 28GL111 (Lothrop and Koldehoff 1994:115).

Examples of Lackawaxen points from a variety of chronological contexts are shown in Figure 23.

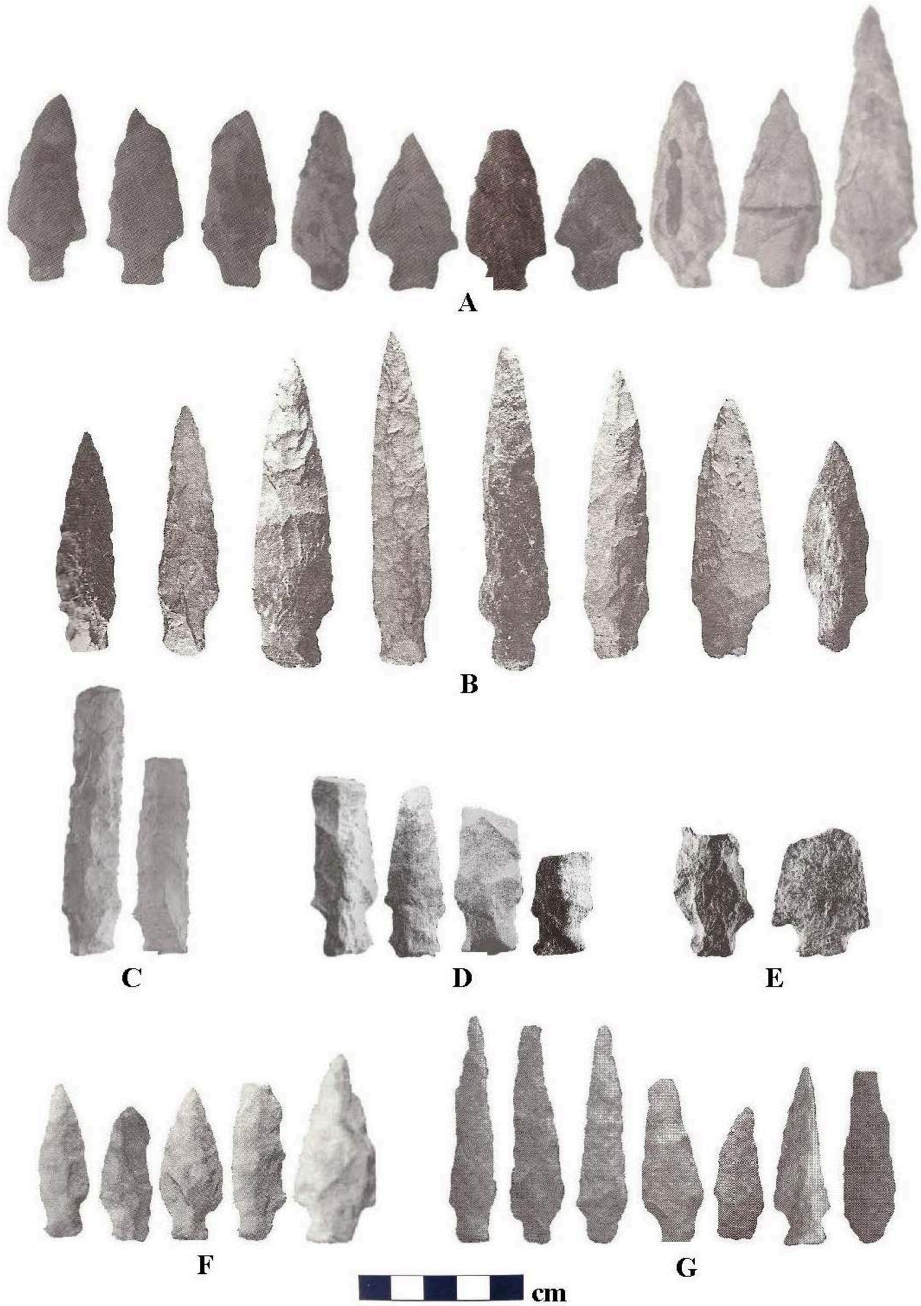


FIGURE 23. Examples of Lackawaxen points from the Delaware Valley. **A**: Lackawaxen component at the Faucett site, 36Pi13A (modified from Kinsey 1975:Figure 23. **B**: Lackawaxen component at Harrys Farm, 28Wa2 (modified from Kraft 1975b:Figure 20). **C**: Shady Brook, 28Me20 (modified from Stewart 1986:Plates 8, 9). **D**: Gropp's Lake, 28Me100G (modified from Stewart 1987:Plate 22). **E**: points from the Lackawaxen/Poplar Island component at 28GL111 (modified from Louis Berger and Associates, Inc. 1992:Plate 5.1). **F**: Lackawaxen-like points from 28Bu273 (modified from Fokken et al 1987:Plate 5.1). **G**: Lackawaxen component at 28Bu252 (modified from Payne 1990:Figure 2).

In the study area Lackawaxen points are found in the same dated contexts as the following types: Poplar Island, Kittatinny, Cresap, Susquehanna Broadspears, Macpherson, and Egypt Mills (see Table 2). The type's occurrence, along with Kittatinny, Cresap and Susquehanna Broadspear points in burial features at Rosenkrans Ferry (28Sx2) can be thought of in a number of ways. One might view the finds of Kittatinny, Lackawaxen, and Susquehanna points as older discarded artifacts collected by mourners and included in the mortuary features as tokens, as Kraft (1976a:25) has. The attested date range for Lackawaxen, however, would make the presence of the type in an Early Woodland context acceptable. The same might be said for the single Susquehanna Broadspear associated with the internments (see Table 7).

At the Zimmerman site (36Pi14) Lackawaxen Stemmed and Susquehanna points occur around the perimeter of the same hearth features, but only the Susquehanna type occurs adjacent to a dated feature (Werner 1972:63, 65, 69). Werner felt that Lackawaxen Stemmed points and Susquehanna Broadspears represented two different components. Their co-occurrence around the same hearths was explained as a result of site formation processes – i.e., earlier deposits had not been thoroughly buried by the time of the Susquehanna occupation (Werner 1972:116). Current knowledge of the chronology of the types would not automatically preclude their contemporaneous use and association.

Protein residue analysis from two sites could support interpreting Lackawaxen points as projectiles, knives, or multi-purpose bifaces. At 36Mr133 a single Lackawaxen biface (FS#438) tested positive for deer (Hornum et al 2009:76-79; Parr 2006). Three bifaces identified as Lamoka/Lackawaxen at 36MR119 also produced interesting results. One specimen (FS #78) tested positive for guinea pig which could represent beaver, porcupine or squirrel. Another (FS #467) indicated the presence of deer and grass (Poaceae) protein. The third example (FS #106) tested positive only for grass protein (Hornum et al 2009:56). All of these bifaces are depicted in Figure 22 above.

As has been observed, variants of the Lackawaxen and Lamoka types can intergrade with one another. The dated first appearance of the types in the project area is nearly identical. Eight of the 10 dates for Lamoka points neatly correspond with the early- to mid-range of assays associated with Lackawaxen bifaces (see Table 8). Two questionable Lamoka dates are from sites (Gardepe, Chenango Point) in the nearby Upper Susquehanna River Basin and relate to the Middle and Late Woodland periods. Funk (1998:411) considers the Lamoka point associated with the dated feature (1400+/-55 BP) at the Gardepe site as intrusive. At Chenango Point a Lamoka point is associated with a dated Feature 119 (860+/-40 BP) that also included maize and Owasco pottery (Knapp 2011:Tables 4.3, 4.4). Although considered as a Late Archaic form, its association with Feature 119, clearly designated as a Late Woodland context, is not commented upon by the investigator (Knapp 2011:41, 51, Table A3-30). Examples of Lamoka points from dated contexts are shown in Figure 24.

Lamoka-like points have been found in the Susquehanna drainage on Middle and Late Woodland sites, although the Lamoka type is typically assigned to the Late Archaic (Hohman and Versaggi 2003:ii, 14, 19 citing a variety of site studies including Funk 1993, 1998). Others have noted the use of the type extending to roughly 1000 BC (Wall 2015 citing East et al 2002). Funk (1993:192-194) assigns the use of Lamoka points to the time 2500 BC - 1900 BC in the

FIGURE 24. Lamoka points from dated sites in the project area (see Table 2). Top: Lamoka-like from Harry's Farm, 28Wa2, modified from Kraft (1975b:Figure 22). Bottom: Lamoka and Lamoka/Dustin from Sydney Hangar, modified from Kudrle (2005:Photo 16).

Upper Susquehanna Valley and notes the lack of temporal continuity between Brewerton and Lamoka occupations. However, dates from the project area and broader region shown the overlap in the use history of Lamoka and various Brewerton biface types (see Tables 7, 8) and supports Custer's (2011) discussion of the longevity of a variety of stemmed points.

Lamoka points are found in dated contexts and associated with the following types in two individual cases in the study area: Kittatinny, Brewerton, Beekman, Poplar Island, Vestal, Macpherson, and Koens-Crispin (see Table 2). In each case the date ranges known for the types share points of overlap. It has been suggested that "Lamoka could be envisioned as one of a series of linked phases advancing northward ca. 2500 B.C. along a broad front into New York and New England from a hypothesized and still obscure homeland in the Mid-Atlantic region" (Funk and Rippeteau 1993b:223). This idea does not seem to have been explored further by regional archaeologists; criteria for recognizing this or any migration using the archaeological record have been outlined (Anthony 1990; Funk and Rippeteau 1993b:215-218; Rouse 1986).

Like a number of the biface types already reviewed, it is evident that Lamoka bifaces were multi-purpose tools. As part of a study of sites in Sussex County, New Jersey, wear analysis produced evidence of bone/meat/hide working and use as projectile points for two Lamoka points (Kelly et al 2012:154, 159).

The Vestal type is not identified in dated contexts from the Pennsylvania and New Jersey portions of the Upper Delaware Valley. Nine dates are ascribed to the type found on sites of the New York segments of the Upper Delaware and nearby portions of the Upper Susquehanna Valley. Of the nine dates, seven appear to be reliable and range from 4710+/-40 BP to 3775+/-115 BP. Two dates that relate to Late Woodland contexts are rejected. Examples of Vestal points from dated contexts are depicted in Figure 25.

FIGURE 25. Examples of Vestal points from dated sites in the project area (see Table 2). Left two: Sidney Hangar, Locus 2, modified from Kudrle (2005:Photo 16). Right three: Chenango Point, modified from Knapp (2011:Photo 7.7).

Although dates for Vestal in the Upper Susquehanna range from 2400 BC to 1800 BC Funk (1993:192-194) sets aside early dates (not included in Table 7, this report) and assigns Vestal bifaces to the time 1900 BC to 1800 BC or possibly 1600 BC. In part his dissatisfaction with these earlier dates stems from their overlap with the use history of Lamoka bifaces; stratigraphic relationships between Lamoka and Vestal components seen repeatedly at sites in the Upper Susquehanna Valley argue against their contemporaneity and for the chronological priority of the Lamoka type (Funk 1993:193-194). Still radiocarbon dates indicate the overlap of their chronologies even assuming a 1900 BC to 1800 BC time frame for Vestal. Ritchie (1971:130) notes their definite association at the Castle Garden site in Broome County, New York. In the study area Vestal is associated in dated contexts with Brewerton, Beekman, Vosburg, Meadowood, and untyped corner notched points (see Table 2). The admixture of types in dated Feature 168 at the Chenango Point site may relate to site formation processes and not a contemporaneous association.

Components associated with Vestal points may be focused in the Upper Susquehanna Valley and barely extend into adjacent drainages (Funk 1993:193; Funk and Rippeteau 1993a:30; Ritchie 1971:130-131). Possible misidentification as Brewerton notched forms might relate to their perceived absence in more southerly portions of the Upper Delaware, although there are observable differences; Vestals bifaces are smaller and thinner with more infrequent use of basal grinding (Funk and Rippeteau 1993b:224). A review of biface assemblages from the Pennsylvania and New Jersey portions of the study area would be important in revealing analogous forms or their absence, with potential implications for group territoriality, identity and interaction.

As has been recognized, the Vestal and Normanskill types occur close in time, are associated with overlapping radiocarbon dates (Funk 1993:194, Table 17), and may “have been simultaneously manufactured and used by some individual groups, perhaps serving different, specialized functions” (Funk and Rippeteau 1993b:224). In his analysis of Upper Delaware data Kinsey (1972:419) considered Normanskill to be a catchall category with some specimens intergrading with Lamoka forms. Custer (2001:40) describes Normanskill as a minority type related to the Pequea biface form with a potential chronological range extending from the Middle Archaic to Middle Woodland periods.

Four assays relating to the Normanskill type are known for the study area. Three of these are considered to be reliable and range from 3685+/-100 BP to 3390+/-100 BP (see Tables 2, 8). The fourth date, 810+/-80 BP, relates to a feature at the Otego Yard site (Otsego County, New York) associated with both the Normanskill and Vestal types; the biface associations are typical, the radiocarbon assay is not. The two earliest dates relate to a single site (Fortin) located in a nearby portion of the Upper Susquehanna Valley. The third and latest of the reliable dates comes from the Brodhead-Heller site (38Pi17) in the Upper Delaware and may extend the late end of the range ascribed to the type by Funk (1993:194). However, when calibrated the three dates overlap between ca. 1937 BC and 1864 BC (see Table 2).

As part of a compliance project in the Upper Delaware Stevens (1994) and colleagues (Stevens et al 1993) examined the distribution and context of Normanskill points on sites (n=9) in the area in an attempt to synthesize settlement patterns. The data presented in Table 9 is part of the analysis Stevens (1994) performed to better understand the chronological position of Normanskill and its relationship with other biface types assigned to the Late Archaic period. The analysis of Upper Delaware sites was hampered somewhat by what appeared to mixed assemblages in shallow, compact stratigraphic sequences. Stevens (1994:10) notes the occurrence of Normanskill with other Late Archaic types in the deepest levels of the Miller Field site (28Wa16) stratigraphically below a Perkiomen component. Kraft (1972:21, 29) considered Normanskill and other point types (Vosburg, Brewerton Side Notched, Lackawaxen) typically assigned to the Delaware Valley Late Archaic Complex to be out of context at Miller Field without further elaboration.

TABLE 9
STRATIGRAPHIC AND TYPOLOGICAL ASSOCIATIONS OF NORMANSKILL POINTS IN THE UPPER DELAWARE VALLEY: PENNSYLVANIA AND NEW JERSEY*

Point Type	Normanskill Points Occur Above (# of relevant sites)	Normanskill Points Occur Below (# of relevant sites)	Normanskill Points Associated With (# of relevant sites)
Otter Creek			
Vosburg			
Brewerton	1		1
Lackawaxen	1		6
Narrow Stemmed			
Lamoka			3
Vestal Notched			
Egypt Mills			1
Genesee			
Lehigh/Snook Kill		2	
Perkiomen	1	2	
Orient/Dry Brook Fishtail		2	1

*Data abstracted from Stevens 1994:10, Table 10

It should be noted that the type associations in Table 9 are not from contexts that were directly dated. However, calibrated radiocarbon date ranges from the project area for the Lackawaxen, Lamoka, Egypt Mills, and Fishtail types have potential points of overlap with the few known dates for Normanskill points. Such cannot be said for the Brewerton and Normanskill types. Of the stratigraphic relationships tabulated only the occurrence of Normanskill below Orient/Dry Brook fishtails seems problematic in the context of the radiocarbon data base.

Protein residue analysis implies that at least in one case a Normanskill point may have been used as a knife and a projectile point. At 36Mr133 a Normanskill biface (FS 226) tested positive for bear. It also tested positive for guinea pig which could represent beaver, porcupine or squirrel (see Figure 21; Hornum et al 2009:76-79; Parr 2006).

Considering the degree of variability in points identified as representing the Macpherson type (Figure 26) one might also consider it a catchall category. Attributes of the Lackawaxen, Lamoka, and Normanskill types can be discerned. Only two dates for the type derive from the project area and confirm Kinsey's assignment of it to the Late Archaic period (see Tables 2, 8). The dates also fall within the chronologies of the Lackawaxen, Lamoka and Normanskill types.

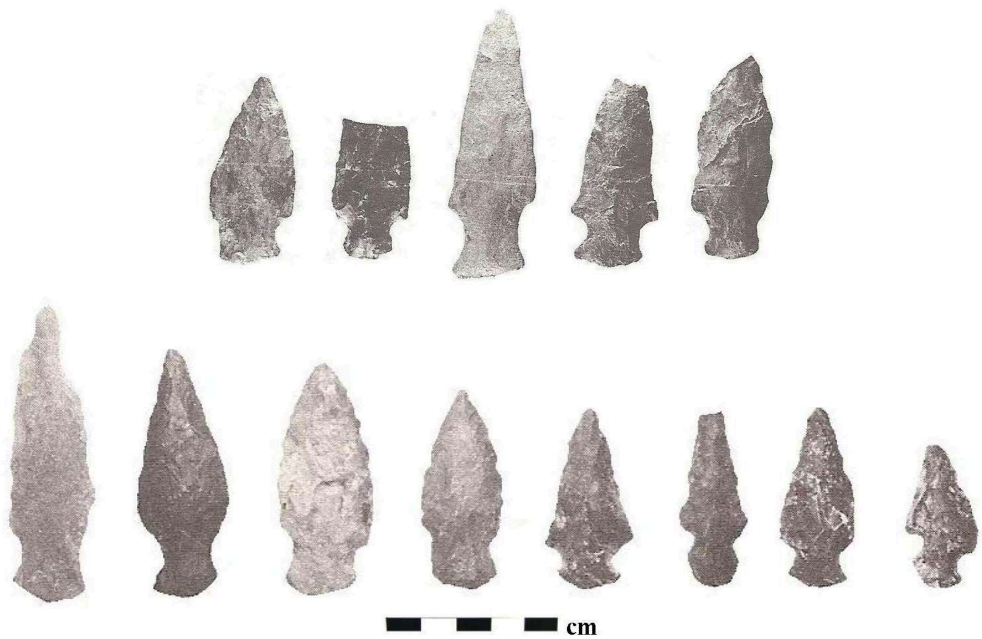


FIGURE 26. Macpherson points from the Upper Delaware Valley. Top row are examples from dated Zone 3 at 28Wa2. Bottom row are speciments from the Macpherson collection. Modified from Kraft (1975b:Figure 22) and Kinsey (1972:Figure 117).

The final biface form to be considered in the grouping of narrow stemmed types is Rossville, originally associated with the Middle Woodland Bushkill Complex of the Upper Delaware Valley and dated ca. 500 BC to 100 BC (Kinsey 1972:364-369). An unacceptable date of 1160+/-120 BP from the deposits in which these points occur at the Faucett site is felt instead to relate to a Jacks Reef point from the same context/occupation area as the charcoal that was dated (Kinsey 1972:191-192, 367). Ritchie (1971:46) notes some overlap in the shape of Rossville with the Poplar Island type. Kinsey (1972:436) suggested that the general Rossville form is a carryover from converging stem variants of the Lackawaxen type. Andrefsky's (1983:Table 12, 120-121) numerical definition of point types for the Upper Delaware Valley reveals substantial variation in the traditional Rossville type. Mounier (1975:11) points out the longevity of the Rossville morphology noting that they can occur in Middle Woodland as well as pre-ceramic and possibly Late Archaic contexts. Custer (2001:43, 59) considers Rossville as a minor type related to Poplar Island and other forms which can be Middle Archaic through Middle Woodland in age.

Of the four dates for Rossville from the study area, two conform to the types expected range and two (1360+/-70 BP, 1230+/-60 BP) fall within a late Middle Woodland time frame that caused Kinsey to reject a similarly late date from the Faucett site (see Tables 2, 8). The two late dates are from the same feature context at site AO71-06-0077 (Orange County, New York). The point associated with the feature is shown in Figure 27. The other example illustrated in Figure 27 is from 28Sx297 and associated with a date (2250+/-80 BP) which is more in line with the regional chronology for the type (see Table 7). A greater longevity for the biface form is suggested by these dates and aligns with the observations of Mounier (1975) and Custer (2001).

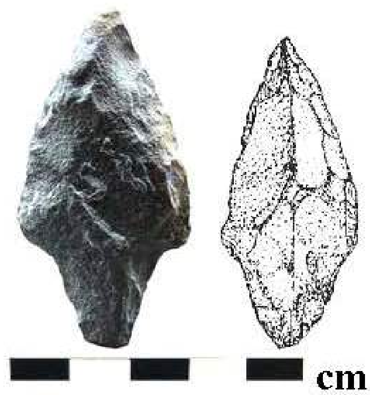


FIGURE 27. Rossville points from dated contexts at 28Sx297 and Site AO71-06-0077, Orange County, New York. Modified from Santone et al (1997:Plate 8) and Hunter Research (1989:Figure 6.1), respectively.

Eshback is a problematic type owing to its appearance in contexts of radically different age. In the Upper Delaware Valley it was proposed to be a minority type found in mixed Archaic contexts but generally thought to be of Late Archaic age (Kinsey 1972:417-419; 1975:63-64). Two dated occurrences are known for the project area. At Treichlers Bridge (36Nm142) a specimen (Figure 28) associated with an assay of 3160+/-75 BP post-dates the age noted by Kinsey for the type, but is in line with other dates from sites in the broader region (see Table 8 and below). An Eshback point found at the Bachman site (36Nm80) is assigned a Late Archaic age, occurring in a strata predating a surface dating to ca. 1800 BC. A radiocarbon assay of 1360+/-120 BP in associated with the excavation context in which the Eshback point was found at the site but is felt to be anomalous by the investigators (Anthony and Roberts 1987:83-85).

At the Byram site (28Hu39), in the Middle Delaware Valley, Kinsey (1975:77) assigns the Eshback type to the Late Archaic. However, its depth in the deposits is noted as 79 inches (Kinsey 1975:Figure 28 caption) which falls within the depth range (72-79 inches) interpreted as representing the Dry Brook Phase of the Fishtail Tradition (Kinsey 1975:72). At 28Me100G near the AFNHL the type is best represented in deposits with late Middle Woodland and Late Woodland radiocarbon dates (Stewart 1987:64, 80, 352, Figures17, 19, Plate 5). At the Gravelly Run site (Atlantic County, NJ) in the Lower Delaware Valley the type is associated with two dates, 3950+/-40 BP and 3980+/-70 BP (Mounier and Cresson 2009; Mounier 2015).

FIGURE 28. Eshback point from a dated context at Treichlers Bridge, 36Nm142. Modified from Anderson et al (2000:Plate 6.3.1-8).

Also in the Lower Delaware, Eshback points from the Berkley Square site (Gloucester County, New Jersey), produced the earliest dates ascribed to the type, and are at variance with what Mounier (2015:3) considers to be valid assays that anchor the form in the Late Archaic period. At Berkley Square Eshback points are associated with features producing AMS dates of 5690+/-30 BP and 5620+/-30 BP. Mounier suggests that the form may be the result of retooling bifaces that have been basally snapped in order to facilitate rehafting "in which case, the basal indentations might represent added enhancements or remnants of previous notches" (2015:3).

Radiocarbon assays for broad-bladed biface types of the Late/Transitional Archaic are listed in Table 10. Where dates are identical for two types it is either because they are associated in a dated context, or a single specimen was identified as an amalgam of types (e.g., Orient/Susquehanna). Dates associated with the Fishtail type are included. Ritchie (1959:90) suggested early-on that Orient Fishtail projectile points may have developed on a local level from a regional Susquehanna Broadspear form. In his analysis of point morphologies in the Upper Delaware Valley Andrefsky (1983:36) concludes that the distinction between the Orient Fishtail, Dry Brook Fishtail, generalized Fishtail, and some Susquehanna broadspear points is not clear in all cases. The resharpening or retooling of a Susquehanna Broadspear could easily result in a form that would intergrade with the morphology of the Fishtail type (e.g., Kent 1996:25). Funk and Rippeteau (1993b:224) view Fishtail points as part of the developmental sequence represented by the "Broadspear-Susquehanna" tradition. In their synthesis the Broadspear-Susquehanna tradition includes components that may possess Genesee, Snook Kill, Lehigh, Koens-Crispin, Perkiomen, Susquehanna, and Fishtail points (Funk and Rippeteau 1993b:224).

Genesee and Snook Kill points are associated with the earliest dates. The morphology of the types closely resemble one another as is reflected in biface identifications such as Snook Kill/Genesee in some reports and publications. Designations such as Snook Kill/Lehigh/Koens-Crispin underline aspects of similar biface morphology that characterize types thought to occur later in time (Funk 1993:196). The Genesee type, with its morphological relationship to Savannah River bifaces (Custer 2001:44, 54; Funk 1993:196), is presumed to be the earliest to appear in the sequence of broad-bladed types of the Late and Transitional Archaic, followed closely by Snook Kill (Funk 1993:195-197). Admitting that more data are needed, Funk

(1993:195-197) and Funk and Rippeteau 1993b:224) assign Genesee to the period 1900-1800 BC and Snook Kill to ca. 1800-1700 BC.

TABLE 10
COMPARISON OF DATES* FOR BROAD BLADED POINTS
UPPER DELAWARE AND ADJACENT AREAS**

Genesee	Snook Kill	Lehigh/Koens-Crispin	Perkiomen Broadspear	Susquehanna Broadspear	Fishtail
4020+/-80	4020+/-80				
	3920+/-95	3920+/-95			
		3770+/-90			
	3740+/-70	3740+/-70			
		3670+/-100	3670+/-100		
				3600+/-80	
			3590+/-100	3590+/-100	3590+/-100
		3570+/-100	3570+/-100	3570+/-100	
			3450+/-120		
				3280+/-90	
					3230+/-120
				3210+/-70	3210+/-70
					3170+/-120
					3120+/-120
					3070+/-80
	3030+/-100				3030+/-100
					2920+/-30
					2760+/-100
				2560+/-120	
				2400+/-60	
					2350+/-95
				1180+/-90	

*Dates are shown BP and derived from Tables 1 and 2.
** See Introduction for details regarding adjacent areas.

Radiocarbon dates from the study area extend the early range of time assigned to both the Genesee and Snook Kill types (see Tables 2, 10). Genesee and Snook Kill points are found together at 4020+/-80 BP at the Park Creek 1 site (Broome County, NY). At 3920+/-95 BP, Bifaces typed as Koens-Crispin/Snook Kill are found in dated Zone 3 (3920+/-95 BP) at 28Wa2 (Kraft 1975b:39, Figure 24). The unusually late date shown for Snook Kill in Table 10 is associated with a problematic typological assessment. The biface was typed as Orient/Snook Kill (see Table 2) at the Otego Yard site (Otsego County, NY) and is suspect given the attributes typically used to identify the individual types. Examples of Genesee, Snook Kill and variants associated with radiocarbon dated contexts are shown in Figure 29.

In the East Branch Valley of the Upper Delaware Basin a date of 3680+/-40 BP (see Table 1) from a thermal feature is applied to Genesee and Snook Kill points found elsewhere on the Mt. Laurel Gardens site (Delaware County, New York). Components at the site could not be separated stratigraphically; the clustering of diagnostic artifacts was used to define a horizontal stratigraphy of sorts. However, this and another later date from a second feature do not coincide with the spatial clustering of diagnostic artifacts and their presumed ages (Carroll et al 2007:49, 60-62). Uncalibrated, the date is consistent with the estimates of Funk and Rippeteau (1993b:224) for the type.

FIGURE 29. Dated examples of Genesee, Snook Kill and variant bifaces. Top row, left to right: Snook Kill or Genesee, Genesee, and Snook Kill from the Park Creek I site, Broome County, New York, modified from Miroff (2002:Photo 5); Snook Kill from the Peake site, Delaware County, New York, modified from Hartgen Associates (1988a:Plate 5); Snook Kill or Lehigh/Koens-Crispin points from the Driftstone site, 36Nm244 (Don Kline collection, photo courtesy of Don Kline). Bottom row: Koens-Crispin/Snook Kill bifaces from Harry's Farm, 26Wa2, modified from Kraft (1975b:Figure 24).

The association of Genesee and Koens-Crispin in a dated context in the study area was noted above. At Harry's Farm, Koens-Crispin/Snook Kill bifaces are associated with the Poplar Island, Macpherson, Lamoka, and Beekman types (see Table 2). Known date ranges for the types make this association reasonable. At Calver Island (36Da89) in the Middle Susquehanna Valley the Genesee type is part of an occupation dated ca.3800 BP. Points in the related excavation level include Pequea, Steubenville Stemmed, Rossville, and Bare Island (Miller et al 2010:94). Also at Calver Island, Snook Kill and Poplar Island points are found together in an occupation dated ca. 3300 BP (Miller et al 2010:93). Snook Kill/Lehigh, Canfield Lobate, Perkiomen, Susquehanna, Orient, Bare Island-like, and Lamoka point types are found together in a context dated to 3520+/-115 BP and 3490+/-75 BP at Canfield Island (Bressler et al 1983:38-42,Table 6). The Perkiomen and Orient finds were considered intrusive with no explanation provided (Bressler et al 1983:39).

Single Snook Kill and Snook Kill/Genesee points from the Park Creek 1 site produced a variety of evidence during use wear analysis (Pope 2002:69 in Miroff 2002). Polish was observed along the lateral edges and surfaces of two artifacts (artifact s BT-2 and BT-3). Both are also damaged by distal impact fractures. In addition, isolated areas of polish on the distal tips and the presence of polish streaks across blade surfaces support their probable use as projectiles.

Along with Snook Kill and Koens-Crispin, Lehigh Broadspears are part of what Carr (2015:60) defines as the Early Broadspear phase in Pennsylvania with an end date of ca. 3700

BP. Dates relevant to the Lehigh type (see Tables 2, 10) extend the late end of this proposed chronology and show considerable overlap with those associated with the Perkiomen type, the next form in the traditional broadspear sequence. Perkiomen and Susquehanna broadspears are part of Carr's (2015:60) Late Broadspear phase dating ca. 3700-3200 BP. While project area data show the chronological priority of the Perkiomen type, dates associated with it are closely aligned with those of Susquehanna broadspears.

Two late dates (2560+/-120 BP, 2400+/-60 BP) for the Susquehanna type relate to the dated burial cluster at the Rosenkrans site where they might be considered as accidental inclusions in pit fill or as older artifacts collected and placed in the mortuary features as tokens. The Rosenkran dates overlap the chronology of Fishtails and reflects on the noted gradation between Susquehanna Broadspears and Fishtails. At the Otego Yard site Vestal, Susquehanna, and triangular points are associated with a feature dated at 1180+/-90 BP (see Table 2) which is clearly an anomalous assay for the Vestal and Susquehanna types. Anomalously late dates for Susquehanna Broadspears are known from sites elsewhere in the Middle Atlantic Region (Inashima 2008:260-262). While some of these are clearly unreasonable, a number that relate to the Early Woodland period may not be, and bring to mind the intergrading of Susquehanna and Fishtail morphologies; it is reasonable to find Fishtail points in Early Woodland contexts. For example, Susquehanna Broadspears are found in Early Woodland pit features in the Shenandoah Valley at 44Wr329, in one case associated with early pottery and a radiocarbon assay of 2740+/-150 BP, generally deemed to be too late for broadspears (McLearen 1991a:64-65, 90). The possibility was considered that there was localized use of this biface form into the Early Woodland period.

The chronology of Fishtail type bifaces considerably overlaps that of Susquehanna Broadspears in the study area as might be expected given their presumed morphological and developmental relationship. At first glance the 2350+/-95 BP assay from the Faucett site seems unusually late given a regional perspective (see Table 7). Calibration renders the date more reasonable (see Table 2), as does its association with a Meadowood point and the typical chronology assigned to this type.

The Dry Brook form of Fishtails is presumed to pre-date the Orient form although the latter appears first in the regional literature (Ritchie 1959). The Dry Brook variant was defined by the work of Werner (1972:75; Kinsey 1972:430-432) in the Upper Delaware Valley. It is the single date associated with Dry Brook Fishtails at the Zimmerman site (36Pi14), reported on by Werner, that suggests the type's chronological priority. The sharply angled shoulders of the Dry Brook form is seen as the primary attribute distinguishing it from the Orient form. However, the intergrading of the morphologies of Dry Brook with Orient and smaller Susquehanna broadspears is acknowledged (Kinsey 1972:431), as is the difficulty of clearly distinguishing between the variant forms (Custer 2001:30). A comparison of illustrations of the two Fishtail forms emphasizes the intergrading of Dry Brook and Orient points (cf. Kinsey 1972:Figure 119; Ritchie 1971:Plate 19; Werner 1972:Figure 23). The intergrading of the morphology of Fishtails with that of Susquehanna broadspear variants, and the chronology of the former clearly including portions of an Early Woodland time frame, may account for the anomalous late dates associated with the Susquehanna type in the Delaware Valley and Middle Atlantic Region.

The dated Fishtail component at the Driftstone site (36Nm244), identified as Orient (Blondino 2008, 2015), is associated with a buried A horizon and associated subsoil. Examples of finished and late stage production forms are illustrated in Figure 30. With few exceptions the morphology of the points conforms to the definition of the Orient form of the Fishtail type. The site has produced a large assemblage of Fishtail points, related preforms, and debitage that can be used to document the production process in detail; a thorough study is needed. Collections resulting from the initial work at Driftstone are held by Donald Kline (Mt. Bethel, Pennsylvania) with those from subsequent studies curated at Temple University's Laboratory of Anthropology. A study of the even larger assemblage from the Zimmerman site (Werner 1972:72), held by the State Museum of Pennsylvania, also would provide significant insights. Examining the production process or *chaine operatoire* related to Fishtails, or any biface type, and how it may vary across space has the potential to provide an archaeological signature of learning networks of artisans.

FIGURE 30. Fishtail points from the Driftstone site, 36Nm244 (Donald Kline collection, photo courtesy of Donald Kline).

Data from such projects could be compared with the analysis of the biface production process documented at the Padula site (36Nm15) and associated experiments. Seven Orient Fishtails were experimentally replicated tracking the weight of debitage by decreasing screen mesh sizes (2.0 mm, 1.0 mm, 500 µm, 250 µm, <250 µm) and the weight of the finished biface

(Bergman, Duerksen and Russell 1994:232-234). For one of the bifaces flake waste was quantified by production stage: edge preparation, initial thinning, secondary thinning, and edge finishing. The production process began with a large flake blank following the implications of the Orient related archaeological deposits. These data were also used as part of archaeological research at Sandts Eddy (36Nm12), including additional experiments with replicated Orient Fishtails (Bergman, Russell, Duerksen and Miller 1996:90-210). Microwear analysis of both experimental and archaeological Fishtails was completed at both sites (Kimball 1994a, b, 1996) and provides a useful approach for future work with the Driftstone, Zimmerman, and other Fishtail assemblages.

Given their chronological ranges in the Delaware Valley and Middle Atlantic Region, the potential exists for contemporaneous occurrences of Snook Kill, Lehigh/Koens-Crispin, Perkiomen, Susquehanna, and Fishtails points (cf. Tables 2, 7, 10). A number of associations of broad-bladed points have already been noted. Additional associations of broadspear and Fishtail point types in dated contexts in the project area include: Lehigh/Koens-Crispin and Perkiomen (28Wa16); Lehigh/Koens-Crispin, Perkiomen, and Susquehanna (36Pi7); Perkiomen, Susquehanna, and Fishtail (28Wa16); Susquehanna and Lackawaxen (36Pi14); Susquehanna, Lackawaxen, Cresap/Cresap-like, untyped side notched, and Kittatinny (28Sx2); and Fishtail (Orient), Meadowood, untyped straight stemmed, and untyped corner notched (36Pi13A).

It is clear from their co-occurrence in pit features and stratigraphic distributions at the Miller Field site (Kraft 1970a:29-45, Table 3) that the use of Perkiomen and Fishtail points is contemporaneous at certain points in time. Perkiomen and Susquehanna broadspears are clearly contemporaneous in Stratum 10 at the Nesquehoning Creek site (36Cr142) in the Lehigh Gorge section of the Delaware River basin (Stewart 2011a; Stewart et al 2011). In the Middle Delaware Valley points identified as Fishtails, and those that resemble Fishtails but are not identified as such, occur together in a deposit dated ca. 1283-793 BC at the Williamson site along with a Perkiomen Broadspear, Lackawaxen-like, Hellgrammite, Meadowood-like and a number of newly named point types (cf. Hummer 1991:133-156, Plates 11-13, 1994, 2005:Figures 1-3, 7-8).

Broadspear and Fishtail associations are notable in the Middle to Upper Susquehanna Valley of Pennsylvania. A ca. 3430 BP occupation on the well stratified Calver Island site (36Da89) includes Susquehanna and Fishtail points (Miller et al 2010:93). The compressed Terminal Archaic sequence of occupations at 36Un82 includes Snook Kill, Perkiomen, Susquehanna, and Fishtail points (Wall 1995:96-98, Table 1). In some areas of the excavations Fishtail points were found both above and below levels containing broadspears, although most occupied higher stratigraphic positions than Susquehanna points (Wall 1995:96). Snook Kill, Perkiomen and Fishtail points were found near Feature 22 dated at 3640+/-110 BP (Wall 1995:105, Table 1, Figures 37, 52). Calibrated with two sigma this date neatly overlaps the dated association of Perkiomen and Fishtail points at the Miller Field site (28Wa16). Snook Kill Broadspears and Fishtails occurred near Feature 33 dated to 2900+/-100 BP (Wall 1995:105, Table 1, Figures 37, 52). It is interesting that calibrating this date reveals a close correspondence with the 3030+/-100 BP date for what was identified as an Orient/Snook Kill point at the Otego Yard site (see Table 2). Funk (1993:197) speculates that Perkiomen and Susquehanna broadspears may have “been simultaneously manufactured and used by individual bands in the Susquehanna Valley and other northeastern regions.”

The co-occurrence of broad-bladed and narrow stemmed points is well demonstrated in the study area and the Middle Atlantic region (e.g., Carr 2015; Custer 1996, 2001; Miller 2015:90; Miller et al 2007; Moeller 2015). What is interesting are the differing approaches in the production of the two categories of bifaces. Broadspears are produced using the staged reduction of bifaces or bifacial cores, a technology different from that used to produce earlier stemmed bifaces or projectile points (cf. Cresson 1990). However, it is clear that broadspears and narrow bladed stemmed biface/projectile types are contemporaneous, with the latter produced using a core and flake approach (Carr 2015:63-64; Stewart 2015b:5).

Challenging the positions of Snethkamp et al (1982) and Custer (1984), Funk and Rippeteau (1993b:225) argue that manifestations of what they defined as the Broadspear-Susquehanna tradition

> do not simply represent a lithic technology and tool kit grafted on to “narrow point” complexes previously established throughout the Northeast. The weight of evidence in New York, the Upper Delaware Valley and New England clearly indicates that the Broadspear-Susquehanna diagnostic traits are material remnants of discrete, whole cultural systems.

The distinctiveness of broadspear-using cultures continues to be affirmed, acknowledging that part of the stone tool kit includes narrow stemmed points that continue an earlier trend in biface style and production (Carr 2015:57, 60-61; Stewart, Carr and Raber 2015).

Kent (1996) rejects the notion that the co-occurrence of broad-bladed and narrow stemmed points reflects the different uses to which each were devoted, citing a lack of convincing evidence regarding function. However, such evidence has accumulated since the time of Kent’s writing. Analysis of broadspears and stemmed and notched point types from four stratified sites in the Middle Susquehanna Valley revealed no differences in the ways that each were used (Miller 2015:89).

The function of broadspears has been a matter for debate. McLearen (1991b:94) summarizes the early experimental work of Callahan (1974) indicating that large hafted bifaces can function well both as projectiles and generalized cutting tools. Dunn’s (1984) study of 75 Perkiomen points found sufficient evidence of proximal surface wear to conclude that the majority of the bifaces functioned as heavy-duty cutting or cleaving implements. Staats (1986b) contested Dunn’s study. He argues on the basis of morphology and breakage patterns that Perkiomen Broadspears found on Upper Delaware sites were initially made and used as projectiles. and incidentally used as knives. Broken Perkiomen projectiles were retooled for more consistent use as knives. Kraft (1990) considers the size and morphology of Perkiomen points as evidence of their use as projectiles and subsequent repurposing to serve other functions. A variety of studies examining patterns of breakage and resharpening by Custer (1991, 1996:172-173) and colleagues (Custer and Bachman 1984, 1986; Custer and Mellin 1986) conclude that broadspears were used more commonly as knives than projectile points. Truncer (1988a, b,

1990) examined fracture patterns in samples of Perkiomen points from the Upper Delaware and Middle Atlantic region, as well as experimental replicas used as projectiles and as knives. He concludes that Perkiomen points were used as both projectiles and knives. Cresson (1990) comes to a similar conclusion based on his experimental work and observations of regional collections.

More recent studies support the multi-purpose nature of broadspears and emphasize the need to demonstrate artifact function on a case-by-case basis rather than simply ascribing use on the basis of morphology. Use wear analysis of a Lehigh Broadspear (artifact 3474.2) from Treichlers Bridge (36Nm142) produced evidence of graving bone, butchering meat or bone, and scraping dry hide (Church 2000:15-16). Three Perkiomen Broadspears from Sandts Eddy (36Nm12) show microwear indicative of heavy butchering, including one with possible evidence of use as a projectile (Kimball 1996:Table 12.3). In a microwear analysis of a collection of 69 bifaces representing Koens-Crispin and Perkiomen broadspears from four stratified sites in the Middle Susquehanna Valley "70% showed macro- or microimpact fractures, and half had both impact fractures and evidence of use for butchering" (Miller 2015:89-90).

Evidence indicates that Fishtail points are also multi-purpose bifaces. Three Orient points from 36Mr133 provided positive reactions during protein residue analysis. Two (artifacts FS864, FS912) tested positive for bear, and one (FS1004) for guinea pig which could represent beaver, porcupine or squirrel (Hornum et al 2009:78; Parr 2006). The points are depicted in Figure 31. Microwear analysis performed as part of investigations at the Padula and Sandts Eddy sites included the examination of Fishtails from the archaeological deposits as well as experimentally replicated Fishtails used as projectiles and in butchering activities (Kimball 1994a, b, 1996). Replicated points and archaeological specimens from Padula were employed both projectiles and knives in butchering, hide and bone/antler working (Kimball 1994a:240-248, 252-284). At Sandts Eddy microwear traces implicate the use of Orient bifaces as potential projectiles and tools used in heavy butchery (Kimball 1996:Table 12.3).

FIGURE 31. Orient Fishtails from 36Mr133 tested positive for protein residues. Left to right: FS864, FS912, FS1004. Modified from Hornum et al (2009:Figure 46 - FS1004 incorrectly labelled as FS1005 in Figure 46, cf. Hornum et al 2009:Appendix III).

Kinsey (1972:353) notes the differential representation of Perkiomen versus Susquehanna broadspears in the Upper Delaware Valley with the former most frequently seen. Given the close correspondence in the types' chronologies in the area (see Table 10) explanations for the disparities in frequencies need to be explored. Carr (2015:65-66, Table 3-3) notes that such disparities also exist between the Delaware and Susquehanna river drainages in Pennsylvania. Table 11 illustrates these differences. Site density calculations per unit of area emploted in the table is a way of dealing with bias from the major differences in the size of the two drainage basins that affects considerations of the total number of sites found and the percentages with which an individual point type is represented. There are other biases in the data sets (e.g., degree of survey coverage, geomorphology and ease of site detection) that are not controlled for in this summary analysis.

TABLE 11
COMPARISON OF BROADSPEAR AND FISHTAIL SITE FREQUENCIES
DELAWARE AND SUSQUEHANNA RIVER BASINS OF PENNSYLVANIA*

Point Type	# Sites for Type, Both Drainages	# Sites With Type Delaware Basin	Percent of Sites by Type Delaware Basin	Density of Sites per 100 km^2 Delaware Basin	# Sites With Type Susquehanna Basin	Percent of Sites by Type Susquehanna Basin	Density of Sites per 100 km^2 Susquehanna Basin
Koens-Crispin	337	81	24%	0.48	256	76%	0.51
Lehigh/Snook Kill	194	56	28,8%	0.33	138	71%	0.28
Perkiomen	336	143	42.5%	0.85	193	57.4%	0.39
Susquehanna	329	52	15.8%	0.31	277	84%	0.56
Fishtail	373	144	38.6%	0.86	229	61.3%	0.46

*Modified from Carr 2015:Table 3-3.

Carr (2015:65-66) attributes sociotechnic or ideotechnic significance to the biface types and suggests that they might be a reflection of differences in the social structure of the groups who inhabited the two river basins. Assuming that a group's stone tool artisans are male Carr (2015:66) states that

> …the distinction suggests a social organization that creates two groups of males. A simple hypothesis is that the distribution is the result of a patrilocal postmarriage residence rule since males did not frequently move their residence between these two drainage basins.

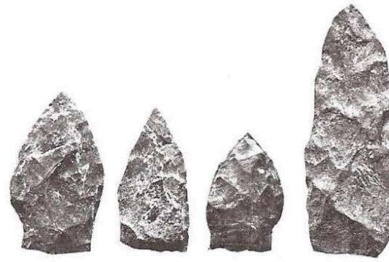
Such reasoning implies that trade might account for some portion of the Perkiomen points found in the Susquehanna Basin, and Susquehanna points found in the Delaware Basin. Complementing Carr's analysis with data from the New Jersey and New York portions of the Delaware Basin would be a first step in exploring this hypothesis and serving as a basis to consider alternative explanations for differential distributions of the biface types. What Carr finds compelling is that similar disparities in point type distributions do not occur prior to the appearance of broadspears. Dealing more effectively with the variability found in earlier biface assemblages is necessary to support this assertion. Similar disparities might arise should we focus such an effort on bifurcate points as Fogelman and Struve have intuited. Also apparent in Carr's data are differences between drainages in the representation of sites with Fishtails points in terms of percentages and site densities. Again, data from New Jersey and New York need to be included in such analyses.

Performing a similar analysis by sub-basins within each of the major drainages might be one way to begin to test Carr's social organization hypothesis. Falloff patterns in site numbers and densities might reveal core areas of macro-social groups and the geography of group movement and interaction. Kent (1970) performed a somewhat similar analysis for the Piedmont of the Susquehanna and Delaware valleys looking at the distribution of Archaic point types by sub-basins and other relatively small environmental zones. In hindsight, sample sizes, issues with crafting analytic types given observed variability/intergrading, and current understandings of the broad or contrasting chronologies of a number of the types employed in his thought-provoking analysis impact his conclusions (cf. Kent 1996). However, like Carr, his results implicate the existence of patrilocal bands.

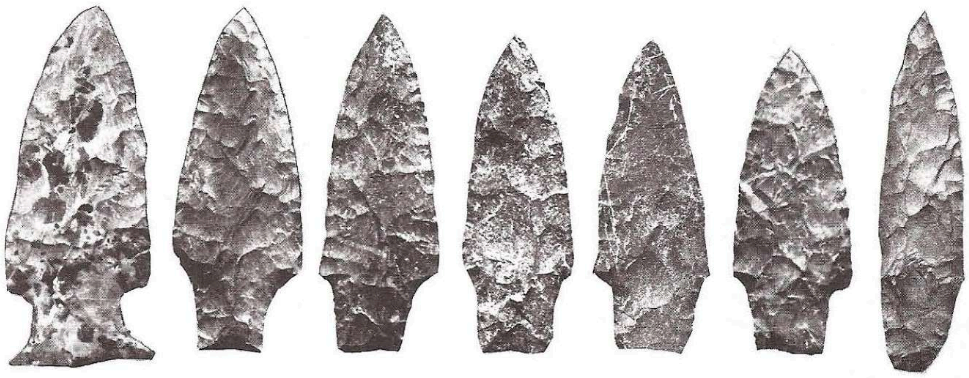
The untyped notched points from the dated burial cluster at the Rosenkrans site (28Sx2) present a challenge for typologically assessing the age of surface sites in settlement pattern analysis, as do the narrow-bladed stemmed and other points previously discussed (i.e. Cresap, Cresap-like, Lackawaxen, Susquehanna, Kittatinny). Points from the burial cluster are shown in Figures 32 and 33 (also see Custer 2001:27; Kraft 1976a:Figures 2, 3, 10, 12, 13, 15). Burial 9 is associated with a date of 2560+/-120 BP and includes untyped corner notched points. No bifaces are associated with Burial 5 which is the source of the other radiocarbon date (2400+/-60 BP) for the burial cluster. Untyped corner notched points also are associated with Burial 8 but not illustrated in Kraft's (1976a:29, 32) report on the site. A side notched point is associated with Burial 1 along with specimens that Kraft (1976a:Figure 2) assigned to the Cresap and Kittatinny types. All of the points from Burial 2 were identified as Cresap-like (Kraft 1976a:Figure 3). The biface cache shown in Figure 33 is from a context "very close to Burial No.10 but possibly in another pit" (Kraft 1976a:38).

Nine points are linked with Burial 7 but not felt to be specific to the period of the other graves; they are items picked up by mourners and placed in the grave, or the result of digging through older deposits to create the grave and subsequently using the generated fill and older artifacts to close the grave. The types identified include: Kittatinny, Vosburg, Lackawaxen, Perkiomen (identified as a Susquehanna broadspear in Kraft's Figure 10), "and other Middle to Late Archaic forms" (Kraft 1976a:25). Not all of these are illustrated in Figure 32. A Kittatinny point associated with Burial 8 also is felt not to have been in use during the period when the grave were created.

Kraft (1976a:15, 32) felt that the side and corner notched points were contemporaneous with the Cresap and Cresap-like points found in the graves. The Rosenkrans dates fall within the chronological range of the Cresap type (see Table 7). Some of the bifaces that Kraft (1976a:Figure 15) identified as Cresap-like would fit within the category of narrow bladed and stemmed forms shown to have a potential longevity extending into and beyond the dated contexts at Rosenkrans. The stemmed points in burials 2 and 10 compare in a general way with points from ca.1283-793 BC contexts at the Williamson site in the Middle Delaware Valley (cf. Hummer 2005:Figures 1, 3, 7; Kraft 1976a:Figures3, 15). A general comparison also can be made between the side notched point in Burial 1 and examples at Williamson (cf. Hummer

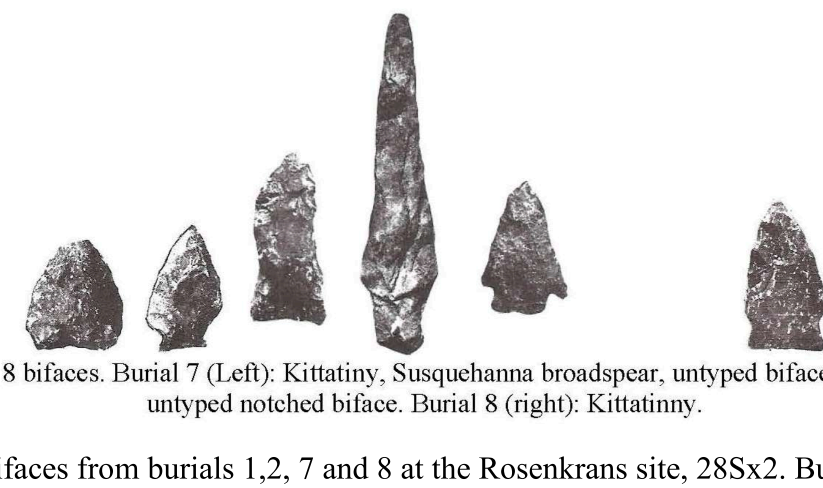


Burial 1 bifaces: Kittatinny (3), biface/knife



Burial 1 bifaces: untyped side notched, Cresap (6)

Burial 2, Cresap-like bifaces.



Burial 7 and 8 bifaces. Burial 7 (Left): Kittatiny, Susquehanna broadspear, untyped biface, Lackawaxen, untyped notched biface. Burial 8 (right): Kittatinny.

FIGURE 32. Bifaces from burials 1,2, 7 and 8 at the Rosenkrans site, 28Sx2. Burial 2 photos courtesy of Gregory D. Lattanzi. Other images modified from Kraft (1976a:29, Figures 2, 10, 12).

FIGURE 33. Bifaces from burials 9 and 10 at the Rosenkrans site, 28Sx2. Top, Burial 9; Middle, Burial 10, specimen third from left part of cache. Bottom, Burial 10, all from cache except for third specimen from left and specimen on far right. Photos courtesy of Gregory D. Lattanzi (cf. Kraft 1976a:Figures 13, 15).

2005:Figures 5, 6; Kraft 1976a:Figure 2). A untyped, corner notched point in a Meadowood cremation feature at the Abbott Farm in the Lower Delaware Valley (Stewart 2017:Figure 6) resembles some of the notched forms at Rosenkrans. The chronological range of Meadowood points overlaps the radiocarbon assays from Rosenkrans.

The potential comparisons with the Williamson site bifaces are far from exact, as are any attempts to associate the Rosenkrans notched points with established biface types. Kraft (1976a:32) noted the suggestion, made by some archaeologists who had examined the collection, that the notched points were Archaic-aged heirlooms added to the burials' grave goods. Some attributes of the points morphologies bring to mind the Vosburg, Vestal and Normanskill types, none of which have chronological ranges which coincide in any way with the Rosenkrans dates. Bases and notches of the corner notched points at Rosenkrans exhibit grinding (Kraft 1976a:32), a practice seen more frequently in earlier times. The use of Onondaga chert compares with the lithic material with which Meadowood points of the Early Woodland period are often fashioned. The coexistence of notched points with narrow bladed stemmed points into the Early and Middle

Woodland periods conforms with the expectations of Custer's (2001:90-113) analysis of biface trends through time.

Four radiocarbon assays from the project area relate to the Meadowood biface type. Of these, two can be questioned. The date of 3180+/-95 BP from the Fortin site is considered to be centuries too old given Funk's (1993:Table 17) expectations for the type. The date of 1380+/-80 BP from the Peake site is considered to be too late to be relevant to the chronology of the biface type. Meadowood points were found in an excavation level coeval with, and on the periphery of dated Feature 89 (2760+/-100 BP), a rock-lined hearth at the Faucett site. Meadowood points are found in both higher and lower excavation levels at the site. Kinsey (1972:190-191, Table 6) does not use the Feature 89 assay to date the Meadowood component at the site. He assigns the date to an Orient component arguing that the two components are closely superimposed and spatially overlapping in places.

Point types associated with Meadowood found around the margins of Feature 161 at the Faucett site include Orient Fishtail and untyped straight stemmed, and untyped corner notched bifaces. The untyped points are not identified in any of the illustrations in Kinsey's (1972, 1975) publications on the site. It would be interesting to see the degree to which they resemble any of the bifaces from the burials at Rosenkrans given the similarities in the radiocarbon dates from the localities. The coeval use of Meadowood and Fishtail points is not unexpected given the regional radiocarbon data base. Meadowood points are relative scarce in the project area (e.g., Funk 1993:199; Kinsey 1972:362).

Two Meadowood points displayed evidence of bone/meat/hide working, as well as being used as projectile points in a study of assemblages of sites from Sussex County, New Jersey (Kelly et al 2012:154, 159). Onondaga chert is presumed to be the lithic material used most frequently in the production of Meadowood points in the study area and elsewhere (e.g., Carr and Moeller 2015:149; Kinsey 1972:191, 433; Kraft 2001:162; Ritchie 1971:36). Artifacts made of Onondaga chert found in the New Jersey and Pennsylvania portions of the study area are generally considered to be exotic and gained through trade (Custer 1996:252-253). The use of this chert is much more common in New York portions of the Delaware Basin and nearby sections of the Upper Susquehanna Valley (e.g., Carroll et al 2007:37-38; Knapp et al 2002:271, 298; Kudrle 2005:125, Tables 26, 53; Levandowski and Versaggi 2003:Appendix 2.2). Others believe that Onondaga-based artifacts are part of the material culture of migrants into the area (see below).

Owing to the scarcity of Meadowood points and artifacts (tubular pipes, birdstones) associated with Meadowood elsewhere, Kinsey (1972:362) infers that the occupations of which they are a part in the Upper Delaware were short term and representative of migrants. Kraft (2001:160), without explanation, views assemblages with Meadowood points as migrants and bearers of a different culture. In an earlier statement he references the scarcity of evidence for his assumption (Kraft 1975b:57). The implication is that very small groups are moving and not populations whose intentions are to establish communities in a new area. While this seems obvious in the early statements of Kinsey and Kraft, the opposite seems to be the case in Kraft's (2001:160-165) later synthesis of Meadowood in the Delaware Valley. Tache´ (2008: 157-158, 227-228) considers the Upper Delaware Valley to be part of an extensive Meadowood interaction sphere with sites representing transitory occupations, probably by groups of Meadowood hunters intermittently visiting the area as a consequence of their trading activities involving Meadowood points and bifaces fashioned from Onondaga chert.

Clark (2016:235, 249) asserts that Meadowood artifacts represent one of a sequence of migrations of Proto Eastern Algonquian speakers into the region and the Upper Delaware specifically. This differs from the interpretations of Kinsey, Kraft, and Tache´ in that it implicates movements of populations and the establishment of communities. Although the linguistic analysis is intriguing, more compelling and detailed analysis of archaeological data regarding such a migration needs to be completed. Criteria for using the archaeological record to establish a potential migration (Anthony 1990; Funk and Rippeteau 1993b:215-218; Rouse 1986) have not been applied in any case.

Custer (1996:242, 251-252) views Meadowood artifacts as relatively isolated occurrences of exotic materials overlain on local Early Woodland cultures, and not part of a distinctive cultural system as it is in western and central New York. He includes Meadowood points and cache blades in what he defines as the Early Bushkill Complex in the Upper Delaware Valley, distinguishing it from a Late Bushkill Complex conforming to Kinsey's (1972:364-369) original characterization. Custer's interpretation represents the most parsimonious use of available data and can accommodate the effects of the occasional transitory group of Meadowood traders.

A variety of Middle Woodland sites have been documented in the study area although there are relatively few radiocarbon dates associated with the Rossville, Lagoon, Fox Creek, Jacks Reef, Tocks Island, and Sand Hill Stemmed biface types typically associated with the period. The Rossville type has been addressed in previous discussions. Its co-occurrence with Lagoon points at the Faucett site were a fundamental part of Kinsey's (1972:364-369) definition of the Bushkill Complex in the Upper Delaware Valley. An assay of 2050+/-135 BP from the Faucett site is the only one for the Lagoon type in the study area.

The Sand Hill Stemmed type (Figure 34) has not been dated, nor frequently recognized in the New Jersey and Pennsylvania portions of the study area. The points are "small, broad, and relatively thick with straight to slightly contracting stems" (Funk 1998:37). Funk (1993:199, 1998:37) originally associated the new type with the Middlesex phase of Early Woodland times although dates (1820+/-55 BP, 1660+/-100 BP) for contexts at the Gardepe site where a cache and additional examples of the points were found are clearly Middle Woodland. A somewhat similar date from the Otego Yard site is associated with the type and would seem to confirm its assignment to a Middle Woodland time frame (see Table 2). Custer (2001:59) views the Sand Hill Stemmed type as a regional variant of the morphology ascribed to Poplar Island, and thus with the potential to range over a wide span of time during Archaic and Woodland periods. The morphologies of these biface forms do not seem to warrant comparison.

Accepting the validity of the Middle Woodland dates for Sand Hill points would make them partially coeval with the Fox Creek and Tocks Island types. Tracking their precise spatial and frequency distributions could provide an interesting perspective on Middle Woodland settlement territories and group interactions, given the type's apparent uniqueness and seeming rarity in the New Jersey and Pennsylvania portions of the Upper Delaware Valley. In contrast, Fox Creek points are found in the New York portions of the Upper Delaware as they are in New Jersey and Pennsylvania, while Tocks Island points seem to be limited to the southern portions of the Upper Delaware.

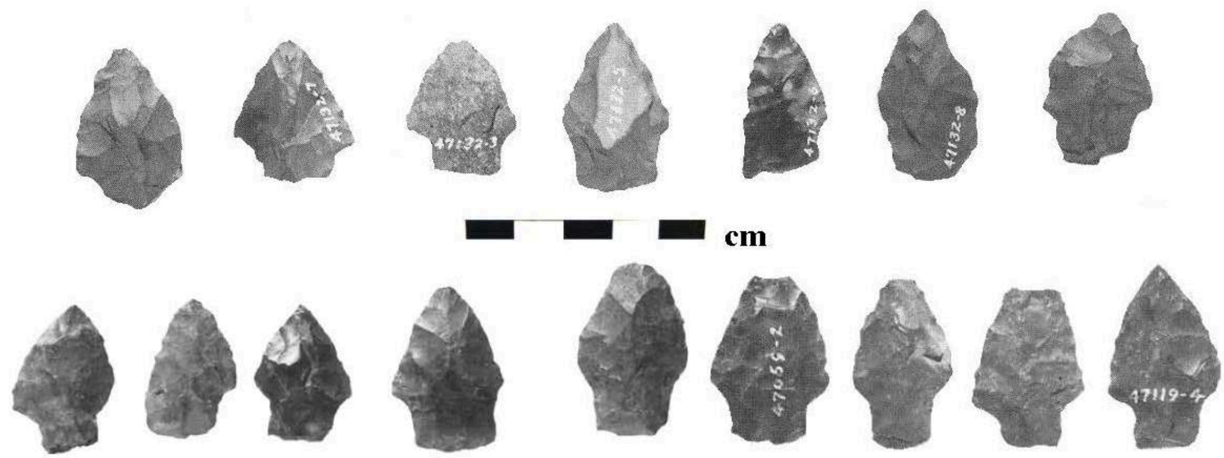


FIGURE 34. Sand Hill Stemmed points from the Gardepe site, Delaware County, New York. Modified from Funk (1998:Plates 133, 135).

Although few examples are associated with radiocarbon dates, the Tocks Island type is clearly a Middle Woodland biface form with a chronology overlapping that attributed to Fox Creek in the region. Examples from the Harry's Farm and Snyder sites (Figure 35) depict the variability that is associated with this biface form. Corner and side notching, and variations in basal morphology might result in specimens found on surface sites or in ambiguous buried contexts being misidentified as one of number of Late Archaic types. Perhaps this is why so little is known of geographic distribution of the form. A Tocks Island biface (artifact 560.2) from Treichlers Bridge is associated with scraping dry and fresh hide as a result of use wear analysis (Church 2000:18). One or more impact fractures are evident on the Tocks Island points from Harry's Farm. The biface's use as a projectile and in other activities is indicated by this limited evidence.

Fox Creek points are associated with only three dates, one of which (640+/-40 BP) from the Padula site (36Nm15) is considered inaccurate. The others fall within the expected chronological range for the type. Fox Creek points are part of the dated component at the Snyder site along with Tocks Island bifaces. A Fox Creek point may be associated with a date of 1440+/-30 BP at the Manna site (36Pi4) but site formation processes have complicated arguing for a direct association between the point and radiocarbon assay (Stewart et al 2015:125). To the west of the study area in the Wyoming Valley of Pennsylvania a Fox Creek component is dated to 1830+/-60 BP at 36Lu169 (Thieme and Schuldenrein 1998:4 citing Herbstritt 1997). In contrast, Orlandini (1996:57) reports "a carbon-14 date of 360 A.D." for the Fox Creek component of the site. This assay is on the very early end of the range assigned to Fox Creek. The scarping of dry hide is indicated by wear present on a Fox Creek point recovered at Treichlers Bridge (Church 2000:14).

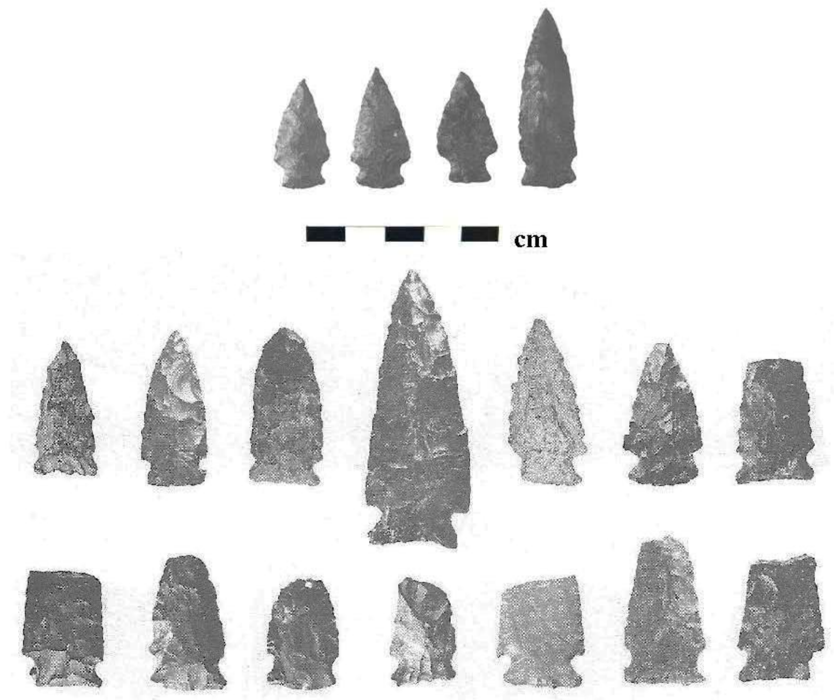


FIGURE 35. Tocks Island points from the Harry's Farm (28Wa2) and Snyder (28Wa528) sites. Top row, 28Wa528 – the rightmost specimen characterized as a possible larger Tocks Island. Middle and bottom rows, 28Wa2. Modified from Kraft (1975b:Figure 30) and Adams and Adams (1991:Figure 1).

Fox Creek points are found throughout the study area but not with the frequencies with which they occur downriver in the Piedmont and Coastal Plain (e.g., Custer 1996:255-259; Fischler and French 1991:148, 155-156; Miller 1991). In some cases Fox Creek points co-occur with shell tempered pottery on sites in the study area (e.g. Graybill 1973; Kline and Staats 1983; Miller 1991; Stewart 2005; Stewart et al 2015; Williams et al 1982:41), a pattern that is typical for components in the Coastal Plain and portions of the Piedmont. For some (e.g., Clark 2016:236; Fischler and French 1991:155-156) these data suggest that the Upper Delaware was used on a seasonal or as-needed basis by groups from the Middle or Lower Delaware Valley. In the Upper Delaware the chronological and stratigraphic resolution of any site associated with Fox Creek or Jacks Reef points is insufficient to talk about strict Fox Creek or Jacks Reef components. The occasional presence of non-local groups in the Upper Delaware is something that should be expected for a variety of reasons. Demonstrating this archaeologically will be difficult, especially in situations where non-local groups are interacting with a local community on the same landscape. Tantalizing but highly speculative evidence of such an occurrence may exist at the Manna site (see Pottery chapter).

Of the five dates for Jacks Reef points (notched and pentagonal) only one seems inaccurate, an assay of 2589+/-80 BP at the Padula site associated with the pentagonal form of the type. The remainder of the assays reflect both the early and late ends of the chronological range ascribed to the type in the region. Funk (1993:Table 16) feels that the dates from Zone 3, Locus 1 at the Gardepe site only apply to Levanna and Jacks Reef, although a number of other point types occurred in the Zone – Adena, Sand Hill Stemmed, Perkiomen/Susquehanna, and

Lamoka. Zone 3 is the remnant of an early plowed soil that was not completely homogenized as a result of cultivation. The co-occurrence of Jacks Reef and triangular points is not expected or unusual; the chronological ranges of the types overlap (e.g., Justice 1995:220).

Concentrations of Jacks Reef points are noted for the Manna site (Kinsey 1972:439) and Pratchler #3 site on Mashipacong Island along the Bennekill (Kraft 1970c:22; 1985:8). They occur in lower frequencies on a modest number of sites (e.g., Miller 1991). The possibility that Jacks Reef points are linked with the adoption of the bow and arrow across the Eastern Woodlands has been raised; the biface type may simply be a trait that is spread along with bow and arrow technology. In a microwear analysis of points from the Sandts Eddy site a Jacks Reef biface showed evidence of use in light butchery (Kimball 1996:Table 12.3).

It has been suggested (Gallivan 2011) that Middle Woodland Fox Creek and Jacks Reef bifaces are part of the material fingerprint of archaeological cultures that represent one or more migrations into the Middle Atlantic Region from the north. Clark (2016:252-253) maintains that Fox Creek and Jacks Reef-related components represent distinctive cultures with the presence of Jacks Reef points part of the archaeological fingerprint of migrants into the Upper Delaware Valley. Studies by McConaughy (2013), Reith (2013) and Walker (2013) encompassing Pennsylvania, New York, and New Jersey make it clear that components that include Jacks Reef points are unlikely to represent migrants into the region. The continuity in the use of specific landscapes and resources from an earlier time, in the Upper Delaware Valley and elsewhere, argues against the migration of populations with a material culture contrastive with that of pre-existing local groups, and the establishment of new communities.

These interpretations of the archaeological record are interesting in light of the linguistic evidence suggestive of the expansion of Algonquian speaking peoples throughout the Northeast and into the area from a homeland between Georgian Bay and Lake Ontario during the Middle Woodland period or possibly earlier (Custer 1987; Denny 1989, 1991; Fiedel 1987, 1990, 2013; Goddard 1978a, b; Luckenbach et al. 1987). Stuart Fiedel (1987, 1990, 2013) draws on the work of linguists and archaeologists to update interpretations of when an Algonquian dispersal from the Great Lakes area into the Middle Atlantic Region may have occurred. Key to the use of archaeological data are material objects that can be reconstructed from the proto-language: chief, town, mound-fort, bow and arrow, squash, seed for sowing, ice chisel, pipe, and kettle (Fiedel 2013:223). While there may have been an initial dispersal from a northern homeland dating no earlier than 600 BC (Fiedel 1990:217), the best archaeological and linguistic evidence implicates the time between AD 500-800 (Fiedel 2013).

Perhaps one of the better models to use in ongoing attempts to reconcile archaeological data with the implications of linguistic analysis is that of chain migrations of small family groups from a distant homeland to a place where distant kin now reside. In other words, the *in situ* communities of the Upper Delaware area have longstanding cultural, social, and linguistic links with the people in the areas from which small, chain-like migrations originate; migrating groups are not moving into unknown or hostile territory nor replacing the native peoples already there.

Trace element analysis of human remains and genetic research provide avenues for future research addressing migration issues. Both approaches will involve working closely with the

Delaware and other descendant communities. Analysis of strontium traces in human bone and teeth has the potential to distinguish between individuals who grew up eating locally versus those who were raised in other regions (e.g., Beehr 2011). The basis of this approach is the variable degree to which strontium is found in the soils of an area and taken up by plants which are eventually consumed by animals and humans. Grimstead et al (2017) provide guidelines for developing the regional data base necessary for understanding the results derived from the analysis of traces in human remains (cf. Price et al 2002).

There have been no genetic studies employing ancient Native American human remains from the greater Delaware Valley. Pfeiffer et al. (2014:Table) include a sample from one Delaware individual, analyzed as part of earlier studies (Bolnick and Smith 2007; Shook and Smith 2008)), in their comparative study of mitochondrial DNA (mtDNA) of Native Americans in the greater Northeast. A single Delaware Native American sample was also involved in the genetic study of Mahli et al. (2001:22). The source of the Delaware sample is not specified. Smith (2003) also employed a Delaware sample in his research citing Malhi et al. (2001) as its source. It seems likely that all of these studies have employed the same Delaware Indian genetic sample.

Genetic studies have identified six Native American haplogroups. The Delaware sample is associated with haplogroup A (Pfeiffer et al. 2014:Table 3). Native American populations in the Northeast, especially Algonquian speakers, display a general pattern of regional continuity featuring high frequencies of haplogroups A and C (Malhi et al. 2001:38). However, the majority of haplotypes are shared among language groups, adding support to the hypothesis that female gene flow has been maintained among relatively recent populations in the Northeast (Shook and Smith 2008). “Analysis of prehistoric populations, however, suggests that the genetic structure of the Northeast has changed significantly with relationship to time, while maintaining regional continuity” (Shook and Smith 2008:23). The inability of Native American haplogroups to neatly sort out by language group or geographic area is testimony to the degree of physical and social mobility and social mobility over time. In conjunction with the geographic distribution of Algonquian languages and archaeological evidence, it suggests that Algonquian speakers expanded dramatically throughout the Northeast during the last three millennia (Denny 1989, 1991; Fiedel 1987, 1990; Luckenbach et al 1987; Malhi et al. 2001:41).

While existing genetic research does not provide a means of distinguishing historic and pre-contact Delawares from other native peoples in the greater Northeast, current approaches hold out the possibility that a more specific genetic fingerprint could be developed. There are caveats to consider in any future genetic research. The study of mtDNA focuses on the female line of inheritance. Research focused on the male-related Y chromosome, and comparisons with mtDNA studies, demonstrate that male and female demographic histories can differ substantially. “Postmarital residence patterns have strongly influenced genetic structure, with patrilocal and matrilocal populations showing different patterns of male and female gene flow. European contact also had a significant but sex-specific impact due to a high level of male-mediated European admixture” (Bolnick et al. 2006:2161).

Triangular points are typically assigned to the late Middle Woodland and Late Woodland periods, continuing in use during historic times and encounters with Europeans (e.g., Custer

2001:113; Ritchie 1971:31, 33) and presumed to herald the widespread use of the bow and arrow. Previous discussions demonstrate that the morphology and function of triangles from this, and earlier time frames show considerable overlap. Triangular points from the late Middle Woodland and Late Woodland periods are the most well dated in the study area. Twenty-one dates are listed in Table 2, only one of which, 2580+/-80 BP from the Padula site, is considered to be in error. The largest portion of the rest (n=11) are associated with points identified as Levanna and range from 1660+/-100 BP to 600+/-30 BP. Only two dates 540+/-30 BP, 300+/-30 BP) are associated with the Madison type. Investigators chose not to type triangular bifaces in seven of the cases associated with radiocarbon dates ranging from 970+/-120 BP to 150+/-60 BP.

The Levanna form is thought to pre-date Madison which Ritchie (1971:34) states is the distinctive Iroquoian form in the Northeast. The date ranges for the two types can partially overlap but what is emphasized is the gradual reduction in point size through time (Custer 2001:113; Engelbrecht 2014:353; Ritchie 1971:33-34). Both the trend in size reduction and the affiliation of specific triangular point types with ethnic groups or archaeological cultures have effectively been challenged (Custer 1983, 2001:113-114; Stewart et al 2000:VI-8, VII-26 to VII-30). In the greater Eastern Woodlands the chronology of the two types is relatively identical (Justice 1995:227-228). While radiocarbon dates from the study area do not reflect this synchrony, contextual data do. For example, Levanna and Madison triangular point types are found in pit features that include European made goods at the Bell-Browning Site, 28-Sx-19. Dated kaolin pipes ranging from 1620 to 1650 AD are associated (Marchiando 1972:157). Marchiando argues that the pits were deep enough so as to not be disturbed by plowing or topsoil removal; therefore, the association of the non-native pipe fragments is a good one.

In a study of Madison triangles from an Iroquoian site Engelbrecht (2015:762) used T-tests to show significant differences between whole and broken and refitted points. "This calls into question the representativeness of existing point typologies" (Engelbrecht 2015:765). However, he does not use these data to question the validity of typing triangular points to begin with, merely suggesting that more representative populations of artifacts need to be taken into account. Engelbrecht explains the differences in the large assemblage that he used in his analysis as potentially reflecting the difference between arrows/points used for hunting and those used for warfare. There is an overlap in the range of metrical data for Engelbrecht's Madison assemblage with the metrical data (length, thickness) from Ritchie's (1961:31) definition of the Levanna type, although average metrics are generally distinctive.

Evidence indicating that Late Woodland triangles were used both as projectiles and tools in other activities was presented in previous discussions of early triangles. Supplementing this evidence are residue and microwear analysis from study area sites. At 36Mr133 one Late Woodland Levanna triangle (FS#131) test positive to chicken antiserum which could indicative of quail, turkey, grouse, and all gallinaceous fowl. It also tested positive for the Asteraceae plant family which could represent rabbitbrush, sunflower, or thistle. A second triangle (FS#185) also tested positive for chicken (quail, turkey, grouse, and all gallinaceous fowl) as well as pine and grasses (Hornum et al 2009:76-79; Parr 2006). Both points are illustrated in Figure 36. Five Levanna points from Sandts Eddy served as projectiles and in light butchery according to mircowear analysis (Kimball 1996:Table 12.3). Microwear on two Madison points (artifacts

1740.16, 572.2) from Treichlers Bridge revealed their use in bone and hide working Church 2000:11, 16).

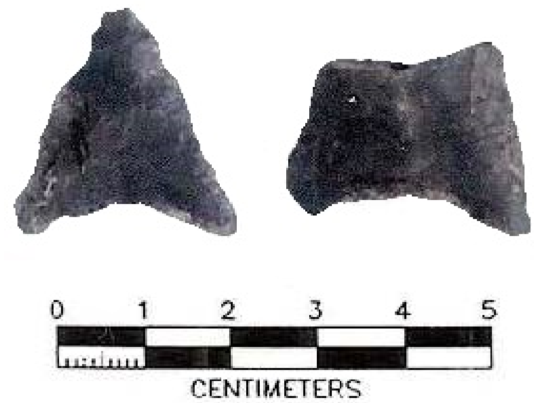


FIGURE 36. Levanna points from 36Mr133 that tested positive for protein residues. Left: FS#131. Right: FS#185. Modified from Hornum et al (2009:Figure 47).

In summarizing research dealing with Late Woodland triangular projectile points Engelbrecht (2014) notes that the lack of notches implicates the probable use of adhesives rather than bindings in securing the bifaces to a shaft. This approach provides advantages for the use of triangular bifaces in a bow and arrow system. The lack of binding promotes penetration of the projectile. The points easily detach from the shaft making it possible to retrieve shafts which are more costly to produce than the bifaces. Given these assumptions about hafting, triangular bifaces may have been too inefficient as knives and were always intentionally produced as projectiles. This does not negate the fact that some may have been used on an expedient basis as cutting implements while secured in a shaft.

The dramatic decrease in the variability of biface forms/types during the Late Woodland period has been linked with the widespread adoption of bow and arrow technology (Custer 2001:113). What remains problematic is the occurrence of nearly identical triangular forms much earlier in time when a variety of biface types characterize assemblages in the region. If we accept that earlier triangles reflect the presence of the bow than we must assume that the technology was not viewed as sufficiently superior to other types of projectile technologies to result in their replacement. A more reasonable interpretation would be to view early triangles as one of many different types of atlatl dart tips, perhaps for use with specific types of prey. A large scale program of residue analysis is necessary to address this possibility.

Notched points (Figure 37) are associated with a Late Woodland date (790+/-80 BP) in an infant burial feature at 28Sx29 that also includes collared pottery. The points seem out of place in such a context where the majority of other artifact recoveries are clearly Late Woodland from a typological perspective. The points' morphologies evoke aspects of the Tocks Island, Macpherson, and Lackawaxen types. Data are insufficient to determine whether any of the artifacts were in direct association with the human remains or part of general pit fill. The site itself is multicomponent so the points could be inadvertent inclusions resulting from digging the grave pit through pre-existing artifact deposits, or older pieces collected by mourners and added to the grave.

FIGURE 37. Notched points from an infant burial at 28Sx29 (Bell Philhower/Ahaloking) dated to 790+/-80 BP.

Future research regarding biface typology as a means of assessing the age of Late Archaic through Middle Woodland archaeological deposits should build on Custer's (2001:90-113) approach to using suites of types and their frequencies. Working out the difficulties of sorting types with lengthy chronological ranges could be pursued from the standpoint of technological style or *chaine de operatoire* which examine the details of the entire manufacturing process from the selection of raw material, core or blank production, and patterned sequences of flake removals. This has been attempted with site specific assemblages from the area (e.g., Bergman, Russell, Duerksen and Miller 1996:207-210).

Use of materials like argillite that weather dramatically will make it difficult to pursue such analyses. In some instances the use of a specific raw material might be diagnostic. While it could be argued that ancient artisans adapted their technology to the nature of available lithic resources, it is clear that in some cases cultural tradition trumped what was available and its quality (e.g., Paleoindian lithic use trends). Should variations in technological style or *chaine de operatoire* for specific biface forms exhibit spatial patterning one might argue that learning networks or the territory of a specific group are being made visible.

There are a variety of sites with archived datable materials from contexts with associated bifaces that could be the focus of a radiocarbon dating project. For example, buried surfaces at the Pahaquarra Lower Terrace site, New Jersey contained charcoal, steatite bowl fragments and broadspears (Sloshberg 1964:73). Undated charcoal from a hearth basin at 28Wa651 relates stratigraphically to Fishtail and Teardrop points as well as potentially early pottery (Lee et al 2010).

Edge beveling of bifaces might also be explored as a potential dating tool. It is my impression that asymmetrically beveled bifaces seem to most closely be associated with Early and Middle Archaic projectiles or knives in the region. In the midwest (Pettigrew et al 2015:591, Figure 1) it is linked with Early Archaic forms where the practice is also seen on Dalton points, which would be considered as Paleoindian in our region. The practice of beveling seems to stop circa 6500 BC (Pettigrew et al 2015:593). "Resharpening remains the best explanation for most beveling. Both points and knives may be efficiently resharpened by beveling, whether on or off a shaft" (Pettigrew et al 2015:599). This attribute remains to be quantified for bifaces in our region. Suggestive data are provided by the analysis of bifaces at the Padula site (36Nm15) where edge beveling is reported for one of five Brewerton projectile points, one of eight Otter Creek points, and one of 58 triangular points. No beveling occurs on Fishtail or Fox Creek points (Bergman, Duerksen and Russell 1994:206-222).

Explaining the variability in biface types at single points in time and through time is also a challenge for future research. Is it the result of a biface's use history (constraints of materials used during production, resharpening, retooling following breakage), a reflection of learning networks, or the signature work of artisans within a specific groups? Some of the variation in a specific biface form might be the result of the work of novice rather than skilled artisans. Shelley (1990) contends that novices can be distinguished by the frequency with which flakes exhibit feathered versus other types of terminations; high percentages of flakes with feathered terminations are associated with experienced knappers. Making such distinctions will require having data from well-defined reduction features.

The mix of biface types in contemporaneous assemblages also requires ongoing study. Explaining biface diversity as a result of functional differences may best be resolved by extensive residue analysis to see if a specific form can be related to specific prey or the harvesting and processing of other identifiable resources. To-date, residue and microwear analyses most frequently imply that biface types are multipurpose but sample sizes and the range of types represented in these studies are small. Perhaps some biface forms are gender-specific as certain types of labor and lithic technology may be (e.g., Sassaman 1992; Waguespack 2005).

Some portion of biface variability for the Late Archaic through Middle Woodland periods likely relates to heightened social interaction. We should closely consider changes through time in the means of travel (foot, boat) and the travel corridors employed (Delaware River and major tributaries, Ridge and Valley system) and the impact that they might have had on the extent and patterns of interaction. Is the diversity of biface types in contemporaneous assemblages greater on sites located within natural transportation corridors, especially sites representing prolonged habitation where local and travelling groups might be expected to interact? Does typological diversity exhibit a falloff pattern with increasing distance from such settings? Simply invoking trade to account for some assemblage variation falls short of what we might otherwise learn.

As the ancient world becomes a smaller place owing to increasing populations and heightened levels of social interaction should we not expect aspects of material culture to function as markers of identity? Meaning or messages as expressed through material culture are best conveyed by the rarity or distinctiveness of the material involved, morphology or design (Miller 2007:206). If objects are used to communicate they must be seen by individuals who interact frequently enough to recognize one another's messages (Braun and Plog 1982:510). Where better for such to take place than at settlements or quarries situated along travel routes linking distinctive environmental zones and group territories.

In conclusion, of all of the issues raised in this chapter perhaps the most fundamental to progress in making use of biface forms is a comprehensive and consistent approach to the detailed reporting and illustration of specimens from secure contexts. These data will obviate problems arising from the use or misuse of typological labels. Establishing the nature of the standards to follow can, and should be a cooperative effort on the part of regional practitioners elaborating on the program initially envisioned by Evans and Custer (1990). More importantly, staff of state historic preservation offices are in a position to ensure that any standards become required for use in cultural resource management projects.

III. POTTERY

Along with bifaces, pottery types are used to assign age to archaeological deposits. As useful as they can be, a number of problems stem from the fact that single typologies are not inherently multipurpose, but often are used as if they are. Types and typologies constructed for chronological purposes aren't necessarily useful as a material fingerprint of a specific group and their movements across the landscape. Types of bifaces and pottery have been, and continue to be used uncritically by some in this way as part of syntheses of Upper Delaware and regional prehistory (e.g., Clark 2016). I repeat an admonition raised in Chapter 2 – the description of the attributes of recovered artifacts must adhere to some basic standard that is not circumvented by simply invoking formal types.

There is so much more that could be learned from pottery derived from dated contexts using other approaches and with attention to attributes not typically reported for assemblages, but fundamental to the study of technological and decorative style and grammar (cf. Arnold 2000; Custer 1987; Dietler and Herbich 1998; Dobres 2000; Dobres and Hoffman 1994; Hart et al 2017; Lattanzi 2009; Skibo and Schiffer 2008; Stark et al 2000; Stewart and Pevarnik 2008). Relevant issues include: the recognition of learning networks; the possibility of getting closer to linking pottery with specific groups, or being better able to define the geography of frequently interacting groups; and the recognition of both short and long distance exchange or trade using pottery that otherwise appears homogeneous over large areas. In turn, attention to technological and decorative style and grammar might reveal useful chronological differences within individual historical types. Recall previous statement that the use of cultural historical periods requires a unilinear chronological logic that makes it impossible to deal with contemporaneous variability that might exist in a region (e.g., Krause 2016:68-69). For example, pottery is associated with some, but not all deposits identified as Transitional Archaic in the Middle Atlantic region, while the use of pottery is deemed an essential attribute of Early Woodland period cultures. I revisit potentially useful approaches and applications later in this chapter.

Table 12 organizes available dates for pottery using existing typological nomenclature and identifications noted by the original analysts. In cases where recoveries from dated contexts were not assigned to a type, abbreviated lists of attributes are provided.

Radiocarbon dates relevant to pottery total 126. Few of these (n=13, 10.3% of total) relate to Transitional Archaic and Early Woodland time frames when pottery makes its initial appearance and slowly spreads through the area. Assays (n= 32) that would fall within what would be considered a Middle Woodland time frame constitute 25% of the total with most (20.6%) post-dating 200 AD. The vast majority of available dates (n=81, 64.2% of total) refer to Late Woodland contexts. For both Middle and Late Woodland time frames a substantial number of dates derive from sites in the New York portion of the Upper Delaware and nearby segments of the Upper Susquehanna Valley.

TABLE 12
RADIOCARBON DATES ASSOCIATED WITH POTTERY TYPES

Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Marcey Creek, Ware Plain	3170+/120 Y-2589	1697-1116 BC	1435 BC	Miller Field 28Wa16 Part of component associated with dated Feature C-F61	Kraft 1970a:43-44, 47, 1972:12, 16, 451
steatite tempered	3070+/-80 UGAMS-02948	1503-1108 BC	1318 BC	Driftstone 36Nm244, Stratum association	Blondino 2008:167, Table 1
Vinette I	2850+/-20 ISGS-A2012	1060-930 BC	1010 BC	36Pi14, Zimmerman, dated residue on pottery	Tache and Hart 2013:Table 1, Appendix 1
Exterior Corded-Interior Smoothed	2760+/100 Y-2477	1210-780 BC	936 BC	Faucett 36Pi13A, Feature 89	Kinsey 1972, 1975:44, 47
Vinette I, Early Series pottery	2760+/100 Y-2477	1210-780 BC	936 BC	Faucett 36Pi13A, part of dated component	Kinsey 1972, 1975:44, 47
Exterior Corded-Interior Smoothed, Vinette I	2700+/100 Y-2476	1127-730 BC	877 BC	Faucett 36Pi13A, associated with dated feature and part of dated component	Kinsey 1972:190, 1975:44
Ware with cordmarked exterior and cordwrapped stick impressions, interior smoothed with single cord impressions	2560+/120 Y-1384 2400+/-60 DIC-407	930-397 BC 756-679 BC 671-603 BC 600-390 BC	665 BC 515 BC	Rosenkrans 28Sx2, Burial 2 associated with dated burials 9 and 5	Cross 1945:5; Kraft 1976a:12, 16, 31, Table 2
Vinette I	2440+/-20 ISGS-A2011	747-685 BC 557-410 BC	526 BC	36Pi14, Zimmerman, dated residue on pottery	Tache and Hart 2013:Table 1, Appendix 1
Vinette I	2435+/-20 ISGS-A2010	743-687 BC 550-409 BC	513 BC	36Pi14, Zimmerman, dated residue on pottery	Tache and Hart 2013:Table 1, Appendix 1
Brodhead Net Marked	2430+/-80 Y-2590	778-394 BC	567 BC	Miller Field 28Wa16, vicinity of dated feature	Fischler and Mueller 1991:Table 3.5; Kraft 1970a:42, 1972:38
Vinette I	2430+/-80 Y-2590	778-394 BC	567 BC	Miller Field 28Wa16, part of dated component	Fischler and Mueller 1991:Table 3.5; Kraft 1970a:42, 1972:38
Brodhead Net Marked, Vinette I	2350+/-95 I-5233	767-341 BC 327-204 BC	467 BC	Faucett 36Pi13A, in component associated with date	Kinsey 1975:40, Table 32
Wiped (cf. Kinsey 1972:456-457)	2080+/-40 no lab # reported	199 BC-3 AD	103 BC	36Nm4, Locus A, "pot break" with dated residue	Hornum et al 2002:iv, 138

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Early Series (cordmarked and net-marked wares), Vinette I	2050+/135 I-5542	389 BC-232 AD	79 BC	Faucett 36Pi13A Feature 68	Fischler and Mueller 1991:Table 3.5; Kinsey 1972, 1975:39
shell tempered-exterior cordmarked-interior smoothed	2010+/-90 Beta 41246	209 BC-220 AD	25 BC	36Mr5, Smithfield Beach/Pardee, associated with dated deposit	Hennessy 1992:115-116
Vinette Complex Dentate	1995+/-35 ISGS A0410	58 BC – 79 AD	4 AD	Fortin Locus 2, Delaware County, NY, pottery residue, occupation zone 3	Funk 1998:68-78; Hart and Brumbach 2005:Table 1; Thompson et al 2004:28-29, Tables 2, 4
grit and shell tempered ware, shell tempered ware, quartz tempered ware, quartzite tempered ware	1970+/-90 Beta 41246	199 BC-242 AD	24 AD	Smithfield Beach/Pardee 36Mr5, Feature 117	Hennessy 1992:145-149, Appendix A
grit tempered, eroded surface	1760+/-40 Beta 198655	209-384 AD	282 AD	Herrick Hollow II, Locus 2, Feature 3, Delaware County, NY	Hohman et al 2005: 97-98, Table 40
grit tempered ware	1720+/-60 Beta 42905	135-426 AD	315 AD	36Mr5, Smithfield Beach/Pardee, adjacent to dated feature	Hennessy 1992:147, 179, Appendix A
Overpeck cordmarked	1680+/-70 Beta 105799	211-544 AD	360 AD	36Nm140, Oberly Island, Feature 22	Siegel et al 2001:40, Table 1
(Abbott?) Horizontal Dentate	1660+/-95 I-4748	207-588 AD	383 AD	Harry's Farm 28Wa2 Feature G-F58	Fischler and Mueller 1991:Table 3.5; Kraft 1975b:49-50, 52, Table 11
Ware I shell tempered	1640+/190 Beta 34807	41 BC-726 AD	385 AD	36Mr5, Smithfield Beach/Pardee, Stratum VII	Fischler and French 199:1Table 6-1
Brodhead Net Marked	1640+/200 W-3135	60 BC-776 AD	383 AD	Shawnee Minisink, 36Mr43, associated with dated deposit	Fischler and Mueller 1991:Table 3.5; McNett 1985b:115, 117
Brodhead Net Marked	1565+/-95 W- no lab # reported	321-653 AD	484 AD	Shawnee Minisink, 36Mr43, associated with dated deposit	Fischler and Mueller 1991:Table 3.5; McNett 1985b:115, 117
Point Peninsula Plain	1525+/-35 ISGS A0406	428-604 AD	537 AD	Fortin Locus 2, Delaware County, NY, pottery residue, occupation zone 3	Funk 1998:68-78; Hart and Brumbach 2005:Table 1; Thompson et al 2004:28-29, Tables 2, 4

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Point Peninsula Plain	1505+/-35 ISGS A0407	529-638 AD 430-493 AD	561 AD	Fortin Locus 2, Delaware County, NY, pottery residue, occupation zone 3	Funk 1998:68-78; Hart and Brumbach 2005:Table 1; Thompson et al 2004:28-29, Tables 2, 4
Abbott Horizontal/Abbott Zoned Dentate	1485 +/-30 PITT 0678	536-645 AD	582 AD	28Wa528, associated with dated hearth	Adams and Adams 1991:2-4
net impressed, exterior cordmarked-interior smoothed	1485 +/-30 PITT 0678	536-645 AD	582 AD	28Wa528, part of dated component	Adams and Adams 1991:2
shell tempered, net impressed, zoned incised –Abbott Zoned variant?	1440+/-30 Beta 355783	568-654 AD	617 AD	36Pi4, Block 2, Feature 10; AMS assay of charred organic material adhering to large sherd of net impressed pot	Stewart et al 2015:179-184, Table 17
cordwrapped stick impressed and incised, nepheline syenite temper	1440+/-30 Beta 355783	568-654 AD	617 AD	36Pi4, Block 2, Feature 10	Stewart et al 2015:184 Table 17
Point Peninsula Plain, dentate stamped ware	1380+/-60 Beta 160180	556-729 AD	649 AD	Deposit Airport I SUBi-2048 Feature 7	Knapp and Versaggi 2002:61, Tables 7, 8
Bainbridge Collared Incised, Sackett Corded, Kelso Corded	1370+/-60 Beta 46950	565-770 AD	658 AD	Chenango Point (SUBi-1274), Feature 53, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
gneiss tempered, exterior smoothed with zoned incised triangular decoration, interior cordmarked; gneiss and sand tempered, smoothed exterior and interior; gneiss and sand tempered, exterior cordmarked, interior damaged; gneiss and sand tempered, exterior cordmarked with incised and punctated decoration, interior cordmarked	1360+/-70 Beta 32599 1230+/-60 Beta 32600	546-778 AD 664-900 AD	669 AD 792 AD	Site AO71-06-0077, Feature 9 Layer 3 and 4, Orange County, NY	Hunter Research 1989b:6-5 to 6-15
shell tempered ware	1200+/-90 Beta 41369	662-993 AD	825 AD	36Mr5, Smithfield Beach/Pardee, adjacent to dated feature	Hennessy 1992:146-147, 171, Appendix A
cordmarked and grit tempered	1190+/-40 Beta 93148	764-904 AD 916-966 AD	831 AD	36Nm212/229, adjacent to dated feature	Lattanzi 1996:Appendix F; Puseman 1996
Owasco Herringbone	1180+/-80 1160+/-80 1150+/-80 1020+/-80 1000+/-70 990+/-60 Beta-no lab # reported	675-994 AD 758-1016 AD 759-1020 AD 863-1211 AD 892-1190 AD 948-1186 AD	842 AD 862 AD 872 AD 1016 AD 1042 AD 1058 AD	Ouleout Site (8W-32-7), Feature 18, Delaware County, NY	Hartgen Associates 1989:26, 32-34, Table 10, Plate 6, Appendix II

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
grit tempered ware	1180+/-70 Beta 42906	686-987 AD	842 AD	36Mr5, Smithfield Beach/Pardee, Feature 128	Hennessy 1992:311, Appendix A
Ware I shell tempered	1170+/-60 (uncorrected) Beta 34215	762-988 AD	853 AD	36Mr5, Smithfield Beach/Pardee, Feature 80	Fischler and French 1991:Table 6-1
Sackett Corded	1090+/120 Beta 61263	675-1168 AD	931 AD	28Wa610 Feature 2	Stevens et al 1993
Carpenter Brook Cord-on- Cord	1060+/-40 Beta 198657	893-1027 AD	980 AD	Herrick Hollow V, from Locus 1, Feature 5 and broader locus, Delaware County, NY	Hohman et al 2005:186, 205, Appendix II
Wickham Punctate	1043+/-40 ISGS A0229	893-1041 AD	994 AD	Street, Otsego County, NY, pottery residue	Hart and Brumbach 2005:Table 1
Owasco/Clemson Island	1040+/-40 Beta 212295	893-1044 AD	996 AD	Shoemakers Ferry 28Wa278 Feature 911	Barse 2006:4-72, 4-95; Harbison 2008:78-79, Table 5.1; Messner et al 2008
Bowmans Brook, Overpeck	1020+/-80 Beta 15576 930+/-80 Beta 21548	863-1211 AD 982-1260 AD	1016 AD 1107 AD	Smithfield Beach/Pardee 36Mr5 Feature 13 base	Fischler and French 1991:158; Fischler and Mueller 1988:Table 3.7, 5-21; Fischler and Mueller 1991:Table 3.6; Hennessy 1992:68
Sackett Corded	1000+/-70 Beta 46948	892-1190 AD	1042 AD	Chenango Point (SUBi-1274), Feature 54, Broome County, NY	Knapp 2011:Tables 4.3, 4.4
grit tempered cordmarked and incised	970+/-120 Beta 62433	859-1272 AD	1067 AD	36Pi4, Unit 1, Level 2, Feature 1D	Wall and Botwick 1995a:150-151, Table 31
Levanna Cord-on-Cord	930+/-60 Beta 168303	1011-1221 AD	1106 AD	Deposit Airport I SUBi-2048 Feature 6	Knapp and Versaggi 2002:59,Tables 7, 8
Carpenter Brook, Owasco Herringbone, Owasco Oblique	920+/-40 Beta 265480	1026-1192 AD	1105 AD	Chenango Point (SUBi-1274), Feature 383, Broome County, NY	Knapp 2011:Tables 4.3, 4.4
grit tempered ware	910+/-70 Beta 42904	1016-1258 AD	1120 AD	36Mr5, Smithfield Beach/Pardee, Feature 123	Hennessy 1992:308-309
Overpeck Incised	900+/-60 Beta 105328	1023-1246 AD	1127 AD	36Nm140, Oberly Island, associated with dated level	Siegel et al 2001:41, Table 1

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Clemson Island Punctate	890+/-60 Beta 15573	1028-1250 AD	1136 AD	Smithfield Beach/Pardee 36Mr5 Feature 10	Fischler and French 1991:160; Fischler and Mueller 1988:Table 3.7; Fischler and Mueller 1991:Table 3.6
Owasco Corded Herringbone	880+/-40 Beta 198654	1037-1225 AD	1156 AD	Herrick Hollow II, associated with dated Locus 1, Delaware County, NY	Hohman et al 2005:76, Table 40
Owasco Platted, Owasco Herringbone	860+/-40 Beta 265476	1044-1098 AD 1146-1260 AD	1180 AD	Chenango Point (SUBi-1274), Feature 119, Broome County, NY	Knapp 2011:Tables 4.3, 4.4
Owasco Herringbone, Carpenter Brook Cord-on-Cord	850+/-40 Beta 168306	1147-1265 AD 1046-1091 AD	1190 AD	Deposit Airport I SUBi-2048 Feature 29	Knapp and Versaggi 2002:44, 99, Tables 7, 8
Owasco Corded Variant (Horizontal/Oblique/Herringbone), Owasco series (type not specified)	840+/-70 Beta 227482	1115-1276 AD 1039-1110 AD	1183 AD	36Pi4, Block 6, Unit 34, Feature 89	Stewart et al 2015:192, 197, Table 17, Figure 73
exterior cordmarked-interior smoothed ware, exterior- interior smoothed ware, incised ware, single cord decorated ware	830+/-50 Beta 219495	1148-1277 AD 1046-1090 AD	1203 AD	Ventura Tract Feature 4, Pike County, PA	Messner et al 2006
Oak Hill Corded, Kelso Corded, cordwrapped stick decorated ware, wiped and possibly slipped ware	790+/-80 Beta 266108	1038-1306 AD	1220 AD	Ahaloking Infant Burial (Bell-Philhower) 28Sx29	Moeller 2009 personal communication; Stewart and Bitting n.d.; Stinchcomb et al 2011
incised ware	780+/-110 Beta 57129	1027-1330 AD	1220 AD	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 2	Alterman 1993:Table 1, 21-23
Carpenter Brook Cord-on-Cord	770+/-50 DIC-1154	1161-1297 AD	1245 AD	Medwin Knoll 28Sx266 Feature 25	Williams et al 1982:41, Tables 5, 7
Owasco Herringbone/Sackett	760+/-100 Y-2591	1117-1399 AD	1240 AD	Miller Field 28Wa16 Assayed charcoal from within collapsed vessel	Kraft 1970b:39-40, 1972:45
Bowmans Brook, Sackett Corded	760+/-60 Beta 15575	1219-1333 AD 1336-1398 AD	1295 AD	Smithfield Beach/Pardee 36Mr5 Feature 13 top	Fischler and Mueller 1988:Table 3.7, 5-21; Fischler and Mueller 1991:Table 3.6
Owasco Platted	760+/-40 Beta 265475	1203-1294 AD	1255 AD	Chenango Point (SUBi-1274), Feature 118, Broome County, NY	Knapp 2011: Tables 4.3, 4.4

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
collared and castellated, possibly Bainbridge Linear	740+/-80 Beta 57128	1152-1405 AD	1262 AD	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 1	Alterman 1993:33, Table 1, 21
Point Peninsula Corded, Kelso Corded	740+/-40 Beta 265473	1215-1301 AD	1267 AD	Chenango Point (SUBi-1274), Feature 102, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Owasco Corded Oblique, Owasco Corded Horizontal, Levanna Cord-on-Cord	730+/-60 DIC-383	1180-1323 AD 1346-1393 AD	1272 AD	Minisink 28Sx48 Feature R-F48	Kraft 1978:89
Owasco Corded Horizontal, fabric impressed ware	720+/-50 DIC-1157	1215-1321 AD 1349-1392 AD	1278 AD	Medwin Knoll 28Sx266 Feature 22	Williams et al 1982: 41,Tables 5, 7
Owasco Horizontal, untyped Iroquois collared ware	700+/-40 Beta 265479	1248-1321 AD 1348-1392 AD	1289 AD	Chenango Point (SUBi-1274), Feature 401, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Carpenter Brook Corded, Owasco Platted, Owasco Herringbone	740+/-40 Beta 265474	1248-1321 AD 1348-1392 AD	1289 AD	Chenango Point (SUBi-1274), Feature 105, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Owasco Corded Horizontal, Castle Creek Beaded	690+/-30 Beta 378840	1266-1312 AD 1358-1387 AD	1291 AD	Otsiningo Market Site (SUBi-3041), Feature 10C, Broome County, NY	Miroff 2014:Table 8
Overpeck Incised, untyped incised with inverted rim	690+/-50 DIC-2782	1246-1332 AD 1337-1398 AD	1301 AD	28Wa580, Pit 11-83	Staats 1986a:28, Figure 4
Owasco Series	680+/-50 DIC-1372	1259-1399 AD	1311 AD	Medwin North 28Sx5 Feature 14	Williams et al 1982:23, Table 7
Carpenter Brook Corded, Owasco Horizontal, Levanna Cord-on-Cord	680+/-50 Beta 46947	1259-1399 AD	1311 AD	Chenango Point (SUBi-1274), Feature 45, Broome County, NY	Knapp 2011:Tables 4.3, 4.4
Owasco Platted, Owasco Corded Horizontal	670+/-90 DIC-1354 670+/-60 DIC-1353	1190-1433 AD 1254-1410 AD	1319 AD 1323 AD	Medwin North 28Sx5, Stratum II	Williams et al 1982:20, Table 7
Owasco Corded Horizontal, Jacks Reef Corded Punctate	660+/-40 Beta 265478	1273-1330 AD 1339-1397 AD	1335 AD	Chenango Point (SUBi-1274), Feature 348, Broome County, NY	Knapp 2011: Tables 4.3, 4.4
Kelso Corded, Kelso Corded variant, Milo Corded	640+/-120 Y-2474	1151-1493 AD	1333 AD	Faucett 36Pi13A Feature 117	Kinsey 1972:194, 464, 1975:28

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Owasco Series	630+/-105 DIC-1355 550+/-135 DIC-1356	1169-1460 AD 1210-1650 AD	1341 AD 1393 AD	Medwin North 28Sx5 Feature 1	Williams et al 1982:20, Table 7
Sackett Corded, Owasco Platted	600+/-30 Beta 309043	1297-1373 AD 1377-1408 AD	1346 AD	Chenango Point South (SUBi-2776),Feature 180, Broome County, NY	Miroff 2012:Table 4.3
Carpenter Brook Cord-on-Cord, Sackett Corded, Owasco Corded Horizontal, Owasco Platted, Owasco Corded Oblique, Wickham Corded Punctate	600+/-30 Beta 378839	1297-1373 AD 1377-1408 AD	1346 AD	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY	Miroff 2014:Table 8
Chance Incised-like, Deowongo Incised-like, Munsee Incised-like	590+/-80 Beta 21552 400+/-140 Beta 21551	1300-1369 AD 1381-1412 AD 1287-1695 AD	1354 AD 1536 AD	Milford Beach 36Pi135 Feature 20	Fischler and Mueller 1988, 1991
Carpenter Brook Cord-on-Cord	585+/-140 GX-11931	1164-1641 AD	1366 AD	Egli (Una7-3), Feature 1, Delaware County, NY	Funk 1993:Table 17
Owasco Corded Collar	570+/-55 DIC-384	1295-1433 AD	1356 AD	28Sx48, Minisink, Feature R-F183	Kraft 1978:78, 89-90
Owasco Corded Horizontal, Sackett Corded, Kelso Corded	550+/-30 Beta 309044	1312-1358 AD 1387-1432 AD	1395 AD	Chenango Point South (SUBi-2776), Feature 275, Broome County, NY	Miroff 2012:Table 4.3
Owasco Corded Horizontal variant, Kelso Corded/Owasco Corded Collar variants	550+/-40 Beta 227479 550+/-40 Beta 227478	1304-1365 AD 1384-1438 AD 1304-1365 AD 1384-1438 AD	1388 AD 1388 AD	36Pi4, associated with component that includes two identical AMS assays of maize kernels	Stewart et al 2015:Table 17, Figures 83, 84
Kelso Corded/Owasco Corded Collar variant	550+/-40 Beta 227479	1304-1365 AD 1384-1438 AD	1388 AD	36Pi4, Block 2, Unit 51, Feature 49, AMS assay of maize kernel	Stewart et al 2015:211, Table 17, Figure 85
Deowongo Incised, Garoga Incised, Durfee Underlined	550+/-80 Y-2338	1276-1483 AD	1375 AD	Kutay 36Pi25, Feature 75	Kinsey 1972:255, 390, 469
Chance Incised, Munsee Incised-like, Kelso Corded, Bainbridge Linear	550+/-80 Y-2338	1276-1483 AD	1375 AD	Kutay 36Pi25, associated with dated component	Kinsey 1972:253, 255, 390, 469
Chance Incised, Durfee Underlined	550+/-90 I-4749	1269-1514 AD	1379 AD	Harry’s Farm 28Wa2, Zone 1, Pit F-H1	Kraft 1975a:121, 1975b:75, 136, Table 11
Collared with diagonal plats, Chance phase	540+/-40 BP Beta 234911	1308-1362 AD 1386-1441 AD	1398 AD	28Wa278, Feature 718, residue on pottery	Harbison 2008:82-83, Table 5.1

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Carpenter Brook Cord-on-Cord, Sackett Corded, Kelso Corded, Oak Hill Corded, Owasco Herringbone, Owasco Platted, Richmond Incised	540+/-30 Beta 332933 300+/-30 Beta 309042	1316-1354 AD 1389-1436 AD 1490-1602 AD 1612-1654 AD	1403 AD 1563 AD	Chenango Point South (SUBi-2776), Feature 176, Broome County, NY	Miroff 2012:Table 4.3
Oak Hill Corded, Durfee Underlined variant	540+/-100 Y-2473	1269-1523 AD	1391 AD	Faucett 36Pi13A Feature 52	Kinsey 1972:195, 468, 1975:28
Deowongo Incised, Chance Incised, Otstungo Notched, Bowmans Brook Incised, Overpeck Incised	540+/-100 Y-2473	1269-1523 AD	1391 AD	Faucett 36Pi13A, associated with dated component	Kinsey 1972:194-195, 1975:28
Brodhead Net Impressed, Kelso Corded or Owasco Corded Collar, Overpeck Incised	520+/-80 Beta 62436	1282-1519 AD	1403 AD	36Pi21, Peters-Albrecht, Feature 4, Catalog No.43	Wall and Botwick 1995a:163, 168, 225, Plate 19, 1995b:Appendix I, VI
Otstungo Notched Lip	520+/-50 DIC-1152 560+/-95 DIC-1153	1383-1453 AD 1303-1365 AD 1261-1516 AD	1407 AD 1372 AD	Bell Browning 28Sx19 Feature 2	Fischler and Mueller 1988:Table 3.7; Puniello 1980:155, Table 2; Williams et al 1982:Table 7
Otstungo Notched Lip Variant (linear stamped)	510+/-55 DIC-1150 450+/-50 DIC-1151	1381-1473 AD 1398-1523 AD	1412 AD 1449 AD	Bell Browning 28Sx19 Feature 1	Fischler and Mueller 1988:Table 3.7; Puniello 1980:155, Table 2; Williams et al 1982:Table 7
Owasco Platted (Sackett Corded)	460+/-50 DIC- no number reported	1394-1521 AD	1442 AD	Minisink 28Sx48 Feature R-F485	Kraft 1978:90
Munsee Incised	450+/-70 Beta 123480 410+/-60 Beta 123483 320+/-60 Beta 123481 290+/-60 Beta 123482	1392-1636 AD 1419-1532 AD 1537-1636 AD 1448-1665 AD 1450-1680 AD	1462 AD 1499 AD 1562 AD 1580 AD	36Pi172, Kidney, Feature 6	Brown et al 2000:i, 41-44, Table 5
Otstungo Incised, Munsee Incised, fabric impressed ware	420+/-45 DIC-1214	1418-1524 AD 1558-1631 AD	1474 AD	Medwin Knoll 28Sx266 Feature 9	Williams et al 1982:40, Tables 5, 7
Munsee Incised	400+/-40 Beta 251447	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 120, Orange County, NY	Pretola and Freedman 2009:239-240, Tables 83, 84
Munsee Incised	400+/-40 Beta 251449	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 152, Orange County, NY	Pretola and Freedman 2009:240-241, Tables 83, 84
Susquehannock-like, Munsee Incised	380+/-40 Beta 251448	1442-1529 AD 1543-1634 AD	1512 AD	Site ORA-0550, Feature 132, Orange County, NY	Pretola and Freedman 2009:235, Tables 83, 84

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Durfee Underlined	370+/- 40 Beta 265508	1446-1530 AD 1539-1635 AD	1524 AD	Faucett 36Pi13A Feature 207	Stewart and Bitting n.d.; Stinchcomb et al 2011; Moeller 2011:Table 6, Figure 15-9
Munsee Incised	370+/-40 Beta 251442	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 26, Orange County, NY	Pretola and Freedman 2009:232-233; Tables 83, 84
Munsee Incised	370+/-40 Beta 251445	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 68, Orange County, NY	Pretola and Freedman 2009:234; Tables 83, 84
Otstungo Incised, Chance Incised, Deowongo Incised	370+/-60 DIC-1156	1440-1643 AD	1536 AD	Medwin Knoll 28Sx266 Feature 12	Puniello 1980:150, Table 2
grit tempered ware	350+/-60 Beta-42910	1444-1648 AD	1549 AD	Smithfield Beach/Pardee 36Mr5 Feature 114	Hennessy 1992:145-149, Appendix A
Munsee Incised	340+/-40 Beta 251450	1462-1642 AD	1556 AD	Site ORA-0550, Feature 106, Orange County, NY	Pretola and Freedman 2009:241-242, Tables 83, 84
Deowongo Incised, Bainbridge Linear	330+/-70 Beta-62434	1437-1669 AD	1560 AD	36Pi21, Peters-Albrecht, Feature 1	Wall and Botwick 1995a:159, 167-168, Plate 19, 1995b:Appendix I, VI
Carpenter Brook Cord-on-Cord, Sackett Corded, Richmond Incised	300+/-30 Beta 309040	1490-1602 AD 1612-1654 AD	1563 AD	Chenango Point South (SUBi-2776), Feature 46, Broome County, NY	Miroff 2012:Table 4.3
Owasco Corded Horizontal, Richmond Incised	270+/-30 Beta 309041	1515-1597 AD 1617-1668 AD	1632 AD	Chenango Point South (SUBi-2776), Feature 90, Broome County, NY	Miroff 2012:Table 4.3
Munsee Framed (Incised), Rice Diagonal, Chance Incised, Chance Incised/Munsee	240+/-120 I-4748	1460-1893 AD	1682 AD	Harry's Farm 28Wa2 Feature G-F25	Kraft 1975a:133-134, 1975b:147-148; Lattanzi 2009:7, Figures 11, 12
Chance Incised, Chance Incised/Munsee	240+/-120 I-4748	1460-1893 AD	1682 AD	Harry's Farm 28Wa2, Features K-F56, K-F76, and K-F114 linked by refitted sherds with G-F25	Lattanzi 2009:7, Figures 11, 12
Munsee Incised	European artifacts associated	Contact-Historic	Contact-Historic	Faucett 36Pi13A Feature 261	Moeller 1992:39, 63, Table 9
Munsee Incised	Refitted pipe sherds link context with Feature 261	Contact-Historic	Contact-Historic	Faucett 36Pi13A Feature 231	Moeller 2011:Figure 22

Table 12 Continued					
Pottery Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Munsee Incised, Wickham Corded Punctate	European artifacts associated	Contact-Historic	Contact-Historic	Faucett 36Pi13A Feature 269	Moeller 1992:39, 64, Table 9
Munsee Incised	Refitted sherds link context with Feature 269	Contact-Historic	Contact-Historic	Faucett 36Pi13A Feature 239	Moeller 1992:Table 9, 2011:Figure 13
Oak Hill	European artifacts associated	Contact-Historic	Contact-Historic	Faucett 36Pi13A Feature 252	Moeller 1992:39, 64, Table 9

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

In the Middle Atlantic region pottery first appears on archaeological sites between roughly 3500 BP and 2900 BP with earlier dates associated with sites in the Hudson Valley and New England (cf. Egghart et al 2014; Funk 1993:Table 17; Hoffman 1998:Table 1; Inashima 2008:203, 232, 251; MacDonald et al 2011; Stewart 1998b, 2011b:Table 1; Tache´ and Hart 2013; Versar, Inc. 2012:Tables 6-11, 7-1, 7-4). This is in contrast to the first appearance of the technology along southern portions of the Atlantic Seaboard and the southeastern United States circa 4500 BP (Bedard 2011; Saunders and Hays 2004; Sassaman 1993). In North Carolina on the southern periphery of the Middle Atlantic region, the earliest dates for pottery are centuries older than those for the Middle Atlantic (Herbert 2009:Table 7.1). It is curious that there is such a gap between the early origins of pottery technology in the Southeast and the Middle Atlantic, especially since archaeological evidence of trade indicates linkages between the regions (e.g., Stewart 1989), as does early ceramic data from Virginia (Egloff 1991). For the Delaware Valley the period from roughly 3200 BP to 2900 BP captures the widespread, but spotty distribution of early pottery, a time frame traditionally ascribed to the Transitional Archaic and Early Woodland periods of regional prehistory.

The earliest dates for pottery in the Upper Delaware relate to the Marcey Creek, Ware Plain, and Vinette I types (see Table 12). Ware Plain is the morphological and probable chronological equivalent of Marcey Creek excepting the use of an aplastic other than steatite, the temper associated with Marcey Creek (e.g., Kraft 1971:36, 1974, 1975a:101; Stewart 1998b:163). The date for Marcey Creek and Ware Plain from the Miller Field site is among the earliest known for the Delaware Valley. At Miller Field "the squares in which the heaviest concentration of Marcey Creek Plain pottery occurred are also the squares which had a high yield of Orient fishtail points" (Kraft 1970a:117). Ware Plain pottery was found in approximately the same area as the Marcey Creek and is believed to be co-eval with it (Kraft 1970a:119). Immediately to the west of the study area at 36Lu169 a carbonized sample of rodent dung in direct association with a collapsed steatite tempered vessel provided a radiocarbon date of 3000+/-30 BP (Pesotine 2016).

A date nearly as old as the Miller Field assay, 3103 +/-34 BP, is associated with a hearth feature and Marcey Creek pottery at 28Ca168 in the Lower Delaware Valley (Grossman-Bailey 2017). Farther south, potentially older dates are associated with steatite tempered pottery at the

Gray Farm site on the eastern side of Delaware Bay (Griffith 2013:Table 2; Hay et al 2013). The oldest date for steatite tempered pottery in the Middle Atlantic Region, 3500+/-100 BP, is from 36BD267 in the Juniata Valley of Pennsylvania (MacDonald et al 2011).

Contexts which might provide additional dates for Marcey Creek or steatite tempered pottery should be considered potentially significant for their ability to contribute to a better understanding of the origins of steatite tempered pottery in general, and the Marcey Creek type in particular. Marcey Creek may have its origins in the circum Chesapeake Bay region, or perhaps even southern New Jersey, based on a consideration of its frequency distribution (e.g., Bedard 2011:137-140; Dent 1995:227; Herbert 2009:116, 145, 149-151; Kinsey 1972:360; Kraft 1975a:101; Mounier 2003:88). The Miller Field date implies that knowledge of the pottery spread into the Upper Delaware Valley fairly early when viewed in the context of regional radiocarbon dates. Increasing the radiocarbon data base for this pottery will contribute to an evaluation of its origin, spread, and usefulness in assessing regional social interactions. Part of such an effort could involve revisiting sites where steatite tempered pottery has been found, or working with archived collections.

Additional dates for Ware Plain will also be useful in assessing if this pottery is absolutely coeval with Marcey Creek, or whether it and other early experimental wares in the Delaware Valley and Middle Atlantic follow after. Dates for flat bottomed vessels and other early forms at the Williamson site in the Middle Delaware Valley (Hummer 2007), the Jughandle (Fokken et al 1987), Gray Farm (Griffith 2013) and other sites (Versar, Inc. 2013:Table 7-4) in the Lower Delaware Valley, suggest that the former is the case (Stewart 1998b:163-164). A date of 3233+/-75 BP associated with pottery comparable to Ware Plain at the Williamson site (Hummer 2007:80) is especially compelling. However, the calibration a number of radiocarbon dates with large standard deviations, and thermoluminescence dates with typically large standard deviations, muddy the interpretive waters.

It is clear that given the chronological ranges assigned to early wares there are times when the use of steatite tempered and other early pottery types are contemporaneous. What is behind the choice of steatite versus other types of aplastics on the part of ancient potters? The use of modelling versus coiling as forming techniques? Flat bottomed versus other vessel shapes?

Of the various types of aplastics employed in the production of early pottery in the Delaware Valley sources of steatite are likely the most restrictive. Numerous sites with steatite tempered pottery, and individual sites with high frequencies of the pottery, have long been linked with lower portions of the Delaware Basin (Cross 1941, 1955; Kraft 1974) and reaffirmed by my re-examination of New Jersey State Museum collections, site files, and published literature begun in 2009. Flat bottomed wares tempered with other materials are also well known for this same area. Potential sources of steatite are generally from 15-50 miles (24-80 km) from this area (cf. Bachor 2017; Cross 1941; Custer and Ward 1988; Rand 1894; Rand et al 1892:181-182; Truncer 1999, 2004b). Some of the other aplastics used in early pottery production in this area could be derived from relatively local cobble deposits, and primary sources exist within the same distance range noted for sources of steatite. Variable and convenient access to sources may not be a key factor in ancient potters' choices of tempering agents.

Potential sources of steatite bracket the Upper Delaware study area. To the south a historically mined source of steatite exists in the Easton, Pennsylvania (Northampton County) - Phillipsburg, New Jersey (Warren County) area (Greene 1995:100-102; Schrabisch 1917:47; Truncer 1999). Kraft (1982:20) doesn't think that this source was ever exploited by the Indians, but offers no basis for his opinion. To the north Schrabisch (1917:47) notes that steatite occurs on the northeastern slope of Jenny Jump Mountain in Warren County, New Jersey. Personal attempts to locate this source have not been successful although deposits of what appears to be the Franklin marble have been observed, a material that also occurs in the vicinity of the Phillipsburg area steatite deposits. In contrast, sources of other lithic materials that could be employed in pottery production are widely distributed. Like the situation in the Lower Delaware Valley ease of access to desired aplastics does not seem to be a the primary factor influencing the choices of ancient potters responsible for creating the flat bottomed vessels found in the area.

In some cultural histories, the use of steatite temper in early pottery production has a certain appeal. since steatite bowls are assumed to appear first, with pottery following after and initially imitating stone containers in form and function. In a scenario where steatite containers inspire the form of early pottery, the use of steatite as temper may have symbolic value, perhaps indicating transference of the strength and qualities of the "ancestor" container to the new technology (e.g., Egloff 1991:246; Stewart 2011b). Steatite temper may be a type of skeuomorph. A skeuomorph is a copy of a prototype object or attribute of the prototype expressed in a different media that allows individuals to satisfy emotional ties to past values while creating new objects and new values (Blitz 2015:666-667).

The use of steatite as temper may be a reflection of early potters' understanding of the thermal properties of steatite, that is, once the material is warm/hot, it stays that way for quite some time. The ancient potter's understanding of the thermal qualities of steatite need not imply a strict evolutionary connection between stone bowls and pottery in terms of stone bowls inspiring the form and nature of early pottery. The widespread use of steatite as temper does imply an understanding of its qualities which is probably derived from a familiarity with steatite containers.

What these speculations suggest is that the variable use of temper may reflect different learning networks or communities that are linked to the potters who are part of a given network. In turn, vessels with one type of temper may be items gained through trade while those with a different aplastic are locally made. Identifying clay sources and developing petrographic and geochemical fingerprints of archaeological ceramics will be needed to address these issues. Unfortunately, flat bottoms and/or the use of steatite as a tempering agent are not always indicative of early pots in the Delaware Valley. Each are known from Middle Woodland contexts (Cross 1956:132, 134-136, 140, 145; Stewart 1998b:162) hampering their strict use in assigning chronology to deposits and surface sites.

Vinette I is the earliest ware in the Northeast (Hoffman 1998; Tache´ and Hart 2013). If accepted at face value, the earliest dates are nearly coeval with initial appearances of pottery technology in the Southeast (Hoffman 1998:50, Table 1). Pottery may have been independently developed in the Northeast (Tache´ and Craig 2015:178, 180). In the greater Northeast, Vinette I may predate finds of the pottery in Upper Delaware study area by up to 1000 years (Hoffman

1998:50, Table 1). North of the study area in the Upper Susquehanna Valley Vinette I occurs at Mattice No.2 in Zone 4 with an age estimate of 3670+/-95 BP (Funk 1993:Table 17). To the east of the study area in the Passaic Basin the ware is associated with a date of 2980+/-130 BP (Kraft 1989), and in the Hudson Valley with a date of 3750+/-150 BP (Brennan 1977; Hoffman 1998:Table 1). To the west of the study area in the Middle Susquehanna Valley the pottery is associated with a date of 3415+/-110 BP (Bressler et al 1983).

Using current standards for chronometric hygiene Tache´ and Hart (2013) reevaluated known radiocarbon dates for Vinette I pottery from the Northeast, including those from the Upper Delaware, in addition to generating assays based on residues adhering to sherds. The result was 30 reliable dates representing 16 sites from an initial database of 171 assays (Tache´ and Hart 2013:360). Rejection of an existing assay was based on the lack of a direct association between the pottery and the dated material/dated feature, and standard deviations of 60 years or greater. The earliest age estimates (n=34) for the pottery from 4530+/-90 BP to 3150+/-125 BP were rejected along with 31 of the latest estimates ranging from 2260+/-120 BP to 1820+/-100 BP (Tache´ and Hart 2013:365-366). The earliest acceptable date for Vinette I is 3110+/-20 BP from a site in Quebec and the latest 2285+/-20 BP, also from a site in Quebec. Bayesian analysis of the data base indicated “that Vinette I pottery becomes archaeologically visible between 1495-1313 B.C., while it is no longer evident in the record between 395-261 B.C.” (Tache´ and Hart 2013:366, Table 4).

Previously available dates for Vinette I from the Miller Field and Faucett sites (see Table 12) were among those rejected in the analysis of Tache´ and Hart (2013:Appendix 1). As I noted in the introduction to this report, employing standards of chronological hygiene to our current data base would so impoverish it as to leave little ground for interpretation, speculation, hypothesis generation, and comparative studies. Nonetheless, the original dates from the Upper Delaware rejected by Tache´ and Hart, in addition to those newly generated by their study, fall within their proscribed chronological range for Vinette I. A few sherds of Vinette I are associated with steatite tempered pottery in Feature 117 at the Williamson site. Five radiocarbon dates, not all with points of overlap, are available for the component of which Feature 117 is a part. They range from 3233+/-75 BP to 2740+/-80 BP (Hummer 2007:80-81). Their relevance as an age estimate for Vinette I is rejected by Tache´ and Hart (2013:Appendix 1).

Cresson (1974) notes the occurrence of Vinette I throughout most of New Jersey with a chronology extending from the earliest introduction of pottery into the Middle Woodland period, an observation affirmed by later research (e.g., Stewart 1998b:171). Although fairly common and found on numerous sites in the Upper Delaware, Vinette I does not occur in high frequnecies at any locality (Kinsey 1972:454; Kraft 1975a:101). This contrasts with impressions of the poor representation of steatite tempered pottery in the area, seemingly more prevalent in areas below the Water Gap (Kinsey 1972:358). Given the assumptions regarding the heartland where each of these wares were originally developed, one might infer that Upper Delaware groups were interacting more frequently with communities to the north than those downriver in the Piedmont and Coastal Plain.

Co-occurrences of Vinette I pottery with Orient, Meadowood, Rossville, and possibly Lagoon points can be noted (Kinsey 1972:357, 364-367; Williams et al 1982:35). These associations conform to the chronological range (i.e., Early to Middle Woodland) established for the pottery in the study area and elsewhere in the Delaware Valley (e.g., Kingsley et al 1990; Stewart 1998b:164-167). These associations also are a reminder that the presence of interior cordmarking on a sherd should not automatically identify it as Vinette I or relegate it to an early time frame independent of the other attributes used to define the type (e.g., Stewart 1998b:98-99, Figure 112).

"Early Series" is a catchall category used by Kinsey (1972:453-458) to include a variety of types associated with the Early and Middle Woodland periods: Vinette I, Exterior Cordmarked/Interior Smoothed, Brodhead Net-Marked, Wiped, Fabric Impressed, and Dentate Stamped. Of these Vinette I and Exterior Cordmarked/Interior Smoothed are relevant to a discussion of early pottery in the study area. Vinette I has been discussed; the few dates for Exterior Cordmarked/Interior Smoothed shown in Table 12 are those originally used by Kinsey in describing the type for the Upper Delaware. It may be a variant of Vinette I with no interior cordmarking, a somewhat finer paste and occasionally thinner vessel walls. It is the earliest pottery at the Faucett site, stratigraphically positioned below finds of Vinette I (Kinsey 1972:358, 362).

Kinsey (1972:190) equivocates about whether Exterior Corded/Interior Smoothed pottery of the Early Series is part of the Orient or Meadowood component at the Faucett Site. He does note, however (1972:Table 6), that the pottery was associated with dated Feature 89. He also notes that nine Meadowood points were found around the perimeter of Feature 89 (1972:191) but this association is not listed for the feature in his Table 6.

Exterior Corded/Interior Smoothed pottery will be difficult to recognize outside of a buried context where estimates of deposit age can be based on evidence other than pottery typology. A more detailed study of the attributes of samples from secure contexts might be helpful in enhancing the potential for recognition. This would include an examination of the orientation of cordmarking from all portions of a vessel, cordage twist, and the estimated size of individual coils used in vessel construction.

Pottery with cordwrapped stick decoration recovered from Burial 2 at the Rosenkrans site is unusual for an Early Woodland context (see Table 12) in the Upper Delaware and elsewhere, but not without precedent (Stewart 1998b:Figure 113). Burial 2 is assigned age estimates based upon its spatial association with dated burials 5 and 9 at the site and similarities in feature contents. Kraft's (1976a) report on the burial complex makes no mention of the pottery that is noted in Cross's (1945) brief description of the excavations there. Eight sherds were found throughout the burial pit and presumed to be from the same pot.

Related to the chronology of Marcey Creek, Vinette I, and other early wares are questions dealing with why and how pottery technology was adopted and used, whether it was readily and broadly accepted, or only slowly gained a foothold among the Native communities of the Upper Delaware and broader region. The appearance of pottery technology in the Middle Atlantic region has been characterized by some as a revolution in container technology, following on the heels of the pre-existing use of steatite bowls and imitating their form (e.g., Custer 1996:218; Gardner 1982; Leslie 1973:54; Mounier 2003:24-25). A common assumption is that "early pottery was a tool that met the utilitarian needs of ancient communities in more technologically efficient ways than antecedent nonceramic containers under complex and changing ecological, demographic, and subsistence conditions" (Blitz 2015:670). Stone bowls, and later pottery, are containers that can be set directly on fires for cooking or resource processing, supplanting millennia-old indirect means of cooking and heat processing (*e.g*., hot rock cooking) in containers made of perishable materials.

It has been argued that pottery technology is integrated relatively slowly and unevenly into the Indian cultures of the Delaware Valley and Middle Atlantic region (e.g., Stewart 1998b, 1998d), and that the reasons for its adoption are not strictly tied to its utility in cooking and heat-related processing of resources. There is no developmental relationship between stone bowls and early pottery in the Southeast (e.g., Sassaman 1993; Saunders and Hays 2004) and such relationships have been challenged for the Middle Atlantic and Northeast regions (Hoffman 1998; Stewart 2011b; Tache´ and Craig 2015:178, 180; Tache´ and Hart 2013).

Like any productive endeavor, pottery technology is grounded in a social/economic context – it involves the relationships that exist between the various individuals involved in all aspects of production, distribution and use of any given product. Because of these relationships, traditional contexts of production can be a barrier to the acceptance of a new technology if the individuals involved perceive the new technology as undercutting their economic or social position (e.g., Sassaman 1993). In other words, pottery technology may have been resisted because it impacted the position of artisans who traditionally produce containers made from perishable materials used in cooking, processing, and storing resources.

Without radiocarbon dates from numerous pottery producing sites from all areas of the Delaware Valley, it is not possible to reliably explore the idea that the technology may have been resisted or ignored by some American Indian groups. The data now in hand tentatively suggest that the initial appearance of pottery is relatively contemporaneous throughout the Delaware Valley. However, "appearance" need not equate with the widespread and consistent use of the technology. Not all archaeological sites which can be dated to the time when pottery makes its first appearance contain pottery in their assemblages. There seems to be more sites with a greater numbers of pots represented in the middle and lower portions of the Delaware Valley than in upper portions of the valley, an impression that needs to be quantified. These observations might reflect the variable degree to which pottery technology is embraced by different Native groups.

Considering the Delaware Basin as a whole, there seem to be more sites with early pottery associated with wetlands and high order streams than other types of environmental settings, again, impressions in need of quantification. This pattern may relate to how early pottery is being used and the way that it is integrated with subsistence and settlement patterns. All of the impressionistic patterns that I've noted could be related to a specialized function for pottery, i.e. processing resources obtained from wetland and stream habitats, rather than reflecting the degree to which the technology is accepted or resisted by Native peoples.

That stone bowls and pottery co-exist for hundreds of years in the Northeast and Middle Atlantic regions (Stewart 2011b) raises questions about the economic and social functions that each served. The most intensive use of stone bowls apparently takes place during the early years of pottery use in the region. This should put to rest the outdated view that stone bowls are the functional precursor to pottery, i.e., early pottery is not an attempt to replicate stone containers and the uses to which they are put using a different medium. If stone bowls and early pottery were being used for the same things, what explains their prolonged co-existence? This is addressed further in Chapter 4.

Tache´ and Craig (2015) conducted bulk carbon and nitrogen isotope analysis of charred surface material from 44 individual Vinette I pots representing coastal and inland sites in the Northeast to better understand the function of early pottery. This was supplemented with the extraction and analysis of lipids from 112 vessels. Comparisons were made with experimentally charred types of foods representing the floral and faunal remains that can occur on sites. The study employed sherds from the Zimmerman (n=10) and Minisink (n=4) sites in the Upper Delaware as part of the inland site sample (Tache´ and Craig 2015:Figure 1, Table 1).

The results revealed what might be considered a mismatch between what was being processed in pots and the range of foods represented by the floral and faunal remains in archaeological deposits. Vinette I pots were not being used to process the variety of foods available in the local environment but were employed selectively; the preparation of aquatic resources is indicated by the data and "it is very unlikely that the fruits of forest trees, such as acorns or nuts, were significantly processed in early pottery from this region" (Tache´ and Craig 2015:185).

> Charred deposits from inland sites have δ15N values that fall within the range of experimentally charred foods from both terrestrial and aquatic animals (Figure 3A), possibly indicating a more complex mixture of sources. Notably, all Vinette 1 vessels have δ15N values well above the median for terrestrial animals and none are consistent with plant foods (Tache´ and Craig 2015:182).
>
> Overall, the fatty acid isotope data confirms that the vast majority of samples submitted for analysis are consistent with a marine or freshwater origin. In contrast, the evidence for ruminant lipids in Vinette I pottery is surprisingly limited considering the high abundance of deer and elk in temperate woodland environments (Tache´ and Craig 2015:184).

The authors suggest that early pottery may have been employed symbolically in seasonal gatherings likely related to the abundance of migratory fish, marine or freshwater species. "The act of cooking and consuming fish with novel ceramic containers would have been largely symbolic, serving to cement social relations during these important periods of aggregation", while the bulk of aquatic resources harvested and consumed during celebratory feasts would have been processed using other means (Tache´ and Craig 2015:186). The processing of fish oil may also explain the results of the analysis.

The work of Tache´ and Craig provides a framework for investigating the socio-technic role of early pottery in Native society that can be emulated using additional samples from the Delaware Valley. From an ethnographic perspective Willoughby (1908:484) maintains that Algonquian potters focused on the production of cooking pots with serving vessels being fashioned from wood and bark, not pottery. Examples of Delaware Indian wooden bowls (1908:431, Plate XXVIII) are used as illustrations in his discussion. This is an interesting parallel to Tache´ and Craig's view of how Vinette I pottery may have been used.

There are a number of explanations/models/hypotheses that exist for the adoption of pottery which cross-cut regional, continental, and international research (cf. Barnett and Hoopes 1995; Rocek 2013; Saunders and Hays 2004; Sturm et al 2016; Vitelli 1989) and can be tested with data from the Upper Delaware and broader region. I have summarized a number of these elsewhere (Stewart 2011b) as have others (e.g., Bedard 2011; Hay et al 2013:167-170).

The most long-standing of these, previously noted, is that pottery is developed and widely accepted to serve a technological need for a more efficient and productive means of cooking, processing, and storing resources. In such scenarios the adoption of pottery is often systemically linked with sedentary trends in settlement and an increased economic focus on plant foods, seeds, and mast whose nutritional value can be increased through the type of cooking or processing possible with a ceramic container. We should find pottery concentrated on habitation sites of some duration and situated in abundant resource zones such as riverine, estuarine or coastal environments. Artisans capable of producing pottery will be distributed throughout these communities and their products will exhibit variation owing to the availability and characteristics of the raw materials used in production. Variation also is expected in vessel size and shapes or overall design, depending on the learning network in which an individual learns the craft. If pottery is, in fact, closely tied to getting more out of traditionally exploited resources, than variations in vessels size and shape may be an accommodation to the particular type of resource being processed, cooked, or stored. Tache´ and Craig's (2015) study, although it needs to be replicated with additional data, renders this explanation as overly simplistic and potentially false in some respects.

Sturm et al (2016) expand upon economic models for the adoption of pottery among mobile hunter gatherers. They investigate how the interaction between environmental factors and settlement and subsistence strategies influence decisions about the adoption of pottery. While pottery may have provided economic benefits, the time involved in pottery production may conflict with the frequency of group movements necessary for harvesting and processing resources, and limit access to the raw materials needed for pottery production (Sturm et al 2016:646). The technological investment model that they propose holds that technologies that offer high returns but are more expensive to produce will replace those that are cheaper to produce and less productive when they are used long enough to offset the cost of their initial manufacture (Sturm et al 2016:647).

The basic variables used in assessing cooking containers are manufacture time, utility, and use time. In contrast to indirect cooking using hot rock and organic containers, pots enable direct heat cooking which (Sturm et al 2016:650):

-requires less labor/attention enabling cooks to multi-task;

-uses less fuel and is a more efficient use of fuel, especially in areas or at times when fuel is scarce; and

-is more efficient in long, slow cooking necessary to detoxify certain plant foods, render grease and oil, and process small seeds.

So over the long run benefits accruing from the use of pottery outweigh the initial cost of its production. Pottery likely requires a greater investment in production when compared to baskets, hide bags, or wooden/bark containers up until the point where the scale of production is increased, i.e., multiple pots are crafted and fired during single production events. An expedient approach to production – using variable or low quality clays and tempers that are close to hand, forming with minimal effort, and firing at low temperatures – would decrease investment costs but lower the longevity of the vessel produced. The role of other factors need not be discounted in the technological investment model. "Cases where investment in pottery cannot be accounted for in terms of caloric utility may be instances in which returns are social or political (Sturm et al 2016:659 citing Roecek 2013 and Skibo et al 2008).

In the context of this model the initial adoption of pottery by Native peoples of the Upper Delaware or elsewhere in the valley would depend upon the type and importance of resources being exploited. An emphasis on the use of seeds and tubers, grease and oils rendered from bone, mast, and fish would favor adoption of pottery in cases where scheduled settlement movements are sufficient to embrace both the production of pottery, and the harvesting and processing of valued resources. Settlement locations from which desired resources and the raw materials for pottery production could be foraged would be predictable sites of early pottery adoption, generally high order stream settings in proximity to uplands.

An elaboration of the models above is that pottery was adopted because as a new or "exotic" technology, it had economic and social or symbolic value not conveyed by the production, use, or ownership of traditional types of cooking containers (i.e., bark, wooden, or basket containers). Russo and Heide (2004; cf. Bedard 2011; Blitz 2015; Hayden 1995, 1998) present a cogent summary of models that consider the symbolic and social value of pottery and see it as a prestige technology. In general:

> …prestige technologists argue that initial pottery was found in ceremonial and public contexts. It arose not because old technology failed but because, as a new technology, it was novel and rare and hence contained inherent economic value and assignable social value. Self-motivated individuals wishing to display their power and prestige would obtain pottery as they would rare and valued technology such as metals, feathers, or exotic stones – that is, through trade, bride wealth, gifts, and repayment (Russo and Heide 2004:108).

Blitz's (2015) consideration of early pottery as a skeumorph, a copy of a prototype object in a different physical material, is relevant to such models of adoption. He emphasizes that a strict focus on utilitarian potential or efficiency may obscure other important factors in the adoption of pottery vessels such as the social impact of skeuomorphs as iconic representations (Blitz 2015:670).

> Studies in small-scale societies indicate that a mechanical performance or cost–benefit assessment of an unfamiliar innovation is less important to potential adopters than the opportunity to imitate a social peer or influential person who has adopted the novelty; in part, this is because potential adopters do not have sufficient experience to evaluate the novel artifact's mechanical performance characteristics (Blitz 2015:674 citing Henrich 2010:103, 108).

The novel pot could thus be viewed as "special" type of pre-existing container, be it a gourd, basket, or wooden bowl (Blitz 2015:674 citing Houston 2014:64–65 as an example). The value of such an object would be both economic and social.

This perspective fits well with what has been described as dependent invention wherein pottery technology, vessel morphology and the use of decoration do not spread as a complete package. Adopting groups make conscious decisions about how to make use of the technology based on the nature of their existing economic and social systems (Bedard 2011:136-137 citing Clark and Gosser 1995). Bedard (2011:137) in turn suggests that morphological similarities between steatite bowls and early pottery represents a ritually significant container technology presented in a new medium.

Earlier discussions by Klein (1997, 2010), marshalling extensive and complex data sets, proposed a similar model that links steatite vessels and early pottery. In brief, steatite containers are used for a variety of purposes including processing, cooking, serving/display. But all of these purposes are related to ritual or socially charged behaviors and gathering. Early pottery is adopted as a social and technological substitute for steatite bowls as trade networks and access to steatite raw materials and finished products is disrupted to varying degrees. This transition is not synchronous across the Middle Atlantic region because of existing social variability, the geographic location of a given group relative to trade networks and valued resources, and the role that trade fulfills in any given society. The model therefore allows for the co-existence of the two container technologies over protracted periods of time, at least at the scale of regional analysis.

Some of the archaeological implications of economic/social models of adoption are that pottery should be found in specialized contexts like burials, caches, or on sites where feasting or public ceremonies can be inferred to have occurred. The work of Tache´ and Craig's (2015) is applicable here. The spatial distribution of early pottery will be discontinuous. As an exotic technology we shouldn't expect its rapid and widespread acceptance, especially if we assume variability in the social makeup and complexity of native groups across the region at the time of the technology's introduction.

The variation that we should see in early pots is hard to predict in such a model (*contra* Stewart 2011b:155). The actual production of pottery may have involved a relatively small number of potters whose wares were widely traded. Variation in manufacturing techniques, the use of raw materials employed, vessel sizes and shapes should not vary as much as would be expected if artisans were more widely dispersed among native communities. Alternatively, early potters may have been working in relative isolation, or experimenting with the new technology. This supposition is more in line with available data. In turn, residential mobility of pottery-using groups, even if few in number, may have served to disperse early wares among local and regional populations as a result of interaction and exchange with groups who did not produce their own pottery (cf. Beck 2009).

What future research may eventually be able to make clearer is that some groups are adopting pottery because of its economic and social/symbolic value, whereas other groups, through their interaction with the former, accept it simply because it is a useful technological innovation satisfying an economic need. So in a sense, some (but not all) early pottery is replicating the practical/economic/social function of stone bowls, but not their physical form. In the social context of the Eastern Woodlands synthesized in the Klein model, I would argue that pottery could be adopted for economic or social purposes in the absence of the prior use of steatite vessels.

Pottery technology and use seems to be fully embraced by regional populations during the Middle Woodland period. Pottery occurs more frequently on sites than ever before and seemingly represents a wider variety of vessel sizes. By 500/400 BC, and perhaps as early as 600 BC, net impressed pottery is found throughout the Middle Atlantic Region and much of the Delaware Valley (Stewart 1998b:172 citing a variety of sources). If nothing else, this bespeaks of a regional scale of social interaction and sharing of ideas.

Vinette I, Brodhead Net Marked, Fabric Impressed, Wiped, and Dentate Stamped are pottery types associated with the Bushkill Complex roughly dated between 500 BC and 100 BC on the basis of radiocarbon dates deemed acceptable (Kinsey1972:364-369, 1975:39; Kraft 1972:38, 1975:49-58). A more restrictive chronological range of 300 BC to 100 BC is also suggested (cf. Custer 1996:251; Kinsey 1972:367). Brodhead Net Marked is the predominant ware of the complex and was first defined in the Upper Delaware. Three of the five assays listed for the type (see Table 12) are from the original work of Kinsey and Kraft.

Much later Middle Woodland dates from Shawnee Minisink are anomalous given the original chronology assigned to the type and the Bushkill Complex. Also unexpected is the association of Brodhead pottery with an undated Fox Creek lithic assemblage at Michaels No.4 in the Upper Delaware (Graybill 1973; Kinsey 1974:12). Given the chronology of the Fox Creek point type (ca. 200-800 AD) the deposit at Michaels No.4 could be roughly coeval with the deposits at Shawnee Minisink producing Brodhead pottery. Net marked and grit tempered pottery is part of a Fox Creek component at the Conrail site (36Lu169) to the west of the study area and associated with a date of 1830+/-60 BP (Thieme and Schuldenrein 1998:4).

The discrepancies between the original chronology for Brodhead Net Marked and these finds implies that the use of net-wrapped paddles in pottery production has an extensive longevity, not the Brodhead type *per se*. Attribute analysis of these collections might be able to tease out things that are more time transgressive than gross net impressions, such as the types of nets represented by the impressions, the distance between knots, and the final twist of the cordage involved. What may be significant is the lack of net impressed interior surfaces on the pottery from Shawnee Minisink (McNett1985b:115, 177) and Michaels No.4 (Graybill 1973:42).

Given Kinsey's (1972:456-457) description of the Wiped type, estimated to be Middle Woodland in age, it would be difficult to isolate this ware in an undated buried context or surface assemblage of pottery. The wiping of exterior surfaces is apparently thorough as no mention is made of remnant signs of prior cordmarking (Kinsey 1972:Figures 28, 48), while noticeable striations occur on interior surfaces resulting from the implement or material employed in the smoothing process. A new radiocarbon date for the Wiped type from 36Nm4 falls within the age range associated with the Bushkill Complex. The pottery is illustrated in Figure 38. Signs of cordmarking on exterior surfaces seem uncharacteristic for the type.

FIGURE 38. Refitted and other sherds from dated "pot break" feature at 36Nm4 representing the Wiped type. Modified from Hornum et al (2002:Figures 52, 53).

Shell tempered pottery is a hallmark of Middle Woodland pottery, circa 200-800 AD in the Coastal Plain of the Delaware Valley and Middle Atlantic region (e.g., Herbert 2009:176-178; Stewart 1998b:173, 175-190, Figure 112). Shell tempered pottery is relatively rare in the Upper Delaware Valley although its presence in Middle Woodland assemblages may have gone unrecognized and underestimated (Fennelle Miller, 1991, 1991 personal communication; Stewart 2005). At the Faucett site some net impressed sherds typed as Brodhead may have shell temper; the use of shell temper may be earlier in the Upper Delaware than elsewhere in the region, Miller suggests. The six dated occurrences of shell tempered pottery generally fall within the 200-800

AD time frame that characterizes downriver assemblages; however, with calibration some of these assays are potentially earlier (see Table 12).

The relative scarcity of Middle Woodland pottery (especially shell tempered wares) in the Upper Delaware Valley has led some to suggest that there are no resident communities in the area at this time, i.e., the area is only used periodically by groups whose home territories are elsewhere (Fischler and French 1991:155-156; but see Kinsey 1972:364-373; Thurman 1985:21). It has been suggested that shell tempered wares are limited to sites from the Wallpack Bend and points south, and that farther upstream coeval but different types of pottery reflect groups with different territories and patterns of interaction (Fischler and French 1991:155). However, a close reading of Schrabisch (1930) indicates that similar shell tempered pottery may, in fact, exist well upstream of the geographic margin noted by Fischler and French.

Circa 200 AD a unique type of zone decorated pottery appears in the Delaware Valley and elsewhere (cf. Cross 1956:144-148, Figures 8-11; Lattanzi et al 2017; Opperman 1980; Pollak 1971; Rockman 1993; Silver 1991; Steadman 2008; Stewart 1998b:190-211, 1998e). Collectively referred to as Abbott zone decorated pottery, design elements are zoned within spaces defined by single or multiple incised lines, and are arranged in two or more fields on vessels. The designs seem to appear out of nowhere from the standpoint of pottery; they have no precedent in the earlier pottery of the Delaware Valley or Middle Atlantic region. However, they frequently are executed on ceramic bodies that characterize contemporaneous wares (e.g., shell tempered Mockley ware). The pottery has a geographically extensive but dramatically spotty distribution appearing on sites in Virginia, Pennsylvania, New Jersey, New York, Connecticut and Massachusetts (Lattanzi et al 2017:Tables 1, 3; Stewart 1998e:Table 1). The Abbott Farm National Historic Landmark (AFNHL), where the pottery was originally defined, represents a dramatic concentration of the wares.

The designs on the Abbott pottery may have traditionally been employed in another medium and were translated to ceramics for some reason during Middle Woodland times (Lattanzi et al 2017; Stewart 1998e:170-171). Textiles/fabrics, or perhaps tattoos seem the most likely sources of the designs. An assumption that follows from this line of reasoning is that there is some symbolic or ideological connection between the two media (i.e., the original and the pottery), or the ways in which the media and related designs are employed in social settings. Ethnographic examples of the displacement or translation of stylistic complexity from one medium to another seem to occur when one medium becomes incapable of projecting the political or social "messages" that style is meant to convey.

The initial social context in which the pottery functioned was likely the occasional gathering of groups and related feasting used to maintain social identity and reinforce group solidarity at the Abbott Farm and other sites in similar, resource-rich settings in the Middle Atlantic region (Lattanzi et al 2017). Both at the landmark and beyond, the Abbott pottery is most concentrated at sites where an argument could be made for the presence of a large and diverse group, and where resources could be obtained that could support such a gathering (e.g., during the seasonal migration of fish). Given the distribution of the Abbott pottery, gatherings involved groups from across the Middle Atlantic Region. Following such gatherings, the pottery gets used and discarded in much the same ways as other contemporaneous wares – it doesn't get used as a formal grave good nor appear in caches, but is eventually discarded in the same contexts as other types of pottery. The distribution of the pottery does not reflect down-the-line or broad based exchange, but more of a restricted network (*sensu* Watts and Ossa 2016:627, 630).

Unique zone decorated wares, likely associated with the Abbott zone decorated wares, are rare in the study area but associated with three dated occurrences, one at 28Wa2 (1660+/-95 BP), one at 36Pi4 (1440+/-30 BP), and the last at 28Wa528 (1485+/-30 BP) farther downriver. The dates fall on the early and mid-range of the chronology associated with Abbott zone decorated pottery, roughly AD 200-800 (Lattanzi et al 2017; Stewart 1998b:190-211, 1998e). The pottery also is found at three undated localities: the Bevans rockshelter, 28Sx25 (Schrabisch 1915:Plate II-5); a site located 0.5 mile east of 28Sx179 (Hemmings 1966); and a site along the Delaware River at Harmony Station, Warren County, New Jersey. Figure 39 shows examples of the pottery. What was described as an Abbott Zoned variant was found on the Kutay site (36Pi25) in the Upper Delaware. Derived from a Late Woodland context and associated with Tribal series ceramics (Kinsey 1972:241, Figure 74), it has incised herring bone designs on a collared rim and closely resembles decoration found on uncollared Overpeck or Bowmans Brook vessels.

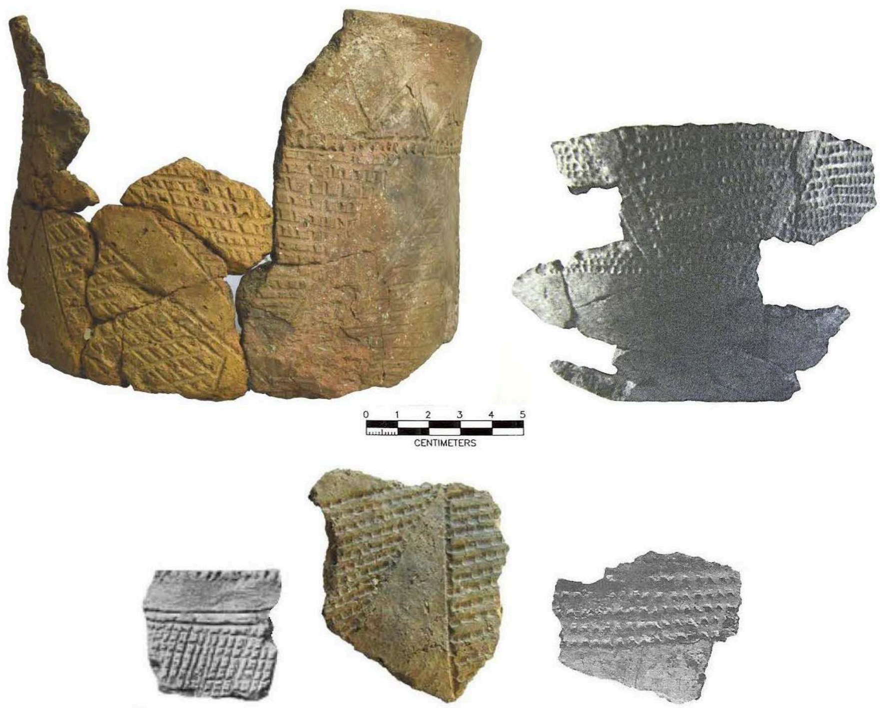


FIGURE 39. Abbott Zone Decorated pottery from project area sites. Top left: reconstructed zoned incised vessel from a locality east of 28Sx179 (see Hemmings 1966; photo courtesy of Gregory Lattanzi and NJSM). Top right: reconstructed zoned dentate vessel from 28Wa528, modified from Adams and Adams (1991:Figure 2). Bottom left: zoned incised sherd from the Bevans rockshelter, modified from Schrabisch (1915:Plate II-5). Bottom middle: sherd from site at Harmony Station, Warren County, New Jersey, collection of Don Troxell, Harmony Township, New Jersey. Bottom right: possible Abbott Horizontal Dentate sherd from 28Wa2, modified from Kraft (1975b:Figure 32).

The large, nearly complete vessel from Feature 10 at the Manna site (36Pi4) is described in detail here owing to its level of completeness relative to other finds, the rarity of such pottery in the study area, and its having been dated on the basis of an adhering residue. Data are abstracted from Stewart et al (2015). Figures 40 and 41 illustrate portions of the pot. Not shown are additional and extensive refitted sections of the vessel. Up to 75% of the original vessel is estimated to be represented, including its base. The pot was originally shell tempered as inferred from the light weight of sherds, and the size and shape of leached voids visible in cross-section and on exterior and interior surfaces. The estimated percentage of temper employed in the production of the pot varies from 5-10% to 10-15% to 20-30% depending on the group of refitted sherds being evaluated. Higher percentages are most typical of body sherds. The vessel base has the lowest estimated percentage of temper.

The circular base of the pot was shaped as a single mass to which coils were added to build higher portions of the vessel. The base is very mildly rounded to flat and may have rested in a supporting form during the construction of the vessel. Cross-sectional views and breakage patterns suggest that the mid-section of the pot may have been formed with slabs rather than coils, with a return to the use of coils to finish upper portions of the body and the rim. The thickness of vessel walls ranges from 7.5 mm to 14.1 mm. Near-rim and decorated sections of the pot are thinner than the lower body. The degree of oxidation in sherd cores varies with some exhibiting thin oxidized exterior and interior surfaces, and others with only a thin to moderately thick oxidized exterior. On the basis of this one could speculate that the pot was fired in an overturned position and then righted while still hot and allowed to cool. The diameter of the vessel's orifice is approximately 41 cm and the circumference about 130.5 cm. The absolute height of the pot is unknown but is at least 26 cm. Three mend holes occur on large refitted portions of the pot indicating that it had been in use for some time prior to being discarded on-site. The vessel profile is mildly excurvate with no defined neck.

The base's surfaces are smoothed, unlike upper portions of the vessel's body which are impressed with a fine meshed net. The base shows no indication of having been net impressed prior to being smoothed. Positive surface impressions of body sherds clearly show knots (see Figure 40) which are spaced at intervals of 6.0 mm to 8.8 mm. Net impressions of the upper 8.0 cm to 10.5 cm of the pot were smoothed-over prior to the application of decoration. Decoration occurs in a zone defined by two incised lines encircling the rim and two encircling incised lines 8 cm to 10.5 cm below the rim. Oval punctations frame the two sets of incised lines. Within the zoned area of the vessel are isosceles trapezoids (or truncated triangles) with interior oval punctations. The punctations associated with the incised lines that bound the decorated area are longer and more deeply impressed than those associated with the isosceles trapezoids. It has not been possible to refit the entire circumference of the rim owing to the fragile nature of the pottery. It is estimated that 7-8 of the trapezoidal motifs are distributed around the vessel's circumference.

The type of temper and the zoned decoration of the Feature 10 pot is atypical of late-Middle Woodland wares in the Upper Delaware Valley. Comparisons can be drawn with the shell tempered and net impressed pottery of Coastal Plain segments of the Delaware Valley for the time from 200 AD to 800/900 AD, as well as the zoned and decorated wares from the Abbott Farm. The Manna pot's designs, however, do not precisely match any of the motifs known for

Abbott Zone decorated pottery (e.g., Cross 1956:Figures 8-10). Also compelling from a comparative perspective is the association of the pot with an argillite biface. Downriver the intensive use of argillite is frequently associated with assemblages including shell tempered and net impressed pottery.

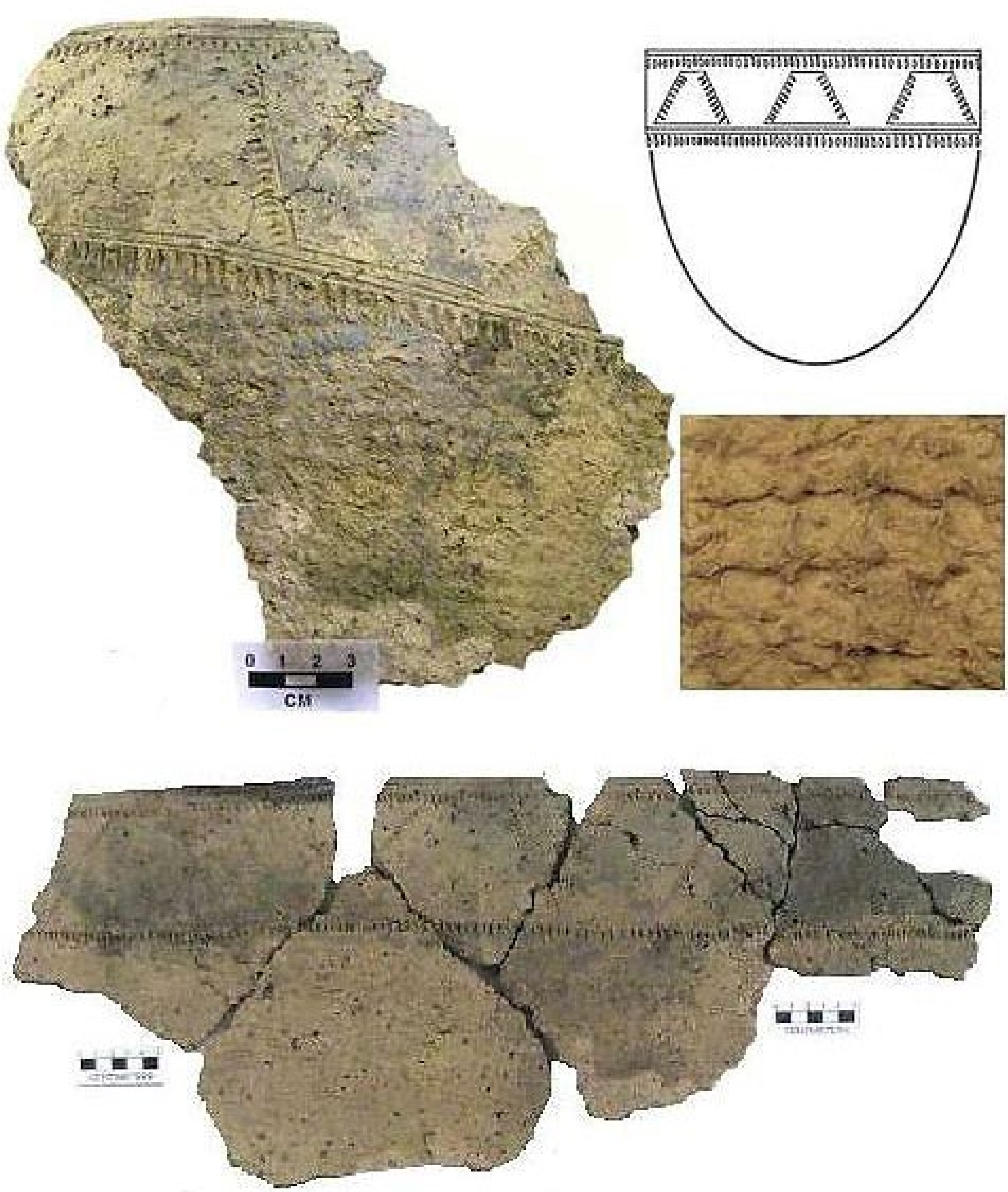


FIGURE 40. Views of rim and upper portions of shell tempered and net impressed pot from Feature 10 at 36Pi4. Also shown is a sketch of the zoned design element that repeats across the rim and a clay impression of the netting used to impress the pot’s exterior surfaces. The scale in the lower image is 5cm. Source: Stewart et al 2015:Figure 68.

FIGURE 41. Base of the shell tempered and net impressed pot from Feature 10 at 36Pi4. Coil breaks are obvious on the interior (upper) views of the base. Source: Stewart et al 2015:Figure 69.

Single vessels are represented at each of the four sites in the study area where the Abbott-like wares were found. Three of the sites, Harry's Farm, Manna, and Harmony Station are along the Delaware River and possess modest Middle Woodland components. The locality reported near 28Sx179 is situated in an upland and apparently associated with what seems to be a rockshelter; sherds of the zone decorated vessel are the only artifacts recovered during the site's investigation (Hemmings 1966). The presence of the pottery suggests that some Upper Delaware groups may have participated in gatherings far downriver. Alternatively, downriver groups may have visited the Upper Delaware or the pots were simply gained through trade. In any of these cases, close social connections are indicated between the peoples of the Upper Delaware and those inhabiting the southern Piedmont and Coastal Plain of the drainage basin.

Rocker stamping, triangular plats of punctations, and cordwrapped stick decorations occur on Point Peninsula pottery types associated with the Middle Woodland period generally dating after 500/600 AD (Kinsey 1972:458-459). Stylistic affinities are with archaeological cultures to the north of the Upper Delaware. Dated Point Peninsula pottery in the study area corresponds with the chronological range associated with it in New York. Table 13 provides comparative data (cf. Table 12).

TABLE 13
NEW YORK LATE MIDDLE WOODLAND POTTERY TYPES WITH DATED RESIDUES

Pottery Type	Date BP	Calibrated* 2 Sigma Age Ranges – AD	Calibrated* Median Age AD	Site	Reference
Point Peninsula Corded	1695+/-35 ISGS-A0454	252-305 311-415	350	Wickham	Hart and Brumbach 2005:Tables 1,A1
Point Peninsula Corded	1648+/-47 ISGS-A0194 1450+/-43 ISGS-A0195	321-539 540-660	400 606	Wickham	Hart and Brumbach 2003:Table 2
Point Peninsula Corded	1575+/-35 ISGS-A0497	407-559	482	Felix	Hart and Brumbach 2005:Tables 1,A1
Point Peninsula Corded	1525+/-40 ISGS-A0503	425-611	534	Felix	Hart and Brumbach 2005:Tables 1,A1
Point Peninsula Corded	1520+/-35 ISGS-A0504	428-610	544	Felix	Hart and Brumbach 2005:Tables 1,A1
Point Peninsula Corded	1405+/-40 ISGS-A0502	571-674	633	Felix	Hart and Brumbach 2005:Tables 1,A1
Point Peninsula Corded	1240+/-40 GX-26451 1210+/-40 GX-27559	679-881 687-895	767 813	Kipp Island	Schulenberg 2002:Table 8.6
Kipp Island Crisscross	1461+/-43 ISGS-A0226	535-659	598	Kipp Island	Hart and Brumbach 2003:Table 2
Kipp Island Crisscross	1390+/-35 ISGS-A0501	595-682	644	Simmons	Hart and Brumbach 2005:Tables 1,A1
Jacks Reef Corded	1430+/-40 ISGS-A0499	559-662	619	Felix	Hart and Brumbach 2005:Tables 1,A1
Jacks Reef Corded	1428+/-41 ISGS-A0227	558-663	620	Kipp Island	Hart and Brumbach 2003:Table 2
Jacks Reef Corded	1315+/-50 ISGS-A0506	635-778	705	Felix	Hart and Brumbach 2005:Tables 1,A1

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

Attempts to define sequent archaeological cultures or phases of the Late Woodland period have been made, largely on the basis of pottery typologies and the artifact and feature assemblages with which they are presumed to be associated (e.g., Kraft 1975a, b; Custer 1996:294-297; Puniello 1991). Single component or single phase occupations in the Upper Delaware Valley are rare (Puniello 1991:45). While pottery typologies, at least at the descriptive level, correspond to a substantial degree with those of central and northern New York, other cultural factors do not (Puniello 1991:80). In addition, the Late Woodland pottery chronologies of New York and the Upper Delaware Valley are not completely synchronous (see Puniello 1991:82 and discussion below).

The linguistic, ethnohistorical and historical records for both the Upper Delaware Valley and central New York make it clear that the two areas are culturally distinct (Puniello 1980, 1991:88). Kraft (1970d:21-22) notes how different the Late Woodland pottery is on the Busic site situated on Mashipacong Island relative to what has been documented for more southern portions of the Upper Delaware. He intimates that areas north of Mashipacong Island characteristically produce pottery that varies from what is typical of Late Woodland sites south of the island and extending to the Water Gap.

The ceramic assemblages of the Upper Delaware Valley are distinctive throughout Late Woodland times (cf. Kinsey 1972; Kraft 1975a, 2001:291-309; Puniello 1991). Two Late Woodland phases defined by Kraft (cf. Kraft 1975a, 1986, 2001), Pahaquarra (1000-1350 AD) and Minisink (1350-1700 AD) reveal extensive interactions/influences with Owasco and proto-Iroquoian cultures to the north. Intermediate types of pottery overlap these phases (ca. 1250-1400 AD) and include collared vessels with cordwrapped stick decoration and collarless vessels with incising (e.g., Kinsey 1972:467-468; Kraft's 1975a:116-120, 1975b:129-132; Puniello 1991:85). Table 14 lists pottery types associated with Kraft's (1975a, b) phases.

TABLE 14
POTTERY TYPES ASSOCIATED WITH KRAFT'S (1975*) PHASES OF THE LATE WOODLAND PERIOD

Pahaquarra Phase Types	**Intermediate Types**	**Minisink Phase Types**
Levanna Cord on Cord	Castle Creek Punctate	Munsee Incised varieties
Canandaigua Plain	Oak Hill Corded	Chance Incised
Sackett Corded	Kelso Corded	Durfee Underlined
Castle Creek Incised Neck	Milo Corded	Deowongo Incised
Clemsons Island Punctate	Bainbridge Linear	Fonda Incised
Bowmans Brook	Smoothed Collared	Garoga Incised
Overpeck		Goodyear Lipped
Other incised collarless wares		Rice Diagonal
		Otstungo Notched Lip
		Collarless Levanna-like

Owasco series pottery is part of the Pahaquarra phase. Sackett series pottery subsumes the former types Owasco Corded Horizontal, Owasco Platted, Owasco Herringbone, and Owasco Corded Oblique (Lenig 1965). Owasco Corded Collar is part of the Kelso Corded pottery series that includes Kelso Corded variants and Bainbridge Collared Incised (Kraft 1975b:131; Lenig 1965). Phases of Owasco culture are largely defined on the basis of changes in the frequencies with which pottery types, including Carpenter Brook, Levanna, and Wickham types in addition to named Owasco wares, occur on sites (Hart 2011:96; Hart and Brumbach 2003; Ritchie 1965, 1980; Ritchie and Funk 1973). This yields the sequence: Carpenter Brook 1000 to 1100 AD, Canandaigua 1100 to 1200 AD, and Castle Creek 1200 to 1300 AD. Snow's (1995:54) research in the Mohawk Valley of New York revised the timing of these phases based on a re-examination of key sites, radiocarbon dates and their calibration: Early Owasco 900 to 1150/1200 AD (Carpenter Brook phase); Middle Owasco (Canandaigua phase) 1200 to 1275 AD; and Late Owasco (Castle Creek phase) 1275 to 1350 AD.

In a re-examination and AMS dating of residues on pottery from classic New York sites, Schulenberg (2002) demonstrates that some Owasco types occur in contexts that are Middle Woodland in age. Later work along similar lines (Hart and Brumbach 2003, 2005; Smith 2011) reaffirms Schulenberg's conclusions noting that there are Owasco pottery types that co-occur with Point Peninsula pottery on sites as early as the 7th century AD (cf. Tables 13, 15). Some of the sites involved are included in the current study area (Fortin Locus 2, Street – see Table 12). This has rendered the Owasco cultural sequence suspect (Hart 2011:97).

TABLE 15
NEW YORK OWASCO SERIES POTTERY WITH DATED RESIDUES

Pottery Type	Date BP	Calibrated* 2 Sigma Age Ranges – AD	Calibrated* Median Age AD	Site	Reference
Wickham Corded Punctate	1425+/-45 ISGS-A0190 1286+/40 ISGS-A0193 1260+/-39 ISGS-A0228 1231+/-44 ISGS-A0192 1228+/-42 ISGS-A0191	551-667 655-778 667-779 789-871 677-889 680-889	620 720 739 785 791	Wickham	Hart and Brumbach 2003:Table 2
Wickham Incised	1280+/-40 GX-26448	657-778	724	Kipp Island	Schulenberg 2002:Table 8.6
Levanna Cord-on-Cord	1180+/-40 GX-27484	767-969	840	Hunter's Home	Schulenberg 2002:Table 8.6
Levanna Cord-on-Cord	1090+/-40 GX-28193	876-1023	950	Levanna	Schulenberg 2002:Table 8.6
Carpenter Brook Cord-on-Cord	1470+/-43 ISGS-A0225	534-655	591	Kipp Island	Hart and Brumbach 2003:Table 2
Carpenter Brook Cord-on-Cord	1247+/-48 ISGS-A0197	670-884	761	Hunter's Home	Hart and Brumbach 2003:Table 2
Carpenter Brook Cord-on-Cord	1130+/-40 GX-27486	799-990	915	Hunter's Home	Schulenberg 2002:Table 8.6
Carpenter Brook Cord-on-Cord	1010+/-40 Beta-193706	966- 1058 1075-1154	1020	Carpenter Brook	Smith 2011:11
Carpenter Brook Cord-on-Cord	960+/-40 GX-26449	1012-1164	1092	Kipp Island	Schulenberg 2002:Table 8.6
Owasco Platted	1138+/-40 ISGS-A0196	798-985	904	Hunter's Home	Hart and Brumbach 2003:Table 2
Owasco Corded Oblique	1360+/-40 GX-27558	607-716	661	Kipp Island	Schulenberg 2002:Table 8.6
Owasco Corded Oblique	781+/-42 ISGS-A0235	1181-1284	1242	Haner	Hart and Brumbach 2005:Tables 1,A1
Owasco Herringbone	1410+/-40 GX-26450	569-671	630	Kipp Island	Schulenberg 2002:Table 8.6
Owasco Corded Horizontal	1280+/-40 GX-27485 1220+/-40 GX-26453	657-778 683-892	724 801	Hunter's Home	Schulenberg 2002:Table 8.6
Owasco Corded Horizontal	1211+/-46 ISGS-A0198	681-899	811	Hunter's Home	Hart and Brumbach 2003:Table 2
Owasco Corded Horizontal	1100+/-40 Beta-193707	865- 1021	941	Carpenter Brook	Smith 2011:11

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

After circa 1300/1350 AD, a variety of collared and castellated pottery types, many mirroring those found in New York, are well represented in study area assemblages. Table 16 provides data from a series of New York sites for typological and chronological comparisons. Residue related dates for Garoga Incised are 445+/-40 BP and 425+/-40 BP from the Smith-Pagerie and Garoga sites, respectively (Hart and Brumbach 2005:Tables 1,A1). At the Klock site residue from Fonda Incised produced an assay of 480+/-40 BP (Hart and Brumbach 2005:Tables 1,A1).

There is ambiguity in both the chronology and phase affiliation of Owasco series pottery found in the Upper Delaware Valley. Table 17 summarizes date ranges for types typically associated with Owasco series pottery and the Pahaquarra phase (also see Table 12). Middle Woodland dates from the New York residue studies for the Wickham, Levanna, Carpenter Brook, Owasco Herringbone, Owasco Platted, Owasco Corded Horizontal and Owasco Corded Oblique types are not replicated in the study area data base. However, a date for Sackett Corded from Chenango Point is clearly Middle Woodland. A rim sherd of Sacket Corded is associated with a date of 860+/-120 AD at 28WA610, and "if correct, would suggest that the Owasco tradition in the Delaware Valley began 100 to 200 years earlier than heretofore recognized" (Stevens et al 1993:34). Dated examples of Owasco series pottery from the study area are shown in Figures 42-47.

Feature 269 at the Faucett site contains a brass earring and pottery identified as Wickham Corded Punctate and Munsee Incised. The Wickham pottery is thought to be an accidental inclusion in the pit from an earlier Late Woodland occupation. Moeller (1992:Figure 16, 63) associates the feature with a Munsee Phase occupation of the site post 1550 AD based on the occurrence of a brass spiral and brass scraps found in the feature. The presence of an abstract human face on a pottery sherd from the feature indicates a date of deposition late in prehistoric or early historic times.

Miroff (2012:90-91, Tables 4.3, 6.6) remarks upon the extreme mixture of pottery types in dated features at Chenango Point South, three of which are reflected in Table 12 of this volume:

> Feature 176: Carpenter Brook Cord-on-Cord, Sackett Corded, Kelso Corded, Oak Hill Corded, Owasco Herringbone, Owasco Platted, Richmond Incised.
>
> Feature 46: Carpenter Brook Cord-on-Cord, Sackett Corded, Richmond Incised.
>
> Feature 90: Owasco Corded Horizontal, Richmond Incised.

Acknowledging that formation processes could have resulted in the mixing of components, she also considers it may also indicate that the typically early Late Woodland types extend beyond the temporal range established in traditional typologies – "there is no reason to believe that types do not extend to more recent dates than traditional typologies state, especially on a region-by-region basis" (Miroff 2012:90).

TABLE 16
ASSOCIATION OF POTTERY TYPES THROUGH TIME ON SELECT LATE WOODLAND SITES, MOHAWK VALLEY, NEW YORK*

Pottery Types in Assemblages from the Oak Hill Phase A.D. 1350-1400

Type	Dewandalaer n=54	El Rancho n=25	Galligan #1 n=122	Oak Hill #2 n=104
Bainbridge Linear	4%		24%	19%
Kelso Corded	41%	33%	18%	5%
Goodyear Lipped	17%	8%	6%	5%
Oak Hill Corded	32%	25%	29%	16%
Durfee Underlined		8%		18%
Chance Incised	6%	8%	6%	32%
Deowongo Incised	2%	8%	18%	
Otstungo Notched		8%		2%
Other				3%

Pottery Types in Assemblages from the A.D. 1400-1525 Period

Percentages under 0.5% shown as 0%

Type	Second Woods	Chance	Elwood	Getman	Wormuth	Otstungo
Kelso Corded		1%			7%	
Goodyear Lipped		1%				
Oak Hill Corded		8%		1%		
Durfee Underlined	3%		1%			
Chance Incised	75%	69%	36%	30%	12%	11%
Deowongo Incised	14%	14%	19%	23%	28%	22%
Otstungo Notched	1%	7%	4%	4%	7%	11%
Garoga Incised			38%	42%	28%	41%
Rice Diagonal[a]			0%	0%	5%	6%
Wagoner Incised			1%		1%	1%
Martin Horizontal				1%		
Cromwell Incised					1%	1%
Thurston Horizontal						2%
Other	9%	2%			10%	5%

Pottery Types in Assemblages from Sites Dating to the A.D. 1525-1580 Period

Percentages under 0.5% shown as 0%

Type	Cayadutta	Ganada	Garoga	Klock	Smith-Pagerie
Durfee Underlined[a]				0%	
Chance Incised[a]	2%	4%	1%	0%	
Deowongo Incised	9%	4%	1%	5%	1%
Otstungo Notched	10%	2%	3%	15%	8%
Garoga Incised	53%	75%	86%	57%	64%
Rice Diagonal	1%	1%	2%	11%	5%
Wagoner Incised	14%	2%	6%	6%	
Martin Horizontal[a]		1%	0%	1%	2%
Cromwell Incised	2%	1%		1%	1%
Thurston Horizontal[a]				1%	0%
Other	10%	9%	1%	2%	19%

*Modified from Snow 1995:Tables 2.14, 3.3, 4.1; Lenig 1965

TABLE 17
STUDY AREA C14/AMS DATES FOR POTTERY TYPES TYPICALLY ASSOCIATED WITH THE OWASCO SERIES AND PAHAQUARRA PHASE

Type	Date Range (BP) n=number of assays	Date Range (BC/AD) Calibrated 2 Sigma Medians*
Wickham	1043+/-40 to 600+/-30 n=2	994-1346 AD
Levanna	930+/-60 to 680+/-50 n=3	1106-1311 AD
Carpenter Brook	1060+/-40 to 300+/-30 n=10	980-1563 AD
Sackett	1370+/-60 to 300+/-3 n=11	658-1563 AD
Owasco Herringbone	1180+/-80 to 300+/-30 n=15	842-1563 AD
Owasco Platted	860+/-40 to 300+/-30 n=10	1180-1563 AD
Owasco Corded Horizontal	730+/-60 to 270+/-30 n=10	1272-1632 AD
Owasco Corded Oblique	920+/-40 to 600+/-30 n=3	1105-1346 AD
Owasco Corded Variant	840+/-70 n=1	1183 AD
Clemson Island	1040+/-40 to 890+/-60 n=2	996-1136 AD
Bowmans Brook	1020+/-80 to 540+/-100 n=4	1016-1391 AD
Overpeck	1020+/-80 to 520+/-80 n=7	1016-1403 AD

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

In summary, age estimates for most of the Owasco-related types both encompass and extend beyond the latest end of the chronologies traditionally assigned them. Kraft (1972:45) notes the unusual continuation of some Owasco vessel forms long after the appearance of collared and incised pottery types and the assays compiled here confirm his observation. One could conclude on the basis of the radiocarbon dates that the designs that typify Owasco series pottery originated north of the Upper Delaware and become popular in the study area at a later date, and continue to be used throughout much of the Late Woodland period. It also is clear that the chronological boundaries assigned to the Pahaquarra phase are not upheld. Settlement pattern or other studies that rely only on pottery typology for the chronological ordering of their data should be considered suspect in light of these data. In New York Owasco types co-occur with Point Peninsula pottery on sites as early as the 7th century AD. The 600 years of overlap of their respective chronologies overlap precludes arguments using pottery to support rapid migration and population replacement (Hart 2011:97).

Clemson Island pottery shares many similarities with Owasco types and has been found on Owasco sites in New York (e.g., Ritchie and Funk 1973:179-194). Dates for Clemson Island pottery in the Upper Delaware coincide with the chronological range ascribed to this ware elsewhere, primarily the Middle and Upper Susquehanna Valley (Raber 2014:Table 1; compilation in Stewart 1994a:11-18, 184-185, Table 1). The dates crosscut the chronological boundaries traditionally ascribed to early (Carpenter Brook) and middle (Canandaigua) Owasco.

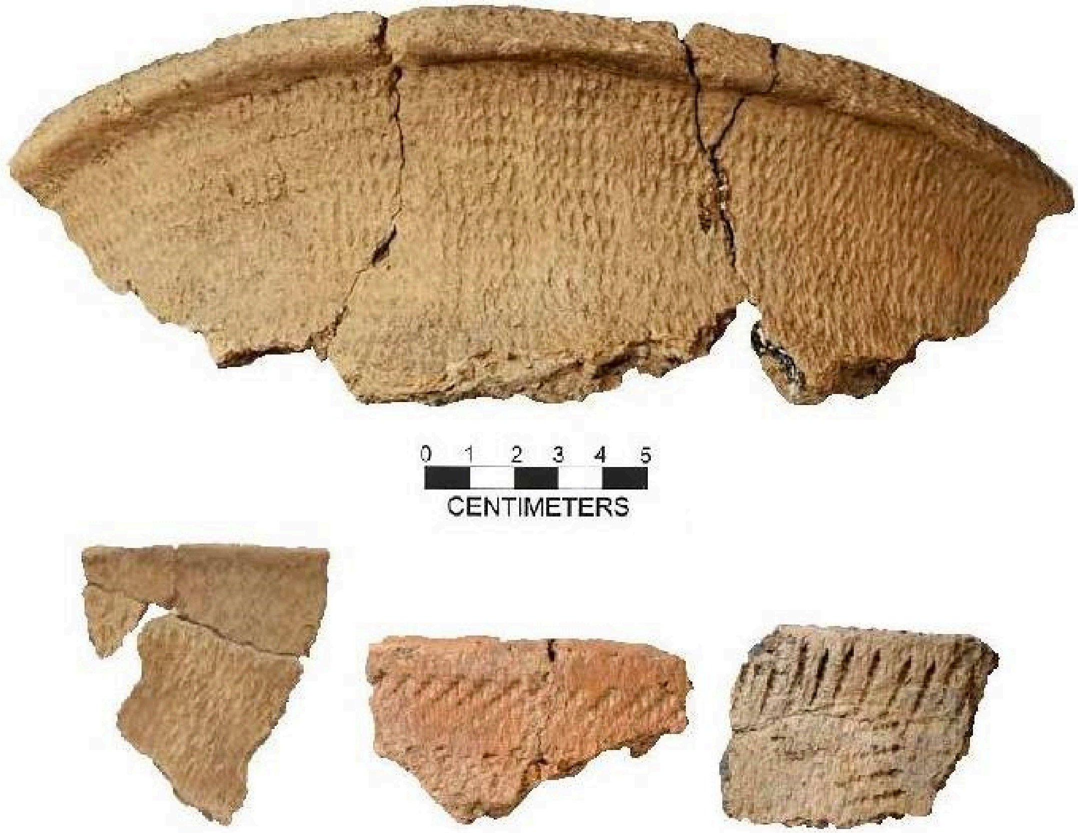


FIGURE 42. Levanna and Carpenter Brook Cord-on-Cord pottery from dated contexts. Top: Levanna Cord on Cord, Feature 275, Chenango Point South site, modified from Miroff (2012:Photo 6.3). Bottom left: Levanna Cord on Cord, Feature 6, Deposit Airport site, modified from Knapp and Versaggi (2002:Photo 9). Bottom middle: Carpenter Brook Cord-on-Cord, Feature 105, Chenango Point site, modified from Miroff (2011 Photo 6.2). Bottom right: Carpenter Brook Cord-on-Cord, Feature 176, Chenango Point South site, modified from Miroff (2012 Photo 6.4).

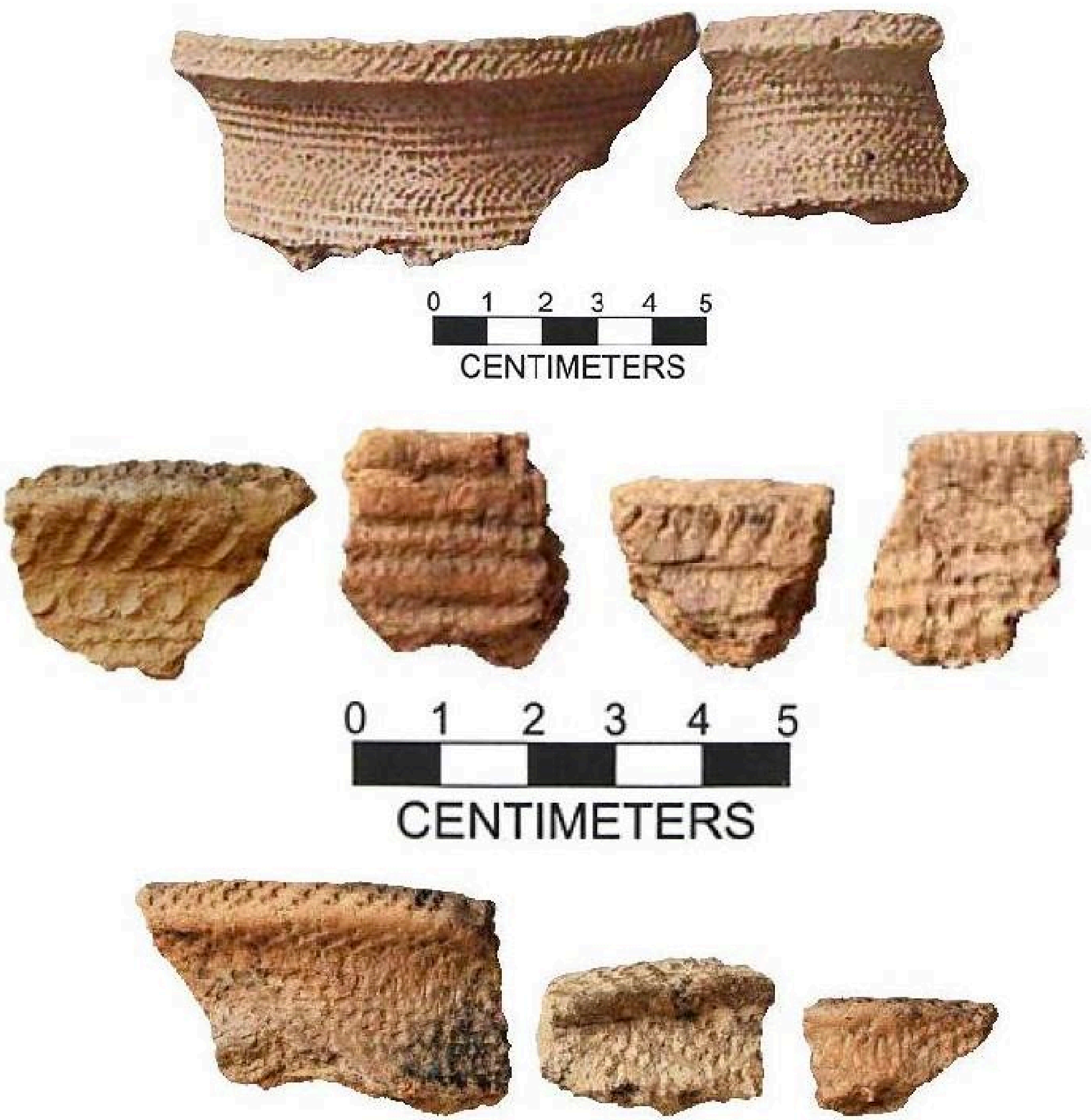


FIGURE 43. Examples of Owasco Corded Horizontal and Corded Oblique from dated contexts. Top: Owasco Corded Horizontal, Feature 10C, Otsiningo Market, modified from Miroff (2014 Photo 21). Middle, left to right: Owasco Corded Horizontal, Feature 275, Chenango Point South, modified from Miroff (2012: Photo 6.7); Owasco Corded Horizontal, Feature 401, Chenango Point, modified from Miroff (2011:6.6); Owasco Corded Horizontal, Feature 401, Chenango Point, modified from Miroff (2011:6.6); Owasco Corded Horizontal, Feature 105. Chenango Point, modified from Miroff (2011:6.6). Bottom: Owasco Corded Oblique, Chenango Point, Feature 383, modified from Miroff (2011:Photo 6.14).

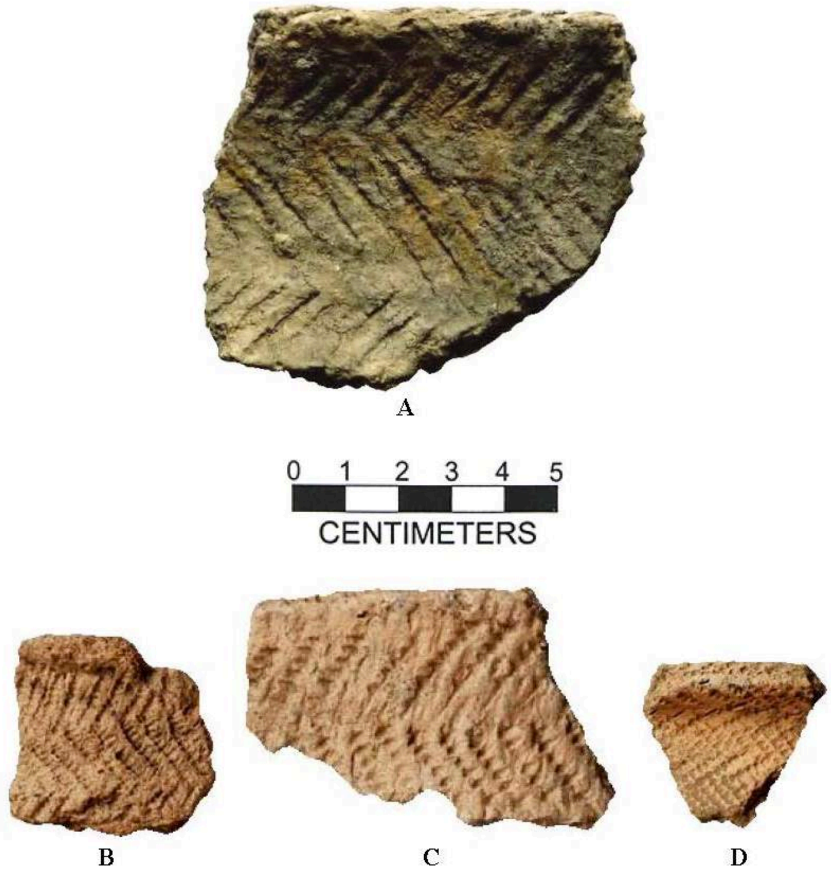


FIGURE 44. Examples of Owasco Herringbone pottery from dated contexts. A: Locus I, Herrick Hollow II, modified from Hohman et al (2005:Figure 41). B: Feature 383, Chenango Point, modified from Miroff (2011 Photo 6.11). C: Feature 119. Chenango Point, modified from Miroff (2011 Photo 6.11). D: Feature 176, Chenango Point South, modified from Miroff (2012: Photo 6.8).

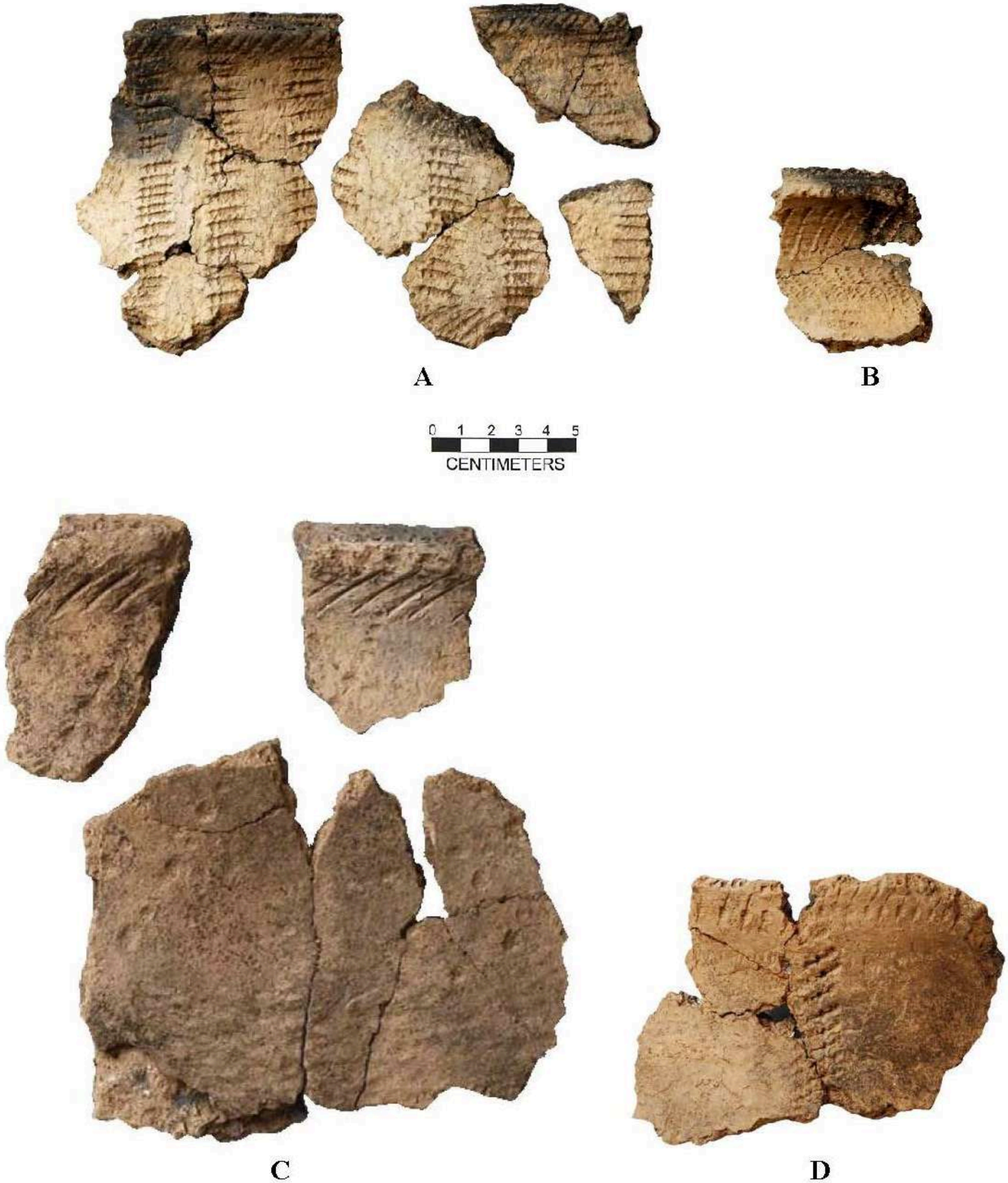


FIGURE 45. Examples of Owasco Platted pottery from dated contexts. A: Feature 105, Chenango Point, modified from Miroff (2011:Photo 6.12). B: Feature 118, Chenango Point, modified from Miroff (2011:Photo 6.13). C: Platted variant, Feature 180, Chenango Point South, modified from Miroff (2012:Photo 6.11). D: Platted variant, Feature 180, Chenango Point South, modified from Miroff (2012:Photo 6.10).

FIGURE 46. Vessel from Feature 89 at 36Pi4 combining attributes of Owasco Corded Horizontal, Corded Oblique, and Herringbone. Source: Stewart et al 2015:Figure 73.

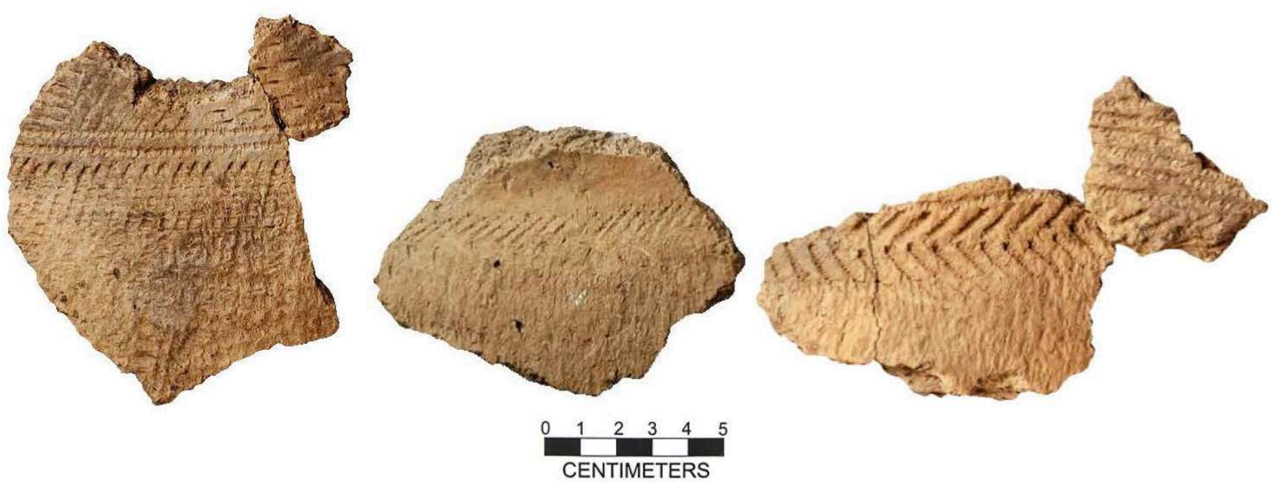


FIGURE 47. Examples of Sackett Corded pottery from dated contexts. Left: Sackett Corded variant, Feature 180, Chenango Point South, modified from Miroff (2012:Photo 6.6). Middle: Feature 176, Chenango Point South, modified from Miroff (2012:Photo 6.5). Right: Feature 383, Chenango Point, modified from Miroff (2011:Photo 6.9).

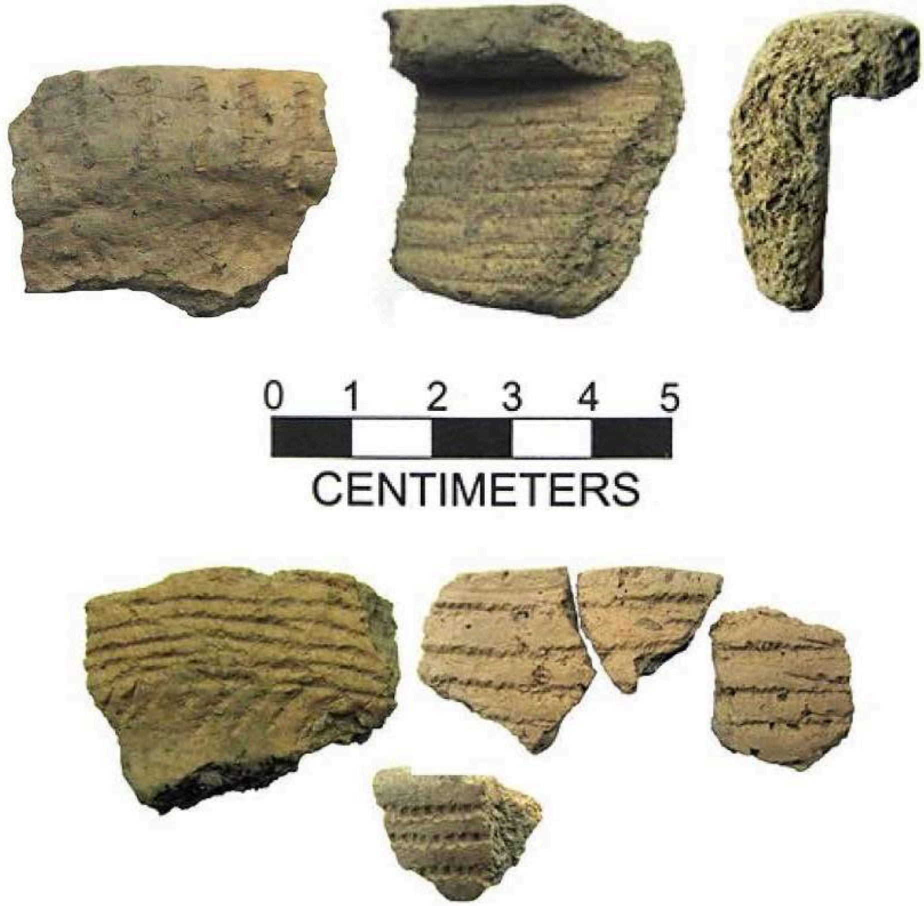


FIGURE 48. Pottery from the dated mid- to late-Late Woodland analytic unit at the Manna site, 36Pi4. Top: Owasco Corded Horizontal from Feature 49; Owasco Corded Horizontal variant and profile (not to scale). Bottom: Kelso Corded/Owasco Corded Collar variants. Modified from Stewart et al (2015:Figures 83-85).

The dated example of Clemson Island pottery from 28Wa278 is depicted in Figure 49. House 1 at the site had an internal association consisting of the Clemson Island rim, related sherds, and a low collared pot potentially representing Chance or Munsee Incised (Barse 2006:4.95). If traditional typology is accepted this suggests that the house area was reused over centuries. Or, on the basis of the assay, it could be concluded that collared pottery appears earlier in time than previously thought confounding the use of historical types like Munsee Incised to distinguish a late phase of the Late Woodland period (contra Barse 2006:5.2).

The Overpeck and Bowmans Brook types, in evidence throughout Late Woodland times in the Middle and Lower Delaware Valley (Stewart 1998b), are dated to the early portion of their overall ranges in the Upper Delaware Valley. It would not be unusual to find small quantities of these wares in Minisink phase components. However, Staats (1974b:2) reports the recovery of 62 pots representing the Bowmans Brook and Overpeck types from the Miller Field site (28Wa16). The Middle Woodland date for Overpeck at Oberly Island is not considered to be reliable.

Investigators argue that the single sherd found is intrusive to dated Feature 22 (Siegel et al 1999:64).

FIGURE 49. Owasco-Clemson Island rim from Feature 911, 28Wa278. Modified from Barse (2006 Plate 4.29).

Overpeck Incised pottery dominates the assemblages at the Padula and Sandts Eddy sites (Bergman 1996b:88) as well as Oberly Island (Siegel et al 1999:76). From a typological point of view this portion of the valley does not seem to be part of an Upper Delaware Valley style zone, or group territory if pottery can be roughly equated with people, wherein Owasco series pottery characterizes assemblages. Sites like Sandts Eddy, Padula, and Oberly Island are near the southern extent of low to very modest distributions of Owasco ceramics (Bergman et al 1994:25; Schuldenrein et al 1991). Sites found in the area between the Delaware Water Gap and the Point Pleasant/Frenchtown area of the Middle Delaware Valley produce a mixture of Upper Delaware wares and pottery more typical of the Trenton to Philadelphia/Camden area (e.g., Stewart et al 1986:Table 4).

Table 18 summarizes assays for pottery types that Kraft (1975a, b) felt were intermediate between the Pahaquarra and Minisink phases. Their fit with Kraft's sequence is not consistent. Single dates for the Castle Creek and Milo types conform to expectations; the assay for Milo Corded is from the work in the Upper Delaware that Kraft employed in organizing his sequence. Calibrated two sigma age estimates for Oak Hill suggest that the pottery could predate Kraft's early chronological boundary for Intermediate types. The latest date for Oak Hill from Chenango Point South in the Upper Susquehanna Valley indicates potential and substantial overlap with the chronology of Minisink phase pottery. Dropping the latest date for Oak Hill yields a calibrated median range of 1220-1391 AD in line with traditional typological expectations. The late assay may be valid, however. For example, at the Bell-Browning site, north field (28Sx19), all Oak Hill horizon sherds were mixed with Chance Incised and Munsee pottery (Marchiando 1969:73).

TABLE 18
STUDY AREA C14/AMS DATES FOR INTERMEDIATE POTTERY TYPES

Type	Date Range (BP) n=number of assays	Date Range (BC/AD) Calibrated 2 Sigma Medians*
Castle Creek	690+/-30 n=1	1291 AD
Oak Hill	790+/-80 to 300+/-30 n=4	1220-1563 AD
Kelso	1370+/-60 to 300+/-30 n=12	658-1563 AD
Milo	640+/-120 n=1	1333 AD
Bainbridge	1370+/-60 to 330+/-70 n=4	658-1560 AD

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

A single early date for Kelso Corded from Chenango Point is also anomalous as is the appearance of other collared pottery in the same feature. The majority of the dates for Kelso Corded pottery have calibrated medians between circa 1200-1400 AD. Examples of Kelso Corded and Oak Hill pottery are shown in Figure 50 and derive from the pit fill of an infant burial at 28Sx29. Feature fill also contained sherds with cordwrapped stick decorations and the rims of five collarless vessels. Moeller (2009, personal communication) notes that it is surprising to see Oak Hill and Kelso pottery mixed together in the same pit feature given current assumptions about the chronology and the attributes that define the types. Oak Hill and Kelso pottery is found on sites in the Mohawk Valley for the periods 1350-1400 AD and 1400-1525 AD (see Table 16) which reflects the later dates and associations from the study area. An early date for Bainbridge Collared Incised from Chenango Point, and the same context that yielded the Kelso Corded pottery noted above, is also unusual. Other dates for the type suggest considerable overlap with the chronology of Kraft's Minisink phase.

Dates pertaining to Minisink pottery types, all collared vessel forms, are summarized in Table 19. All fall within the expected chronological range for the Minisink phase. Collared vessel forms are typical in Upper Delaware assemblages of the later years of the Late Woodland period and into the era of contact with Europeans. This is not the norm in more downriver sections of the Delaware Valley for a similar time frame (Stewart 1998b). Dated examples of collared wares from the study area are illustrated in Figures 51-54.

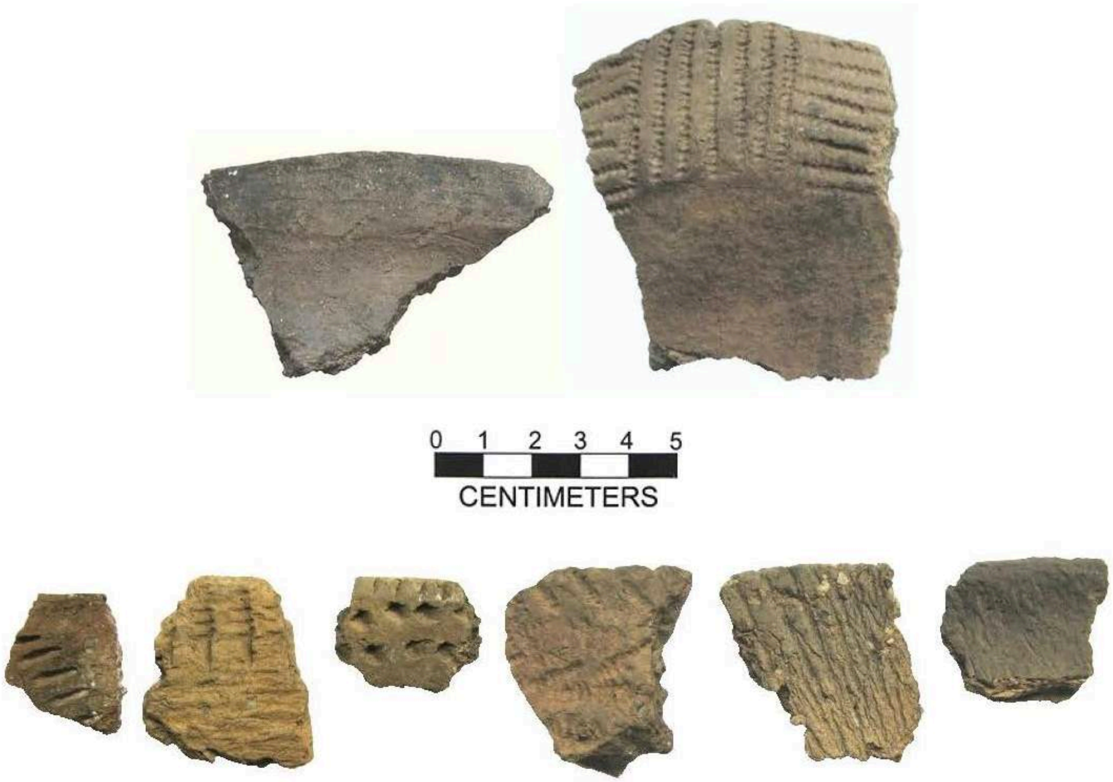


FIGURE 50. Pottery from a dated infant burial at Ahaloking/Bell-Philhower, 28Sx29. Top left: Kelso Corded. Top right: Oak Hill Corded. Bottom: untyped sherds. Collections of the New Jersey State Museum.

TABLE 19
STUDY AREA C14/AMS DATES FOR POTTERY TYPES TYPICALLY ASSOCIATED WITH THE MINISINK PHASE

Type	Date Range (BP) n=number of assays	Date Range (BC/AD) Calibrated 2 Sigma Medians*
Munsee	590+/-80 to 240+/-120 n=17	1354-1682 AD
Chance	590+/-80 to 240+/-120 n=9	1354-1682 AD
Durfee	550+/-80 to 370+/- 40 n=4	1375-1524 AD
Deowongo	590+/-80 to 330+/-70 n=6	1354-1560 AD
Garoga	550+/-80 n=1	1375 AD
Rice	240+/-120 n=1	1682 AD
Otstungo	540+/-100 to 370+/-60 n=7	1391-1536 AD

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

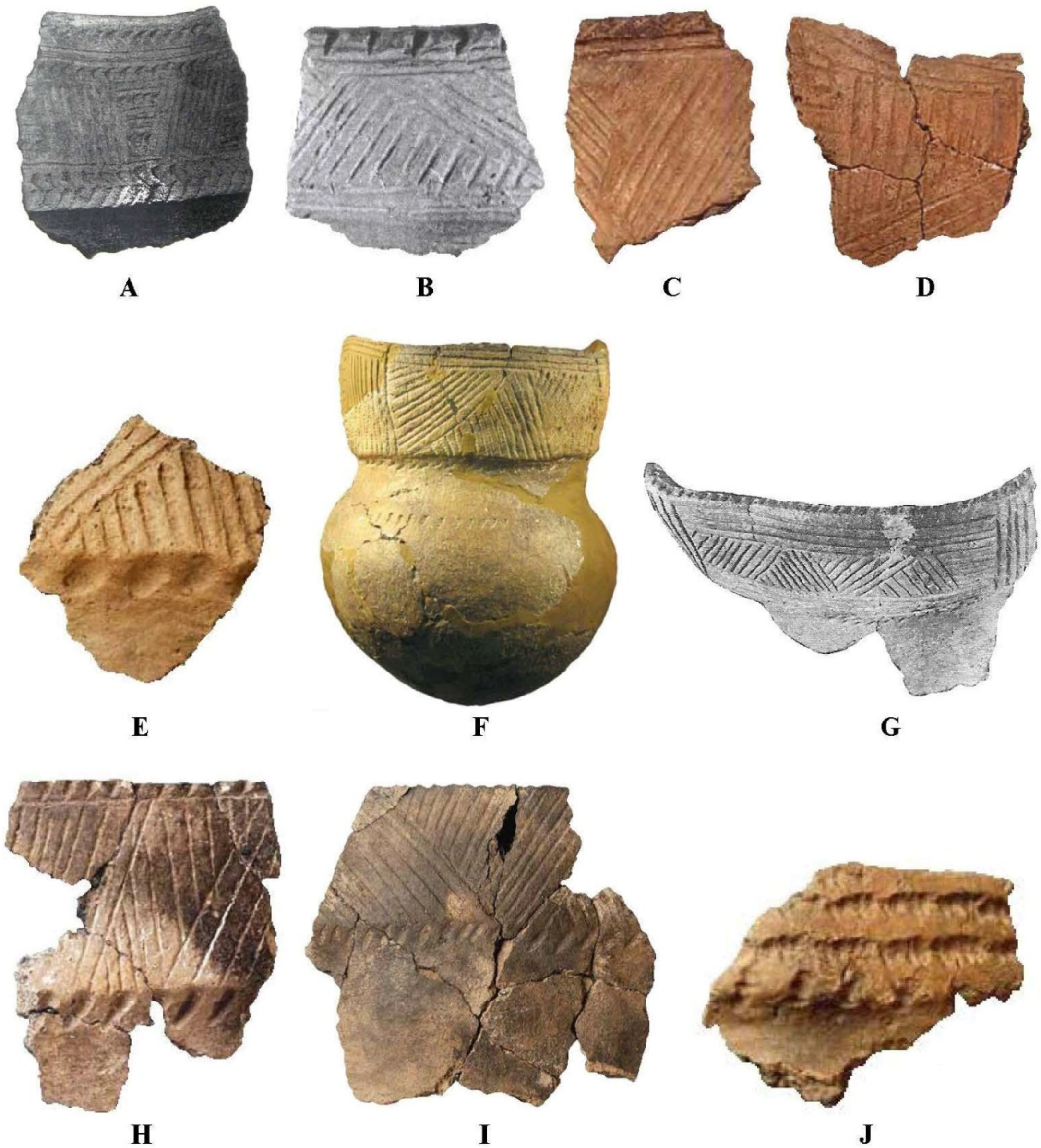


FIGURE 51. Examples of collared wares from dated contexts. A: Munsee Incised, Feature 6, 36Pi172, modified from Brown et al (2000). B: Durfee Underlined, Feature 207, 36Pi13A, modified from Moeller (1992:Figure 9). C: Munsee Incised, Feature 68, Site ORA-0550, modified from Pretola and Freedman (2009:Plate B22). D: Munsee Incised, Feature 26, Site ORA-0550, modified from Pretola and Freedman (2009:Plate B22). E: Oak Hill, Feature 275, Chenango Point South, modified from Miroff (2012 Photo 6.12). F: Oak Hill-like, Feature 52, 36Pi13A, collections of NPS-Delaware Water Gap National Recreation Area. G: Durfee Underlined variant, Feature 52, 36Pi13A, modified from Kinsey (1972:Figure 49). H: Richmond Incised, Feature 176, Chenango Point South, modified from Miroff (2012:Photo 6.15). I: Richmond Incised, Feature 90, Chenango Point South, modified from Miroff (2012:Photo6.14). J: Kelso Corded, Feature 176, Chenango Point South, modified from Miroff (2012:Photo 6.12). Artifacts not shown to scale in order to highlight decoration of smaller specimens.

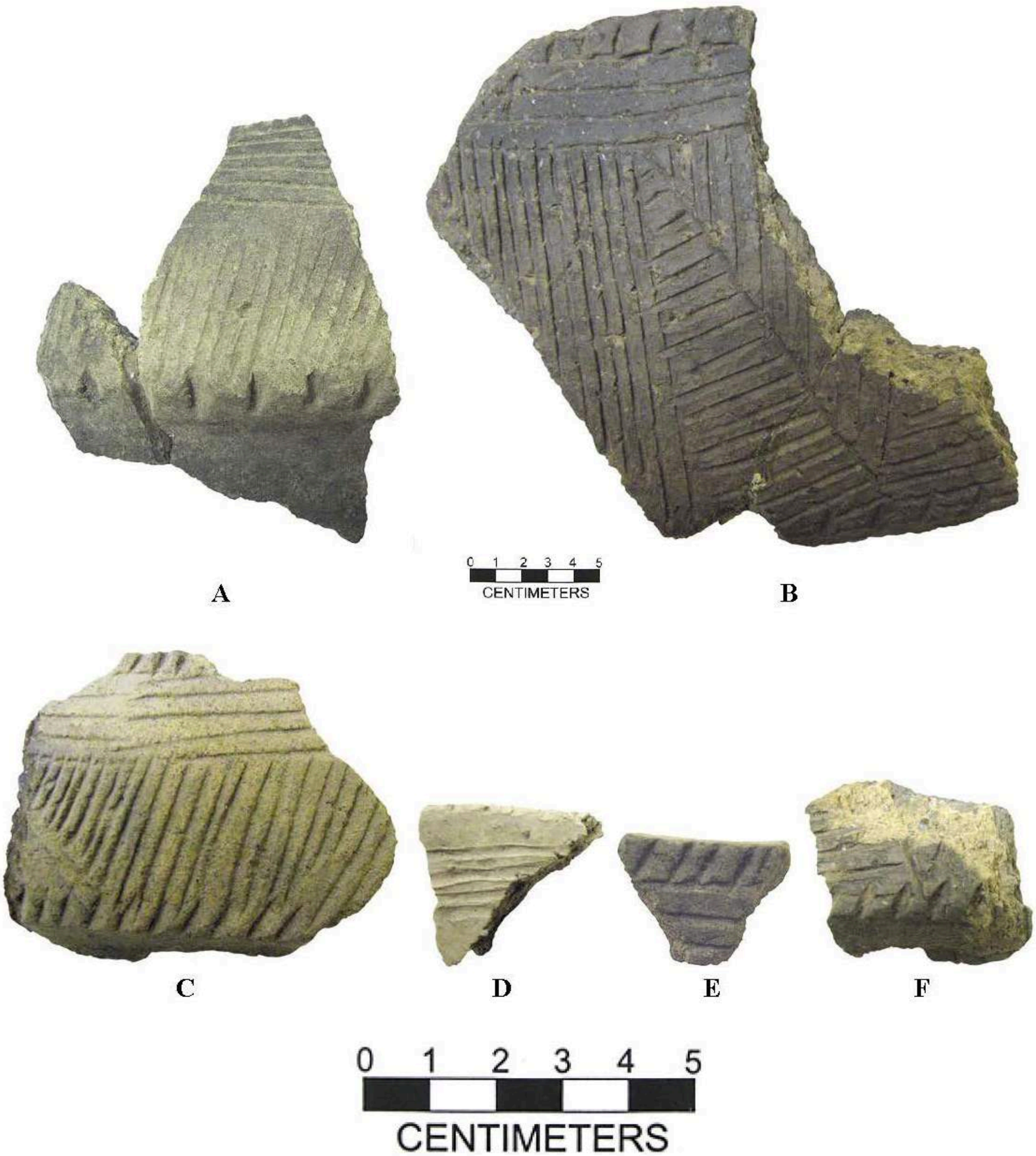


FIGURE 52. Pottery from dated Feature 75 at the Kutay site, 36Pi25. A: Chance/Garoga. B: Deowongo Incised or Chance/Garoga (cf. Kinsey 1972:255, Figure 73-H; Moeller 2007 personal communication). C: Deowongo Incised. D: untyped. E: untyped. F: Chance/Garoga. Collections of the NPS-Delaware Water Gap National Recreation Area. Kinsey (1972:255) also noted Durfee Underlined from this feature.

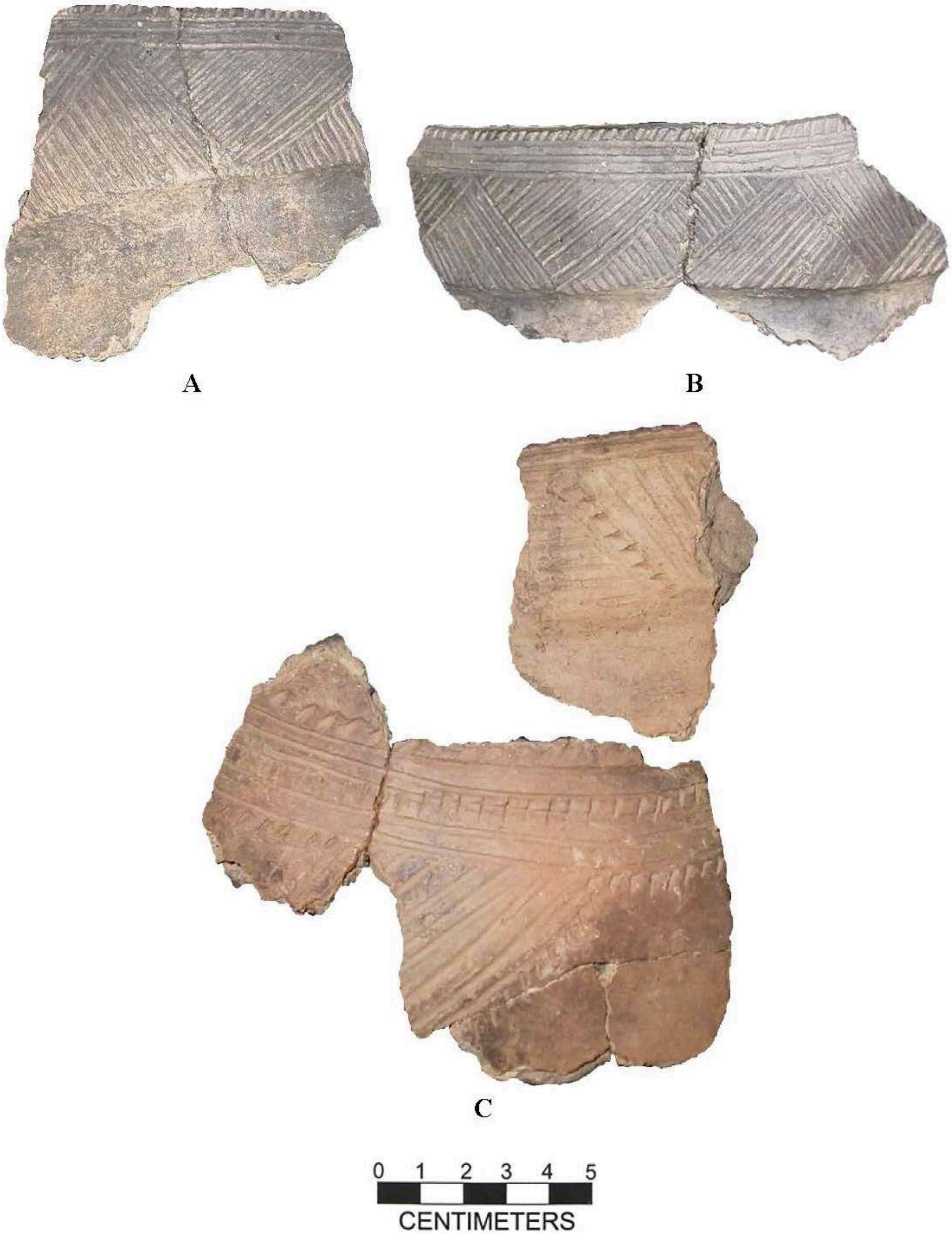


FIGURE 53. Refitted vessels linking features at Harry's Farm, 28Wa2. A and B: Chance Incised/Munsee vessel from refitted sherds in features K-F56, K-F76 and G-F25. C: Chance Incised vessel from refitted sherds in features K-F56, G-F25 and K-F114. Photos courtesy of Gregory Lattanzi (cf. Lattanzi 2009:7, Figures 11, 12).

FIGURE 54. Pottery from Contact Period contexts at the Faucett site, 36Pi13A. A: Wickham Corded Punctate, Feature 269, modified from Moeller (2011:Figure 13). B: Munsee Incised, Feature 269 modified from Moeller (2011:Figure 12). C: Munsee Incised, Feature 269, collections of the NPS-Delaware Water Gap National Recreation Area. D: Munsee Incised, Feature 239, collections of the NPS-Delaware Water Gap National Recreation Area. E: Refitted sherds linking features 239 and 269, modified from Moeller (2011:Figure 13). F, G: Munsee Incised, Feature 239, photos courtesy of Roger Moeller. Artifacts not shown to scale in order to emphasize decoration.

The series of assays listed in Table 19 (also see Table 12) support a more thorough chronological overlap for Chance Horizon and Oak Hill horizon pottery as well as other collared forms than what is envisioned by Lenig (1965:63, 73, Figures 21- 22) and Kinsey (1972:380-384). Association of types in pit features argues for their contemporaneous use (e.g., Werner 1972:Table 2). Although Kraft (1975a:120) employs similar type names he sets aside the chronological implications that they have. "I do believe that it is hazardous to suggest that such Chance Incised vessels are necessarily confined to the early Iroquois-Minisink series soon to be replaced by the Deowongo Incised type, which in turn yields its popularity to the Garoga Incised type" (Kraft 1975a:120 citing and partially quoting Lenig 1965:73). Moeller (1992:65) likewise questions the utility of using Owasco, Oak Hill Horizon, and Chance Horizon ceramic typologies to define discrete occupations on Upper Delaware sites. Available radiocarbon dates support Kraft's and Moeller's doubts as to the chronological priority of select types. They also reflect the persistence of types indicated by Snow's (1995) research in the Mohawk Valley of New York (see Table 16).

Not included in Table 19 are dates for Susquehannock-like pottery from Site ORA-0550 (Orange County, New York) and Richmond Incised from Chenango Point South. The calibrated probabilities for the Susquehannock-like pottery fall within the early range of the chronology assigned to the ware in the Middle Atlantic region, beginning in the second half of the 16th century AD (e.g., Kent 1984:15). The four dates associated with Richmond Incised are potentially problematic: 540+/-30 BP, 300+/-30 BP, 300+/-30 BP, and 270+/-30 BP. Richmond Incised has been considered ancestral to increasingly high collared and incised forms, including Proto-Susquehannock pottery (Kent 1984:14-15, 112, 115-116, Figure 10).

Moeller (1992) emphasizes that the co-occurrence of pottery types in Late Woodland pit features calls into question the chronological relationship between New York and Upper Delaware pottery sequences, as does Puniello (1991). It might be argued that site formation processes have influenced the variety and sometimes unexpected associations of pottery types in the features of the Upper Delaware Valley, although Moeller (1992) has offered a reasonable critique of that perspective. A program of dating adhering residues in archived pottery assemblages modelled after the New York research discussed previously would be an appropriate way to further address the issue of mixing or the contemporaneous use of types.

Design motifs and design grammars on pottery associated in features is also highly variable (e.g., Lattanzi 2009) calling into question the attributes that have been used to define types and their ability to serve as chronological mileposts. Puniello's (1991:90) study of Late Woodland pottery in the Upper Delaware Valley concluded that exterior surface treatments and decorative technique are somewhat diagnostic of temporal periods. Excluding notching and punctuation, "incision is the sole decorative technique employed during the Minisink subperiod and cord-wrapped stick impression the sole decorative technique for the Owasco subperiod" (Puniello 1991:118). Cordmarking ceases to appear on Minisink phase pottery (Puniello 1991:94; Salwen 1972; Williams 1972).

The observations of Puniello (1991), Salwen (1972) and Williams (1972) can be challenged. Incising appears, however rarely, on some Middle Woodland pottery in the Upper Delaware, with the zone decorated pot from the Manna site being a prime example. Manna site assemblages also show the longevity of cordmarked surfaces and the use of cordwrapped stick decoration throughout Late Woodland times and into the Contact period (Stewart et al 2015). Moeller (2011:103) notes the contemporaneous use of the following design elements and motifs as a result of his study of Late Woodland pottery in the Upper Delaware: castellations, incising, cording, cordwrapped stick impression, fingernail impression, punctates, human effigy faces, triangles, slanted lines, parallelograms, trapezoids, chevrons, and notches.

Cordage twist data has not been systematically collected for Late Woodland or earlier pottery assemblages, leaving its potential as a chronological and/or cultural marked unexplored. Pottery from late Middle Woodland through Late Woodland and Contact period contexts at the Manna site reveal Z twist when adequate impressions could be obtained (Stewart et al 2015). To the south at Sandts Eddy (36Nm12) S twist cordage was noted for exterior/interior cordmarked sherds with leached shell temper. The pottery is presumed to be Early-Middle Woodland in age but derives from mixed Stratum IV (Bergman 1996b:83-65). Downriver at the Padula site rim sherds assigned to the Middle Woodland Bushkill Complex, and Overpeck and Kelso/Oak Hill pottery types possessed Z twist cordage impressions (Fassler 1994:162-164). At Treichlers Bridge (36Nm142) final cordage twist direction is recorded for the small pottery assemblage from a buried plowzone. All revealed final S twist but the sherds cannot be related to a particular historical type or time frame (Johnson 2000:6-347). Rieth (2004) examined cordage twist in a study of Point Peninsula and Owasco pottery from sites in New York. She found that although Z final twist is predominant in the cordage represented on Point Peninsula and Owasco vessels, S twist consistently occurs (Rieth 2004:138, Tables 7.1, 7.2).

Elsewhere in the Middle Atlantic region a variety of Late Woodland cultures from Coastal Plain, Piedmont, and Ridge and Valley areas show a preponderance of final Z twist cordage (Johnson 1996). Shifts from S to Z twist pottery have been used in arguments for population replacements (e.g., Johnson and Speedy 1992). Tracking cordage twist across all types of Early through Late Woodland pottery in the greater Virginia region yields the common battleship-curve pattern of change suggestive of stylistic drift rather than population replacement (Klein and Magoon 2017:92). Early Woodland pottery is overwhelming S twist with decreasing frequencies to Late Woodland times when it consistently represents 49%-50% of analyzed assemblages (Klein and Magoon 2017:Figure 9).

Because of the relatively fine grained contexts at the Manna site, 36Pi4 Stewart et al (2015) were are able to assess the relationship between aspects of pottery production through the Late Woodland period. There is no question that a wide variety of aplastics are used contemporaneously in pottery production, and that temper choices are not specific to a particular cultural historical type, or vessel form, i.e., collarless versus collared pots. Shell temper is shown to be present in both late Middle Woodland and most Late Woodland/Contact pottery assemblages. Basic descriptions of Owasco/Pahaquarra through Minisink pottery types also reveal the use of a variety of tempering agents (e.g., Kraft 1978a; Staats 1978).

Kraft (1975a:137) recognized the consistent use of nepheline syenite as a pottery aplastic in the Upper Delaware Valley for wares made throughout the Late Woodland period, and its occurrence as lumps in Late Woodland pit features of the area. It is an igneous intrusive type of rock characterized as an anhydrous sodium potassium alumino silicate. Small outcrops occur northwest of Beemerville, New Jersey (USGS 2015) in interior portions of the Upper Delaware Valley, although Kraft (1975a:137) notes its occurrence as gravel along the Delaware River and in glacially transported deposits. Nepheline syenite is important in modern ceramic industries for its ability to act as a flux in lowering the temperature at which ceramic mixtures melt. Given the temperatures at which native-made pottery was fired, it is doubtful that nepheline syenite's potential as a flux was realized by ancient potters. However, its ubiquity in the production of many Late Woodland wares, given its relatively restricted natural distribution, suggests that it provided some type of functional advantage. This should be explored with experimental and laboratory analysis in the future.

The use of clays that fire to a tan/white color seems to be a phenomenon solely linked with the Late Woodland period in the Upper Delaware and other areas of the drainage basin. Interest in such clays and the uniquely colored pottery was stimulated by research involving assemblages and clay sources in the Lower Delaware Valley. The pottery stands out in collections yet does not occur in substantial quantities, here or in other areas. In the Lower Delaware Valley sources of clays that retain a white/tan color upon firing are widespread and frequently co-occur with clays of other colors. Such clays also occur in the Middle and Upper Delaware Valley but their distribution is not well known.

Stewart and Pevarnik (2008) employed particle size, petrographic thin section, and Instrumental Neutron Activation analyses to examine raw clays, archaeological sherds, experimental briquettes and pots in an attempt to understand why white/tan firing clays were not used more frequently by native artisans. Firing temperatures were estimated by re-firing archaeological sherds at controlled intervals in an electric kiln. They concluded that the raw clays were somewhat difficult to use during the forming process of a vessel, and needed to be fired at a higher temperature (in excess of 800°C) than other commonly available clays. Their use thus presents a technological challenge for ancient potters.

At the Manna site tan/white sherds were most confidently linked with Late Woodland and Contact period occupations (Stewart et al 2015). Unprovenienced Owasco series sherds from the site in the collections of the New Jersey State Museum indicate the use of the tan/white firing clay. At Manna the clay is used with a number of different types of temper (dark grit, light and dark grit, dark and angular platy rock, nepheline syenite) that likely have no effect on lowering the firing temperature of the clay. The presence of pottery made from such clays reflects the technological skill of native potters. Examples of rims made from the distinctive clay from sites in the Upper Delaware and to the west in the basin are shown in Figure 55. The designs/types represented imply use of the distinctive clay at different times during the Late Woodland period.

Of special note is the occurrence of a cached ball of the clay from a pit feature at 28Sx29. Geochemical analysis of the cached clay and tan/white sherds from area sites has the potential to determine whether one or more sources of the material exists (also see Table 20 below). This should be coupled with surveys to locate potential sources. That such sources exist is clear. A blue/grey clay which would likely fire to a pale grey/white color occurs in the riverbank near the Minisink site (Sidoroff 1978:100). Deep trenching at the Stoehr Site (36Pi148) on a terrace along the Delaware River at the Bushkill Access Area (Delaware Water Gap National Recreation Area) encountered a gray clay about 5 meters below surface (Wright 1997:Figure 8) which might be exposed along nearby riverbanks. White clay deposits between Kunkletown and Saylorsburg, Monroe County, Pennsylvania, were mined as early as 1891 and continued to be used into the 20th century (Hosterman 1984:5-7). White clay has been observed in the bed of Oxford Brook in Washington Township, Warren County, New Jersey (Jim Lee, Hunter Research Inc., 2008 personal communication).

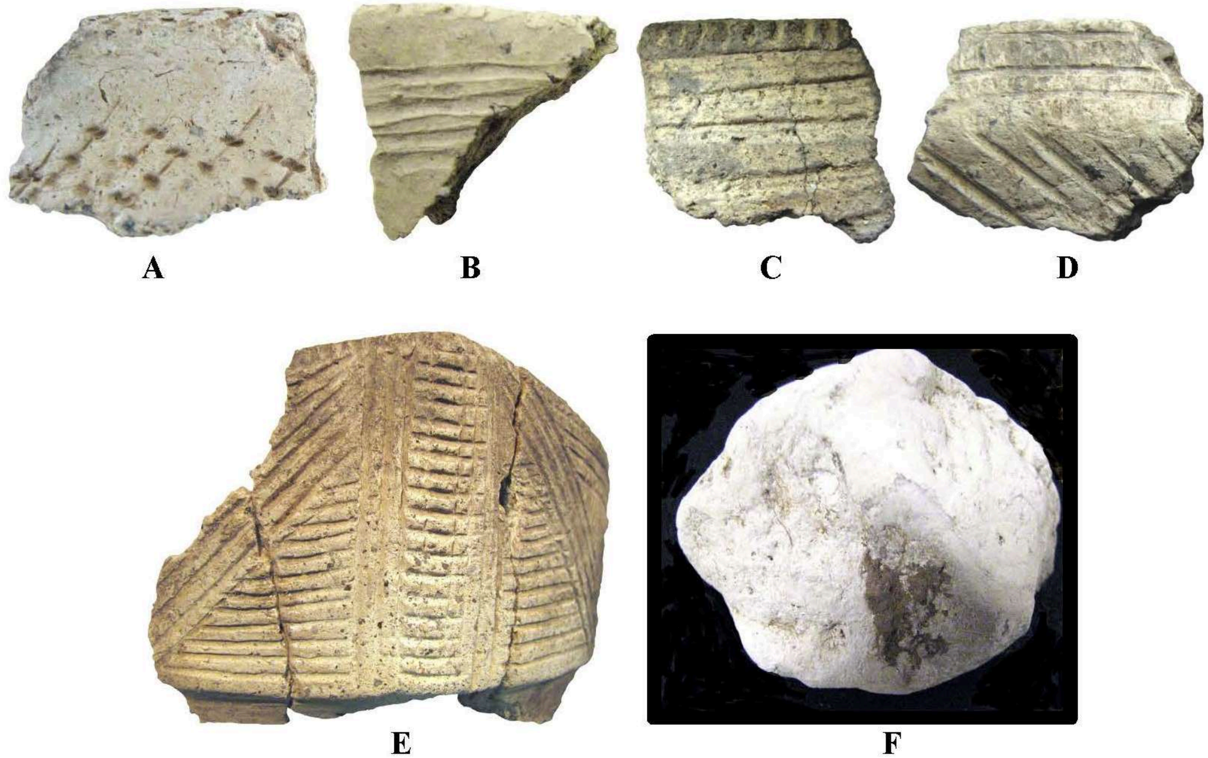


FIGURE 55. Examples of Late Woodland rim sherds made with white/tan firing clay and ball of white clay from a pit feature at Ahaloking/Bell Philhower, 28Sx29. A: Manna site, 36Pi4. B: Kutay, 36Pi25, collections of the NPS-Delaware Water Gap National Recreation Area. C-D: Silver Run site, Palmerton, Pennsylvania. E: Brodhead Heller, 36Pi7, collections of the NPS-Delaware Water Gap National Recreation Area. F: Clay ball from 28Sx29, approximately 6 cm in diameter. Artifacts not shown to scale in order to emphasize decoration.

Given the apparent rarity of vessels made with this clay, tracking their presence on other Late Woodland/Contact period sites in the Upper Delaware could point out important social connections. Are sites which produce a higher frequency of white pottery situated closer to sources of white firing clays than other types of clays? Why are clays that fire white or pale in color not used more frequently, especially given the significance of the color white in traditional Algonquian culture (Bierhorst 1995; Hamell 1983; Pietak 1998, 1999)? Regarding the potential symbolic use of the clay, white pots don't stay white long if you're using them for either wet or dry cooking. Replicated white pots used for cooking quickly lost their original color. However, long term exposure to heat, as would be expected if the vessels were repeatedly used for cooking, can bring back their original color. Exposure to heat of 600°C or more can burn off sooting, fire clouding, and charred residues, a cycle witnessed during cooking experiments (Stewart and Pevarnik 2008:406).

Caches of clay in general are well known from Upper Delaware Valley sites and apparent Late Woodland contexts (Table 20). These also could be the focus of geochemical testing and comparisons with archaeological pottery along with a survey of area clay sources. Results would contribute to a better understanding of pottery technology, artisan networks, and foraging radii associated with individual communities. Examining clay deposits will also be useful in distinguishing natural inclusions from aplastics intentionally added to clay during the manufacturing process. Calling something temper presumes intentionality on the part of the potter. Without the extensive and intensive sampling of locally available clays, bedrock, and sediments, any such designation is fraught with inconsistencies. Patterning in the use of specific sources could have chronological implications, or be related to the production of a specific type of pottery.

TABLE 20
EXAMPLES OF CLAY CACHES FROM SITES IN THE UPPER DELAWARE VALLEY

Site	Context and Associations	Reference
Blair Section of Bell-Browning, 28Sx19	Pit 217 with Munsee and Chance pottery	Marchiando 1970:16
Blair Section of Bell-Browning, 28Sx19	Pit 283 with Kelso Corded pottery	Marchiando 1970:20
Blair Section of Bell-Browning, 28Sx19	Pit 303 with Interrupted Linear pottery	Marchiando 1970:27
Blair Section of Bell-Browning, 28Sx19	Pit 319 with Chance pottery	Marchiando 1970:32
Blair Section of Bell-Browning, 28Sx19	Pit 322 with Tribal pottery	Marchiando 1970:33
Blair Section of Bell-Browning, 28Sx19	Pits 272, 275, 276, 286	Marchiando 1970:17, 18, 21
Bell-Browning North Field, 28Sx19	Pit 118 with grey clay and Owasco Platted rim sherd	Marchiando 1969:17, Table 3
Bell-Browning North Field, 28Sx19	Pits 123, 125 with grey clay and Castle Creek punctate pottery	Marchiando 1969:19, 20, Table 3
Bell-Browning North Field, 28Sx19	Pit 130 with grey clay and Chance Incised and Owasco Herringbone pottery	Marchiando 1969:21, Table 3
Bell-Browning North Field, 28Sx19	Pit 145 with Kelso Corded pottery	Marchiando 1969:28, Table 3
Bell-Browning North Field, 28Sx19	Pit 163 with grey clay and Chance Incised, Oak Hill Corded, Owasco series and Munsee-like pottery	Marchiando 1969:35, Table 3
Bell-Browning North Field, 28Sx19	Pit 165 with Chance Incised, Oak Hill Corded and Munsee pottery	Marchiando 1969:36, Table 3
Bell-Browning North Field, 28Sx19	Pit 174 with grey clay and Chance Incised and Owasco Corded Collar pottery	Marchiando 1969:39, Table 3
Bell-Browning North Field, 28Sx19	Pit 185 with Owasco series pottery	Marchiando 1969:43, Table 3
Bell-Browning North Field, 28Sx19	Pit 210 with incised pottery	Marchiando 1969:50, Table 3
Bell-Browning North Field, 28Sx19	Pits 219 and 219a with grey clay and rolled copper bead, Venetian glass bead, and colonial pipe stem	Marchiando 1969:53, Table 3
Bell-Browning North Field, 28Sx19	Pits 265 and 265a with Castle Creek Incised and Owasco Corded Punctate pottery	Marchiando 1969:68, Table 3
Bell-Browning North Field, 28Sx19	Pits 137, 147, 151, 157, 158, 168, 204	Marchiando 1969:24, 28, 30, 32, 37, 48, Table 3
Bell-Browning North Field, 28Sx19	Pits 150, 153, 156, with grey clay	Marchiando 1969:29, 31, 32, Table 3

Ahaloking/Bell Philhower, 28Sx29	Pit feature	C. Philhower collections and notes, New Jersey State Museum
Shoemakers Ferry, 28Wa278	Feature 29, House 3A/3B	Barse 2006; Harbison 2008:Table 7.1
Harry's Farm, 28Wa2	Section K, Feature 56	Kraft field notes, Delaware Water Gap National Recreation Area, Bushkill, PA

Bell-Browning, 28Sx19, emerges as an excellent place to begin such work. A number of pit features there also contain grey clay which likely would fire as white/pale grey. It is interesting that clay caches seem to be rare, if present at all, on the Pennsylvania side of the river (cf. Kinsey 1972).

A sherd possessing what appears to be a slip is part of the assemblage from the dated infant burial pit at 28Sx29, and is associated with Oak Hill, Kelso Corded, and other decorated pottery (see Table 12, Figure 50). The sherd is illustrated in Figure 56. A possible slip appears on a pipe from 28Wa290 (Lee, Sergejeff and Stiteler 2005:33). Leslie (1973:142) notes that a rouletted pipe from the Davenport site in the Upper Delaware was originally painted with a carmine slip. These examples relate to Late Woodland and possibly Contact period time frames.

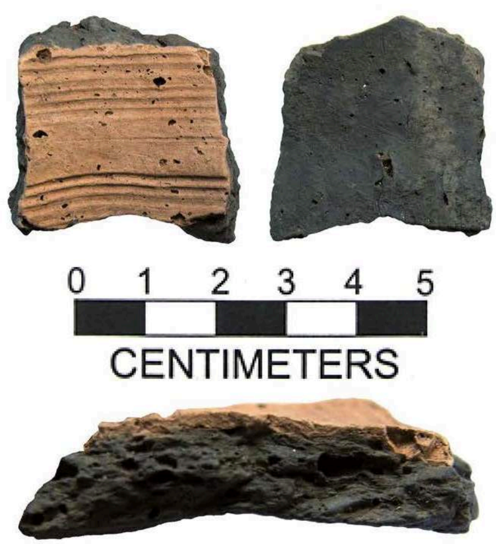


FIGURE 56. Pottery sherd with potential slip from a dated infant burial at Ahaloking/Bell-Philhower, 28Sx29. Top: exterior and interior views. Bottom: cross section (not to scale). Collections of the New Jersey State Museum.

The use of slips, washes, or paints on pottery in the region is extremely rare. Schrabisch makes observations about this practice in statements about Native American pottery found in New Jersey, and in particular the Raritan Bay area (cf. Mounier 2003:96).

> Greenville – the writer has seen some potsherds daubed over with red paint, probably ochre, that were said to have been collected on a site on the point at Greenville (Schrabisch 1913:42).

and

> A few vessels are found showing that a sizing or wash of fine clay was spread over the pot to enhance its appearance. More rarely traces of red ochre show that the entire kettle was daubed with paint. Designs painted on the vessel seem never to have been employed (Schrabisch 1913:270).

Potentially slipped sherds are part of assemblages from the Douglas Gut Archaeological Complex in Trenton, New Jersey. They cannot be related to a specific historical type or time period and derive from a mixed context which can include Late Woodland and Contact period artifacts (Hunter Research 2002:iii, 3-91 to 3-102, Table 3.11). Farther afield, red and/or black pigments or slips occur on some of the pottery from the late 15th to early 16th century Mantle Site in Ontario (Birch and Williamson 2013:128). Future research should address the possibility that while rare, Delaware Valley pottery with signs of slips or washes may be chronologically diagnostic of the Late Woodland and Contact periods.

The pottery of the Late Woodland and Contact in the Upper Delaware Valley reveals the danger in automatically associating historical types with cultural or ethnic affiliations. Munsee speakers of the Upper Delaware, presumed to be in-place by Late Woodland times or earlier, are Algonquian but their pottery looks very Iroquoian and likely reflects a measure of interaction rather than identity. Initially researchers associated Owasco pottery types with Algonkian-speaking peoples until MacNeish's (1952) publication of the *in situ* hypothesis for the development of the Iroquois (Kinsey 1972:393; Williams et al 1982:4). The Mahican and Esopus are other Algonquian groups whose pottery closely resembles that of the eastern Iroquois (Puniello 1980:149).

A related issue is the historical presence of the Shawnee in the Upper Delaware, the utility of pottery in recognizing their presence on area sites, and related chronology. The Shawnee first arrived in the Upper Delaware in 1688/1692 (Leo and Rutsch 1981; Wright 2009:51-52). The settlement, *Pechoquealin*, near the mouth of Shawnee Run at Shawnee, Pennsylvania with plantations across the river on the Pahaquarry Flats, is in existence in 1693/1694 (Donehoo 1977:148-149; Kent et al 1981:10; and map; Wright 2009:51-52). This may be the same community seen by the surveyor, John Reading, in 1719. According to Reading's diary of 1719, from the top of the hill above Dunnfield Creek…"the surveying party viewed the Indian settlements on both sides of the river near Shawnee Island" (Leo and Rutsch 1981 citing Honeyman 1927:596-597). Philhower (1954) also notes Shawnee Island as the location of a Shawnee settlement. Downriver, and on southern end of the study area, another Shawnee settlement is indicated (Donehoo 1977:148; Philhower 1926:523). Additional groups of Shawnee arrive in eastern Pennsylvania circa 1694 (Callender 1978:630 citing Hanna 1911:Volume 1, 137-142, 158) and 1715 (Callender 1978:630 citing Swanton 1922:317-318). By 1720 the Pennsylvania Shawnee were moving westward (Callender 1978:631). The settlement at *Pechoquealin* is maintained until 1728 (Kent et al 1981:Table 1, entry 87; Wallace 1965:132).

The precontact Shawnee are likely correlated archaeologically with the Fort Ancient culture (Callender 1978:630) so their pottery on Contact period sites in the Upper Delaware would likely be shell tempered, at least initially. Vessel shapes contrasting with locally made wares might appear, e.g., jars with distinctive necks. Pots could have flat as well as other types of bottoms, some with pottery lids, and some potentially three-legged (Voegelin and Neumann

1948:5-6). Incised designs on vessels are described as "simple" with meandering rectilinear patterns. Boiled walnut bark was used to make a black paint that would be used to apply some designs (Voegelin and Neumann 1948:10). In sum, jars with prominent necks, collareless pots with simple incised designs and possibly shell tempered, and sherds that may have been painted would be potential archaeological fingerprints of the Shawnee in the Upper Delaware, circa 1688/1692 to 1728 AD.

The detailed study of Late Woodland design grammars (linear and radial) and the sequence of design application on individual pots from dated contexts may reveal patterns that are time transgressive. For example, the Overpeck type is dated throughout the Late Woodland period. Attention to design grammars and the sequence of design application could result in chronological divisions of the gross type. This would be in addition to the information that design grammars and application sequences can provide about symbolism, social interactions and identity, the recognition of short distance exchange, and the learning networks of potters (e.g., Brett and Custer 2015; Custer 1987; Lattanzi 2009; Stewart and Pevarnik 2007). Such an approach might also reconcile problems with clearly distinguishing between Upper Delaware pottery and that of the eastern Iroquois (Puniello 1980:149).

To conclude this chapter I note some issues that should/could drive future pottery-related research in the Upper Delaware, as well as the broader region. A fundamental need is more directly dated examples of pottery from throughout the history of the technology's use. Ideally this would involve residues adhering to pots, which would also be analyzed for the resources they represent. There are substantial curated collections held by the New Jersey State Museum, the State Museum of Pennsylvania, and the National Park Service at the Delaware Water Gap National Recreation Area that could be the initial focus.

The ways in which pottery or any type of artifact are produced are best described as technological styles in that performance and engineering attributes, forming and finishing techniques are linked to the social and cultural contexts in which a practice was developed, learned, practiced, and shared, at single points in time and across time (cf. Arnold 2000:113; Dietler and Herbich 1998; Dobres 2000; Dobres and Hoffman 1994; Van der Leeuw 1993). Technological style crosscuts aspects of Rice's (1996: 173) distinction between pottery manufacturing as the actual construction of a vessel or other object, and production as the social and cultural context of manufacturing or construction. To what degree do the performance attributes of likely materials influence their use in pottery production versus considerations that are more socio-cultural in nature? It is often easiest to examine the strictly "technical" aspects production. But if we can control for technical variables, recognizing potential socio-cultural variables should be easier.

In the construction of types that reflect specific moments in time, and their arrangement into chronological typologies, we focus upon attributes that appear to be time transgressive. In the case of pottery, this has traditionally meant attributes like temper, surface treatment, and decoration. The time transgressive nature of these attributes, and their co-occurrence, must be demonstrated in the field through the excavation of materials from good, datable contexts. And once shown to be time transgressive, an attribute, suite of attributes, type or technological style must be continually tested with new data to retain its chronologically sensitive status, being revised or discarded when necessary.

A wide range of variability exists at single points in time, and this is a good thing because pottery attributes and the classificatory types that we might create allow us to do more than provide descriptive data and orient objects in time. Yet most, if not all, of the historical or chronological typologies in use in the region focus on relatively few suites of grossly defined attributes. In some type definitions, temper is irrelevant, in others, the range of decorative variability included in the type definition is tremendous. The chronological types that we currently use span centuries. Are trends in ceramic ecology, technological style, or decorative style and design grammars really that conservative?

The arrangement of types in a chronological typology also tends to get us thinking about pottery and its development in a rigid linear fashion, creating problems of its own. The relatively sudden appearance of Abbott Zone Decorated pottery circa 200 AD is just such a problem. The complex designs on this pottery are puzzling, the traditional assumption being that we should be able to see the development of complex designs in earlier pottery types, whether within the local region or elsewhere. This is a reminder that if we are trying to understand change and meaning in a particular class of material culture, we need to be thinking in reference to other artifact classes in the same behavioral/cultural system.

I believe that approaches more thoroughly grounded in technological style, decorative style, design grammars, and design application sequences have great potential to enhance pottery's use as a chronologically diagnostic tool, as well as contributing to an investigation of other significant research issues. A special emphasis should be placed upon whole pots and large sections of reconstructed vessels, as this allows for the best view of the "recipes" that native potters are using in the production of their wares - the combination of technological style and decorative style. Of course this will not always be possible.

Table 21 summarizes some of the variables that impact a technological style approach to pottery analysis. Figure 57 provides a graphic example of how different "look-ailke" pots, and by extension, a pottery type, might be when considered from the perspective of technological style. The point is that there are multiple ways to make pots that all end up looking the same (equifinality). The type of clay used, the temper, the forming techniques, the type of tools used to create surface treatments and decoration, even the sequence with which a design is applied are sources of variability underlying an otherwise homogeneous looking series of pots. Patterns or trends that emerge from such an approach will be useful in refining the resolution of our chronological types, and will enable us to address a variety of social and cultural issues.

TABLE 21
SOME SOURCES OF VARIABILITY RELEVANT TO THE ANALYSIS OF THE TECHNOLOGICAL STYLE OF POTTERY

1. Raw materials employed, sources, availability and access to raw materials.
2. Manufacturing technologies: processing of raw materials, forming, finishing, and firing methods.

3. Tools and implements employed in all aspects of manufacturing.
4. Vessel size; intended function of vessel, where "function" embraces both the practical and social/symbolic and contexts of use.
5. Learning networks, and interaction patterns of artisans; pre-existing potting traditions.
6. Idiosyncratic behavior of individual artisans.
7. Social, ethnic, or cultural identity of artisans, the group within which they reside, or the consumers of what is being produced.

A	B	C
Southeastern PA, clay Gneiss tempered Entirely coil constructed Coils 3 cm in diameter Paddled with implement wrapped with "S" twist cordage	NJ Coastal Plain clay Quartz tempered Entirely coil constructed Coils 1 cm in diameter Paddled with implement wrapped with "Z" twist cordage	NJ Coastal Plain clay Quartz tempered Slab constructed base Body coil constructed Coils 1 cm in diameter Paddled with implement wrapped with "Z" twist cordage

FIGURE 57. Hypothetical pots with the same 'look', same historical type, but different technological styles.

Behind the visible sameness of pottery can be variability that reflects a variety of phenomena such as: the idiosyncratic behavior of a potter, learning networks, the settlement where a pot was produced, the season of the year when a pot was produced, group identity, exchange between communities, or chronological differences at scales of generations rather than centuries. In the end, attention to the attributes of technological and decorative styles will provide the greatest advantage for the creation of types and typologies useful for, or adaptable to the greatest variety of research issues.

In 2009 I began a project to investigate early pottery in the Delaware Valley employing a limited technological style approach and focusing on museum collections. Significant variation in the attributes of early pottery that I have observed include: differences in the sizes of the clay coils used in the production of some types; differences in the ways in which vessel walls are attached to the bases of pots; differences in the amount and type of temper added to clay employed in vessel production; and differences in the types of textiles represented by impressions on the bases and walls of pots. As my data base is enlarged I hope to see patterning in these attributes across time geographic space. Presently I can note geographic variation in the size of the clay coils used in the initial forming process. Ancient potters in the Lower Delaware Valley, when using coil construction, employ coils that are two to three times as wide/thick as those being used by artisans in the valley's mid-section. What I don't know without additional data is whether this spatial pattern is time transgressive or representative of relatively contemporaneous behaviors.

Setting aside the chronological issue these initial results raise other significant questions. For example, spatial patterning in differing coil sizes could represent learning networks of potters or represent the work of distinctive potters. If so, this attribute might also allow us to track the exchange of pots over short distances. From a strictly technological point of view, differences in coil sizes could be a reflection of the workability of the clays being used. The use of small coils allows for the use of clays that are workable but not stiff enough when slaked to hold their shape or the weight of additional coils without first being allowed to dry somewhat. The use of small coils might also be viewed as a way of extending the use life of a pot. Given the proclivity of pottery to break along joins between clay masses, small coils translate into less traumatic breakage in terms of the upper portions of a vessel allowing it to continue to be used. Given the nature of sherds assemblages from archaeological deposits we can reliably infer that unless pots are breaking from the bottom up they continue to be used even though the original form is damaged.

While just a first step these examples reveal what might be possible from the use of a technological style perspective. In the future standard observations for pottery assemblages need to go beyond simple reporting of temper, surface treatment, and decoration. Reporting more detail for these and a variety of other attributes, and how they do or do not vary across large sections of pots and reconstructed vessels, should become standard practice. One of the more visible and potentially useful attributes to include in reporting standards would be coil size, where sherds representing a single coil break are evident, or the distance between the midpoints of individual coils that can often be detected in the surface topography of a large sherd. Where coil breaks are lacking, individual coils may be visible in a sherd's cross section. Petrographic thin sections of a sample of sherds representative of a temper type in assemblages would be a more precise way of identify tempers and distinguishing natural inclusions from deliberate additions to the clay.

Attempts to explain the variability (technological choices) evident in pottery through time will need to consider both the technological and social components of innovations. The form and prevalence of any technology are context dependent, "contingent upon local, historically constituted conditions" (Skibo and Schiffer 2008:67).

> It has been shown that owing to the complex linkages between technological choices and performance characteristics, an artifact's design cannot optimize the values of all behaviorally relevant performance characteristics; some are necessarily achieved at lower levels than others. Thus, each artifact embodies compromises in performance characteristics relating, for example, to activities of manufacture, use, and maintenance. The pattern of compromises in each case is

determined by behavioral factors pertaining to lifeway and social organization (Skibo and Schiffer 2008:115).

Through the construction of a variety of performance matrices that compare different forms of an artifact, including "ideal" forms, compromises that can reflect aspects of lifeways that impinge on the purely technological are made visible. Settlement movements, territoriality, access to raw materials, trade, visual aesthetics and cultural values are factors that may underlay compromise (Skibo and Schiffer 2008:115-119). I would argue that such comparative matrices would also be useful in examining changes in select artifact attributes, pottery temper for example. Table 22 is an example of a hypothetical matrix for comparing temper.

TABLE 22
PERFORMANCE MATRIX FOR COMPARING TYPES OF POTTERY TEMPER

Performance Characteristic	Temper Type A Value	Temper Type B Value	Temper Type C Value
Familiarity			
Availability			
Ease of access			
Ease of processing			
Impact on clay workability			
Impact on forming processes			
Impact on firing methods			
Impact on vessel strength			
Impact on vessel weight			
Impact on vessel permeability/porosity			
Impact on appearance of vessel surfaces			
Symbolic value			
Utility for pots used in dry cooking			
Utility for pots used in wet cooking			
Utility for pots used in dry storage			
Utility for pots used in wet storage			
Utility for pots used over open fire			
Utility for pots used in hot rock cooking			

Textiles/fabrics are rarely preserved in the archaeological deposits of the Delaware Valley. Textile impressions that appear on pottery provide a unique window into this craft. With sufficient data the use of specific types in pottery production may prove to be chronologically diagnostic. In some cases, patterns in incised decoration on pottery may be reflecting designs used in basketry and other textiles (e, g, Browning-Hoffman 1979).

Ceramic pipe styles were not specifically tracked during the course of examining pottery from radiocarbon dated contexts but could be the focus of future research. Pipes in general are most frequently represented on sites of the Late Woodland period but often in low quantities, even where areal exposures have been extensive (cf. Kinsey 1972; Kraft 1972, 1975b, 1976b). Data from Late Woodland sites in the Upper Delaware Valley support the observation that pipes are more infrequent for periods predating the Minisink phase (Puniello 1991:162-163). Additional data are needed to confirm this pattern.

The chronology of certain pipe forms could be refined with future research adding to their usefulness as diagnostic artifacts. This would include pipes with roulette or pointille types of decoration, effigies, or distinctive forms such as ring, squared or trumpet bowls. All of these are generically associated with portions of the Late Woodland and/or Contact periods in the Upper Delaware Valley (cf. Kinsey 1972:Figure 58; Kraft 1975b:Figure 87, 2001:307-309; Lenik 2002:Table 3; Leslie 1973:Plates LVII, LVIII; Moeller 2011:Figure 22; Ritchie 1949:Plates 9, 16; Stewart et al 2015:Figures 102, 130, 131; Werner 1972:Figure 39). The earliest European-made pipes appear in Pennsylvania and New Jersey between 1610-1625, and in New York between 1600-1625 (Trubowitz 2004:156). European clay pipes are well represented in Native burials of the Upper Delaware (e.g., Heye and Pepper 1915).

Pointille decoration is found on pipes at the Faucett site (36Pi13a) in a component dated to 1410+/-100 AD (Kinsey 1972:197). Both the trumpet and ring bowl forms are found at Faucett, and refitted pieces of a trumpet style pipe derive from features associated with historic artifacts (Moeller 2011:Figure 22; see Table 12, this report). At the Manna site (36Pi4) a ring bowl pipe is associated with a context that is terminal Late Woodland or Contact in age (Stewart et 2015:Figure 102). In the Susquehanna Valley of Pennsylvania ring bowls probably date no earlier than 1550 AD and are the earliest form in a sequence that then progresses through pipes with effigies and finally tulip bowls with roulette designs that are best known from the 17th century in the broader region (Kent 1984:19, 145-151). Ring bowls continue to be seen well into the 17th century (e.g., Kenyon 1982; Pendergast 1992; Wray et al 1991). Ring decoration does occur earlier in time on trumpet bowl pipes associated with the Chance Phase (1400-1525 AD) in the Mohawk Valley of New York (e.g., Snow 1995:105).

Brasser (1980:96) notes that Iroquoian speaking peoples started making effigy pipes as early as the 15th century AD and continued the practice into historic times. This is contrary to Lenig's (1965:11-17) documented pipe forms of the Oak Hill Horizon, circa 1200-1360 AD, based on assemblages from the Mohawk Valley of New York. In the Upper Delaware effigy pipes span the Late Woodland and Contact periods. The representation of human faces in a variety of media begins circa 1380+/-55 AD and persists later in time (Kraft 1978:78-81, 2001:325;Lenik 2002:Table 3; Stewart 1998b:221-231).

Figures 58-61 illustrate examples of ceramic effigy pipes from the Upper Delaware. The human effigy pipe from Miller Field does not figure into Kraft's (1972) discussion of the site but is acknowledged in a later work without mention of its specific context (Kraft 2001:Figure7.72). It may derive from 1973 fieldwork reported by Staats (1974a).

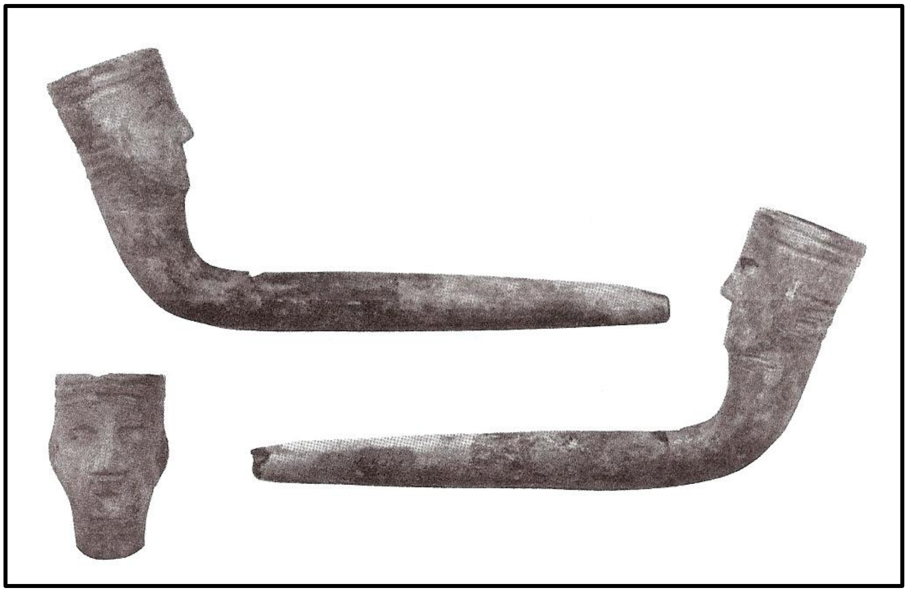


FIGURE 58. Views of effigy pipe from the Miller Field site, 28Wa16, Dayton Staats collection. The pipe is approximately 15.5 cm long. Modified from Leslie (1973:Plate LVIII).

A human effigy pipe and one with a tulip bowl, following Kent's (1984) terminology, were found together in the grave containing skeleton 67 at the "Munsee Cemetery" excavated by Heye and Pepper (1915:29-30, 48, Plate XII; Figure 59, this volume). The locality corresponds with what is recorded as site 28Sx48. The two pipes were on the left shoulder of an adult, above which were fragments of iron indicating that the internment dates to Contact/Historic times. This conforms with Kent's (1984:147) assessment of the age of tulip bowl pipes in the Susquehanna Valley.

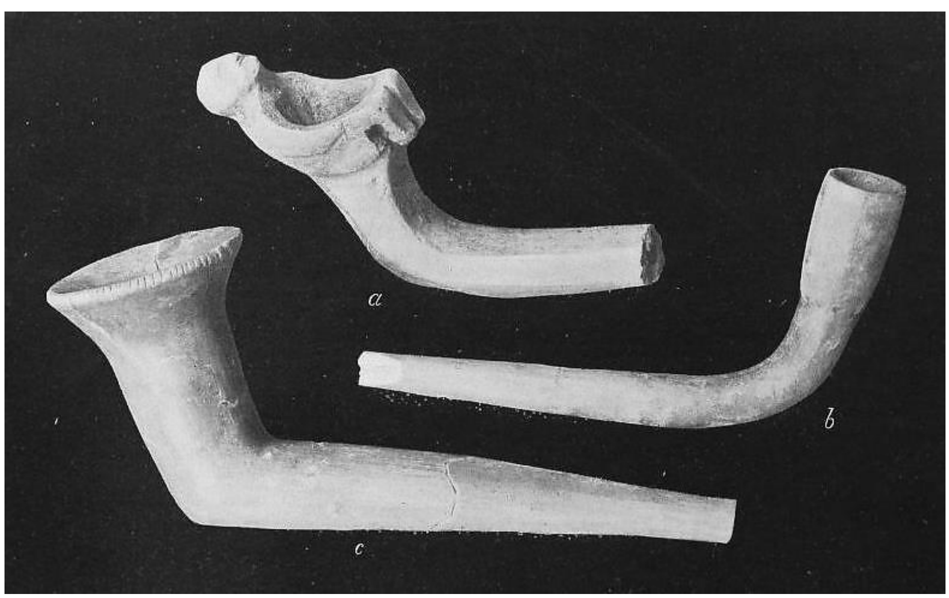


FIGURE 59. Human effigy and other pipes from the 1915 excavations at the “Munsee Cemetery”. Specimens *a* and *b* are associated with the grave containing skeleton 67. The effigy pipe is 4 inches (10.16 cm) long. Source: Heye and Pepper 1915:Plate XII.

A provocative fragment of an effigy pipe (Figure 60) derives from an analytic unit at the Manna site that represents a mixture of artifacts and features that could span the time from 1312-1444 AD into the 17th and possibly 18th centuries (Stewart et al 2015:244). Refitted fragments of the pipe initially appeared in both Features 25 and 31 prior to the pits recognition as a single extensive feature. The stem is rounded to slightly flattened and has a bore diameter of 5.8 mm. Visible on the side of the stem at its distal end is portion of a three-fingered hand or appendage. No analogous pipes can be noted in the regional literature. Ritchie (1949:Plate 9-Figure 2) illustrates a turtle effigy pipe bowl from the Bell-Philhower site (28Sx29). On the underside of the bowl are 3-4 fingered appendages.

A three-fingered human effigy occurs at the Genoa Fort site in New York and similar figurines are known from late 16th and early 17th century contexts on Iroquoian sites (Engelbrecht 2003:65). Antler or bone effigies of humans do show hands, some of which are three-fingered (e.g., Ritchie 1954:Plate 11) and can date from as early as the 16th century (e.g., Snow 1995:Figure 4.49). Rutsch (1973:212-213, 216-218, 232, 235) illustrates salamander/lizard motifs on pipes that he characterizes as Iroquoian. The creatures grasp the pipe’s bowl and distal portion of the stem with all four legs, but three-fingered appendages or claws are not seen (also see West 1970:193-197, Plates 123-124).

FIGURE 60. Broken effigy pipe from the Manna site, 36Pi4. Source: Stewart et al 2015:Figure 197.

Equally provocative is an effigy pipe (Figure 61) attributed to Late Woodland deposits at the Zimmerman site, 36Pi14, and curated at the Boston Museum of Fine Arts (Accession number 1993.617. http://www.mfa.org/collections/object/pipe-42637 . It is described as having a serpent-like horizontal stem with a creature-face twisted toward the smoker. The pipe's bowl emerges from front half of stem. It was originally part of the Lyman Vandermark collection. Vandermark apparently assisted with Werner's (1972) work at the site. The pipe was sold by Vandermark's widow to Glenn Del Gaizo, Stockholm, New Jersey. In October of 1993 Glenn Del Gaizo sold the piece to the museum. The pipe's form is somewhat reminiscent of a shell figure of a lamprey eel found with skeleton 26 at the "Munsee Cemetery" (Heye and Pepper 1915:Figure 16). Werner (1972:114, Figure 39) describes and illustrates the pipes from the Zimmerman site; there is no mention of this pipe.

A miniature pot with lugs is also attributed to the Zimmerman site and noted as originating in the Vandermark collection http://www.mfa.org/collections/object/miniature-vessel-42641. No mention is made of this unusual pot in Werner's report. Leslie (1973:Plate LXII) illustrates the same pot, attributes it to the Vandermark collection, but associates it with the Manna site. In the light of the discrepancies noted above the provenience of the serpent-like pipe is in doubt, but may derive from a site in the Upper Delaware.

FIGURE 61. Effigy pipe attributed to Late Woodland deposits, circa 1340 AD, at the Zimmerman site, 36Pi14. The pipe is 12.7 cm long. Collections of the Boston Museum of Fine Arts, Massachusetts. Accession number 1993.617. http://www.mfa.org/collections/object/pipe-42637

A variety of authors have emphasized that pipes are intimately associated with social interaction, interactions with the non-human world, ritual, prayer, and shamanistic behavior among the prehistoric and historic peoples of the Eastern Woodlands (e.g., Emerson 2003; Paper 1988; Rafferty and Mann 2004; Romain 2009; Von Gernet 1992, 2000). Rafferty (2016:256) maintains that pipes are drug delivery systems and all other consideration of their social and ideological functions must be based on this fact. Where their frequency of occurrence is substantial it is tempting to view pipes as a reflection of the interaction of individuals from different households, or perhaps communities that are cooperating in the economic activities or feasting. Pipes in general (stone, ceramics, metal) demonstrably figure into longstanding mortuary practices in the Upper Delaware Valley and broader region (e.g., Stewart 2017). In the Upper Delaware when pipes are found in Late Woodland or Contact period burials they are typically associated with adults with no distinction between men and women (Cushman 2007:154, 2013).

IV. DISTINCTIVE MATERIALS/ARTIFACTS

This chapter highlights artifacts fashioned from distinctive materials. The emphasis is on materials other than those represented by chipped stone artifacts. Table 23 charts relevant radiocarbon dates. As initially conceived the focus was to be on steatite and copper. Both are easily recognized materials with relatively restrictive source areas (e.g., Allen et al 1975; Bachor 2017; Green 1995:100-101; Wholey 2011; Wholey and Shaffer 2014). Certain steatite and copper artifacts are often taken as diagnostic of a particular time period. The distribution of steatite and copper artifacts relative to potential source areas figures into most discussions of exchange/trade networks for the region (e.g., Bachor 2017; Klein 1997; Lattanzi 2007, 2013; Stewart 1989). As data was being collected it was decided to include other, somewhat unusual or more infrequently found artifacts in the compilation. I suspect that a closer look at the published literature and CRM reports would reveal additional information regarding the chronology of these other materials.

Artifacts based on steatite, predominantly bowls, are the most well represented of the materials considered. Radiocarbon assays track the use of steatite bowls over a period of approximately 1500 years, predating but significantly overlapping the history of the initial use of pottery in both the Upper Delaware and the broader region (cf. Hoffman 1998; Inashima 2008; Stewart 2011b; Tache´ and Hart 2013). In the Delaware Valley the use of steatite may predate its role in the production of bowls. For example, a steatite bannerstone is associated with a feature dated to 3730+/-30 BP at Gunnars Run South, 36Ph162, in the Lower Delaware Valley (AECOM 2016).

Steatite, in general, continues in use throughout Woodland times and is used as pottery temper, and in the crafting of pipes, ornaments, and bannerstones. A steatite pipe from a dated Late Woodland context at the Otsiningo Market site is shown in Figure 62. On the underside of the pipe are indentations or holes for eyes, mouth and what may be a beak, the latter represented by a hole that penetrates the pipe bowl. The image of an owl is suggested representing a possible symbolic connection between birds and the "upper world" of native belief systems (Miroff 2014:94). There is colonial mention of the Indian use of steatite in the region (Abbott 1881:190; Holmes 1897:133; 1903:60).

Radiocarbon dates from the study area for steatite bowls range between 3670+/-120 BP and 2180+/-70 BP, spanning the chronological boundaries of the Transitional Archaic, Early and Middle Woodland periods (*contra* Carr 2015:67). The sample of assays is too small to follow best practices for the use of summed probability plots (e.g., Williams 2012) but is of interest for comparison with other plots of radiocarbon dates associated with steatite bowls. Summed probability plots for the study area are shown in Table 24. The plots employ calibrated dates using two standard deviations. Figures 63-65 compare study area frequency distributions with those of the Eastern Woodlands and eastern United States.

TABLE 23
RADIOCARBON DATES ASSOCIATED WITH DISTINCTIVE MATERIALS/ARTIFACTS

Material/Artifact Type	Date BP	Calibrated* 2 Sigma Age BC/AD	Calibrated* Median Age BC/AD	Site & Context	Reference
quartz crystal	UCIAMS 24866	11,056-10,823 BC	10,932 BC	36Mr43, Shawnee Minisink, associated with dated deposit	McNett et al 1985:6-7; McNett 1985b:88-89, 92, Figure 6.4; Dent 2002:Table 1; Gingerich 2013a:Table 9.8
	10,970+/-50 OxA-1731	11,030-10,772 BC	10,872 BC		
	10,940+/-90 Beta 101935	11,068-10,750 BC	10,877 BC		
	10,915+/-25 UCIAMS 24865	10,866-10,761 BC	10,814 BC		
	10,900+/-40 Beta 127162	10,877-10,752 BC	10,810 BC		
	10,820+/-50 Beta 203865	10,841-10,722 BC	10,771 BC		
	10,750+/-600 W-3134	11,838-8789 BC	10,509 BC		
	10, 590+/-300 W-2994	11,112-9646 BC	10,427 BC		
	9310+/-1000 W-3388	11,117-6357 BC	8701 BC		
quartz crystal	10,480+/-30 Beta 379217	10,612-10,431 BC	10,518 BC	36Cr142, Nesquehoning Creek, part of dated component	Stewart et al 2018
	10,340+/-40 Beta 379729	10,439-10,309 BC 10,304-10,059 BC	10,240 BC		
	9940+/-50 Beta 278334	9658-9573 BC 9554-9289 BC	9406 BC		
red ochre	7380+/-120 I-6133	6445-6026 BC	6250 BC	28Wa2, Harry's Farm, Zone 8- associated with dated component	Kraft 1975b:6-7, 9. 12, 15, Table 11
red and yellow ochre, quartz crystal	7320+/-125 I-6600	6432-5987 BC	6191 BC	28Wa2, Harry's Farm, Zone 6 - associated with dated component	Kraft 1975b:6, 15, 19, Table 11
quartz crystal	4460+/-130 Beta 127251	3522- 2873 BC	3158 BC	36Pi169, Shohola Flats, associated with dated deposit	Trachtenberg et al 2008:72-73, 112-113, Appendix L
	4370+/-140 Beta 127250	3375- 2620 BC	3046 BC		
	3960+/-110 Beta 127247	2764- 2192 BC	2467 BC		

Table 23 Continued					
Material/Artifact Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
red and yellow ochre	3670+/-120 Y-2587	2351-1746 BC	2063 BC	28Wa16, Miller Field, Pit 4-Feature C-F42	Kraft 1970a:31, 1972:10-11, 1975b:Table 11
steatite bowl	3670+/-120 Y-2587 3590+/-100 Y-2588	2351-1746 BC 2207-1683 BC	2063 BC 1948 BC	28Wa16, Miller Field, associated with dated component	Kraft 1970a:31, 1972b:10-11, 33, 1975b:Table 11
steatite bowl	3450+/-120 Y-2478	2043-1496 BC	1772 BC	36Pi13A, Faucett, associated with dated component	Kinsey 1975:49, 51, Table 32
steatite bowl, some fragments incised	3230+/-120 Y-2343	1777-1209 BC	1510 BC	36Pi14, Zimmerman, Hearth 4-Feature 44	Werner 1972:118
steatite bowl, side notched steatite bead	3170+/-120 Y-2589	1697-1116 BC	1435 BC	28Wa16, Miller Field, associated with dated component	Kraft 1970a, 1972:12, 56
steatite bowl	3120±120 Y-2339	1645-1044 BC	1367 BC	36Pi7, Brodhead-Heller, nearby dated feature	Kinsey and McNett 1972:222
steatite bowl	3070+/-80 Beta 43899	1503-1108 BC	1318 BC	36Nm244, Driftstone, associated with dated component	Kline 1999 (personal communication); Blondino 2008:167, Table 1, 2015:Table 5.1
steatite bowl	2920+/-30 UGAMS-02948	1211-1020 BC	1115 BC	36Nm244, Driftstone, associated with dated component	Blondino 2008:Table 1, 2015:Table 5.1
steatite	2710+/-150 Beta 15568	1231-471 BC	887 BC	36Mr5, Smithfield Beach/Pardee, Feature 2	Fischler and Mueller 1988:Table 3.5
steatite	2710+/-90 Beta 37465 2390+/-70 Beta 45960	1122-750 BC 767-369 BC	884 BC 513 BC	36Pi136, Dingmans Launch, Feature 1	Alterman 1993:12; Alterman and Koldehoff 1991:35-36, 39, Appendix 1
steatite bowl	2680+/-80 Beta 129347	1043-748 BC	856 BC	Broome Tech Site (SUBi-1005) , midden, Broome County, NY	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
steatite bowl	2560+/-70 Beta 129344	833-473 BC	671 BC	Broome Tech Site (SUBi-1005) , context not specified, Broome County, NY	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
copper ring, nugget, ball, and tubular beads, red ochre, conch columella beads, olivella shell beads, copper boatstone, slate boatstone, limestone blocked-end tube, sandstone blocked-end tube, copper plate, twined fabric, antler time projectile	2560+/-120 Y-1384 2400+/-60 DIC-407	930-397 BC 756-679 BC 671-603 BC 600-390 BC	665 BC 515 BC	28Sx2, Rosenkrans, associated with dated burial cluster	Kraft 1976a:23, 31

Table 23 Continued					
Material/Artifact Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
steatite cone, copper awl, copper tubular beads, twined cloth, keeled boatstone	2560+/-120 Y-1384	930-397 BC	665 BC	28Sx2, Rosenkrans, Burial 9	Kraft 1976a:23, 31-32
steatite bowl	2490+/-40 Beta 129343	788-477 BC	633 BC	Broome Tech Site (SUBi-1005) , midden, Broome County, NY	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
copper spherical beads, copper celt, conch columella beads, olivella shell beads, open twined fabric	2400+/-60 DIC-407	756-679 BC 671-603 BC 600-390 BC	515 BC	28Sx2, Rosenkrans, Burial 5	Kraft 1976a:21-24
steatite bowl	2400+/-60 Beta 129346	756-679 BC 671-603 BC 600-390 BC	515 BC	Broome Tech Site (SUBi-1005), feature, Broome County, NY	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
steatite bowl	2180+/-70 Beta 129345	388-85 BC	241 BC	Broome Tech Site (SUBi-1005), nearby dated feature, Broome County, NY	Truncer 2004a:Table 2 citing Versaggi and Knapp 2000; Tache and Hart 2013:Appendix 2
steatite pipe, red ochre	600+/-30 Beta 378839	1297-1373 AD 1377-1408 AD	1346 AD	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY	Miroff 2014:Tables 8, 46
Dutch glass seed beads	430+/-40 Beta 251444	1414-1521 AD 1590-1624 AD	1459 AD	Site ORA-0550, Feature 42, Orange County, NY	Pretola and Freedman 2009:233, 256, Tables 77, 84
Dutch glass seed beads	370+/-40 Beta 251445	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 68, Orange County, NY	Pretola and Freedman 2009:234, 256; Table 84
crinoid fossil	350+/-60 Beta-42910	1444-1648 AD	1549 AD	Smithfield Beach/Pardee 36Mr5 Feature 114	Hennessy 1992:151, 153, Appendix A
copper/brass	340+/-40 Beta 251450	1462-1642 AD	1556 AD	Site ORA-0550, Feature 106, Orange County, NY	Pretola and Freedman 2009:241-242, Table 84
possible copper fragment	150+/-60 Beta 42909	1663-1895 AD 1903-1950 AD	1798 AD	36Mr5, Smithfield Beach/Pardee, Feature 121	Hennessy 1992:303, Appendix A
copper	European artifacts associated	Contact-Historic	Contact-Historic	28Wa16, Miller Field, pit feature with cache	Kraft 1972:52
copper	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pits 219, 219a	Marchiando 1969:1, 53, 77, Table 3
copper	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 242	Marchiando 1969:Table 3
copper bead, catlinite bead	European artifacts associated	Contact-Historic	Contact-Historic	28Sx48,Munsee Cemetery, Skeleton 53	Heye and Pepper 1915:28
red ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx48,Munsee Cemetery, Skeleton 8	Heye and Pepper 1915:20-21

Table 23 Continued					
Material/Artifact Type	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
red ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx48,Munsee Cemetery, Skeleton 30	Heye and Pepper 1915:25
red ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx48,Munsee Cemetery, Skeleton 33	Heye and Pepper 1915:25-26
ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 143	Marchiando 1969:Table 3
ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 235	Marchiando 1969:Table 3
ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 184	Marchiando 1969:Table 3
ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 202 and 203	Marchiando 1969:Table 3
ochre	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 220a	Marchiando 1969:Table 3
fossil coral	European artifacts associated	Contact-Historic	Contact-Historic	28Sx19, Bell-Browning north field, pit 218	Marchiando 1969:Table 3
catlinite bead	European artifacts associated	Contact-Historic	Contact-Historic	28Sx48,Munsee Cemetery, Skeleton 29	Heye and Pepper 1915:24-25

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

FIGURE 62. Views of a steatite pipe from a dated context at the Otsiningo Market site, Broome County, New York. Modified from Miroff (2014:Photos 29, 30).

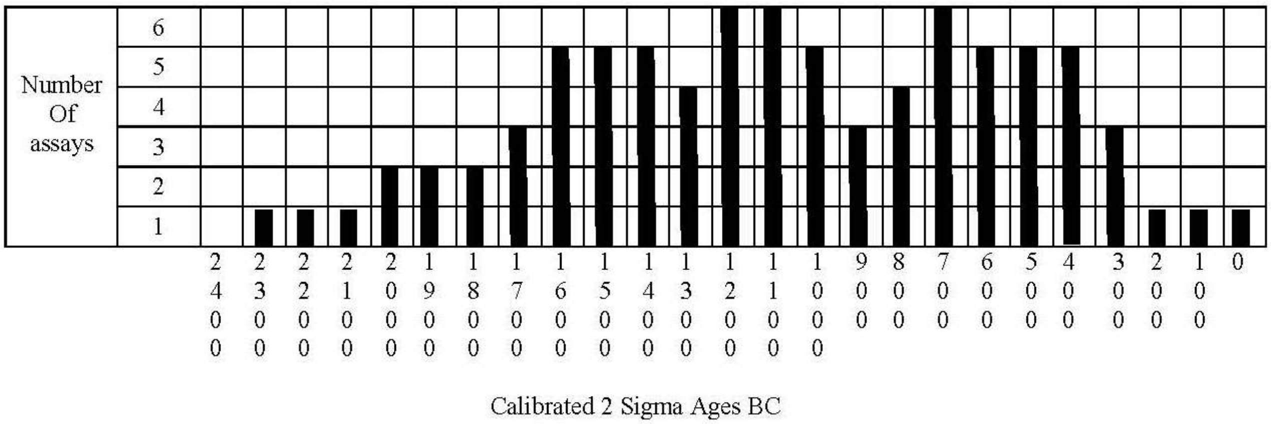


FIGURE 63. Summed probability distributions organized by 100 year intervals for 14 radiocarbon dates relevant to steatite bowls in the study area.

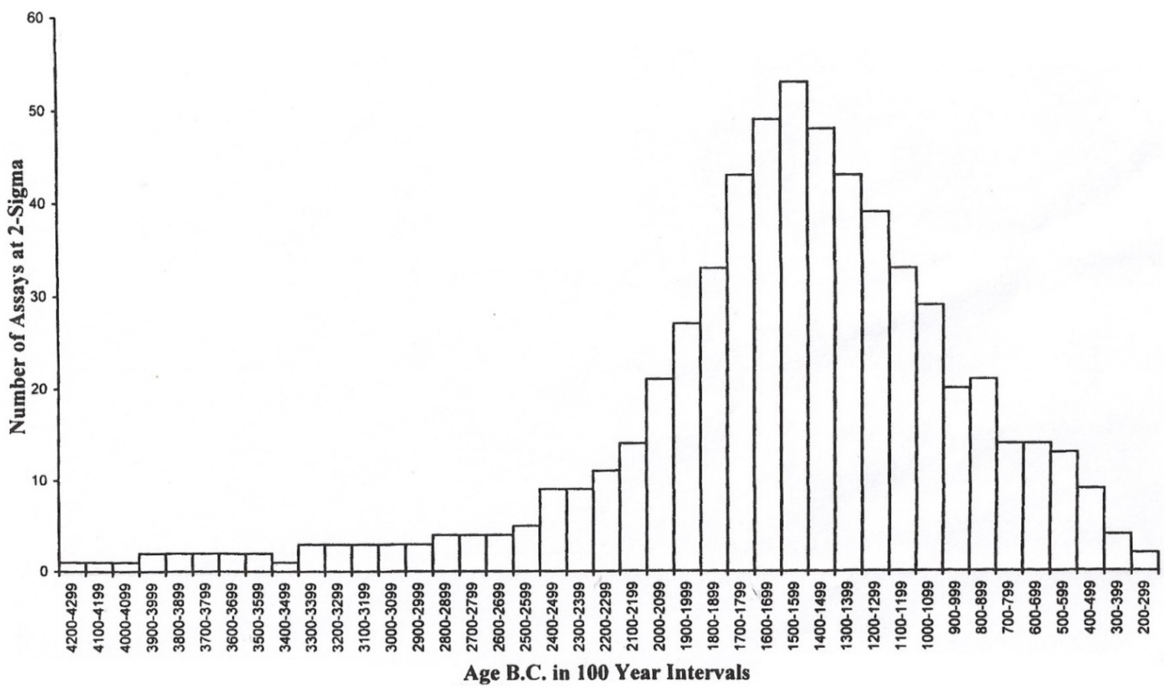


FIGURE 64. Summed probability distributions organized by 100 year intervals for radiocarbon dates relevant to steatite bowls in the Eastern Woodlands. Source: Truncer 1999:Figure 45.

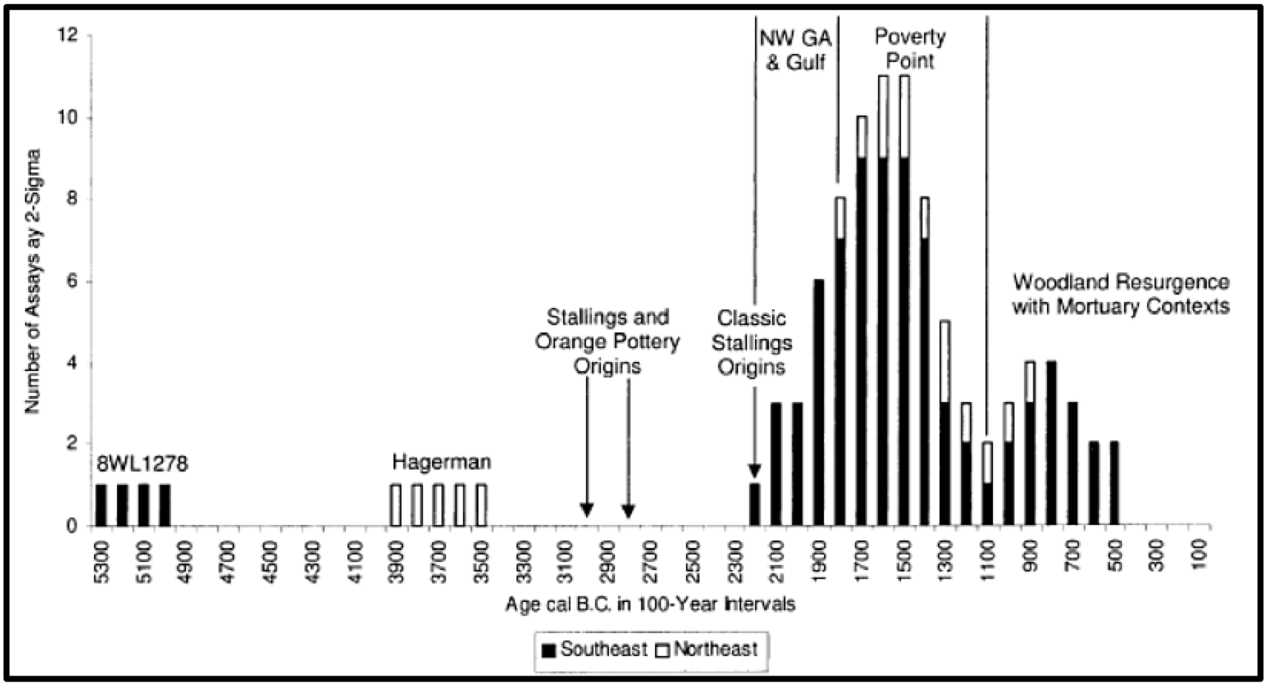


FIGURE 65. Frequency distribution of AMS dates on soot/residue from steatite vessels, eastern United States. Annotations relate to key samples, historical events, and related archaeological phenomena. Source: Sassaman 2006:Figure 2.

Truncer's (1999:Figure 45) summed probability distribution utilizes assays from throughout the Eastern Woodlands and reveals a peak in steatite bowl use clearly and strongly around 1500 BC (Truncer 1999:287-288). The broader peak in the distribution of assays falls between roughly 1700 BC and 1300 BC.

In an initial study by Sassaman (1999) peak use for steatite bowls falls roughly between 1250 BC and 750 BC. In a later work he plots the frequency distribution of AMS dates on soot/residue adhering to steatite vessels from the eastern United States as part of a critique of Truncer's research (Sassaman 2006:Table 1, Figures 1, 2; Figure 65, this volume). The distribution of dates is somewhat bimodal with the largest mode centered roughly on 1650 BC and a smaller mode centered on circa 800 BC (Sassaman 2006:143). A variety of evidence led Sassaman (2006:151) to conclude that the initial use of steatite vessels does not pre-date 3700 BP, although earlier dates exist and are considered relevant by others (cf. Hoffman 1998:Figure 6; Truncer 1999, 2004, 2006).

No clear, single peak in steatite dates is evident for the study area. There is a general correspondence with Truncer's peak of use and the bimodal distribution documented by Sassaman. It does seem evident, however, that the chronology of steatite bowls roughly parallels trends seen throughout the greater Eastern Woodlands.

Kraft (1970) encountered two types of steatite bowls on the Miller Field site. He suggested that flat bottomed forms with visible tool marks are likely the earliest, while vessels with rounded bottoms and smoothed walls, associated with Fishtail points, occur later in time.

This assertion needs to be tested with additional data from the Upper Delaware Valley and nearby portions of the Upper Susquehanna and Hudson drainages. Kraft's distinctions may not be relevant on a broader, regional scale and indicated below.

While variations in vessel form do not seem to strictly be a result of the natural form in which steatite occurs at various outcrops in the region (Ward and Custer 1988), Truncer's (1999:156-167) assessment of steatite bowls from throughout the Eastern Woodlands does not lend support to Kraft's speculation regarding the chronology of vessels forms. Neither vessel size or the presence/absence of lugs display chronological or spatial restrictions. "Flat-bottomed basin-shaped vessels appear to be a Middle Atlantic phenomena, occurring only after about 2000 B.C…. a distribution which does not appear to be the result of sampling effect since other base forms occur both before and after 2000 B.C." (Truncer 1991:161). Round-bottomed vessels have a large temporal distribution. The exteriors of both flat- and round-bottomed vessels can exhibit chiseled or smoothed surfaces. It appears that after 2000 BC interior surfaces are typically smoothed and after 1000 BC exterior surfaces are typically smoothed. Kraft's (1972:37) conjecture that the distribution of round-bottomed and smoothed exterior vessels is regionally restricted also is not upheld by Truncer's (1999:167) analysis. If steatite quarries were considered to be common ground, they would have been the locus of interaction between groups and a means by which group specific technological traditions could be shared and become widespread, resulting in the contemporaneous variability seen in the archaeological record.

Approximately 50 steatite quarries of varying size are documented within the Middle Atlantic Region (cf. Brown 1980; Luckenbach et al 1975; Holland et al 1981; Holmes 1919:228-240; Truncer 1999; Turnbaugh et al 1984; Ward and Custer 1988; Wholey 2011; Wholey and Shaffer 2014). Attempts have been made to geochemically link steatite artifacts with sources of the raw material (Allen et al 1975; Bachor 2011, 2017; Holland et al 1981; Luckenbach et al 1975; Luckenbach, Holland and Allen 1975; Truncer 1999, 2004b; Truncer et al 1998; Turnbaugh and Keifer 1979; Turnbaugh et al 1984) with potential implications for settlement movements, social interactions and exchange. Without geochemical testing we cannot assume that there is a correspondence between an artifact's location and the nearest source of relevant material. The inaccuracy of this assumption has been documented as regards steatite (e.g., Holland et al 1981). The spatial distribution of steatite sources in eastern Pennsylvania and west-central New Jersey is such that interpretations of settlement movements, territories, and trade can be skewed depending upon which source is implicated.

The most recent and extensive sourcing study is that of Truncer (1999, 2004b) employing Instrumental Neutron Activation Analysis. Artifact samples from the study area and greater Delaware Valley were used in this research (Truncer 1999:Tables 27, 32). Study area localities included Mashipacong Island (Kraft 1985), Miller Field (Kraft 1972), and Skunk Run (Launer 1960). Unfortunately, samples from sources in the Easton/Philipsburg area of Northampton and Warren counties (Bachor 2017:Table 2.3; Geyer et al 1976:193-198; Greene 1995:100-102; Schrabisch 1917:47) were not analyzed as part of the study. As noted previously, Kraft (1982:20) doesn't think that this source was ever exploited by the Indians. Bachor (2017:29-30) suggests that the fibrous asbestos component of the material may have made it problematic to carve causing it to be overlooked, as seems to have been the case with similar material elsewhere in the steatite belt of the eastern United States.

Significantly, Truncer's (1999:243) analysis shows that individual steatite quarries and regions are able to be identified at high rates of probability. However, very few of the steatite bowls tested could be linked with a quarry, a dramatically different result than that reported in the earlier work of Allen et al (1975). None of the artifact samples from the Upper Delaware could be linked with a quarry source (Truncer 1999:253). Truncer (199:291) suggests that the failure to securely assign artifacts to a source may relate to: the existence, or former existence, of a large number of unknown quarries; the possibility that quarry sources that weren't part of the analyzed sample are represented to a large degree by the artifacts that were sampled; or the possibility that the bulk of the extant quarries that were sampled are exhausted of the material used for vessels, and the remaining material is not characteristic of what was actually used by native peoples.

Intensive sampling and geochemical analysis of potential steatite sources and artifacts needs to continue in the future. Were more secure linkages for artifacts and quarry sources to be demonstrated we might eventually see patterning in the chronological sequence in which certain sources were used. In other words, it might become possible to estimate the age of a steatite bowl fragment depending on the source of the raw material used to create it.

Residues adhering to steatite bowl samples from the study area also were analyzed in Truncer's wide-ranging research. Residues on the Miller Field steatite bowl sample contained 11 identifiable chemical components related to plant material. The two most common saturated fatty acids found in acorn (palmitic and stearic) were found in the Miller Field sample (Truncer 1999:259, 265, 276, Table 33).

The technological function of steatite vessels is debated. While thermal tests show that at least some vessels functioned as fire-proof containers as always assumed, variation in vessel form, use-wear, heat-related damage, sooting, and residues indicate multiple functions for steatite vessels (Truncer 1999:171). Truncer (2004a, 2006) argues for the primary function of steatite containers in the processing of mast, based on his residue analysis and spatial distributions of vessel sherds that frequently, but not exclusively, correlate with physiographic zones that typically include mast-producing species (but see Sassaman 2006).

Truncer's hypothesis is weakened by arguments presented by Sassaman (2006) and Hart et al (2008). The identification of grass-, pine-, and meat-related residues on steatite vessel sherds from the Hunter's Home site in New York (Hart et al 2008) does support, however, Truncer's (1999:171) basic generalization that no single function can be attributed to all steatite vessels. I agree with Hart et al (2008:731) when they state that "while it is likely steatite vessels found in domestic settings were used for heat processing food resources, it cannot be assumed that steatite vessels were used for processing the same resources throughout their temporal and spatial distributions in eastern North America".

The spatial distribution of steatite vessels is fairly discontinuous (Klein 1997; Stewart 2011b; Wholey 2011; Wholey and Shaffer 2014) making it extremely unlikely that either type of container satisfied the domestic cooking, serving, storage or transport needs of native peoples. It has been argued that steatite containers were highly valued because of procurement and production costs, and used for a variety of purposes including processing, cooking, and serving/display. But all of these purposes are related to ritual or socially charged behaviors and social gatherings (cf. Carr 2015:67-68; Klein 1997, 2010; Stewart 1998d, 2011b; Truncer 2004a:495). Again, more detailed and area-specific studies may reveal that the function of steatite vessels is time transgressive and cannot be divorced from the social context of use.

Perforated steatite disks and slabs appear circa 3000 BC in the Southeast and are used in "hot rock" cooking, analogous to the function ascribed to some assemblages of fire cracked rock so common in the Middle Atlantic region. Steatite disks and slabs are found as far north as coastal North Carolina and continue in use even after the appearance of pottery (Herbert 2002:295). Given the obvious thermal properties of steatite it is curious that disks and slabs are rarely, if ever, found in the Delaware Valley or Middle Atlantic region. Does this lack underscore the high sociocultural perception and value placed upon the material? Fragments of steatite bowls could be used without modification in hot rock cooking and end up with residues or absorbed fatty acids that reflect such use, and not simply reflect the original use of the intact steatite vessel. A comparative study of residues from intact vessels and vessel sherds might be revealing.

There is no question that in the Delaware Valley and Middle Atlantic region examples of steatite bowls have been dated to earlier times than pottery. However, a comparison of radiocarbon dates for stone bowls and early pottery shows considerable overlap. While steatite and early pottery vessels share certain attributes of form, it is not clear that the latter is imitating the former; both types of containers may be mimicking basket, bark or wooden vessels (Klein 1997; Stewart 1998d, 2011b). William Henry Holmes (1886) pointed out this possibility 125 years ago. The coincident use of the two technologies, I believe, reflects the distinctive socio-technic functions of each.

A high, group-specific or cultural value placed upon steatite or other exotic material (e.g., copper, mica, marine shell, sharks teeth) may have necessitated direct procurement, no matter the distance involved, rather than obtaining it through some type of exchange system. An ethnographic example of this is the procurement of pipestone (catlinite) from sources in Minnesota (Holmes 1919:253-264). The Yankton Sioux "in large parties, journey 200 miles each summer to work the red pipe stone quarries and to make pipes or prepare the stone for trade" (Holmes 1894:132). It strikes me that steatite bowls readily fit into this category of highly valued material requiring direct procurement, especially since they are found over a broad region and do not exhibit frequency distributions that easily conform to modeled systems of exchange (cf. Bachor 2017; Stewart 1989; Ward and Custer 1988; Wholey 2011). The widespread geographic distribution of steatite artifacts and the lack of base camps associated with quarries, even though appropriate settings for such exist, suggests that they are common ground and not controlled by a local group (Stewart 2016; Ward and Custer 1988:47; Wholey 2016).

Assigned value or cultural perceptions of a material and specific sources would be historically contingent. Singular historical moments that significantly alter the trajectories of societies are one focus of what has been called an event-centered archaeology (Gilmore and O'Donoughue 2015). This perspective asks us to think about how the initial discovery of a useful material source conditioned peoples use or perceptions of a particular landscape and associated materials through time, and the degree to which they later sought out, and repeatedly used, other sources of the same material. The nature of a group's initial experiences with steatite may have motivated direct procurement even in the face of changes in settlement movements and territorial ranges. The event-centered perspective also leaves open the possibility that the use of specific sources may change through time, and through appropriate sourcing studies lead to a chronological typology of source material, as I suggested above.

The occurrence of quartz crystals in the archaeological deposits of the study area have the longest chronology of any of the distinctive materials considered here. Radiocarbon dated contexts from which they are derived span the Paleoindian to Late/Transitional Archaic periods. Eighteen quartz crystals are attributed to what are termed the Early Archaic levels of the Rockelein site (28Sx14) but cannot be associated with a specific aspect of these deposits, i.e., Bifurcate, Kirk, or Stanly/Neville loci (Dumont and Dumont 1979:50). Crystals are known from undated Late Woodland and/or Contact period contexts in the Upper Delaware. For example, at the Bevans Rockshelter (28Sx25) quartz crystals occur in a pit feature along with collared pottery (Cross 1948:15-16). Skeleton 27 excavated by Heye and Pepper (1915:23) at the Munsee Cemetery had a quartz crystal between its teeth. Although Heye and Pepper (1915:23) describe the individual as a white man of the "Scandinavian or Nordic type" with no explanation, the flexed positioning of the body with the head oriented to the southwest is typical of Late Woodland and some Contact period Native internments (Cushman 2007). Mouthed crystals are also implicated in some shamanistic practices recorded for historic Algonquian and Iroquoian peoples of the Northeast (Hamell 1983:13). The remains are being repatriated as Native American (Beaver 2009:Table 1).

It is assumed that the use of crystal also occurs during Early and Middle Woodland times. Kipp Island burials can include copper, shell beads, platform pipes, mica, quartz crystal, and paint cups, and seem reflective of a Hopewellian influence (Kraft 2001:193-198; Ritchie 1980:234-253). A potential Kipp Island burial in the Upper Delaware Valley consisted of a cremation associated with a bone/antler comb, sharks teeth and the a platform pipe (Kraft 2001:198).

Known sources of crystal include:

> Crystal Hill immediately northwest of Stormville, Monroe County, PA (Brodhead 1870:77), associated with the Ridgeley through Coeymans formations, undivided of sandstones, siltstone, limestone and chert (Berg and Dodge 1981:Stroudsburg Quadrangle; USGS 2018a);
>
> Kunkletown, Monroe County, PA ((French 1968:Table 113), part of Chestnut Ridge and associated with the Mahantango Formation (Berg and Dodge 1981:Sheet 318, Kunkletown Quadrangle) of shale and sandstone (USGS Mineral Resources Online Spatial Data 2018b); and
>
> Wind Gap, Monroe County, PA (Donald Kline, 2014 personal communication) , part of the Blue Mountain and associated with the Shawangunk Formation (Berg and Dodge 1981: Wind Gap Quadrangle) consisting of fine- to very coarse grained sandstone (USGS Mineral Resources Online Spatial Data 2018c).

Using the closest of these sources (Crystal Hill) sites with dated occurrences of crystals are from 13 km (8 miles) to 64 km (40 miles) distant. From the farthest known source (Kunkletown) the range is 34 km (21 miles) to 88 km (54 miles). One could speculate on this basis that native peoples were directly procuring crystals rather than gaining them through trade.

Perhaps the most outstanding occurrence of quartz crystals is at 36Cr142 in the Lehigh Gorge to the west of the study area. A quartz crystal is associated with the dated Paleoindian deposits at the site (see Table 23). In a small rockshelter on the edge of the site over 70 crystals have been recovered from clusters and scatters in alluvial deposits linked stratigraphically with strata producing Susquehanna and Perkiomen broadspears beyond the shelter. In fact, a cache of Susquehanna Broadspears is immediately adjacent to the shelter. Some of the crystals exhibit damage from use and a few have been notched. Whole specimens are up to 4 cm in length. Most appear to be unaltered but a detailed analysis has not been completed. A potential source of the crystals is 5 km upriver from the site linked with the Pocono Sandstone (Geyer et al 1976:59; Inners 1998).

Crystal quartz is known to have been employed in the production of chipped stone artifacts in the region. Quartz crystals may have served a variety of other purposes. Claassen (2015:191) notes that one attraction of quartz crystals is the phenomena of triboluminescence – light created (and visible in the dark) when crystals are rubbed or scratched against one another. Ethnographically, crystal, along with shell and copper, are considered as other-worldly substances when consecrated to ritual use and become material expressions of a "metaphysics of light" shared by Algonquian, Iroquoian, and Siouan peoples of the Northeastern Woodlands (Hamell 1983:5-6; Miller and Hamell 1986). They “were their owner's assurance and insurance of long life (immortality through resuscitation), well-being (the absence of ill-being), and success, particularly in the conceptually related activities of hunting and fishing, warfare, and courtship” (Hamell 983:25). They were employed in the seeking of visions and divination, especially regarding finding game animals (Hamell 1983:14, 16). Ritual placement in the mouth or ingestion is known. “In these beliefs and practices the ingested, swallowed, or internal crystal or shell is conceptually its keeper's "power", "life", "heart", or "soul". Such substances may be "owned" by shamans (sorcerers, wizards, and witches) or by members of various medicine and doctor's societies” (Hamell 1983:13).

Historically the lightest colored crystals with the greatest clarity were most valued (Hamell 1983:26-27). Among the Cherokee crystals served different purposes depending upon their size (Hamell 1982:14). These observations should be kept in mind for their interpretive potential when documenting crystals and their contexts at sites in the Upper Delaware and broader region. It has also been suggested based on the historical record of eastern North America that European glass first entered native thought and behavior as “crystal” (Miller and Hamell1986:316, 325). Hamell (1983:20) cautions that we should therefore be more sensitive to the significance of the presence of European glass in mortuary or potential ritual contexts.

Like crystal and mica, copper was thought of as an other-world/lower-world substance by native peoples with the power to bring long life, health, and good fortune (Hamell 1983:6; Romain 2009:160). Copper is associated with archaeological deposits of the Early, Middle, and Late Woodland, and Contact periods in the Delaware Valley (Britton 1967; Cross 1956:41, 121;

Kraft 1976a; Lattanzi 2013; Newcomb 1956:27-28). The style of some objects recovered in New Jersey from contexts whose ages are not known resemble those of the Late Archaic Old Copper Culture (Veit et al 2004). Copper artifacts are a component of Meadowood, Middlesex, Delmarva Adena, and Kipp Island burial complexes in the greater region (e.g., Custer 1989; Kraft 2001; Lowery 2012; Lowery et al 2015; Ritchie 1980; Stewart 2017; Tache´ 2008).

The only precontact dates relevant to copper artifacts are from the cluster of 13 burials at Rosenkrans Ferry, 28Sx2, and deemed part of a Middlesex component, a northeastern expression of Ohio Valley Adena (Funk 1976:277-278; Kirk 1998; Kraft 2001:168-178; Mackey 2007; Ritchie 1965:200-203; Ritchie and Dragoo 1959; Williams and Thomas 1982:113-114). The site was investigated and reported upon by a number of individuals (cf. Carpenter 1950; Clabeaux 1976; Cross 1945; Kraft 1976a; Lattanzi 2013; Leslie 1973;70, Plate XCXVII; Ubelaker 1976). Grave goods at Rosenkrans exhibit the variety, if not the quantity, of artifacts associated with mounds in the Adena heartland. Beads excavated from Burial 2 by Kenneth Gleason are shown in Figure 66. Kraft (1976a:16) did not have access to this collection so they are not illustrated in his seminal publication on the site. Nor are they depicted in Carpenter's (1950:298, Figure 90) initial report on the burials, although Gleason's finds are mentioned. Beads from Burial 12 at the site are shown in Figure 67 and were part of a copper sourcing project completed by Lattanzi (2013).

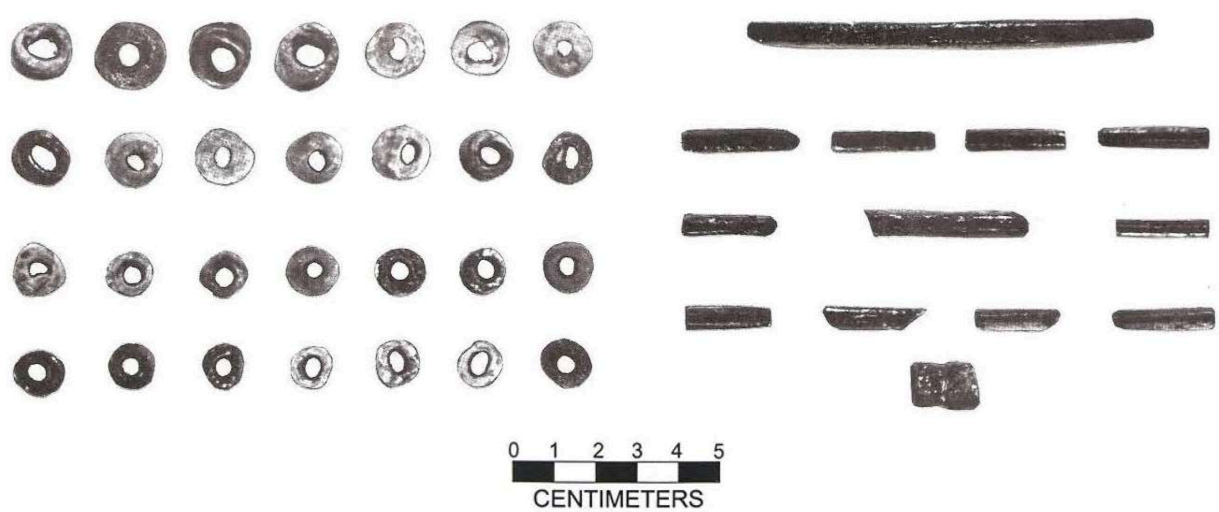


FIGURE 66. Copper beads excavated by Kenneth Gleason from Burial 2 at the Rosenkrans site, 28Sx2. Modified from Leslie (1973:Plate XXVII). The largest bead in the photo is approximately 9.6 cm long.

A copper celt from the Shawnee area of the Water Gap could be Early Woodland in age based upon its style but contextual information is lacking (see Figure 67). Brodhead (1870:89) speaks of a copper axe found in the Upper Delaware made "from the raw material, and ground down to the required size and form." Again, an Early Woodland or perhaps later age for the piece might be assumed. A burial plowed up on the Kerr site (28Sx249) included copper arm bands and possibly represents a Middlesex related internment (Kraft 1970c:20). However, arm bands also are represented in Contact period burials in the Upper Delaware (e.g., Heye and Pepper 1915).

FIGURE 67. Examples of copper artifacts from the Upper Delaware used in sourcing studies. Top: beads from Burial 12 at the Rosenkrans site, 28Sx2. Part of collection housed at the Walsh Gallery, Seton Hall University, South Orange, New Jersey. Bottom: undated celt found in the vicinity of Shawnee, Monroe County, Pennsylvania. Philhower collection, New Jersey State Museum. Photos courtesy of Gregory D. Lattanzi.

Copper artifacts are more likely to be associated with the Contact period in the study area. A possible fragment is derived from a dated historic feature at Smithfield Beach, 36Mr5, and site ORA-0550 in Orange County, New York (see Table 23). AMS dates from historic contexts must be used with caution. A case in point are the Dutch beads from AMS dated contexts at site ORA-0550 (see Table 23). All are Dutch seed beads traded at Fort Orange between 1624 and 1635 (Pretola and Freedman 2009:256). Without the aid of documentary evidence the radiocarbon dates could be taken to represent an earlier historic context.

A cache that was likely in a fiber pouch was excavated on the Miller Field site (28Wa16) and included 18 rectangular pieces of sheet copper one to three inches in length, and a triangular brass arrowhead. The cache is part of a historic component dated between 1650-1710 on the basis of a silver-plated seal spoon from a burial that is compared with a dated example from Jamestown (Kraft 1972:52-53). The contents of Pit 219 and 219a at the Bell-Browning site north field (28Sx19) includes a rolled copper bead, Venetian glass bead, and kaolin pipe stem confirming a Contact period age for the pits' contents (Marchiando 1969:1, 53, 77, Table 3). A tubular copper bead was recovered at the Beisler site, 28Sx17, from a plowzone context. Collared pottery is found in the plowzone along with fragments of colonial pipes. The first subsurface level of the site also produced collared, Iroquoian-like pottery (Ward and Salwen 1960:23, 24, Figure 2). This suggests that the plowzone copper could relate to a Late Woodland or Contact period component at the site. A triangular arrowpoint of sheet copper or brass was found on the Davenport site, 28Sx27; it is not believed to be native copper so it would relate to an occupation historic in age (Leslie 1946:103, 1968). Natural copper fragments are included in the multi-component prehistoric artifact assemblage from an investigation of 36Pi30, the Brodhead site (Wright 1997:Table 1).

Available data suggest that regardless of age, recoveries of copper artifacts are as likely to derive from a mortuary or mortuary-related context as any other type of context. Yet copper artifacts are unevenly distributed in the graves of any era. Future research focused on a comparative study of mortuary features with and without copper for a given unit of time might reveal more about the social and spiritual role of the material, and the individuals with which it is associated. Mortuary features of the Contact period would be an obvious place to start such an investigation given available data and the potential usefulness of historic documents, ethnographic analysis and analogies.

Nearest sources of copper that may have been capable of being manipulated by native peoples of the study area occur in central New Jersey, eastern Pennsylvania, and southeastern New York (cf. Britton 1967; Lattanzi 2008a:Figure 2, 2008b:Figure 1, 2013; Levine 2007; Veit et al 2004:74-75; Veit et al 2004:75-77; Williams et al 1981:148; Woodward 1944). Some of these sources fall within a reasonable foraging radius of sites in the study area that have produced copper artifacts. Others could be 100-200 miles distant. Of course, there are major and well known sources of copper beyond this region, notably those of the Lake Superior area (e.g., Levine 2007). Harder to pinpoint are locations where nuggets and larger masses of copper were a consistent part of glacial drift, a source that is likely to be well represented by native-made artifacts (Lattanzi 2008a:300-301). The copper at the Pahaquarry mine in the Upper Delaware is from chalcocite (Cu2S – copper combined with sulfur). It is not a pure copper that could be worked by native peoples (Chavez et al 1995:30; Leslie 1973:229-244; *contra* Veit et al 2004:76).

Lattanzi's (2007, 2008a, b, 2013) research is the most relevant to understanding the use of copper by native peoples in the Delaware Valley and embraces previous efforts in other areas. His most recent sourcing project created a geologic copper collection from a number of regions and a collection of approximately 500 artifacts from caches from three different localities in the Middle Atlantic region representing the Early and Middle Woodland periods (Lattanzi 2013). The project used laser ablation multi-collector inductively coupled plasma mass spectrometry (LA-MC-ICP-MS) to elementally characterize the artifacts and raw geologic source material, and serve as a basis for evaluating models of exchange. Copper artifacts from the Middlesex burial cluster at the Rosenkrans site were one of the sites involved in this study.

Much of the copper represented by the Rosenkrans artifacts may be associated with Michigan sources, with a minority possibly derived from North Carolina, Pennsylvania and New Jersey sources; intra- and extra-regional sources are represented. However, the copper assemblage in some burials appear to represent only intra-regional sources (Lattanzi 2013:188-189, 201). It is clear from the analysis of the Rosenkrans assemblages, and those from other sites in this and earlier projects, that procurement/exchange strategies were not static during the Early and Middle Woodland periods (Lattanzi 2013:Table 9.1). In contrast, Late Archaic copper artifacts from the Delaware Valley implicate only Michigan sources (Lattanzi 2008a:320). Thus, sole reliance on an extra-regional source may prove to be a chronological diagnostic of sorts for copper artifacts. This work again demonstrates that we cannot assume without compositional analyses that artifact raw materials are derived from sources in closest proximity to the deposits in which the artifacts are found. This has most recently been demonstrated by a copper sourcing study focusing on late prehistoric artifacts from Virginia where it has traditionally been assumed that copper was being procured from sources in the Blue Ridge province (Gunter and Stevenson 2016). Results of this analysis suggest that native copper likely came from sources beyond the Middle Atlantic region.

Lattanzi's recent sourcing effort focused on copper in caches (burial or otherwise), as others have done, the assumption being that caches represent single purposeful events that often can be dated and provide a perspective on exchange (Lattanzi 2013:170). Whether single or multiple sources are represented in a cache, or in composite items found in a cache (e.g., necklaces), could vary depending on how the copper objects were procured (directly or exchanged/traded for), the reason for a cache's creation, or the social context in which its creation takes place (cf. Lattanzi 2013:170-172). Objects gained through broad based exchange networks (*sensu* Stewart 1989) could reveal multiple or single sources of copper. Focused exchange (*sensu* Stewart 1989) or direct procurement might represent only a single source. Individuals contributing items to a cache might result in multiple copper sources being represented. Beads or other ornaments associated in a necklace or bracelet could represent a single source if both the beads/ornaments and necklace/bracelet were crafted by an individual. In contrast, multiple copper sources could be indicated if the beads/ornaments were collected through various means prior to being incorporated into a piece of jewelry.

These considerations make it difficult to evaluate sourcing data in the context of existing regional exchange models (e.g., Custer 1984b, c; Stewart 1989, 1994b, 2004) that operate on a more generalized level. Copper, like mica, shark's teeth, marine shell, catlinite, obsidian, and to some degree steatite, present difficulties in assessing how relevant objects were moving across the physical and cultural landscape. An examination of frequency distributions may not reveal patterning because of the rarity of the materials involved and in the case of copper, the lack of preservation in a wide variety of depositional contexts. Lattanzi (2013: Table 9.1) argues that copper caches with multiple sources, like most of those at Rosenkrans, could still be the result of individuals obtaining objects through broad-based exchange networks.

We should question whether highly valued or potentially symbolically charged objects are moving through down-the-line or broad based exchange networks, or accumulate in an area as result of hoarding by individuals (*sensu* Stewart 1989). Hand-to-hand exchange between group elites, ritual specialists, or shamans could be considered as a type of broad based exchange but its archaeological fingerprint would resemble focused exchange in not resulting in a frequency fall-off pattern emanating from a source or production area.

A detailed search of the regional literature would undoubtedly reveal the more frequent occurrence of fossils on sites than what is represented in Table 23. I suspect that such finds may be under-reported or simply considered as a component of the natural sediments in a deposit. As a result of my brief review I can point to only one radiocarbon dated example from a Late Woodland deposit at Smithfield Beach, 36Mr5. Fossils of probable Late Woodland or Contact period affiliation were found in pits 170, 186, and 218 at Bell Browning, 28Sx19 (Marchiando 1969:Table 3). Three fragments of crinoid stems, possibly used as beads, were recovered in excavations of the multicomponent Bevans rockshelter (Cross 1948:19). In the Lower Delaware Valley what are assumed to be collected fossils found on sites date at least to Late Archaic times (Mounier 2003:83-84).

Greater attention to the presence of fossils in archaeological deposits could contribute to the analysis of settlement movements in that fossil types can be linked with specific geological formations in the Upper Delaware and greater region (e.g., Wolfe 1977:Figure 3). Trilobites occur in the Hardyston (Wolfe 1977:43), a formation well known for its association with jasper deposits and Native American quarries in the region (e.g., Anthony and Roberts 1988). Given the attention given jasper by native toolmakers it would be interesting to see if trilobites are more well represented than other types of fossils in archaeological deposits, or if the frequency of their occurrence fluctuates with that of jasper. Emphasis on a particular type of fossil/geologic context might relate to the collection of tokens from culturally meaningful or ancestral landscapes (Claassen 2015:17). As Gavin Lucas (2005:88) and many anthropologists maintain, societies create traditions or a past in order to make the present seem natural or proper. Native encounters with fossils, especially those resembling some living analog ,or being in a group's mythology, may have been incorporated into an understanding of their world.

Shark's teeth have been the recipient of great attention given their connection with regional Middlesex, Delmarva Adena, Kipp Island, and Webb artifact and mortuary assemblages representing the Early, Middle, and initial Late Woodland periods (see summaries in Stewart 2017). Shark's teeth, especially fossilized ones of gigantic species, are material representations of a monster of the lower world (Romain 2009:80-81). No examples are known from radiocarbon dated contexts in the study area. North of the Rosenkrans site Charles Philhower excavated a probable Kipp Island/Point Peninsula burial consisting of a cremation associated with a bone comb, calcined bone fragments, two drilled shark's teeth, and a platform pipe of steatite (Carpenter 1950:313, Figure 101; Kinsey 1972:450; Kraft 2001:198). Trade in shark's teeth along the Atlantic seaboard is in evidence during the Late Archaic period (Betts et al 2012:637, Table 2). Trade in shark's teeth between the Middle Atlantic coast and the Ohio Valley seems evident during the Middle Woodland period (e.g., Lowery et al 2011).

Ochre has a dated history in the study area nearly as long as that of quartz crystals, beginning during the Middle Archaic period and still evident during historic times (see Table 23). The importance of color for aesthetic or symbolic reasons in the selection of materials or objects is infrequently addressed by archaeologists but worthy of consideration (e.g., Hamell 1983; Pietak 1998, 1999). An exception is the presumed symbolic connection between red ochre and life, which often involves the coating of human remains and grave goods. Ochre is found in five pits (117, 154, 170, 210, 228) at the Bell Browning site and are potentially Late Woodland in age given the presence of biface and pottery diagnostics (Marchiando 1969:Table 3. It is possible that some might date to historic times given the substantial evidence for Contact/Historic components on this site (see Table 23).

Red ochre in association with Contact/Historic period burials is well attested at 28Sx48. Powdered ochre is part of undated burial 15 at the Zimmerman site (Werner 1972:Table 1).Two of the Contact/Historic pits with which ochre is associated at Bell Browning were assigned dates based on the analysis of the bore diameters of a very small sample of kaolin pipe stems: Pits 202 and 203 = 1750 to 1800 AD; Pit 220a = 1620 to 1680 AD (Marchiando 1969:76-77, Table 5). During historic times the Delaware were observed using paint on their faces, breasts thighs, and legs (Newcomb 1956:27).

Possible sources of ochre occur in Sussex and Warren counties, New Jersey where it was mined historically (Hunter et al 2001; New Jersey State Centennial Board 1877: 287-289). The principal ochre/ocher belt in eastern Pennsylvania is a comparatively narrow strip extending from Reading to Allentown in Lehigh County (Stoddard and Callen 1910:424), to the west of occurrences in Warren County, New Jersey. Of interest is its co-occurrence with clays that are plastic and vary in color from white to brown with red and purple hues also observed (Stoddard and Callen 1910:424). A number of these historically known ochre sources would fall within a foraging radius of the native sites on which ochre is found.

Catlinite is a metamorphosed claystone with sources in Minnesota (e.g., Drooker 2004:78; Holmes 1919:253-264; Sigstad 1970). Drooker (2004:78) notes that catlinite has been used generically to refer any fine grained red claystones and related metamorphic rocks with sources in Minnesota, Wisconsin, and southeastern Ohio to name some examples. Catlinite seems to be the ubiquitous term used by Middle Atlantic archaeologists to refer to what seems to be a visually distinctive material (e.g., Kent 1984:165-171). I continue that usage here for lack of more precise characterizations of the relatively few artifacts of the material discovered in the study area. Examples are depicted in Figure 68.

Catlinite unequivocally appears in Contact/Historic period contexts (see Table 23). Leslie (1973:112) asserts that native trade brought the material into the Upper Delaware from sources in Minnesota between the late 1600s and early 1700s. He contends, without citations, that the peak of the catlinite trade occurred from 1700-1720 AD (Leslie 1968:126). The calumet style pipe shown in Figure 68 is alleged to have been made with steel tools, as were other catlinite artifacts found in the Upper Delaware (Leslie 1968:126). Documentary evidence indicates Delaware Indian use of catlinite pipes at least by 1712 AD (Kent 1984:170). It is possible that catlinite artifacts are making their way into the Upper Delaware via interactions with groups in western New York, as Kent (1984:166-171) argues for the Susquehanna Basin.

Catlinite beads are found at the Schultz site located in the Lower Susquehanna Valley and dated circa 1575 to 1600 AD (Kent 1984:167). Also in the Lower Susquehanna, excavations at the Strickler site (circa 1640 to 1665 AD) produced a prowled calumet type pipe of catlinite (Kent 1984:22-23, 167-168, Figure 31). Susquehanna Valley finds also date to the 18th century (Kent 1984:169). Catlinite is most commonly employed from the 14th century AD onward in the broad region surrounding sources (Drooker 2004:78). While it remains a possibility that catlinite artifacts could be found in late prehistoric contexts in the Upper Delaware and broader valley they are more likely to be associated with deposits of the 17th and 18th centuries.

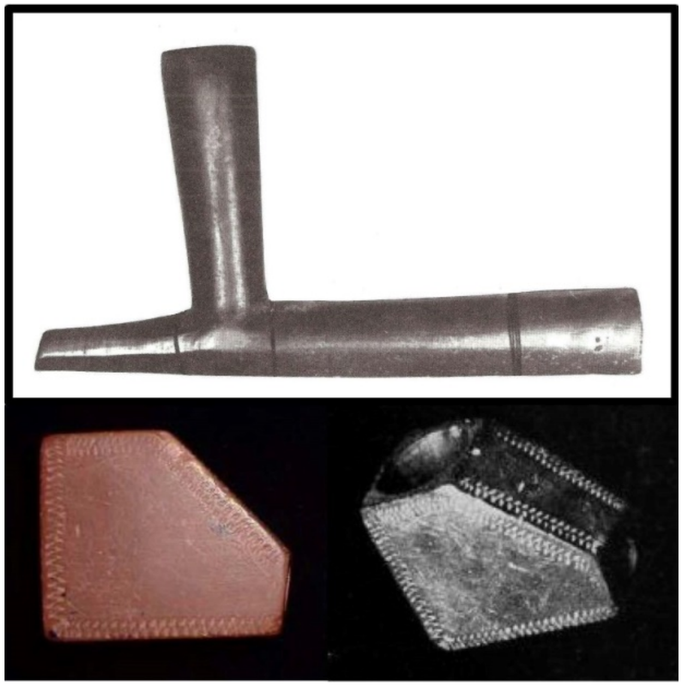


FIGURE 68. Catlinite pipes from the Upper Delaware. Top: pipe found at the Davenport site during the early 20th century; modified from Leslie (1973:Plate LIX); pipe is 17.2 cm long. Bottom: two views of pipe found in a field north of the Munsee Cemetery, 28Sx48; left image courtesy of Dustin Cushman; right image modified from Heye and Pepper (1915:Plate XXIII); the base of the pipe is approximately 4.2 cm long.

Shell beads were not explicitly tracked as part of the current project but one type bears discussion from at least a chronological perspective. These are runtee/disk-shaped and animal form ornaments crafted from marine shell. They are well represented in the burials excavated by Heye and Pepper (1915) at the Munsee Cemetery and are frequently in association with items of European manufacture. Ornaments in the shape of animals are illustrated in Figure 69 and were associated with skeletons 10, 18, 30, 53, and 59 (Heye and Pepper 1915:21-23, 25, 28, 29). In the case of skeleton 30 it is clear that the bird ornament is part of a necklace also involving glass beads. This seems to be the case with a number of the other runtee/disk and animal ornaments.

Esarey (2013) mounts a very compelling case for the intensive production of these types of beads/ornaments by Euro-American craftsmen explicitly for use in trade with Native Americans throughout the Eastern Woodlands. Referred to as Standardized Marine Shell ornaments (SMS) they are part of a Dutch-related industry that lasts from roughly 1635 to 1710 AD. The ornaments were typically incorporated into necklaces with other Euro- and Native-made beads. Munsee affiliated sites are considered to exist within the core area of SMS ornament trade (Esarey 2013:91). Iroquoian related sites, especially those of the Seneca, possess a substantial percentage of the SMA ornaments accounted for in Esarey's research. Given the obvious interactions of Upper Delaware folk with groups in central, northern and eastern New

York, it is possible that native-to-native trade could account for the presence of some of these artifacts in the study area.

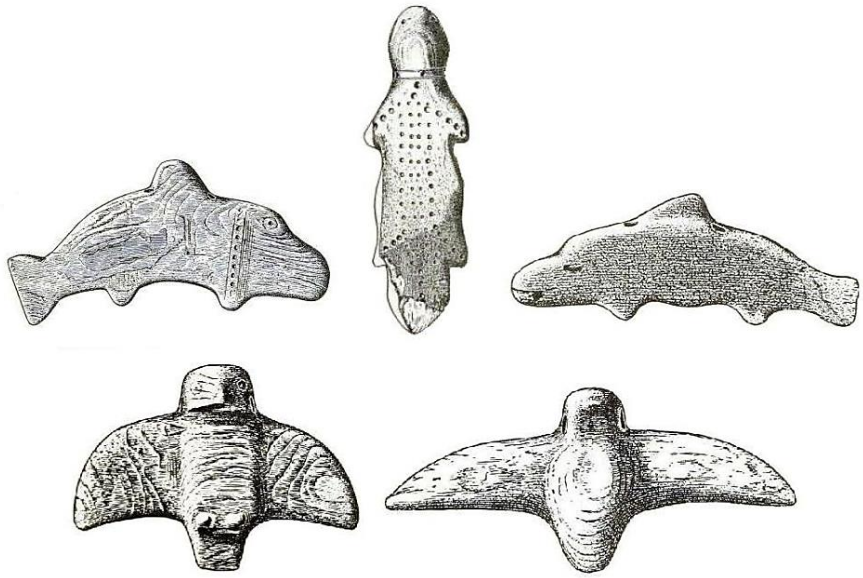


FIGURE 69. Examples of marine shell ornaments from the Munsee Cemetery, 28Sx48, associated with European artifacts in Contact/Historic period graves. Compiled and modified from Heye and Pepper (1915:Figures 14, 17, 15, 10, 11). Images not to scale.

Table 24 summarizes Esarey's (2013:Table 8.1) probable date ranges for the types of SMS ornaments that have been found in the study area. A detailed analysis of the glass bead types found in the graves with these ornaments at 28Sx48 could aid in the refinement of these age estimates. Downriver in the Trenton area, geese and owl forms of SMS ornaments are associated with a Native cemetery on Biles Island (Stewart 2017:194, 196, Table 10, Figure 3; Veit and Bello 2001:Figure 4). Veit and Bello (2001:53) draw comparisons with similar beads found on Seneca sites in upstate New York where they date from 1630 to 1675 AD.

TABLE 24
SUGGESTED DATE RANGES FOR STANDARDAIZED MARINE SHELL ORNAMENTS FOUND IN THE UPPER DELAWARE VALLEY*

Standardized Marine Shell Ornament Type	Assigned Beginning Date	Earliest Terminal Date	Assigned End Date
Runtee Disk	1645 AD	1649 AD	1710 AD
Owl	1650 AD	1650 AD	1690 AD
Beaver	1650 AD	1650 AD	1710 AD
Runtee Circuloid	1650 AD	1655 AD	1710 AD
Triangle, vertically drilled	1655 AD	1650 AD	1690 AD
Fish	1660 AD	1663 AD	1710 AD

*Abstracted from Esarey (2013:Table 8.1).

Mica is another material whose chronology of use could be examined more closely in the future, especially given its importance to Middle and Late Woodland cultures in the Lower

Delaware Valley, and earlier cultures in the Middle Atlantic and adjacent regions (Boulanger et al 2017; Stewart 1989, 2017). Boulanger et al (2017:Figure 1) map and discuss a variety of sources of mica of potential relevance to the study area. Additional sources are noted in French (1968:Table 113), Geyer et al (1976), Holmes (1919:241-252), and Leasure and Shirley (1968). A formally mined source of mica is located in Warren County, New Jersey, west of the town of Harmony (Vermeule 1959:Sheet 24, 11-9, 12-7).

Burnt mica was recovered from a burial at 28Sx48 along with blue glass beads indicating an internment of the Contact/Historic period (Heye and Pepper 1915:16-17). Tubular shell beads and two SMS ornaments, possibly of a hawk or eagle, also were associated. Historically, the Delaware believed that mica chips are the scales of the horned serpent and other horned hairy snakes, and kept chips in medicine bags (Harrington 1910:Figure 33). When they wish for rain, the Delaware expose the scales and rain medicine, believing the sight of mica would incite the thunder beings to call up thunderclouds (Harper 1999:36 cited in Claassen 2015). Newcomb (1956:63) mentions Delaware rain-making with a scale from the mythical horned serpent but does not reference the use of mica. How might Delaware beliefs concerning mica affect the use of landscapes associated with, or located near sources of this material?

Although I have not included unusual lithic materials in this chapter finds of obsidian in the study area cannot escape mention. An obsidian biface in direct association with a fully grooved axe was found in an undated context at the Rockelein I site (Dumont et al 1974:17). The recoveries were made at a depth of 34 inches below the surface. The fully grooved axe suggests that the context may be Late Archaic in age. A corner notched obsidian point of unknown age is attributed to a collection made long ago in the area of Easton, Northampton County, Pennsylvania (Dillian et al 2006:42, Figure 1, 2010:Table 1). Schrabisch (1915:8, 26, 47, 63) notes the occurrence of obsidian in artifact collections representing sites near Lafayette and Middleville, Sussex County, New Jersey. One is one the east bank of the Paulins Kill and the “Indian Spring” near Lafayette. Two other sites producing obsidian artifacts art situated along Trout Brook near Middleville.

Dillian and colleagues (2006, 2007, 2010) have verified finds of obsidian artifacts from Delaware Valley and Middle Atlantic region localities and sourced a sample of 19 using X-ray florescence for distinguishing trace elements. The notched point from the Easton area sourced to Glass Buttes, Oregon. Two artifacts of unknown age from Hunterdon County, New Jersey were linked with deposits at Black Rock, Utah, and undated artifacts from the Lower Delaware Valley connect to possible sources in Oregon, California, and New Mexico (Dillian et al 2010:Table 1). Sources represented by artifacts found on Hopewell related sites in the midwest are limited in geographic scope in contrast to Middle Atlantic artifacts representing obsidian sources that are over 1500 km distant from one another, and 3000 km from the sites where the artifacts are found (Dillian et al 2007:99-100).

Placing these occurrences in the framework of existing models of exchange is problematic. Obsidian artifacts are well represented in deposits linked with Hopewell and Mississippian artifact assemblages in the midwest (Dillian et al 2007:93). Their rarity in the Middle Atlantic region suggests that they were not highly valued items deliberately sought (Dillian et al 2010:32). A system of casual exchange, in which objects were passed between individuals as gifts, unstructured trades, or heirlooms is proposed as a mechanism for the movement of obsidian artifacts into the region (Dillian et al 2010:32).

V. Faunal Remains

Table 25 presents faunal remains associated with dated contexts. As with other categories of artifacts, the table could be expanded through a listing of remains associated with chronologically diagnostic artifacts in a deposit. It is no surprise that the greatest number of dates relate to the late Middle and Late Woodland periods if preservation factors and site formation processes are considered. What is not tracked in the table are dated occurrences of calcined bone that could not be identified in any meaningful way. These would reveal more examples of faunal remains pre-dating Middle Woodland times. Examples of faunal remains found in features associated with European or colonial artifacts, but not radiocarbon dated, are included at the end of the table; the listing of such cases is not comprehensive.

TABLE 25
RADIOCARBON DATES ASSOCIATED WITH FAUNAL REMAINS

Faunal Remains	Date BP	Calibrated* 2 Sigma Age BC/AD	Calibrated* Median Age BC/AD	Site and Context	Reference
fish	10,940+/-90 Beta 101935 10,900+/-40 Beta 127162 10,590+/-300 W-2994	11,068-10,750 BC 10,877-10,752 BC 11,112-9646 BC	10,877 BC 10,810 BC 10,427 BC	36Mr43, Shawnee Minisink, Kline hearth feature, southwestern portion of site	Kline 1985:18-19, Figure 2.3; Gingerich 2013a:Tables 9.8, 9.11; McNett et al 1985:3, 6; Dent 2002, Dent 2002:Table 1; Dent 2007:Table 7.1, Figure 7.2; Kraft 1975b:Table 11
deer (*Odocoileus virginianus*), turkey (*Meleagris gallopavo*), wood turtle (*Glyptemys insculpta*)	4450+/-130 I-4837	3520-2868 BC	3147 BC	10 Mile River Rockshelter, Sullivan County, NY, associated with dated deposit	Funk 1989:39-40, 47, Figure 6, Table 5
fox (*Vulpes sp.*)	3600+/-40 Beta 266909	2044-1877 BC	1959 BC	28Wa290, Unit 110, Context 30	Lee et al 2010: 4-41, Appendix C
dog/wolf (*Canis sp.*), turkey (*Meleagris gallopavo*), elk (*Cervus canadensis*), long tailed weasel (*Mustela frenata*), turtle (possibly *Terrapene carolina*)	2560+/-120 Y-1384 2400+/-60 DIC-407	930-397 BC 756-679 BC 671-603 BC 600-390 BC	665 BC 515 BC	28Sx2, Rosenkrans, associated with dated burial cluster	Kraft 1976a:23, 25, 31, 35
deer (*Odocoileus virginianus*)	1440+/-30 Beta 355783	568-654 AD	617 AD	36Pi4, Block 2, Feature 10 as exposed and excavated on Raymondskill Creek bank	Stewart et al 2015:Tables 17, 56
unidentified shell	1440+/-30 Beta 355783	568-654 AD	617 AD	36Pi4, associated with dated component	Stewart et al 2015:Tables 17, 58
clam, unidentified shell	1230+/-100 Beta 35558	644-996 AD	802 AD	Chenango Point South (SUBi-2776), Feature 1/101, Broome County, NY	Miroff 2012:Table 4.3, Appendices IV, IX

Table 25 Continued					
Faunal Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site and Context**	**Reference**
mackerel shark (order *Lamniformes*), raccoon (*Procyon lotor*), unidentified fish	1160+/-120 Y-2475	650-1050 AD	863 AD	36Pi13A, Faucett, Pit 84, part of dated component	Kinsey 1972:192, 196 1975:28
deer (*Odocoileus virginianus*)	880+/-70 Sample 961, no lab # reported	1026-1261 AD	1146 AD	36Nm15, Padula, Feature 1B	Doershuk 1994: 307, 311,323, Figure 14.17; Bergman et al 1994:4; Weed et al 1990:152
mussel (*Elliptio complanata*)	790+/-80 Beta 266108	1038-1306 AD	1220 AD	28Sx29, Bell Philhower/Ahaloking, infant burial pit	Stewart and Bitting n.d.; New Jersey State Museum collections
unidentified mammal, fish, bird (*Aves*), turtle	780+/-110 Beta 57129	1027-1330 AD	1220 AD	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 2	Alterman 1993:Table 1, 21-23
deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), raccoon (*Procyon lotor*), turtle (unspecified)	730+/-60 DIC-383	1180-1323 AD 1346-1393 AD	1272 AD	28Sx48, Minisink, Feature R-F48	Kraft 1978:89, Table 4
deer (*Odocoileus virginianus*), black bear (*Ursus americanus*), bird (*Aves*), bony fish (*Osteichthyes*), mussel (*Unio sp.*), sunfish/black bass/crappies (*Centrarchidae*)	690+/-30 Beta 378840	1266-1312 AD 1358-1387 AD	1291 AD	Otsiningo Market Site (SUBi-3041), Feature 10C, Broome County, NY	Miroff 2014:101, Table 8, Appendix V, Table A5-10
deer (*Odocoileus virginianus*)	690+/-50 DIC-2782	1246-1332 AD 1337-1398 AD	1301 AD	28Wa580, Pit 11-83	Staats 1986a:28
deer (*Odocoileus virginianus*), toads/frogs (*Anura*), frog (*Rana sp.*), dog (*Canis sp.*), perches (*Percidae*), bony fish (*Osteichthyes*), mussel (*Unio sp.*), snail	670+/-30 Beta 379672	1274-1319 AD 1351-1391 AD	1309 AD	Otsiningo Market Site (SUBi-3041), Feature 1, Broome County, NY	Miroff 2014:100-101, Table 8, Appendix V, Table A5-1
unidentified shell	640+/-70 Beta 42902 260+/-60 Beta 42903	1262-1423 AD 1460-1692 AD 1728-1811 AD	1342 AD 1637 AD	36Mr5, Smithfield Beach/Pardee, Feature 122	Hennessy 1992:306, 308, Appendix A
mussel (*Unio sp.*), box turtle (*Terrapene sp.*), deer (*Odocoileus virginianus*), gray fox (*Urocyon cinereoargenteus*), bird (*Aves*)	630+/-105 DIC-1355 550+/-135 DIC-1356	1169-1460 AD 1210-1650 AD	1341 AD	28Sx5, Medwin North, Feature 1	Williams et al 1982: 20, Tables 2, 4, 7
deer (*Odocoileus virginianus*), pig (*Sus scrofa*), unidentified shell	600+/-30 Beta 309043	1297-1373 AD 1377-1408 AD	1346 AD	Chenango Point South (SUBi-2776), Feature 180, Broome County, NY	Miroff 2012:Table 4.3, Appendices IV, IX
deer (*Odocoileus virginianus*), toad/frog (*Anura*), frog (*Rana sp.*), bird (*Aves*), dog (*Canis sp.*), carnivore (*Carnivora*), water and	600+/-30 Beta 378839	1297-1373 AD 1377-1408 AD	1346 AD	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY	Miroff 2014:100-101, Table 8, Appendix V, Table A5-5

Table 25 Continued					
Faunal Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site and Context**	**Reference**
box turtles (*Emydidae*), bony fish (*Osteichthyes*), perches (*Perciformes*), mussel (*Unio sp.*), Eastern box turtle (*Terrapene carolina*), black bear (*Ursus americanus*), suckers (*Catostomidae*), sunfish/black bass/crappies (*Centrarchidae*), catfish (*Ictaluridae*), mice (*Peromyscus sp.*), squirrels/chipmunks (*Sciuridae*)	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY continued				
deer (*Odocoileus virginianus*), elk (*Cervus canadensis*)	570+/-55 DIC-384	1295-1433 AD	1356 AD	28Sx48, Minisink, Feature R-F183	Kraft 1978:89, Table 4
saltwater conch (*Busycon canaliculatum*), mussel (*Elliptio complanatus*)	550+/-80 Y-2338	1276-1483 AD	1375 AD	36Pi25, Kutay, Feature 75	Kinsey 1972:253, 255, Table 9
deer (*Odocoileus virginianus*), box turtle (*Terrapene carolina*), turkey (*Meleagris gallapavo*), bobcat (*Lynx rufus*)	550+/-80 Y-2338	1276-1483 AD	1375 AD	36Pi25, Kutay, associated with dated component	Kinsey 1972:251, 255
unidentified shell	550+/-40 Beta 227479	1304-1365 AD 1384-1438 AD	1388 AD	36Pi4, Block 2, Unit 51, Feature 49	Stewart et al 2015:Tables 17, 84
deer (*Odocoileus virginianus*), deer family (*Cervidae*), toad/frog (*Anura*), vulture (*Cathartes sp.*), mussel (*Unio sp.*), bird (*Aves*), bony fish (*Osteichthyes*),	550+/-30 Beta 309044	1312-1358 AD 1387-1432 AD	1395 AD	Chenango Point South (SUBi-2776), Feature 275, Broome County, NY	Miroff 2012:Table 4.3, Appendices IV, IX
deer (*Odocoileus virginianus*), elk *(Cervus canadensis*), possible box turtle (*Terrapene sp.*)	540+/-100 Y-2473	1269-1523 AD	1391 AD	36Pi13A, Faucett, part of dated component	Kinsey 1972:195, 1975:22, 28
deer (*Odocoileus virginianus*), possible coyote (*Canis sp.*), toads/frogs (*Anura*), even-toed ungulate (*Artiodactyla*), dog (*Canis sp.*), bony fish (*Osteichthyes*), pig (*Sus scrofa*), snail, mussel *Unio sp.*), bird (*Aves*), carnivore (*Carnivora*), suckers/minnows (*Cypriniformes*), catfish (*Ictaluridae*), perches (*Percidae*),	540+/-30 Beta 332933 300+/-30 Beta 309042	1316-1354 AD 1389-1436 AD 1490-1602 AD 1612-1654 AD	1403 AD 1563 AD	Chenango Point South (SUBi-2776), Feature 176, Broome County, NY	Miroff 2012:124-125, Table 4.3, Appendices IV, IX
deer (*Odocoileus virginianus*), turtle (*Testudines*)	520+/-80 Beta 62436	1282-1519 AD	1403 AD	36Pi21, Peters-Albrecht, Feature 4, Catalog No.43	Wall and Botwick 1995a:163, 168, 233, 1995b:Appendix VI

Table 25 Continued					
Faunal Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site and Context**	**Reference**
mussel (*Elliptio complanata*), fish (*Centrarchid*)	500+/-40 Beta 265509 1170+/-40 Beta 265509 assay based on mussel shell	1391-1454 AD	1422 AD	Depue Island 36Mr45 Kline pit feature	Stewart and Bitting n.d.; Stinchcomb et al 2011
deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*)	460+/-50 DIC- no number reported	1394-1521 AD	1442 AD	28Sx48, Minisink, Feature R-F485	Kraft 1978:90, Table 4
mussel (*Elliptio complanata*)	440+/-40 Beta 265507 740+/-40 Beta 265506 assay based on mussel shell	1410-1519 AD	1451 AD	36 Pi33, McCann #1&2, Pit 19	Stewart and Bitting n.d.; Stinchcomb et al 2011
beaver (*Castor canadensis*)	430+/-40 Beta 251444	1414-1521 AD 1590-1624 AD	1459 AD	Site ORA-0550, Feature 42, Orange County, NY	Pretola and Freedman 2009:233, Table 84
mussel (*Unionidae sp.*), fox (*Vulpes/Urocyon*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethicus*), turkey (*Meleagris gallapavo*), catfish (*Ictaluridae*), fish	400+/-40 Beta 251447	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 120, Orange County, NY	Pretola and Freedman 2009:239-240, Table 84
red or gray fox (*Vulpes vulpes* or *Urocyon cincreoargenteus*), bobcat (*Lynx rufus*), turkey (*Meleagris gallapavo*), mussel (*Unionidae sp.*), catfish (*Ichtluride*), pike/pickerel (*Esocidae sp.*), chain pickerel (*Esox niger*), unidentified small and large mammal	400+/-40 Beta 251449	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 152, Orange County, NY	Pretola and Freedman 2009:240-241, Table 84
turtle, deer (*Odocoileus virginianus*), catfish (*Ictaluridae*), unidentified small and medium mammal	380+/-40 Beta 251448	1442-1529 AD 1543-1634 AD	1512 AD	Site ORA-0550, Feature 132, Orange County, NY	Pretola and Freedman 2009:235, Table 84
deer (*Odocoileus virginianus*), turtle	370+/-40 Beta 251442	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 26, Orange County, NY	Pretola and Freedman 2009:232-233; Table 84
eastern box turtle (*Terrapene carolina*)	370+/-40 Beta 251445	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 68, Orange County, NY	Pretola and Freedman 2009:234; Table 84
turtle, rodent, beaver (*Castor canadensis*), unidentified small and large mammal	370+/-40 Beta 251446	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 74, Orange County, NY	Pretola and Freedman 2009:234, Table 84

Table 25 Continued					
Faunal Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site and Context**	**Reference**
mussel (*Elliptio complanata*)	370+/- 40 Beta 265508 1380+/-40 Beta 266401 assay based on mussel shell	1446-1530 AD 1539-1635 AD	1524 AD	36Pi13A, Faucett, Feature 207	Stewart and Bitting n.d.; Stinchcomb et al 2011; Moeller 1992
raccoon (*Procyon lotor*), unidentified mammal	340+/-40 Beta 251450	1462-1642 AD	1556 AD	Site ORA-0550, Feature 106, Orange County, NY	Pretola and Freedman 2009:241-242, Table 84
unidentified shell	330+/-70 Beta-62434	1437-1669 AD	1560 AD	36Pi21, Peters-Albrecht, Feature 1	Wall and Botwick 1995a:159, 167-168, 1995b:Appendix I, VI
unidentified shell	300+/-30 Beta 309040	1490-1602 AD 1612-1654 AD	1563 AD	Chenango Point South (SUBi-2776), Feature 46, Broome County, NY	Miroff 2012:Table 4.3, Appendices IV, IX
cow (*Bos sp.*), pig (*Sus scrofa*)	270+/-30 Beta 309041	1515-1597 AD 1617-1668 AD	1632 AD	Chenango Point South (SUBi-2776), Feature 90, Broome County, NY	Miroff 2012:Table 4.3, Appendices IV, IX
deer (*Odocoileus virginianus*)	260+/-60 Beta-no lab # reported	1460-1692 AD 1728-1811 AD	1637 AD	Otego Yard Site (NYSM 121), Feature 21, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 34
unidentified shell	150+/-60 Beta 42909	1663-1895 AD 1903-1950 AD	1798 AD	36Mr5, Smithfield Beach/Pardee, Feature 121	Hennessy 1992:303, 305, Appendix A
mussel (*Elliptio complanata*), deer (*Odocoileus virginianus*), fish, elk *(Cervus canadensis*), bird (*Aves*), turtle	European artifact associated	Contact-Historic	Contact-Historic	36Pi13A, Faucett, Feature 269	Kinsey 1972:195; Moeller 1992:64
mussel (*Elliptio complanata*), elk *(Cervus canadensis*)	European artifacts associated	Contact-Historic	Contact-Historic	28Sx29, Ahaloking High Bank Pits 1-5 (Munsee Cemetery)	Stewart and Bitting n.d.; New Jersey State Museum Collections
mussel *(Unio sp.*)	European artifacts associated	Contact-Historic	Contact-Historic	Bell-Browning north field, 28Sx19. Pit 220A	Marchiando 1969:54, Table 3
mussel *(Unio sp.*)	European artifacts associated	Contact-Historic	Contact-Historic	Bell-Browning north field, 28Sx19. Pit 242	Marchiando 1969:61, Table 3
mussel *(Unio sp.*), deer (*Odocoileus virginianus*), turtle	European artifact associated	Contact-Historic	Contact-Historic	Davenport, 28Sx27, Pit #8	Leslie 1968:128

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas ranging from .90-1.00.

Dated Late Pleistocene/Early Holocene fauna, with mastodon predominating, are known for the Upper Delaware and adjacent areas (Kraft 2001:Figure 3.10) but associations with Paleoindians have rarely been demonstrated. Mastodon remains found at Marshall's Creek, Monroe County, Pennsylvania have been AMS dated to 11,410+/-30 BP (Boulanger et al 2015:191) but have no association with human activity. A stag moose from Mount Hermon, Warren County, New Jersey is most reliably dated to 10,370+/-40 BP (Boulanger et al 2015:190). This find also cannot be related to any human activity. In general, the age range of megafaunal occurrences overlaps that of the Paleoindian presence in the Delaware Valley and broader region (e.g.. Boulanger 2015; Boulanger and Lyman 2014:Table 1; Crowl and Stuckenrath 1977; Custer 1996:99; Pretola and Freedman 2009:Table 2).

Early excavations of the Fairy Hole rockshelter (28Wa25) recovered the remains of giant beaver recently AMS dated to 11,140+/-30 BP. Their association with artifacts in the shelter, including a fluted point, is not clear (Boulanger et al 2015:191; Cross 1941:143-152; Parris 1983; Parris and Case 1980). The possible association of Paleoindian artifacts with a variety of Pleistocene fauna in the Dutchess Quarry Caves of Orange County, New York is disputed (cf. Funk et al 1969; Funk and Steadman 1994; Steadman et al 1997). Undated and likely Pleistocene-aged remains of giant beaver, peccary, Woodland caribou, and bison are noted for Hartman's Cave near Stroudsburg, Monroe County, Pennsylvania (Leidy 1889; Mathews 1886:1045-1047; Mercer 1894).

The "black dirt" area is the remnant of extensive wetlands and peat deposits that developed in the former basins of glacial lakes in the Wallkill River Valley of portions of Sussex County, New Jersey and Orange County, New York (Connally and Sirkin 1970; Freedman 2009; Funk 1992:28; Pretola and Freedman 2009:128-171; Witte 2011). A variety of Pleistocene megafauna have been documented in the area (e.g., Pretola and Freedman 2009:Table 2). Vesper and Gramly (2016) report 66 finds of proboscideans from Orange County, New York. Their Bowser Road Mastodon excavation represents the most recent of such finds. A group mean of radiocarbon dates from the same tusk run by three different labs is 11,027+/-54 BP. The authors present evidence that the remains have been butchered by humans. Hammerstones and a few chipped stone tools are in association and a variety of ivory and bone tools are identified. They argue that the numerous rib bone atlatls from the site have been ritually broken (also see Gramly et al 2017).

The large number of mastodon finds that date to Paleoindian times and the few documented instances of predation by humans may represent the infrequent social or ritual role of megafauna hunting in Paleoindian cultures (Vesper and Gramly 2016:6). This follows an argument laid out by Speth and colleagues (2013) largely based on ethnographic observations of big game hunting in hunting and gathering cultures. They suggest that the primary purpose of big game hunting was not to provide subsistence (a secondary result), but was pursued for other social or political goals such as the garnering of prestige or the maintenance of social position (Speth et al 2013:113, 125-129). In the ethnographic examples that they highlight, big game hunting is not as cost effective as gathering or the hunting of small game; big game hunting was "possible because it was underwritten by the availability of other productive, dependable, and cost-effective food sources" (Speth et al 2013:128). The prestige of the big game hunter(s) accrues from the skill involved but also from the fact that the kill is of sufficient size to allow it to be widely shared within the community. This provides a provocative perspective on the paucity of megafaunal remains in regional Paleoindian deposits, and a more nuanced view of subsistence practices that are characterized as generalized (cf. Custer 1996:97-131; Dent 1985a; Gardner 1989).

Of related interest are stories historically known to the Lenape/Delaware regarding mammoths/mastodons (Bierhorst 1995:30, abstract 8, 39, abstract 47). In the legend of the Yáh Qúa W'hee, mastodons make war on other animals and the Great Spirit decides that they must be annihilated. Men and animals align against the mastodons in a great battle resulting in "so much blood that the mastodons became mired, sank, and died" (Bierhorst 1995:39). Later in the story it is noted that "today the mastodons' bones are found in the marshes" (Bierhorst 1995:39). The black dirt area of Sussex and Orange counties and numerous associated proboscidean finds are readily brought to mind by this story.

Early dates for fish as well as botanical remains at the Shawnee Minisink Site (see Table 25) are notable for influencing regional discussions regarding the broadness of Paleoindian subsistence practices. That hunting is at least the cultural, if not caloric focus of Paleoindian subsistence is certainly suggested by the nature of the preserved toolkit. Technologies that are absent from regional Paleoindian assemblages also hint at the relative importance of hunting. In an analysis of ethnographic data for foraging societies Waguespack (2005) points out that when meat/hunting is emphasized, plant use involves resources that do not require major investments of labor in procurement and processing, or the creation of related tools and implements. The non-specialized use of plants by Paleoindians might therefore be inferred from the lack of milling equipment, and the rarity of fire altered rock that might have been employed in hot rock cooking in earth ovens or watertight containers.

Although not directly dated, residues on diagnostic bifaces/projectiles provide evidence of faunal resources used during the Early, Middle, Late, and Transitional Archaic, periods of time that are not well represented in Table 25. At the Treichlers Bridge Site (36Nm142) a Decatur point tested positive for deer. Lecroy bifurcates tested positive for deer and dog antisera, and St. Albans bifurcates tested positive for rabbit and deer antisera (Anderson et al 2000:7-88; Newman 2000:Tables 3, 4). Deer antiserum could relate to all species of deer, elk, moose, caribou, or pronghorn antelope; dog antiserum could relate to coyote, wolf, fox, or dog; and rabbit antiserum could relate to rabbit, hare, or pika (Newman 2000:Table 3). Lamoka-Lackawaxen bifaces from 36MR119 tested for residues reacted positively to guinea pig (which could represent beaver, porcupine or squirrel) and deer (Hornum et al 2009:56). At 36Mr133 a number of biface types reacted to antisera during residue analysis: Brewerton side notched points tested positive for guinea pig and chicken (which could represent quail, turkey, grouse, and all gallinaceous fowl); a Normanskill biface tested positive for guinea pig and bear; a Lackawaxen biface tested positive for deer; and Orient Fishtails tested positive for guinea pig and bear (Hornum et al 2009:76-79; Parr 2006). An Otter Creek-like projectile tested positive for deer antiserum at 36NM204 (Hornum et al 2009)

On the basis of recoveries from dated contexts, deer, turkey, turtle, and fish have a long, and not unexpected history of use in the Upper Delaware and beyond. Given the symbolic importance to later Lenape/Delaware peoples of turkey, turtle, and other animals, (e.g., Bierhorst 1995) there seems not to have been any culture-wide food taboos regarding them. Rabbit and ground hog, however, do seem to have been avoided (Kraft 2001:266; Newcomb 1956:20). Both of these animals are missing in the dated contexts of Table 25 and are rare or absent in archaeological deposits in general. Marchiando (1972:158) associates rabbit with the Contact/Historic period component at the Bell Browning Site (28Sx19).

Although a longstanding component of the ancient environments of the area, bear first appears in a dated Late Woodland context (730+/-60 BP) and only sporadically afterwards (see Table 25). Bear has been found in Middle and Late Woodland contexts that have not been radiocarbon dated (e.g., Marchiando 1969:18, 20, Table 3; Stewart 2005). Finds most typically involve teeth or claws. The presence of bear residue on biface types (Normanskill and Orient Fishtail) typically assigned to a Late/Transitional Archaic time frame suggests the probable impact of preservation factors on the representation of macro-remains. The contents of 84 rockshelters and caves documented by Schrabisch (1915, 1917, 1930) frequently (over 78%) included faunal remains. This may reflect depositional environments where bone or shell is more likely to survive than on open sites. However, bear is found only in three of the rockshelters - Buckskin Cave, Otter Brook Upper Shelter, and Lower Rock Run Shelter. The implication is that preservation factors alone may not fully explain the rarity of bear bone in faunal assemblages.

Historically, bear flesh figures as part of ceremonial feasting and as a sacrifice to corn (Newcomb 1856:67; Speck 1937:30-43; Tantaquidgeon 1977:55; Witthoft 1949:14). A number of Lenape stories reveal a close relationship between bears and humans (Bierhorst 1995:41–abstract 52; 43-abstract 60; 49-abstract 87; 56–abstracts 115, 116; 57-abtracts 121, 122). Kraft (2001:265) notes that in order to not offend “Grandfather” bear “some tribes carefully disposed of a bear’s bones and did not allow dogs to gnaw on them”. Could the cultural status of bears account for the disposal of their skeletal remains in such a way as to be under-represented in the archaeological record?

In an analysis of ethnohistoric and ethnographic data for native peoples of the Northeastern Woodlands, Harper (1999:176) comments that the disposal of animal remains could be dependent on the animal’s species, age, or specific body part. If appropriate procedures were not followed “the animals, animal spirits, and manitou-beings, including game keepers, would become offended and the animal would not let themselves be taken in the future” (Harper (1999:176). Among central and northern Algonkians the bear is given special treatment. Bones are cleaned and deposited in running water with the skull being hung in a tree (Harper 1999:178-179 citing the work of Skinner 1921).

What was targeted, the technology involved, the dietary contribution, and the social interactions that fishing promoted have undoubtedly changed through time (Stewart 1999). The association of netsinkers with a dated component at the Rockelein Site (7520+/-120 BP), and with a component characterized by bifurcated-base points are suggestive of fishing (Dumont and Dumont 1979:46, 50). Such implements are not part of the Paleoindian deposits at Shawnee Minisink which included fish remains. Their presence at Rockelein in what would be a Middle Archaic time frame could be an indication that the importance of fish had increased relative to earlier times.

The Tache´ and Craig (2015) study examining residues on Vinette I pottery employing carbon and nitrogen isotope analysis, and the analysis of lipids using gas chromatography mass spectrometry (GC-MS) and GC-combustion-isotope ratio MS (GC-C-IRMS) was reviewed in Chapter 3. Samples from the Zimmerman and Minisink sites were among those tested which as a group indicated that aquatic resources were selectively being processed in the pots (Tache´ and Craig 2015:185).

Dated occurrences of fish, including shellfish, become more frequent by 1440+/-30 BP in the Upper Delaware, although indirect evidence for fishing/shell fishing suggests that it gains in importance throughout the Middle Atlantic region during the Late Archaic/Transitional Archaic period (e.g., Custer 1988; Moeller 2015; Wall et al 1996; Waselkov 1982). Fish remains occur in a number of undated Late Woodland features in the Sussex County, New Jersey portion of the drainage basin, frequently along with collared forms of pottery. Puniello (1994) argues that the use of fish increases through the Late Woodland period.

Kraft (2001:269) underscores the importance of fish during the Late Woodland period by noting the thousands of notched rocks interpreted as netsinkers that have been found on area sites. Fishing with a line and hook appears to be rare during pre-Contact times given the rarity of bone fishhooks in archaeological deposits of the Upper Delaware (cf. Budinoff 1983b:4-200; Leidy 1889:7-8, Plate 1 Figure 6; Schrabisch 1915). References to time in a 1772 Delaware vocabulary identify March as “shad month” (Whritenour 2014:254).

An unusual find is that of a mackerel shark tooth (family, genus or species not indicated) associated with a date of 1160+/-120 BP at the Faucett Site (36Pi13A) and ascribed to a Late Woodland Owasco component. Kinsey (1972:196) interprets this as a travel or trade connection with the Atlantic Coast. The occasional presence of Late Woodland pottery types such as Bowmans Brook and Overpeck on sites of the Upper Delaware Valley could be construed as similar evidence of coastal or downriver travel or cultural interactions. The conjectured routes of Indian trails link the Upper Delaware with coastal areas (Wacker 1975:Map 2.1).

Sharks teeth figure in mortuary behaviors. A potential Kipp Island (circa 300 AD - 850 AD) burial in the Upper Delaware Valley consisted of a cremation associated with sharks teeth among other objects (Kraft 2001:198). The Webb Complex of the Lower Delaware Valley (circa 400 AD - 1180 AD) includes sharks teeth in mortuary features (Custer et al 1990:Table 10). In the Middle Atlantic Region shark teeth have been found in Middle and Late Woodland contexts and relate to mortuary behaviors, trade, ornamentation, and the manufacture of tools (Lowery et al 2011; Stewart 1989:62, 64; Walker 2003:239, 339).

The earliest use of shell (type unidentified) is tentatively dated at 1440+/-30 BP at the Manna Site (36Pi4). Dates for the use of any type of shell or shellfish become more frequent circa 790+/-80 BP (two sigma calibrated median of 1220 AD) and into the period of native contact with Europeans. Of the radiocarbon dates associated with shell (n=23) listed in Table 25 (exclusive of direct shell dates), 91.3% (n=21) relate to this range of time. The specific use of mussels occurs throughout this same time. Freshwater species of mussels occur naturally in the Upper Delaware Valley (Lellis 2001; Strayer and Ralley 1991).

The importance of mussels during the Late Woodland period in the Upper Delaware Valley, and their abundance in pits found on river-oriented sites, is well known (e.g., Carr and Moeller 2015:194; Kinsey 1972; Kraft 1975b, 1986:107, 2001:276-277; Marchiando 1969, 1970, 1972; Moeller 1992; Sloshberg 1962; Stewart 2015 et al; Williams et al 1982). Puniello (1991:142-146, 1994) argues that mussels appear more frequently and in greater quantities on Minisink phase sites. Minisink phase sites have been identified generally on the basis of a suite of pottery types generally dated from about 1350/1400 AD into the historic period (Kraft 1975a).

Mussels were frequently found in the rockshelters investigated by Schrabisch (1915, 1917, 1919, 1930; cf. Cross 1948) in the Upper Delaware Valley and adjacent areas. While contextual data are not precise, mussels typically occur in shelter deposits that also include triangular points, incised pottery, and collared pottery suggesting that their use most consistently relates to Late Woodland occupations. Eighty-four rockshelters or caves were included in my analysis of Schrabisch rockshelter data. Not included are rockshelters described in his 1913 publication. Mussels occurred in 46 (54.7%) of the shelters/caves. Late Woodland occupations are recognized in 34 of the shelters/caves and 20 of these include deposits of mussels. (Table 26). It is notable that mussels are well represented in non-riverine settings where shelters are situated near streams and wetlands.

TABLE 26

ROCKSHELTERS OR CAVES WITH LATE WOODLAND COMPONENTS*

	Pottery Present	Incised or Collared Pottery	Triangular Points	Pottery dominated assemblage	Hearths	Non-local Lithics	Netsinkers	Bone	Mussels
River Oriented Shelters n=11	n=10 90.9%	n=10 90.9%	n=5 45.4%	n=3 27.2%	n=8 72.7%	n=5 45.4%	n=3 27.2%	n=9 81.8%	n=7 63.6%
Other Shelters n=23	n=20 86.9%	n=16 69.5%	n=16 69.5%	n=5 21.7%	n=17 73.9%	n=8 34.7%	n=5 21.7%	n=21 91.3%	n=13 56.5%

*Data extracted from Schrabisch (1915, 1917, 1919, 1930).

Cross's excavations at the Rosenkrans site revealed a number of pits with mussel shells (1941:Table 3). Of these, five contained shell and pottery (pits 2, 4, 11, 12, 22). Pit 12 had mussel shells in association with a celt and celt fragment (Rosenkrans artifact catalog, New Jersey State Museum), which would not be out of place in a Late Woodland assemblage. Although pottery from the site is discussed and illustrated (Cross 1941:141-142, Plates 66, 67) the association of specific types with specific pits is not made clear. Obvious examples of incised Late Woodland wares are both described and pictured. Collared and incised pottery occurs in Pit 12 (Gregory Lattanzi, 2017 personal communication). A triangular point was recovered from the lower level of Pit 4 (1938 field diary, sheet 10, New Jersey State Museum). In combination with pottery this suggests a Late Woodland time frame. For Cross (1941:143) the shallow depths at which artifacts and most pits were encountered was thought to be suggestive of relatively late occupations.

It seems clear that the presence of mussel shell on archaeological sites in the study area could be considered as a time diagnostic artifact. What remains a mystery is why the exploitation of this resource begins relatively late in time; there is no reason to assume that mussels were not a part of the natural environment prior to the Late Woodland period. Researchers have also remarked on the typically small size of mussels found in archaeological contexts in the Upper Delaware when compared with modern populations (cf. Lellis 2001, 2008 personal communication; Kinsey 1972:248-250; Stewart and Bitting n.d.). Kinsey (1972:250) attributes mussel size to human selection, also commenting that the quantity of mussels found in any given feature does not represent a huge amount of meat. An extreme example is Feature 9, a U-shaped pit at 36Mr40 (Michaels #4) that contained over 148 pounds of shell. On the basis of a replicative experiment and observations by others dealing with modern mussel populations, Kinsey (1972:250) estimated that the ratio of shell weight to meat weight is 5:1. The nutritional value of mussels is low (e.g., Parmalee and Klippel 1974).

It is interesting that the history of mussel use corresponds with the time during which maize is most frequently encountered on archaeological sites in the Upper Delaware (see Botanical Remains, Chapter 6). Evidence for the first use of freshwater shellfish in the Upper Susquehanna Valley also dates to the Late Woodland (Funk 1993:291). A diet based heavily on maize, unless properly prepared or supplemented with other foods such as animal protein or beans, can lead to nutritional problems. Hominy, the result of processing maize with heat and an alkaline solution (nixtamalization), makes maize more digestible and provides a greater nutritional benefit to the human body (Briggs 2015, 2016:323). McConaughy (2008:24) speculates that a greater emphasis on maize by native peoples may be tied to the development and spread of hominy technology.

Could the production of hominy be one reason why the use of mussels in the Upper Delaware Valley parallels the intensive use of maize? The shells could be rendered into lime to create the needed alkaline solution and the meat provides additional protein, albeit in small quantities. In one Delaware myth, mussel shells are burnt as a sacrifice to the spirits to ensure the return of corn (Bierhorst 1995: 44, 91-92). However, historical sources indicate that the Delaware used ashes instead of lime in the production of hominy (e.g., Briggs 2015:Table 3; Tantaquidgeon 1977:55-58)

A climate-related study of stable oxygen isotopes in mussel shells employed samples from four feature contexts dated from 790 +/-80 BP (two sigma calibrated median 1220 AD) to 370 +/-40 BP (two sigma calibrated median 1524 AD) from sites in the Upper Delaware Valley (Stewart 2008; Stewart and Bitting n.d.). The analysis of stable isotopes of oxygen (Oxygen 16 and Oxygen 18) has a longstanding history of use in climate studies, with applications in archaeology (e.g., Bailey et al 1983; Hoefs 2004; Peacock and Seltzer 2008; Rozanski et al 1992). Depending on temperature, moisture/water incorporates varying ratios of the two oxygen isotopes. Shellfish like mussels incorporate these ratios into the calcium carbonate of their shells where they remain stable. Using a mass spectrometer, the ratios of oxygen isotopes are determined and used as an index of water temperature at the time that the shellfish was alive. Isotopic results are extrapolated to climate since water temperature can be related to air temperature.

The age of the samples spans portions of the climatic Medieval Warm Period and the Little Ice Age. The original goal of the study was to create a chronologically fine grained record of climate in order to assess the potential impact of environmental change on the intensity with which maize was used through time. Final analysis of the data and publication of results have not been completed but the oxygen isotope data tentatively indicate that temperatures in the past were within the “warm” end of the spectrum of the modern growing season values, and ranged to slightly warmer than modern values (Kelsey Bitting, 2013 personal communication).

The remains of frogs recovered from archaeological features are often considered to be accidental inclusions resulting from a variety of deposit formation processes. Toad/frog remains have been recovered from multiple dated features at the Chenango Point South and Otsiningo Market sites in Broome County, New York. Two sigma calibrated median dates for the contexts range from 1309 AD to 1563 AD (see Table 25). Miroff and Zlotucha Kozub (2014:100) argue that at the Otsiningo Market Site these are remnants of meals. Toad/frog remains were found in four different features with hindquarter elements predominating over forelimbs and skull fragments. Elsewhere the consistent presence of skulls is maintained to be a feature of frogs that become accidently trapped in open pit features (Cook 1989:131). The uniformity of the amphibian assemblage across the features is additional support of cultural selection and use.

Drawing on the work of Waugh (1916) and Beisaw (2007) they note that the Iroquois used toads/frogs for subsistence and ritual practices (Miroff and Zlotucha Kozub 2014:100). Similar dated occurrences are lacking for the New Jersey and Pennsylvania portions of the Upper Delaware. In the future, newly generated and curated faunas from feature excavations should be examined for the patterning documented at the New York sites. It is interesting that references to time in a 1772 Delaware vocabulary identify February as "frog month" (Whritenour 2014:254).

Faunal remains from dated burial contexts comprise only two listings in Table 25 but do not reflect the degree to which such remains occur in the matrix of burial features. These may relate to grave side feasting and offerings as part of mortuary rituals (cf. Beaver 2009; Cushman 2008; Newcomb 1956; Obermeyer 2017; Sieg 2008; Sloshberg 1962; Stewart 2017).

Domestic dog remains have been found in Archaic contexts in the Northeast and broader Eastern Woodlands (Allitt 2011). In the Upper Delaware and elsewhere in the drainage basin finds of domestic dog bone are limited to the Late Woodland period (e.g., Allitt 2011; Allitt et al 2008; Bierbrauer et al 2014; Sieg 2008:114-123). Dogs, potentially representing spiritual companions, also occur within human burials and in separate internments as part of Late Woodland components (e.g., Marchiando 1970:15; Sieg 2008:114-123).

Future research should consider the insights that isotopic studies of faunal remains might reveal. Examination of stable isotopes of carbon and nitrogen in turkey bone may reveal that maize was a substantial part of the bird's diet and be used in arguments regarding the human management of wild flocks or the process of domestication. The assumption is that wild turkeys were foraging waste in maize fields or were deliberately provided access to seed (Morris et al 2016; Peres and Ledford 2016). The isotopic signature of maize in turkey bone could also inform on the chronology of maize use in the area.

Dog as well as deer remains have the potential to provide a perspective on the chronology of the presence and extensive use of maize by native peoples in the region. Given the ethical and legal challenges inherent in the testing of human remains, studies of stable isotopes of carbon and nitrogen in deer and dog bone may stand as proxies. The reasoning is that deer and dog represent animals likely to be foraging maize in or adjacent to human settlements. A test case comparing the stable isotopes of Shenks Ferry/Late Woodland human remains and those of deer from the Mohr Site in southeastern Pennsylvania revealed a high human reliance on maize and no indication of deer feeding on the crop (Allitt 2007). A subsequent case study employing dog remains from the Lower Delaware Valley was more informative (Allitt et al 2008).

Stable isotopes of dogs from Late Woodland deposits at the Bell Browning, Blair section of Bell Browning, Minisink, and Bell Philhower sites in the Upper Delaware Valley also have been examined. Maize contributed to all of the dogs sampled but to varying degrees. Two dogs from the Bell Browning Site and one dog from the Blair section of Bell Browning have isotopic signatures indicating that maize contributed significantly to their diet (Allitt 2011:127, Table 6.1).

It is obvious that with the possible exception of the Late Woodland period, insufficient faunal assemblages exist to address any number of research issues. Prior to the appearance during the Archaic of tools and implements that likely relate to plant processing, the assumption can be made that hunting is the focus of subsistence procurement and processing efforts, and technological production. But is it specialized hunting in terms of only large game being targeted, or more generalized with prey of varying body masses more equitably represented? Is the infrequent targeting of a particular prey species more related to cultural or ritual practices than to providing subsistence? Could the differential distribution of skeletal elements of a species across sites of a given time link them more securely to hypothesized settlement patterns?

The limited preservation of macro-faunal remains can be overcome to a degree by more consistent testing of stone tools and implements for residues. The potential insights from the analysis of stable isotopes of human and dog bone have been noted, as have studies of blood residues and lipids. The analysis of lipids/fatty acids in residues on pottery or absorbed in the fabric of sherds can provide information on the type of faunal resources represented, Using experimental data and fat references aquatic (freshwater, marine) and terrestrial (non-ruminant, ruminant) fauna can be distinguished (e.g., Anderson et al 2017; Tache´ and Craig 2015). A detailed study of seasonal fluctuations in deer harvesting using remains from Late Woodland sites in the Upper Delaware (Guida 1989) has been informative and could be applied on a broader scale and for varying chronological contexts.

Additional dates could be run for the curated faunal assemblages from Late Woodland sites in the Upper Delaware and would provide a more fine grained chronology of subsistence practices, related technologies and social relations. For example, does the suggested increase in the importance of fishing through the Late Woodland period relate to supplementing and nutritionally balancing a native diet increasingly focused on maize? On the basis of existing data the presence of mussel shell in a deposit can stand as chronologically diagnostic of a Late Woodland time frame.

Future dating projects should also consider targeting calcined bone in archived collections. Since calcined bone is more resistant to weathering than other organics it is more likely to survive in deposits. Exposure to temperatures of 650°C or more that results in bone becoming calcined consumes the organic component (collagen) of bone, traditionally making it a poor choice for a radiocarbon assay. However, The carbon that remains in a calcined fragment represents a mixture of carbon atoms absorbed from the fuels involved in the heating process and from the bone mineral itself (Chatters et al 2017:606). Employing a protocol that involved pairing calcined bone with charcoal samples from the same features, Chatters and colleagues (2017) demonstrated the reliability of dates based on the calcined bone.

VI. BOTANICAL REMAINS

Historically the Lenape/Delaware and other native peoples of the Middle Atlantic and Northeast used plants for a variety of purposes other than food including: medicines, hygiene, domestic activities, ceremonial agents, structures, watercraft, tool and implement production, crafts, clothing, and adornment (cf. Hill and Rementer 2015; Moeller 1992:Appendix; Moerman 1986:816-818, 1998; Newcomb 1956; Tantaquidgeon 1977). Ethnohistoric and ethnographic sources are useful starting points for developing different approaches to the analysis and interpretation of paleobotanical assemblages. Understanding the prehistory of plant use by native peoples needs to consider the environmental and archaeological contexts of finds, and the chronology and frequency of appearance of artifact types often implicated in plant use (e.g., fire cracked rock – hot rock cooking, pitted stones, muellers, edge ground cobbles, mortars and pestles, pottery, and stone bowls). The analysis of residues on artifacts, pollen, and phytoliths has, and continues to be significant for illuminating plant prehistory.

The Native American transition from a hunting and gathering way of life to one in which food production, i.e., the farming of domesticated plants like maize, is an issue of local, regional, and national significance. The probable management and intensive use of wild plant resources prior to the adoption of cultigens may in itself represent a form of low level food production (Smith 2001) and facilitated the adoption of cultigens. Environmental management and the adoption of farming would have had an impact on the character of the environment (e.g., Stinchcomb et al 2013), essentially making it one that humans had "domesticated". These are some of the issues that need to be explored in depth with existing data and additional research, and are part of the grand challenges for archaeology (Kintigh et al 2014:15-18).

The list of botanical remains from dated contexts in the study area is surprisingly substantial (Table 27). This compilation of botanical remains builds on somewhat recent syntheses for the Upper Delaware and broader region (e.g., McConaughy 2008; Messner 2008, 2011; Messner et al 2008; Stewart 2015a; Stewart et al 2015; Stinchcomb et al 2011). The previous work of Stewart (2015a) and colleagues (Stewart et al 2015) incorporates data and insights generated as part of the current project. Common and taxonomic names employed in Table 27 follow those used in the reports in which they were described. Where family, genus, or species was not designated in a reference they were provided, where feasible, by the current author.

Botanical remains that were directly dated using AMS are shown in bold in Table 27. Unidentified nuts are listed in entries as they are useful information regarding subsistence and the seasonality of occupations, even in the absence of an assignment to genus or species. Unidentified seeds are not included in entries since the information that they provide is equivocal, other than as a sign of the preservation potential of a deposit. Genus/species represented by wood are distinguished in the listings from other elements of the same genus/species. For example, the listing of hickory indicates the occurrence of nutshell. The appearance of hickory in the "wood" portion of an entry refers only to the presence of charred wood.

TABLE 27
RADIOCARBON DATES ASSOCIATED WITH BOTANICAL REMAINS

Floral Remains	Date BP	Calibrated* 2 Sigma Age BC/AD	Calibrated* Median Age BC/AD	Site & Context	Reference
hawthorn (*Crataegus sp.*)	10,940+/-90 Beta 101935 10,900+/-40 Beta 127162 10,590+/-300 W-2994	11,068-10,750 BC 10,877-10,752 BC 11,112-9646 BC	10,877 BC 10,810 BC 10,427 BC	36Mr43, Shawnee Minisink, Kline hearth, southwestern portion of site	Kraft 1975b:Table 11; McNett et al 1985:3, 6; Dent 2002::Table 1; Dent 2007:Table 7.1, Figure 7.2;Gingerich 2013a:Tables 9.8, 9.11
hawthorn (*Crataegus sp.*), hickory (*Carya sp.*)	11,020+/-30 UCIAMS 24866 10,915+/-25 UCIAMS 24865 10,820+/-50 Beta 203865	11,056-10,823 BC 10,866-10,761 BC 10,841-10,722 BC	10,932 BC 10,814 BC 10,771 BC	36Mr43, Shawnee Minisink, Unit 2, Hearth 1	Gingerich 2013a:Tables 9.8, 9.11
hawthorn (*Crataegus sp.*)	10,970+/-50 OxA-1731	11,030-10,772 BC	10,872 BC	36Mr43, Shawnee Minisink, Unit 4/4E, Hearth 2	Gingerich 2013a:Tables 9.8, 9.11
hawthorn (*Crataegus sp.*), Acalypha (*Acalypha virginica*), amaranth, (*Amaranthus sp.*), blackberry (*Rubus sp.*), buckbean (*Menyanthes trifoliate*), lambsquarter/goosefoot (*Chenopodium sp.*), grape (*Vitus sp.*), hackberry (*Celtis sp.*), smartweed (*Polygonum sp.*), winter cress (*Barbarea orthoceras*)	11,020+/-30 UCIAMS 24866 10,970+/-50 OxA-1731 10,940+/-90 Beta 101935 10,915+/-25 UCIAMS 24865 10,900+/-40 Beta 127162 10,820+/-50 Beta 203865 10,750+/-600 W-3134 10, 590+/-300 W-2994 9310+/-1000 W-3388	11,056-10,823 BC 11,030-10,772 BC 11,068-10,750 BC 10,866-10,761 BC 10,877-10,752 BC 10,841-10,722 BC 11,838-8789 BC 11,112-9646 BC 11,117-6357 BC	10,932 BC 10,872 BC 10,877 BC 10,814 BC 10,810 BC 10,771 BC 10,509 BC 10,427 BC 8701 BC	36Mr43, Shawnee Minisink, associated with dated component	McNett et al 1985:6-7; Dent and Kaufman 1985:Tables 5.1, 5.2; Dent 2002:Table 1; Dent 2007:127; Gingerich 2011:Table 3; Gingerich 2013a:Tables 9.8, 9.11

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
hazelnut (*Corylus sp.*)	9420+/-90 Beta 51501 9300+/-130 Beta 53142	8941- 8453 BC 8849 8261 BC	8718 BC 8555 BC	36Nm12, Sandts Eddy, Stratum XI	Doershuk and Bergman 1996:Figure 14.1; Moeller and McWeeney 1996:Figure 13.4
wood = white pine (*Pinus strobus*), maple (*Acer sp.*), elm family, possibly hackberry (*Ulmus sp.*)	9330+/-545 UGa-5488	10,292-7325 BC	8680 BC	36Mr45, Depue Island/Upper Shawnee Island, Unit 12/12A, hearth feature, 4.3 meters below surface	Stewart et al 1991:173; 176, Stewart 2014
hazelnut (*Corylus sp.*)	8450+/-130 Beta 61332	7748-7136 BC	7482 BC	36Nm12, Sandts Eddy, Stratum IX	Bergman et al 1994:164; Moeller and McWeeney 1996:Appendix F
butternut (*Juglans cinerea*)	7320+/-125 I-6600	6432-5987 BC	6191 BC	28Wa2, Harrys Farm, Zone 6, Feature J-F163	Kraft 1975b:15
hazelnut* (*Corylus sp.*)	7330+60 Beta 61582 CAMS 5834	6274-6063 BC	6182 BC	36Nm12, Sandts Eddy, Stratum IX	Bergman et al 1994:164
hazelnut (*Corylus sp.*); wood = oak (*Quercus sp.*), sycamore (*Platanus occidentalis*)	7080+/-70 Beta 51500	6071-5796 BC	5951 BC	36Nm12, Sandts Eddy, Stratum IX, Feature 9	Bergman et al 1994:164; Doershuk and Bergman 1996:Figure 14.1; Moeller and McWeeney 1996:Table 13.4, Appendix F
unidentified nut fragments	5120+/-130 Beta-no lab # reported	4233-3657 BC	3920 BC	Peake Site, Feature 31A, Delaware County, NY	Hartgen Associates 1988:57-59,Table 18
butternut/black walnut/hickory nutshell (*Juglandaceae* family, hawthorn (Crataegus sp.), wild rye (Elymus sp.), and bramble (Rubus sp.), chestnut (Castanea dentata), hickory (*Carya sp.*)	4710+/-40 Beta 265477	3632-3557 BC 3538-3489 BC 3471-3372 BC	3495 BC	Chenango Point (SUBi-1274), Feature 168, Broome County, NY	Knapp 2011:Table 4.3, Appendix 3, Table A3-35; Asch Sidell 2011:Table 7
goosefoot (*Chenopodium sp.*), mustard family (*Brassicaceae*), acorn (*Quercus sp.*), hickory (*Carya sp.*), unidentified starchy tissue fragments (possibly nutmeat); wood = oak (*Quercus sp.*), pine (*Pinus sp.*)	4460+/-130 Beta 127251 4370+/-140 Beta 127250	3522-2873 BC 3375-2620 BC	3158 BC 3046 BC	36Pi169, Shohola Flats, Feature 36	Trachtenberg et al 2008:72-73, Appendix L; Appendix G - Cummings and Puseman 2003
butternut (*Juglans cinerea*)	4420+/-40 Beta 206644	3122-2918 BC 3328-3218 BC	3058 BC	Sidney Hangar Site (SUBi-2073), Feature 1, Chenango and Delaware counties, NY	Kudrle 2005:45, Table 14, Appendix 6

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
butternut (*Juglans cinerea*)	4380+/-40 Beta 206649	3099-2903 BC	2993 BC	Sidney Hangar Site (SUBi-2073), Feature 37, Chenango and Delaware counties, NY	Kudrle 2005:45, Table 14, Appendix 6
butternut (*Juglans cinerea*)	4370+/-40 Beta 206646	3092-2904 BC	2985 BC	Sidney Hangar Site (SUBi-2073), Feature 6, Chenango and Delaware counties, NY	Kudrle 2005:45, Table 14, Appendix 6
goosefoot (*Chenopodium sp.*)	4290+/-90 Beta-no lab # reported 4270+/-70 Beta-no lab # reported	3118-2620 BC 3033-2832 BC 2820-2632 BC	2917 BC 2889 BC	Peake Site, Feature 25III, 25B Delaware County, NY	Hartgen Associates 1988:56-57, Table 18
hickory nutshell (*Carya sp.*)	4170+/-40 Beta 142040	2823-2628 BC 2886-2829 BC	2762 BC	Park Creek I (Subi-1464, NYSM #10222), Broome County, NY	Miroff 2002:41, 44, Table 4; Asch Sidell 2002a:75
un-carbonized branches of unidentified wood	4105+/-90 GX-22942	2889-2472 AD	2683 AD	36Pi148 vicinity, excavation monitoring, 20 feet below surface	Wright 1997:35
butternut (*Juglans cinerea*), raspberry/blackberry/dewberry (*Rubus sp.*); wood = birch (*Betula sp.*), beech (*Fagus grandifolia*), ash (*Fraxinus sp.*), hop hornbeam (*Ostrya virginiana*), pine (*Pinus sp.*), white oak group (*Quercus sp.*)	4020+/-80 Beta 142039	2778-2336 BC	2561 BC	Park Creek I (Subi-1464, NYSM #10222), Feature 12/13, Broome County, NY	Miroff 2002:41, 44, Table 4; Asch Sidell 2002a:75, Tables 31, 32
acorn (*Quercus sp.*), butternut (*Juglans cinerea*), butternut/walnut (*Juglans sp.*)	4010+/-50 Beta 253258	2676-2433 BC	2537 BC	BRO-212 Site, Feature 2 Block 6, Broome County, NY	Kelly 2009a:70, Table 43, Appendix H
wood = hickory (*Carya sp.*), pine (*Pinus sp.*), oak (*Quercus sp.*)	3960+/-110 Beta 127247	2764-2192 BC	2467 BC	36Pi169, Shohola Flats, Feature 35/37	Trachtenberg et al 2008:72-73, Appendix L; Appendix G - Cummings and Puseman 2003
goosefoot (*Chenopodium sp.*)	3870+/-100 Beta-no lab # reported	2582-2031 BC	2337 BC	Otego Yard Site (NYSM 121), Feature 188D, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 34
hickory (*Carya sp.*)	3800+/-100 Beta 10657	2488-1952 BC	2244 BC	36Nm80, Bachman, Feature 6	Anthony and Roberts 1987:81-82, 103-104

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
acorn (*Quercus sp.*), butternut (*Juglans cinerea*), goosefoot (*Chenopodium sp.*)	3800+/-80 Beta-no lab # reported	2488-1952 BC	2244 BC	Otego Yard Site (NYSM 121), Feature 22D, Otsego County, NY	Hartgen Associates 1988b:46,101-102, 108, Table 32, 34
butternut or walnut (*Juglans sp.*)	3775+/-115 I-6351	2491-1891 BC	2208 BC	Fortin Locus 1, Delaware County, NY occupation zone 5, Feature 28	Funk 1993:Table 17; 1998:53-54
raspberry/blackberry/dewberry (*Rubus sp.*), chickweed (*Stellaria sp.*), tupelo (*Nyssa sp.*); possible hickory (*Carya sp.*); wood = oak (*Quercus sp.*), hickory/pecan (*Carya sp.*), pine (*Pinus sp.*), possible elm (*Ulmus sp.*)	3770+/-90 Beta 41370	2464-1963 BC	2200 BC	36Mr5, Smithfield Beach/Pardee, Feature 126	Hennessy 1992:146, 255-258, Appendix A
butternut (*Juglans cinerea*); wood = maple (*Acer sp.*), sugar maple (*Acer saccharum*), hornbeam (*Carpinus caroliniana*), beech (*Fagus grandifolia*), butternut (*Juglans cinerea*), black gum (*Nyssa sylvatica*), hop hornbeam (*Ostrya virginiana*)	3680+/-40 Beta 216699	2147-1948 BC	2070 BC	Mt. Laurel Gardens(SUBi-2523), Feature 2, Delaware County, NY	Carroll et al 2007:32-34, 55, Tables 8, 27
pignut hickory (*Hicoria glabra/Carya glabra*)	3670+/-120 Y-2587	2351-1746 BC	2063 BC	28Wa16, Miller Field, Pit 4-Feature C-F42	Kraft 1970a:10, 31, Plate 4.1, 1972:10-11, 32, 1975b:Table 11
wood = oak (*Quercus sp.*)	3670+/-40 Beta 247744	2145-1940 BC	2054 BC	Site ORA-9936, Feature 5, Orange County, NY	Pretola and Freedman 2009:Tables 23-24; Largy 2009a:Table 2
butternut (*Juglans cinerea*), goosefoot (*Chenopodium sp.*)	3640+/-170 Beta-no lab # reported	2479-1608 BC	2027 BC	Otego Yard Site (NYSM 121), Feature 182, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 34
hickory (*Carya sp.*)	3630+/-210 Beta 10656	2575-1497 BC	2244 BC	36Nm80, Bachman, Feature 5	Anthony and Roberts 1987:80-81, 103-104
butternut (*Juglans cinerea*)	3500+/-80 Beta-no lab # reported	2028-1629 BC	1826 BC	Otego Yard Site (NYSM 121), Feature 204, Otsego County, NY	Hartgen Associates 1988b:55, 101-102, Tables 32, 34
butternut (*Juglans cinerea*), raspberry/blackberry/dewberry (*Rubus sp.*); wood = birch (*Betula alleghaniensis*)	3490±40 Beta 292478	1917-1733 BC	1815 BC	Delhi Holding Pond Site (SUBi-2673) Feature 1, Delaware County, NY	Kudrle 2011:50, 77-79, Table 31
goosefoot (*Chenopodium sp.*), unidentified nuts	3440+/-90 Beta-no lab # reported	1973-1526 BC	1757 BC	Otego Yard Site (NYSM 121), Feature 188B, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 33, 34

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
unidentified nut fragments	3370+/-80 Beta-no lab # reported	1884-1497 BC	1667 BC	Peake Site, Feature 18, Delaware County, NY	Hartgen Associates 1988:54-56, Table 18
unidentified nut fragments	3350+/-70 no lab # reported	1780-1495 BC	1641 BC	36Nm4, Locus A, Feature 10-01	Hornum et al 2002:144, Table 4
acorn (*Quercus sp.*), goosefoot (*Chenopodium sp.*); wood = sycamore (*Platanus sp.*), oak (*Quercus sp.*), walnut (*Juglans sp.*), hop hornbeam (*Ostrya virginiana*), pine (*Pinus sp.*), eastern red cedar (*Juniperus virginiana*), hickory (*Carya sp.*)	3350+/-110 Beta 127248	1920-1414 BC	1648 BC	36Pi169, Shohola Flats, Feature 2/26/28/31	Trachtenberg et al 2008:70, Appendix L; Appendix G - Cummings and Puseman 2003
acorn (*Quercus sp.*), hickory (*Carya sp.*)	3230+/-120 Y-2343	1777-1209 BC	1510 BC	36Pi14, Zimmerman, part of dated component	Werner 1972:118-119; Carr 2015:Table 3.2; Blondino 2015:Table 5.1
wood = sycamore (*Platanus occidenttalis*), poplar (*Populus sp.*), red oak subgroup (*Quercus* subfamily *Erythrobalanus*)	3230+/-60 Beta 57130	1644-1394 BC	1509 BC	36Pi136, Dingmans Launch, Feature 4	Alterman 1993:23, Table 1; Parker 1993a:Table 1
carpetweed family (*Mollugo*), clover (*Trifolium sp.*), raspberry/blackberry (*Rubus sp.*); wood = hickory (*Carya sp.*), maple (*Acer sp.*), oak (*Quercus sp.*), chestnut (*Castanea dentata*), ash (*Fraxinus sp.*), walnut (*Juglans sp.*)	3180+/-80 Beta 42907	1632-1259 BC	1454 BC	36Mr5, Smithfield Beach/Pardee, Feature 134	Hennessy 1992:148, 214, Appendix A
tupelo/black gum (*Nyssa sylvatica*), violet (*Viola sp.*); wood = chestnut (*Castanea dentata*), oak (*Quercus sp.*), ash (*Fraxinus* sp.),	3160+/-75 Teledyne I-18, 913	1613-1259 BC	1430 BC	36Nm142, Treichlers Bridge, Feature 9	Anderson et al 2000:6-121, Appendix VIII; Ericksen 1999:Feature 62
maize (*Zea mays*), raspberry/blackberry (*Rubus sp.*), elderberry (*Sambucus sp.*), goosefoot (*Chenopodium sp.*), pokeweed (*Phytolacca americana*), mustard family (*Brassicaceae*), sunflower family (*Asteraceae*), dock (*Rumex sp.*), mint family (*Lamiaceae*), vervain (*Verbena sp.*), tuliptree (*Liriodendron tulipifera*), parsley or carrot family (*Apiaceae*), bedstraw (*Galium sp.*), *Phacelia sp.*; wood = ash (*Fraxinus sp.*),	3150+/-70 Beta 127260 3100+/-70 Beta 86420 3090+/-150 Beta 127257 3030+/-60 Beta 127258 3010+/-150 Beta 127259 2810+/-150 Beta 123478	1562-1257 BC 1507-1191 BC 1666-968 BC 1429-1110 BC 1545-892 BC 1429-1110 BC	1418 BC 1351 BC 1326 BC 1277 BC 1232 BC 1008 BC	36Pi169, Shohola Flats, Feature 58	Trachtenberg et al 2008:74-75, 133-134, 137, 162-163, Appendix L; Appendix G - Cummings and Puseman 2003:399, 418, 420

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
birch (*Betula sp.*), eastern red cedar (*Juniperus virginiana*), pine (*Pinus sp.*), walnut (*Juglans sp.*), tuliptree (*Liriodendron tulipifera*), sycamore (*Platanus sp.*), oak (*Quercus sp.*), hickory (*Carya sp.*), hop hornbeam (*Ostrya virginiana*), conifer	36Pi169, Shohola Flats, Feature 58 continued				
goosefoot (*Chenopodium sp.*), mustard family (*Cruciferae*), hickory (*Carya sp.*), sedge family (*Cyperaceae*), raspberry/blackberry (*Rubus sp.*); wood = oak (*Quercus sp.*)	3100+/-80 Beta 41371	1527-1125 BC	1349 BC	36Mr5, Smithfield Beach/Pardee, Feature 135	Hennessy 1992:148, 214, 216, Appendix A
butternut (*Juglans cinerea*), goosefoot (*Chenopodium sp.*)	3030+/-100 Beta-no lab # reported	1500-1002 BC	1263 BC	Otego Yard Site (NYSM 121), Feature 52, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 34
hickory (*Carya sp.*); wood = maple (*Acer sp.*), beech (*Fagus grandifolia*), hop hornbeam (*Ostrya virginiana*), poplar (*Populus sp.*)	2970+/-40 Beta 216698	1297-1050 BC	1186 BC	Mt. Laurel Gardens (SUBi-2523), Feature 1, Delaware County, NY	Carroll et al 2007:32-34, 55, Tables 8, 27
pondweed, (Potamogeton sp.); toadflax (Linaria vulgaris); grass family (Gramineae), maygrass (Phalaris caroliniana), hickory (Carya sp.), walnut (Juglans sp.); wood = chestnut (Castanea dentata), basswood (Tilia americana), beech (Fagus grandifolia), birch (Betula sp.), cherry (Prunus sp.), cottonwood (Populus sp.), elm/hackberry (Ulmus/Celtis sp.), dogwood (Cornus florida), hickory, hophornbeam (Ostrya virginiana), maple (Acer sp.), red oak (Quercus rubra), white oak (Quercus alba), sycamore (Platanus occidentialis), pine (Pinus sp.)	2950+/-100 Beta 108183	1413-914 BC	1160 BC	36Nm140, Oberly Island, Feature 20	Siegel et al 1999:Table 4; 2001:Table 1; Raymer and Bonhage-Freund 1999:Tables 2, 3, 4, 6, 7

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
huckleberry (*Gaylussacia sp.*), smartweed (*Polygonum sp.*), raspberry/blackberry (*Rhus sp.*), hickory (*Cary sp.*), black walnut (*Juglans nigra*), acorn (*Quercus sp.*), hickory/walnut family (*Juglandaceae*), hazelnut (*Corylus americana*); wood = red oak subgroup (*Quercus* subfamily *Erythrobalanus*), hickory (*Cary sp.*), oak (*Quercus sp.*), white oak subgroup (*Quercus* subfamily *Lepidobalanus*)	2710+/-90 Beta 37465 2390+/-70 Beta 45960	1122-750 BC 767-369 BC	884 BC 513 BC	36Pi136, Feature 1, Dingmans Launch	Alterman 1993:12; Alterman and Koldehoff 1991:35-36, 39, Appendix 1Parker 1993b:Table 1
raspberry (*Rubus sp.*), hazelnut (*Corylus sp.*), black walnut (*Juglans nigra*), hickory (*Carya sp.*); wood = hickory (*Carya sp.*), oak (*Quercus sp.*), maple (*Acer sp.*)	2580+/-80 Beta 52248	899-476 BC	689 BC	36Nm15, Padula, Feature 6	Doershuk 1994:318, Figures 14.14-14.17; Long 1994
pignut hickory (*Carya glabra*)	2560+/-120 Y-1384 2400+/-60 DIC-407	930-397 BC 756-679 BC 671-603 BC 600-390 BC	665 BC 515 BC	28Sx2, Rosenkrans, associated with dated burial cluster	Kraft 1976a:23, 25, 31
walnut family (*Juglandaceae*)	2520+/-40 Beta 251451	797-536 BC	646 BC	Site ORA-9931, Feature 47, Orange County, NY	Pretola and Freedman 2009:184, Table 51
acorn (*Quercus sp.*); wood = maple (*Acer sp.*), hawthorn (*Crataegus sp.*), beech (*Fagus grandifolia*)	2400+/- 40 Beta 198658	564-394 BC	487 BC	Herrick Hollow VII Site, Feature 1, Delaware County, NY	Hohman et al 2005:239; Asch-Sidell 2005:Tables 1, 6
butternut (*Juglans cinerea*)	2100+/-90 Beta-no lab # reported	365 BC-62 AD	135 BC	Otego Yard Site (NYSM 121), Feature 42A, Otsego County, NY	Hartgen Associates 1988b:54-55, 101-102, Tables 32, 34
hickory (*Carya sp.*)	2080+/-90 Beta 10655	361BC-77AD	111 BC	36Nm80, Bachman, Feature 4	Anthony and Roberts 1987:79
hickory (*Carya sp.*); wood = ash (*Fraxinus sp.*), pine/spruce/larch (*Pinaceae*); white pine leaf bundle (*Pinus strobus*)	2030+/-40 Beta 253257	120 BC-57 AD	35 BC	BRO-212 Site, Feature 1, Broome County, NY	Kelly 2009a:68, 79, Table 41, Appendix H
tuliptree (Liriodendron tulipifera); wood = birch (Betula sp.), elm (Ulmus sp.), sycamore (Platanus occidentialis), walnut (Juglans sp.)	2010+/-70 Beta 105331	198BC-130AD	21 BC	36Nm140, Oberly Island, Feature 24	Siegel et al 1999:Table 4; 2001:Table 1; Raymer and Bonhage-Freund 1999:Tables 2, 3, 4, 6, 7

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize (*Zea mays* phytoliths)	1995+/-35 Illinois State Geological Survey A0410	58 BC – 79 AD	4 AD	Fortin Locus 2, Delaware County, NY, pottery residue, occupation zone 3	Funk 1998:68-78; Thompson et al 2004:28-29, Tables 2, 4
hickory (*Carya sp.*), walnut (*Juglans sp.*), mint family (*Labiatae*), carpetweed family (*Mollugo*), bedstraw/Cleaver's vine (*Galium sp.*), unidentified berries; wood = oak (*Quercus sp.*), hickory/pecan, walnut (*Juglans sp.*), maple (*Acer sp.*)	1970+/-90 Beta 41246	199 BC - 242 AD	24 AD	36Mr5, Smithfield Beach/Pardee, Feature 117	Hennessy 1992:116, 145-146, 175, 179, Appendix A
maize (*Zea mays*), hickory (*Carya sp.*), bitternut hickory (*Carya cordiformis*), chestnut (*Castanea dentata*), acorn (*Quercus sp.*), beechnut (*Fagus grandifolia*), hazelnut (*Corylus sp.*), tick-trefoil (*Desmodium sp.*), bean family (*Fabaceae*); wood = pine (*Pinus sp.*), white oak (*Quercus alba*), hop hornbeam (*Ostrya virginiana*), beech (*Fagus grandifolia*), birch (*Betula sp.*)	1850+/-40 Beta 168304	68-251 AD	165 AD	Deposit Airport I (SUBi-2048), Feature 18, Delaware County, NY	Knapp and Versaggi 2002:79-80, Tables 7, 8; Asch Sidell 2002d
unidentified nuts	1800+/-90 Beta-no lab # reported	24-418 AD	223 AD	Otego Yard (NYSM 121), Feature 183A, Otsego Co., NY	Hartgen Associates 1988b:100-102, Tables 32, 33
grass family (*Gramineae*)	1790+/-180 Beta-no lab # reported	178 BC - 617 AD	228 AD	Peake Site, Feature 37/39A Delaware County, NY	Hartgen Associates 1988:68, Table 18
maize (*Zea mays*); wood = maple (*Acer sp.*), birch (*Betula sp.*), chestnut (*Castanea dentata*) beech (*Fagus grandifolia*)	1760+/-40 Beta 198655	209-384 AD	282 AD	Herrick Hollow II, Feature 3, Delaware County, NY	Hohman et al 2005:97-98, Table 40, Appendix II; Asch-Sidell 2005:Table 6
mint family (*Labiatae*), unidentified nut; wood = oak (*Quercus sp.*)	1720+/-60 Beta 42905	135-426 AD	315 AD	36Mr5, Smithfield Beach/Pardee, Feature 132	Hennessy 1992:147, 179, Appendix A
bedstraw (Galum sp.), copperleaf (Acalypha virginica), grass family (Gramineae), walnut (Juglans sp.); wood = red oak (Quercus rubra), white oak (Quercus alba), sycamore (Platanus occidentialis)	1680+/-70 Beta 105799	210-540 AD	349 AD	36Nm140, Oberly Island, Feature 22	Siegel et al 1999:Table 4; 2001:Table 1; Raymer and Bonhage-Freund 1999:Tables 2, 3, 4, 6, 7

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
Acalypha (*Acalypha virginica*), amaranth, (*Amaranthus sp.*), buckbean (*Menyanthes trifoliate*), lambsquarter/goosefoot (*Chenopodium sp.*)	1640+/-200 W-3135	60 BC – 776 AD	383 AD	36Mr43, Shawnee Minisink, Feature 26	McNett et al 1985:9; Fischler and Mueller 1991:Table 3.5; McNett 1985b:115, 117; Dent and Kaufman 1985:Table 5.1
unidentified nuts	1630+/-80 Beta 19934	242-596 AD	422 AD	Ouleout Site (8W-32-7), Feature 23, Delaware County, NY	Hartgen Associates 1989:26, 35-36
wood = birch (*Betula sp.*), hickory (*Carya sp.*), chestnut (*Castanea dentata*), beech (*Fagus grandifolia*), hop hornbeam (*Ostrya virginiana*), pine (*Pinus sp.*)	1530+/-120 Beta 142036	241-694 AD	506 AD	Raish Site (Subi-1465, NYSM #10223),Feature 2, Broome County, NY	Miroff 2002:Tables 77, 79; Asch Sidell 2002c:Appendix 11.10
maize (*Zea mays* phytoliths), squash (*Cucurbita sp.* phytoliths)	1525+/-35 Illinois State Geological Survey A0406	428-604 AD	537 AD	Fortin Locus 2, Delaware County, NY, pottery residue, occupation zone 3	Funk 1998:68-78; Thompson et al 2004:28-29, Tables 2, 4
unidentified nuts	1470+/-30 Beta 20233	546-644 AD	595 AD	Ouleout Site (8W-32-7), Feature 10, Delaware County, NY	Hartgen Associates 1989:26, 31
maize (*Zea mays*)	1440+/-30 Beta 355783	568-654 AD	617 AD	36Pi4, Manna, associated with dated component	Stewart et al 2015:Tables 17, 60
butternut (*Juglans cinerea*), butternut or walnut (*Juglans sp.*)	1390+/-55 Dic 177	555-717 AD	641	Fortin Locus 2, Delaware County, NY Occupation zone 3, Feature 48	Funk 1993:Table 17; 1998:75
maize (*Zea mays*), hickory (*Carya sp.*), bitternut hickory (*Carya cordiformis*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), blackberry/raspberry/dewberry (*Rubus sp.*); wood = pine (*Pinus sp.*), white oak (*Quercus alba*), red oak (*Quercus* group *Lobatae)*, maple (*Acer sp.*), ash (*Fraxinus sp.*)	1380+/-60 Beta 160180	556-729 AD	649 AD	Deposit Airport I (SUBi-2048), Feature 7, Delaware County, NY	Knapp and Versaggi 2002:61, Tables 7, 8; Asch Sidell 2002d
maize (*Zea mays*), acorn (*Quercus sp.*), hazelnut (*Corylus sp.*), hawthorn (*Crataegus sp.*), sumac (*Rhus sp.*)	1370+/-60 Beta 46950	565-770 AD	658 AD	Chenango Point (SUBi-1274), Feature 53, Broome County, NY	Knapp 2011: Table 4.3; Appendix 3, Table A3-17; Asch Sidell 2011:Table 7
hickory (*Carya sp.*), hawthorn (*Crataegus sp.*), rose family (*Rosaceae*), blackberry/raspberry/dewberry (*Rubus sp.*), butternut (*Juglans cinerea*); wood = white oak group (*Quercus sp.*)	1350/-50 Beta 256723	606-769 AD	672 AD	BRO-117 Site, Block 3 Feature 9, Broome County, NY	Kelly 2009b:196, Table 125, Appendix I

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
sunflower or gourd seed(?), blackberry/raspberry/dewberry (*Rubus sp.*)walnut (*Juglans sp.*); wood = walnut (*Juglans sp.*), hickory (*Carya sp.*), ash (*Fraxinus sp.*), beech (*Fagus grandifolia*)	1300+/-110 Beta 50977	554-980 AD	742 AD	36Nm15, Padula, Feature 5	Doershuk 1994:311, 323, Figures 14.14-14.17; Long 1994, Appendix F
unidentified nut fragments	1280+/-60 Beta-no lab # reported	652-882 AD	739 AD	Peake Site, Feature 12A, Delaware County, NY	Hartgen Associates 1988:51-54, Table 18
goosefoot (*Chenopodium berlandieri*), acorn (*Quercus sp.*), butternut (*Juglans cinerea*), hazelnut (*Corylus sp.*), butternut/black walnut/hickory (*Juglans sp.*)	1230+/-100 Beta 35558	644-996 AD	802 AD	Chenango Point South (SUBi-2776), Feature 1/101, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8
hickory (*Carya sp.*), butternut (*Juglans cinerea*), wild rye (*Elymus sp.*), hog peanut (*Amphicarpa bracteata*), blackberry/raspberry/dewberry (*Rubus sp.*); wood = white oak (*Quercus alba*), elm (*Ulmus sp.*), conifer, maple (*Acer sp.*), beech (*Fagus grandifolia*)	1220+/-40 Beta 168305	683-892 AD	801 AD	Deposit Airport I (SUBi-2048), Feature 27, Delaware County, NY	Knapp and Versaggi 2002:93-94, Tables 7, 8; Asch Sidell 2002d
blackberry/raspberry/dewberry (*Rubus sp.*), goosefoot (*Cheopodium sp.*), elderberry (*Sambucus sp.*), clover (*Trifolium sp.*), saltbush (*Atriplex sp.*)	1220+/-80 Beta-no lab # reported	663-972 AD	807 AD	Peake Site, Feature 30A, Delaware County, NY	Hartgen Associates 1988:65-66, Table 18
maize (*Zea mays*)	1210+/-40 lab sample # not reported	687-895 AD	813 AD	Deposit Airport I (SUBi-2048), Context not reported, Delaware County, NY	Knapp 2009:104
elderberry (*Sambucus sp.*), sunflower family (*Compositae*), mustard family(*Cruciferae*), bedstraw (*Galium sp.*), poppy family (*Papaveraceae*), hickory (*Carya sp.*), wood sorrels (*Oxalis sp.*), mint family (*Labiatae*), blackberry/raspberry/dewberry (*Rubus sp.*), hickory (*Carya sp.*)	1200+/-90 Beta 41369	662-993 AD	825 AD	Smithfield Beach/Pardee 36Mr5 Feature 130	Hennessy 1992: 146-147, 171, Appendix A
walnut (*Juglans sp.*); wood = walnut (*Juglans sp.*), oak (*Quercus sp.*)	1190+/-40 Beta 93148	764-904 AD 916-966 AD	831 AD	36Nm212/229, Feature 1	Lattanzi 1996:Appendix F; Puseman 1996

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
goosefoot (*Chenopodium sp.*), grass (*Gramineae sp.*), clover (*Trifolium sp.*), smartweed or knotweed (*Polygonum sp.*), cherry (*Prunus sp.*), spike rush (*Eleocharis sp.*), blackberry/raspberry/dewberry (*Rubus sp.*), hawthorn (*Crataegus sp.*)	1180+/-80 1160+/-80 1150+/-80 1020+/-80 1000+/-70 990+/-60 Beta-no lab # reported	675-994 AD 758-1016 AD 759-1020 AD 863-1211 AD 892-1190 AD 948-1186 AD	842 AD 862 AD 872 AD 1016 AD 1042 AD 1058 AD	Ouleout Site (8W-32-7), Feature 18, Delaware County, NY	Hartgen Associates 1989:26, 32-34
raspberry/blackberry/dewberry (*Rubus sp.*), mint family (*Labiatae*); wood = chestnut (*Castanea sp.*), oak (*Quercus sp.*)	1110+/-100 Beta 41248	683-1051 AD	911 AD	Smithfield Beach/Pardee 36Mr5 Feature 136	Hennessy 1992:148-149, 174, Appendix A
hickory (*Carya sp.*), walnut (*Juglans* sp.), legume or bean family (*Leguminosae*), horned pondweed family (*Zannichelliaceae*), nightshade family (*Solanaceae*), grass (*Sataria sp.*), possible mustard family (*Cruciferae*), cinquefoil (*Potentilla sp.*)	1100+/-50 Beta 42908	857-1022 AD	935 AD	Smithfield Beach/Pardee 36Mr5 Feature 133	Hennessy 1992: 148, 174, Appendix A
wood = maple (*Acer sp.*), birch (*Betula sp.*), hickory (*Carya sp.*), chestnut (*Castanea dentata*), beech (*Fagus grandifolia*), hop hornbeam (*Ostrya virginiana*), red oak group (*Quercus sp.*)	1060+/-40 Beta 198657	893-1027 AD	980 AD	Herrick Hollow V, Locus 1, Feature 5, Delaware County, NY	Hohman et al 2005:186, 205, Appendix II; Asch-Sidell 2005:Table 6
maize phytoliths (*Zea mays*)	1043+/-40 ISGS A0229	893-1041 AD	994 AD	Street, Otsego County, NY, pottery residue	Hart and Brumbach 2005:Table 1; Hart et al 2007:Tables 1, 6, 7
maize starch residue (*Zea mays*), possible legume or bean family starch residue (*Fabaceae*), true grasses family starch residue (*Poaceae*)	1040+/-40 Beta 212295	893-1044 AD	996 AD	Shoemakers Ferry 28Wa278 Feature 911	Barse 2006; Harbison 2008:Table 6.3; Messner et al 2008
hickory (*Carya sp.*), walnut (*Juglans sp.*)	1020+/-80 Beta 15576	863-1211 AD	1016 AD	Smithfield Beach/Pardee 36Mr5 Feature 13 base	Fischler and Mueller 1988; French 1988
maize (*Zea mays*), little barley (*Hordeum pusillum*), morning glory (*Ipomoea sp.*), hawthorn (*Crataegus sp.*), hickory (*Carya sp.*)	1000+/-70 Beta 46948	892-1190 AD	1042 AD	Chenango Point (SUBi-1274), Feature 54, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-18; Asch Sidell 2011:1057
unidentified seeds	990+/-120 Beta 19676	801-1260 AD	1045 AD	Ouleout Site (8W-32-7), Feature 19, Delaware County, NY	Hartgen Associates 1989:26, 34

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize (*Zea mays*), bunchberry (*Cornus canadensis*), acorn, *Quercus sp.*), hickory (*Carya sp.*), black walnut (*Juglans nigra*); wood = hickory (*Carya sp.*), ash (*Fraxinus sp.*), pine (*Pinus sp.*), red oak group (*Q. Erythrobalanus*), bean family (*Fabaceae*)	970+/-120 Beta 62433	859-1272 AD	1067 AD	Manna, 36Pi4 Feature 1D	Parker 1995:Table 3; Wall and Botwick 1995a:150-151, 1995b:Appendix VI
unidentified nuts	960+/-80 Beta 19933	949-1227 AD	1088 AD	Ouleout Site (8W-32-7), Feature 20, Delaware County, NY	Hartgen Associates 1989:26, 34-35
maize (*Zea mays*), acorn (*Quercus sp.*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), hazelnut (*Corylus sp.*), blackberry/raspberry/dewberry (*Rubus sp.*); wood = white oak (*Quercus alba*), hickory (*Carya sp.*), pine (*Pinus sp.*), chestnut (*Castanea dentata*), ash (*Fraxinus sp.*), maple (*Acer sp.*), birch (*Betula sp.*)	930+/-60 Beta 168303	1011-1221 AD	1106 AD	Deposit Airport I (SUBi-2048), Feature 6, Delaware County, NY	Knapp and Versaggi 2002:59,Tables 7, 8; Asch Sidell 2002d
bean (*Phaseolus vulgaris*), maize (*Zea mays*), goosefoot (*Chenopodium berlandieri*), marshelder (*Iva annua*), huckleberry (*Gaylussacia sp.*), acorn (*Quercus sp.*), black walnut (*Juglans nigra*), hickory (*Carya sp.*), butternut (*Juglans cinerea*), butternut/black walnut/hickory (*Juglans sp.*)	920+/-40 Beta 265480	1026-1192 AD	1105 AD	Chenango Point (SUBi-1274), Feature 383, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-48; Asch-Sidell 2011:Table 7
maize (*Zea mays*), butternut (*Juglans cinerea*), acorn (*Quercus sp.*), beechnut (*Fagus grandifolia*), goosefoot (*Chenopodium berlandieri*), blackberry/raspberry/dewberry (*Rubus sp.*)	920+/-40 Beta 168307	1026-1192 AD	1105 AD	Deposit Airport I (SUBi-2048), Feature 34, Delaware County, NY	Knapp and Versaggi 2002:107, Tables 7, 8; Asch Sidell 2002d
mint family *(Labiatae*), acorn (*Quercus sp.*) and hickory (*Carya sp.*); wood = oak (*Quercus sp.*)	900+/-40 Beta 247746	1034-1215 AD	1124 AD	Site ORA-9936, Feature 1-DD, Orange County, NY	Pretola and Freedman 2009:Tables 23-24; Largy 2009a:Tables 2-4
maize (*Zea mays*), ironwood (*Carpinus caroliniana*), blackberry/raspberry/dewberry (*Rubus sp.*); wood = maple (*Acer sp.*), birch (*Betula sp.*), chestnut (*Castanea dentata*), beech (*Fagus grandifolia*)	890+/-40 Beta 198656	1034-1220 AD	1136 AD	Herrick Hollow II, Locus 5, Feature 4, Delaware County, NY	Hohman et al 2005:76, Table 40, Appendix II; Asch-Sidell 2005:Table 6

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
pumpkin/squash (*Cucurbita sp.*), hickory (*Carya sp.*), goosefoot (*Chenopodium sp.*)	890+/-60 Beta 15573	1028-1250 AD	1136 AD	Smithfield Beach/Pardee 36Mr5 Feature 10	Fischler and French 1991, Fischler and Mueller 1988, French 1988, Hennessy 1992
maize (*Zea mays*), raspberry/blackberry/dewberry (*Rubus sp.*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), hazelnut (*Corylus sp.*); wood = maple (*Acer sp.*), birch (*Betula sp.*), hickory (*Carya sp.*), chestnut (*Castanea dentata*), hawthorn (*Crataegus sp.*), beech (*Fagus grandifolia*), ash (*Fraxinus sp.*), hop hornbeam (*Ostrya virginiana*), pine (*Pinus sp.*), basswood (*Tilia americana*), red oak group (*Quercus sp.*), conifer (*Coniferales*)	880+/-40 Beta 198654	1037-1225 AD	1156 AD	Herrick Hollow II, Locus 1, Feature 1, Delaware County, NY	Hohman et al 2005:76, 97, Table 40;); Asch-Sidell 2005:Tables 1, 6
maize (*Zea mays*), hickory (*Carya sp.*)	880+/-70 Sample 961, no lab #	1026-1261 AD	1146 AD	36Nm15, Padula, Feature 1B	Doershuk 1994:Figure 14.17, 307, 311,323; Weed et al 1990:152; Bergman et al 1994:4; Long 1994:293
maize (Zea mays), goosefoot (*Chenopodium berlandieri*), hawthorn (*Crataegus sp.*), blueberry (*Vaccinium sp.*), butternut (*Juglans cinerea*), acorn (*Quercus sp.*), hazelnut (*Corylus sp.*), hickory (*Carya sp.*), butternut/black walnut/hickory (*Juglans sp.*)	860+/-40 Beta 265476	1146-1260 AD 1044-1098 AD	1180 AD	Chenango Point (SUBi-1274), Feature 119, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-30; Asch Sidell 2011:Table 7
maize (*Zea mays*), acorn (*Quercus sp.*), butternut (*Juglans cinerea*), beechnut (*Fagus grandifolia*), sumac (*Rhus sp.*), blackberry/raspberry/dewberry (*Rubus sp.*); wood = white oak (*Quercus alba*), red oak (*Quercus* group *Lobatae*), elm (*Ulmus sp.*), poplar (*Populus sp.*), maple (*Acer sp.*), chestnut (*Castanea dentata*), pine (*Pinus sp.*), birch (*Betula sp.*), hickory (*Carya sp.*), conifer	850+/-40 Beta 168306	1147-1265 AD 1046-1091 AD	1190 AD	Deposit Airport I (SUBi-2048), Feature 29, Delaware County, NY	Knapp and Versaggi 2002:44, 99, Tables 7, 8; Asch Sidell 2002d
acorn (*Quercus sp.*)	840+/-70 Beta 227482	1115-1276 AD 1039-1110 AD	1183 AD	36Pi4, Manna, Feature 88, associated with dated component	Stewart et al 2015:Tables 17, 68

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize and maize starch (*Zea mays*), marshelder (*Iva annua)*, giant ragweed (*Ambrosia trifida*), hog peanut (*Amphicarpa bracteata*), goosefoot (*Chenopodium berlandieri*), false buckwheat (*Polygonum scandens*), huckleberry (*Gaylussacia sp.*), bramble (*Rubus sp.*), elderberry (*Sambucus sp.*), blueberry (*Vaccinium sp.*), black cohosh (*Cimicifuga racemosa*), spurge (*Euphorbia sp.*), touch-me-not (cf. *Impatiens sp.*), pokeweed (*Phytolacca americana*), smartweed (*P. pensylvanicum*), sumac (*Rhus sp.*), vervain (*Verbena urticifolia*), panic grass (*Panicum sp.*), grass family (*Poaceae*), composite family (*Asteraceae*), lily family (*Liliaceae*); nutshell = acorn (*Quercus sp.*), beechnut (*Fagus sp.*), black walnut (*Juglans nigra*), black walnut/hickory, hickory (*Carya sp.*); wood = black walnut (*Juglans nigra*), red oak group (*Quercus sp.*)	840+/-70 Beta 227482	1115-1276 AD 1039-1110 AD	1183 AD	36Pi4, Manna, Block 6, Unit 34, Feature 89	Stewart et al 2015:197-200, Tables 17, 69, 70; Asch-Sidell 2015
maize (*Zea mays*), hickory (*Carya sp.*), acorn-oak starch residue (*Quercus sp.*), beech and oak family starch residue (*Fagaceae*), true grasses family starch residue (*Poaceae*), little barley/ wild rye (*Hordeum/Elymus*)	830+/-50 Beta 219495	1148-1277 AD 1046-1090 AD	1203 AD	Ventura Tract, Pike County, PA Feature 4	Messner 2008:92; Messner et al 2006; Messner 2011:91, Table 5.1
squash (*Cucurbita pepo*)	820+/-40 AA31006	1154-1277 AD	1218 AD	Broome Tech Site (SUBi-1005) , midden, Broome County, NY	Knapp 2002:Table 9.1
goosefoot (*Chenopodium sp.*)	810+/-80 Beta-no lab # reported	1030-1298 AD	1203 AD	Otego Yard Site (NYSM 121), Feature 79, Otsego County, NY	Hartgen Associates 1988b:54, 78, 101-102, Tables 32, 34
maize (*Zea mays*), bean family (*Fabaceae*), common sunflower (*Helianthus annus*), hickory (*Cary sp.*), black walnut (*Juglans nigra*); wood = hickory (*Cary sp.*), chestnut (*Castanea dentata*), walnut	780+/-110 Beta 57129			36Pi136, Dingmans Launch Lower Boat Ramp, Feature 2	Alterman 1993:Table 1; Parker 1993a:Table 1

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
or butternut (*Juglans sp.*), pine (*Pinus sp.*), sycamore (*Platanus occidenttalis*), oak (*Quercus sp.*), red oak subgroup (*Quercus* subfamily *Erythrobalanus*)	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 2 continued				
hickory (*Carya sp.*) and/or walnut (*Juglans sp.*)	770+/-50 DIC-1154	1161-1297 AD	1245 AD	Medwin Knoll 28Sx266 Feature 25	Williams et al 1982:41, Table 5
maize (*Zea* mays), butternut (*Juglans cinerea*), acorn (*Quercus sp.*), hazelnut (*Corylus sp.*), hickory (*Carya sp.*), butternut/black walnut/hickory (*Juglans sp.*), raspberry/blackberry/dewberry (*Rubus sp.*), huckleberry (*Gaylussacia sp.*), sumac (*Rhus sp.*)	760+/-40 Beta 265475	1203-1294 AD	1255 AD	Chenango Point (SUBi-1274), Feature 118, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-29); Asch Sidell 2011:Table 7
hickory (*Carya sp.*), walnut (*Juglans sp.*)	760+/-60 Beta 15575	1154-1316 AD	1249 AD	Smithfield Beach/Pardee 36Mr5 Feature 13 top	Fischler and Mueller 1988; French 1988
hickory (*Carya sp.*), goosefoot (*Chenopodium sp.*)	750+/-60 Beta 15574	1160-1316 AD	1257 AD	Smithfield Beach/Pardee 36Mr5 Feature 11	Fischler and Mueller 1988; French 1988
maize (*Zea* mays), wild rye (*Elymus sp.*), butternut (*Juglans cinerea*)	740+/-40 Beta 265473	1215-1301 AD	1267 AD	Chenango Point (SUBi-1274), Feature 102, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-22; Asch Sidell 2011:Table 7
maize (*Zea* mays), squash rind (*Cucurbita pepo*), acorn (*Quercus sp.*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), hickory (*Carya sp.*), butternut/black walnut/hickory (*Juglans sp.*), goosefoot (*Chenopodium berlandieri*), huckleberry (*Gaylussacia sp.*), smartweed (*Polygonum cf. persicaria*), grape (*Vitis sp.*), raspberry/blackberry/dewberry (*Rubus sp.*)	740+/-40 Beta 265474	1215-1301 AD	1267 AD	Chenango Point (SUBi-1274), Feature 105, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-23; Asch Sidell 2011:Table 7
maize (*Zea* mays), sedge family (*Cyperaceae*), bean family (*Fabaceae*), common bean (*Phaseolus vulgaris*), common sunflower (*Helianthus annus*), pokeweed (*Phytolacca Americana*), grass family (*Poaceae*), knotweed (*Polygonum sp.*), sumac	740+/-80 Beta 57128	1152-1405 AD	1262 AD	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 1	Alterman 1993:21; Parker 1993a:Table 1

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
(*Rhus sp.*), elderberry (*Sambucus canadensis*), hickory (*Carta sp.*), chestnut (*Castanea dentata*), hickory/walnut family (*Juglandaceae*), black walnut (*Juglans nigra*), acorn (*Quercus sp.*); wood = hickory (*Cary sp.*), chestnut (*Castanea dentata*), walnut/butternut (*Juglans sp.*), pine (*Pinus sp.*), oak (*Quercus sp.*), red oak subgroup (*Quercus* subfamily *Erythrobalanus*)	36Pi136, Dingmans Launch Lower Boat Ramp, Feature 1 continued				
raspberry/blackberry/dewberry (*Rubus sp.*), butternut (*Juglans cinerea*), hickory (*Carya sp.*); wood = hickory (*Carya sp.*), red oak group (*Quercus sp.*)	730+/-40 Beta 256727	1218-1304 AD	1272 AD	BRO-117 Site, Feature 99, Broome County, NY	Kelly 2009b:145, Table 83, Appendix I
maize (*Zea mays*) and/or legume or bean family (*Leguminosae*)	720+/-50 DIC-1157	1215-1321 AD 1349-1392 AD	1278 AD	Medwin Knoll 28Sx266 Feature 22	Williams et al 1982:41, Table 5
maize (*Zea mays*)	705+/-40 AA31005	1244-1318 AD 1352-1390 AD	1286 AD	Broome Tech Site (SUBi-1005) , Feature 7, Broome County, NY	Miroff 2014:Table 9; Knapp 2002:Table 9.1
maize (*Zea mays*), squash rind (*Cucurbita sp.*), goosefoot (*Chenopodium berlandieri*), hawthorn (*Crataegus sp.*), raspberry/blackberry/dewberry (*Rubus sp.*), butternut (*Juglans cinerea*), butternut/hickory/black walnut (*Juglans sp.*)	700+/-40 Beta 265479	1248-1321 AD 1348-1392 AD	1289 AD	Chenango Point (SUBi-1274), Feature 401, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-53
bean (*Phaseolus vulgaris*), maize (*Zea mays*), sunflower (*Helianthus annus*), tick trefoil (*Desmodium sp.*), sumac (*Rhus sp.*), blueberry *Vaccinium sp.*), butternut (*Juglans cinerea*), hickory (*Carya sp.*); wood = hickory (*Carya sp.*), chestnut (*Castanea dentata*), ash (*Fraxinus sp.*), sycamore (*Platanus occidentalis*), red oak group (*Quercus sp.*), white oak group (*Quercus sp.*)	690+/-30 Beta 378840	1266-1312 AD 1358-1387 AD	1291 AD	Otsiningo Market Site (SUBi-3041), Feature 10C, Broome County, NY	Miroff 2014:43, Table 8, Appendix V, Table A5-10; Asch Sidell 2014:Table 7

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
raspberry/blackberry/dewberry (*Rubus sp.*), hawthorn (*Crataegus sp.*), plum/cherry (*Prunus sp.*); wood = hop hornbeam (*Ostrya virginia*), conifer (*Coniferales*), white oak group (*Quercus sp.*), pine/spruce/larch (*Pinaceae*), maple (*Acer sp.*)	690+/-40 Beta 256724	1258-1323 AD 1346-1393 AD	1296 AD	BRO-117 Site, Feature 35, Broome County, NY	Kelly 2009b:108, Table 53, Appendix I
maize (*Zea mays*), dogwood (*Cornus sp.*), acorn (*Quercus sp.*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), butternut/hickory/black walnut (*Juglans sp.*)	680+/-50 Beta 46947	1259-1399 AD	1311 AD	Chenango Point (SUBi-1274), Feature 45, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-15); Asch Sidell 2011:Table 7
maize (*Zea mays*), bean (*Phaseolus vulgaris*), blueberry (*Vaccinium sp.*), acorn (*Qyercus sp.*), butternut (*Juglans cinerea*), hickory (*Carya sp.*); wood = hickory (*Carya sp.*), chestnut (*Castanea dentata*), ash (*Fraxinus sp.*), hop hornbeam (*Ostrya virginiana*), pitch pine (*Pinus rigida*), red oak group (*Quercus sp.*), elm (*Ulmus sp.*)	670+/-30 Beta 379672	1274-1319 AD 1351-1391 AD	1309 AD	Otsiningo Market Site (SUBi-3041), Feature 1, Broome County, NY	Miroff 2014:Table 8, Appendix V, Table A5-1; Asch Sidell 2014:Table 7
maize (*Zea mays*), hickory (*Carya sp.*), walnut (*Juglans sp.*)	670+/-70 Beta 15572	1241-1413 AD	1322 AD	Smithfield Beach/Pardee 36Mr5 Feature 7	Fischler and Mueller 1988; French 1988
maize (*Zea mays*), goosefoot (*Chenopodium berlandieri*), huckleberry (*Gaylussacia sp.*), smartweed (*Polygonum cf. persicaria*), sumac (*Rhus sp.*), acorn (*Quercus sp.*), hickory (*Carya sp.*)	660+/-40 Beta 265478	1273-1330 AD 1339-1397 AD	1335 AD	Chenango Point (SUBi-1274), Feature 348, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-41); Asch Sidell 2011:Table 7
maize (*Zea mays*), sunflower (*Helianthus sp.*), hickory (*Carya sp.*)	650+/-40 Beta 140973	1278-1332 AD 1337-1398 AD	1345 AD	Park Creek II (Subi-1464, NYSM #10222), Feature 3, Broome County, NY	Miroff 2002:Tables 34, 36; Asch Sidell 2002b
maize (*Zea mays*)	650+/-40 Beta 196043	1282-1399 AD	1347 AD	Broome Tech Site (SUBi-1005), Feature 58, Broome County, NY	Miroff 2014:Table 9
black walnut (*Juglans nigra*)	640+/-120 Beta 50979	1151-1493 AD	1333 AD	36Nm15, Padula, Feature 7	Doershuk 1994:Figures 14.5, 14.17; Long 1994
maize (*Zea mays*)	630+/-105 DIC-1355 550+/-135 DIC-1356	1169-1460 AD 1210-1650 AD	1341 AD 1393 AD	Medwin North 28Sx5 Feature 1	Williams et al 1982

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize (*Zea mays*), false buckwheat (*Polygonum scandens*), hazelnut (*Corylus sp.*), hickory (*Carya sp.*), butternut/black walnut/hickory (*Juglans sp.*); wood = hickory (Carya sp.), bitternut hickory (*Carya cordiformis*), ash (*Fraxinus sp.*), white pine (*Pinus strobus*), red oak group (*Quercus sp.*), white oak group (*Quercus sp.*)	600+/-30 Beta 309043	1297-1373 AD 1377-1408 AD	1346 AD	Chenango Point South (SUBi-2776), Feature 180, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8
maize (*Zea mays*), sunflower (*Helianthus annuus*), hawthorn (*Crataegus sp.*), tick trefoil (*Desmodium sp.*), sumac (*Rhus sp.*), blueberry (*Vaccinium sp.*), acorn (*Quercus sp.*), butternut (*Juglans cinerea*), hickory (*Carya sp.*); wood = chestnut (*Castanea dentata*), pitch pine (*Pinus rigida*), red oak group (*Quercus sp.*), white oak group (*Quercus sp.*), elm (*Ulmus sp.*)	600+/-30 Beta 378839	1297-1373 AD 1377-1408 AD	1346 AD	Otsiningo Market Site (SUBi-3041), Feature 5, Broome County, NY	Miroff 2014:Table 8, Appendix V, Table A5-5; Asch Sidell 2014:Table 7
hawthorn (*Crataegus sp.*), grass family (*Gramineae*), butternut (*Juglans cinerea*), goosefoot (*Chenopodium sp.*), dogwood (*Cornus sp.*), mint family (*Labiatae*), daisy family (*Asteraceae*), clover (*Lespedeza sp.*), knotweed family (*Polygonaceae*), violet (*Viola sp.*), pondweed (*Potomogeton sp.*), sedge family (*Cyperaceae*), unidentified nut; wood = white oak group (*Quercus sp.*), red oak group (*Quercus sp.*), hop hornbeam (*Ostrya virginiana*), pine/spruce/larch (*Pinaceae*), hickory (*Carya sp.*), ash (*Fraxinus sp.*), chestnut (*Castanea dentata*), maple (*Acer sp.*), flowering dogwood (*Cornus florida*), elm (*Ulmus sp.*), hornbeam (*Carpinus caroliniana*), walnut family (*Juglandaceae*), beech family (*Fagaceae*)	590+/-40 Beta 256726 580+/-40 Beta 256725 560+/-40 Beta 256731 450+/-40 Beta 256730 310+/-40 Beta 256728	1296-1415 AD 1298-1373 AD 1377-1421 AD 1301-1367 AD 1382-1433 AD 1407-1513 AD 1473-1653 AD	1349 AD 1350 AD 1358 AD 1444 AD 1563 AD	BRO-117 Site, Feature 13/14, sheet midden, Broome County, NY	Kelley 2009b:64, Table 17, Appendix I

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
purslane (*Portulaca sp.*), goosefoot (*chenopodium sp.*)	590+/-80 Beta 21552 400+/-140 Beta 21551	1300-1369 AD 1381-1412 AD 1287-1695 AD 1726-1813 AD	1354 AD 1536 AD	Milford Beach 36Pi135 Feature 20	Fischler and Mueller 1991:131-132
goosefoot (*chenopodium sp.*), blackberry/raspberry/dewberry (*Rubus sp.*), amaranth (*Amaranthus sp.*), unidentified nuts	570+/-60 Beta-no lab # reported	1293-1436 AD	1357 AD	Otego Yard Site (NYSM 121), Feature 22C, Otsego County, NY	Hartgen Associates 1988b:46, 108, 101-102, Tables 32, 33, 34
maize (*Zea mays*), bramble (*Rubus sp.*), acorn (*Quercus sp.*), beechnut (*Fagus grandifolia*)	560+/-40 Beta 140975	1301-1367 AD 1382-1433 AD	1358 AD	Park Creek II (Subi-1464, NYSM #10222), Feature 2, Broome County, NY	Miroff 2002:Tables 34, 36; Asch Sidell 2002b
wood = birch (*Betula sp.*), hickory (*Carya sp.*)	560+/-60 Beta 142037	1295-1439 AD	1362 AD	Raish Site (Subi-1465, NYSM #10223), Feature 3, Broome County, NY	Miroff 2002:Tables 77, 79; Asch Sidell 2002c:Appendix 11.10
maize (*Zea mays*), sunflower (*Helianthus annuus*), acorn (*Quercus sp.*), black walnut (*Juglans nigra*), hickory (*Carya sp.*); wood = hickory (*Carya sp.*), bitternut hickory (*Carya cordiformis*), chestnut (*Castanea dentata*), pitch pine (*Pinus rigida*), sycamore (*Platanus occidentalis*), elm/hackberry (*Ulmaceae*), red oak group (*Quercus sp.*), white oak group (*Quercus sp.*)	550+/-30 Beta 309044	1312-1358 AD 1387-1432 AD	1395 AD	Chenango Point South (SUBi-2776), Feature 275, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8
maize (*Zea mays*), water lily starch (*Nymphaea odorata*), lily (possibly *Erythronium sp.*), possible little barley starch (*Hordeum pusillum*)	550+/-40 Beta 227479	1304-1365 AD 1384-1438 AD	1388 AD	36Pi4, Manna, Block 2, Unit 51, Feature 49	Messner and Dickau 2005, Messner et al 2008, Messner 2008:315-316; Stewart et al 2015:Table 17
maize (*Zea mays*)	550+/-40 Beta 227478	1304- 1365 AD 1384- 1438 AD	1388 AD	36Pi4, Manna, Block 6, Unit 31, Stratum 5	Stewart et al 2015:Table 17
marshelder (*Iva annua*) ***maize*** (*Zea mays*) goosefoot (*Chenopodium berlandieri*), hawthorn (*Crataegus sp.*), huckleberry (*Gaylussacia sp.*), blueberry (*Vaccinium sp.*), butternut or black walnut, hickory (*Juglans sp.*); wood = hickory (*Carya sp.*), bitternut hickory (*Carya cordiformis*), pitch pine (*Pinus rigida*), red oak group and white oak group (*Quercus sp.*)	540+/-30 Beta 332933 300+/-30 Beta 309042	1316-1354 AD 1389-1436 AD 1490-1602 AD 1612-1654 AD	1403 AD 1563 AD	Chenango Point South (SUBi-2776), Feature 176, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize (*Zea mays* starch), acorn (*Quercus sp.*), hickory (*Carya sp.*), amaranth (*Amaranthus sp.*), goosefoot (*Chenopodium sp.*)	540+/-40 Beta 234911	1308-1362 AD 1386-1441 AD	1398 AD	28Wa278, Shoemakers Ferry, Feature 718, residue on pottery	Harbison 2008:82-83, 118, Table 6.1
unidentified nuts	540+/-100 Y-2473	1269-1523 AD	1391 AD	36Pi13A, Faucett, Feature 52	Kinsey 1972:195, 1975:28
maize (*Zea mays*)	530+/-40 Beta 227481	1312-1359 AD 1387-1444 AD	1405 AD	36Pi4, Manna, Block 2, Units 48E, 47E, Feature 10, feature stratum 8, level 3	Stewart et al 2015:Table 17
maize (*Zea mays*), raspberry/blackberry/dewberry (*Rubus sp.*), sumac (*Rhus sp.*)	530+/-50 Beta 46946	1302-1366 AD 1382-1448 AD	1400 AD	Chenango Point (SUBi-1274), Feature 4, Broome County, NY	Knapp 2011: Table 4.3, Appendix 3, Table A3-6
wood = ash (*Fraxinus sp.*)	520+/-40 Beta 256733	1389-1447 AD 1315-1355 AD	1412 AD	BRO-117 Site, Feature 126, Broome County, NY	Kelly 2009b:155, Appendix I
raspberry/blackberry/dewberry (*Rubus sp.*)	510+/-60 Beta-no lab # reported	1297-1484 AD	1411 AD	Otego Yard Site (NYSM 121), Feature 158, Otsego County, NY	Hartgen Associates 1988b:48, 108, 101-102, Tables 32, 34
maize (*Zea mays*)	500+/-40 Beta 265509 1170+/-40 Beta 265509 assay based on mussel shell	1391-1454 AD	1422 AD	Depue Island 36Mr45 Kline pit feature	Stewart and Bitting n.d.; Stinchcomb et al 2011
maize (*Zea mays*), hickory (*Carya sp.*)	480+/-40 Beta 140976	1395-1475 AD	1430 AD	Park Creek II (Subi-1464, NYSM #10222), Feature 5, Broome County, NY	Miroff 2002:Tables 34, 36; Asch Sidell 2002b
maize (*Zea mays*), raspberry/blackberry/dewberry (*Rubus sp.*), walnut/hickory family (*Juglandaceae*), goosefoot (*Chenopodium sp.*), spurge (*Euphorbia sp.*), mint family (*Lamiaceae*), carpetweed (*Mollugo verticillata*), wood sorrel (*Oxalis sp.*), pokeweed (*Phytolacca americana*), grass family (*Poaceae sp.*), purslane (*Portulaca sp.*), sumac (*Rhus sp.*), clover (*Trifolium sp.*), smartweed/knotweed (*Polygonum sp.*), mustard family (*Brassicaceae sp.*);	450+/-70 Beta 123480 320+/-60 Beta 123481 290+/-60 Beta 123482 410+/-60 Beta 123483	1392-1636 AD 1448-1665 AD 1450-1680 AD 1419-1532 AD 1537-1636 AD	1462 AD 1562 AD 1580 AD 1499 AD	36Pi172, Kidney, Feature 6	Brown et al 2000:I, 41-44, Table 5

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
wood = chestnut (*Castanea dentata*), oak (*Quercus sp.*), pine (*Pinus sp.*)	36Pi172, Kidney, Feature 6 continued				
maize (*Zea mays*), hickory (*Carya sp.*)	440+/-40 Beta 265507 740+/-40 Beta 265506 assay based on mussel shell	1410-1519 AD	1451 AD	McCann #1&2 36 Pi33 Pit 19	Stewart and Bitting n.d.; Stinchcomb et al 2011
hickory (*Carya sp.*)	430+/-40 Beta 251444	1414-1521 AD	1459 AD	Site ORA-0550, Feature 42, Orange County, NY	Pretola and Freedman 2009:233, Table 84
maize (*Zea mays*), bean family (*Fabaceae*), acorn (*Quercus sp.*), hickory (*Carya sp.*), dogwood family (*Cornaceae*), huckleberry (*Gaylussacia sp.*), grass family (*Poaceae*), elderberry (*Sambucus Canadensis*), blueberry (*Vaccinium sp.*); wood = hickory (*Carya sp.*), chestnut (*Castanea dentata*), red oak group (*Q. Erythrobalanus*)	430+/-110 Beta 62435	1294-1667 AD	1498 AD	Peters-Albrecht 36Pi21 Feature 2	Parker 1995:Table 4; Wall and Botwick 1995b:Appendix VI
hickory (*Carya sp.*), walnut (*Juglans sp.*)	420+/-45 DIC-1214	1418-1524 AD 1558-1631 AD	1474 AD	Medwin Knoll 28Sx266 Feature 9	Williams et al 1982:40, Table 5
goosefoot (*Chenopodium sp.*), walnut (*Juglans sp.*), raspberry/blackberry (*Rubus sp.*), pine cone scale (*Pinus sp.*); wood = hornbeam (*Carpinus caroliniana*), pine (*Pinus sp.*), oak (*Quercus sp.*)	400+/-60 Beta 123476 190+/-60 Beta 123477	1427-1637 AD 1635-1898 AD 1901-1950 AD	1509 AD 1772 AD	36Pi169, Shohola Flats, Feature 50	Trachtenberg et al 2008:73-74, Appendix L; Appendix G – Cummings and Puseman 2003
maize (*Zea mays*), acorn (*Quercus sp.*), hackberry (*Celtis sp.*), dogwood (*Cornus sp.*), mulberry (*Morus sp.*), goosefoot (*Chenopodium sp.*), slender bush clover (*Lespedeza sp.*), burclover (*Medicago sp.*), mint (*Mentha sp.*), grass (*Panicum sp.*), Poke (*Phytolacca sp.*), plantain (*Palntago sp.*), knotweed (*Polygonum sp.*), purslane (*Portulaca sp.*), wild bean (*Strophostyles sp.*), violet (*Viola sp.*), domesticated bean (*Phaseolus sp.*)	400+/-70 Beta 15571	1418-1643 AD	1513 AD	Smithfield Beach/Pardee 36Mr5 Feature 6	Fischler and Mueller 1988; French 1988

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
hickory (*Carya sp.*)	400+/-40 Beta 251447	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 120, Orange County, NY	Pretola and Freedman 2009:239-240, Table 84
possible maize (*Zea mays*), hickory (*Carya sp.*)	400+/-40 Beta 251449	1432-1526 AD 1555-1632 AD	1489 AD	Site ORA-0550, Feature 152, Orange County, NY	Pretola and Freedman 2009:240-241, Table 84
maize (*Zea mays*)	390+/-40 Beta 227480	1437-1528 AD 1551-1634 AD	1502 AD	36Pi4, Manna, Block 6, Unit 34, Stratum 3	Stewart et al 2015:Table 17
maize (*Zea* mays), goosefoot (*Chenopodium sp.*), hickory (*Carya sp.*)	380+/-40 Beta 251448	1442-1529 AD 1543-1634 AD	1512 AD	Site ORA-0550, Feature 132, Orange County, NY	Pretola and Freedman 2009:235, Table 84
maize (*Zea mays*), black walnut (*Juglans nigra*), bean (*Phaseolus sp.*), goosefoot (*chenopodium sp.*), poke (*Phytolacca sp.*), smartweed (*Polygonum sp.*), three-seeded mercury (*Acalypha virginica*)	370+/- 40 Beta 265508 1380+/-40 Beta 266401 assay based on mussel shell	1446-1530 AD 1539-1635 AD	1524 AD	Faucett 36Pi13A Feature 207	Stewart and Bitting n.d.; Stinchcomb et al 2011; Moeller 1992:Table 9
hickory (*Carya sp.*), acorn (*Quercus sp.*)	370+/-40 Beta 251446	1446-1530 AD 1539-1635 AD	1524 AD	Site ORA-0550, Feature 74, Orange County, NY	Pretola and Freedman 2009:234, Table 84
raspberry/blackberry/dewberry (*Rubus sp.)*, coneflower (*Rudbeckia sp.*), false pennyroyal (*Hedeoma sp.*), carpetweed (*Mollugo sp.*), unidentified nut; wood = oak (*Quercus sp.*), pine (*Pinus sp.*), hickory/pecan (*Carya sp.*)	350+/-60 Beta 42910	1444-1648 AD	1549 AD	Smithfield Beach/Pardee 36Mr5 Feature 114	Hennessy 1992:151, 153, Appendix A
unidentified nut	340+/-50 Beta 28855	1454-1644 AD	1554 AD	36Nm12, Sandts Eddy, Feature 12	Doershuk and Bergman 1996:321; Weed et al 1990
hickory (*Carya sp.*)	340+/-40 Beta 251450	1462-1642 AD	1556 AD	Site ORA-0550, Feature 106, Orange County, NY	Pretola and Freedman 2009:241-242, Table 84
maize (*Zea mays*), hickory (*Carya sp.*), acorn (*Quercus sp.*), grass family (*Poaceae*); wood = maple (*Acer sp.*), hickory (*Carya sp.*), chestnut (*Castanea dentate*), ash (*Fraxinus sp.*), pine (*Pinus sp.*), oak (*Quercus sp.*), red oak group (*Q. Erythrobalanus*), elm family (*Ulmaceae*), American elm (*Ulmus Americana*)	330+/-70 Beta 62434	1437-1669 AD	1560 AD	Peters-Albrecht 36Pi21 Feature1	Parker 1995:Table 4; Wall and Botwick 1995b:Appendix VI
unidentified nut	300+/-40 No lab # listed	1477-1662 AD	1565 AD	28Wa278, Shoemakers Ferry, Feature 1700	Harbison 2008:119, Table 6.1

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
maize (*Zea mays*), butternut (*Juglans cinerea*), hickory (*Carya sp.*)	300+/-30 Beta 309040	1490-1602 AD 1612-1654 AD	1563 AD	Chenango Point South (SUBi-2776), Feature 46, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8
raspberry/blackberry/dewberry (*Rubus sp.)*, plum (*Prunus sp.*)	280+/-80 Beta-no lab # reported	1444-1695 AD 1726-1814 AD	1609 AD	Otego Yard Site (NYSM 121), Feature 99, Otsego County, NY	Hartgen Associates 1988b:48, 108, 101-102, Tables 32, 34
maize (*Zea mays*)	270+/-70 GX-11930	1449-1694 AD 1727-1813 AD	1621 AD	Russ (Una 19-4), Locus 2, Feature 89, Section W15S45, Otsego County, NY	Funk 1993:Table 16, 1998:450-451
maize (*Zea mays*), huckleberry (*Gaylussacia sp.*), raspberry/blackberry/dewberry (*Rubus sp.*), butternut (*Juglans cinerea*), chestnut (*Castanea dentata*), hazelnut (*Corylus sp.*), hickory (*Carya sp.*)	270+/-30 Beta 309041	1515-1597 AD 1617-1668 AD	1632 AD	Chenango Point South (SUBi-2776), Feature 90, Broome County, NY	Miroff 2012:Table 4.3, Appendix IV; Asch Sidell 2012:Table 8
maize (*Zea mays*)	270+/-40 Beta 227477	1486-1604 AD 1608-1675 AD	1612 AD	36Pi4, Manna, Block 6, Unit 31, Stratum 4	Stewart et al 2015:Table 17
butternut (*Juglans* cinerea), acorn (*Quercus sp.*), goosefoot (*Chenopodium sp.*), raspberry/blackberry/dewberry (*Rubus sp.)*, amaranth (*Amaranthus sp.*), elderberry (*Sambucus sp.*)	260+/-60 Beta-no lab # reported	1460-1692 AD 1728-1811 AD	1637 AD	Otego Yard Site (NYSM 121), Feature 21, Otsego County, NY	Hartgen Associates 1988b:101-102, Tables 32, 34
hickory (*Carya sp.*), walnut (*Juglans sp.*), hackberry (*Celtis sp.*), goosefoot (*chenopodium sp.*), poke (*Phytolacca sp.*), knotweed (*Polygonum sp.*), purslane (*Portulaca sp.*), clover (*Trifolium sp.*)	260+/-80 Beta 15569	1450-1699 AD 1721-1818 AD 1915-1950 AD	1643 AD	Milford Beach 36Pi135 Feature 1	Fischler and Mueller 1988. 1991; French 1988
knotwood or sedge (*Polygonaceae or Cyperaceae*), wormwood (*Artemisia sp.*), unidentified nut; wood = oak (*Quercus sp.)*	260+/-40 Beta 250830	1491-1602 AD 1613-1681 AD 1763-1802 AD	1641 AD	Site ORA-9936, Feature 1-U, Orange County, NY	Pretola and Freedman 2009:Tables 23-24
legume (*Leguminoseae*), rose family (*Rosaceae*), grass family (*Gramineae*), bracken fern (*Pteridium aquilinum*), unidentified nut; wood = sycamore (*Plantanus occidentalis*) or beech (*Fagus grandifolia*)	230+/-40 Beta 247745	1625-1691 AD 1728-1811 AD 1920-1950 AD	1739 AD	Site ORA-9936, Feature 4, Orange County, NY	Pretola and Freedman 2009:120, Tables 23-24, 120; Largy 2009a:5, Tables 2-5

Table 27 Continued					
Floral Remains	**Date BP**	**Calibrated* 2 Sigma Age BC/AD**	**Calibrated* Median Age BC/AD**	**Site & Context**	**Reference**
wood = hickory (*Carya sp.*), chestnut (*Castanea dentata*)	210+/-40 Beta 216050	1635-1696 AD 1725-1814 AD 1917-1950 AD	1766 AD	36Nm204, Feature 1-07	Hornum et al 2009:46; Appendix III:487; McKnight 2006

*Calibrated with Intcal13.14c data (Reimer et al 2013) using Calib 7.10 (Stuiver et al 2017; cf. Stuiver and Reimer 1993). Calibrated 2 sigma age ranges represent the greatest relative area under the probability distribution curve, generally areas between .90 and 1.00. **italicized and bold indicates direct AMS date of botanical.

Messner (2008:Tables 1, 3, 11; 2011:Tables 2.2-2.4) previously compiled lists of macrobotanical remains from archaeological and ethnohistoric contexts for the Delaware River watershed. Table 28 summarizes additions to his summaries, abstracted from Table 27. Neither Messner's original tables nor the listed additions include tree species represented by wood charcoal found in the archaeological deposits of the region. Dent (1985b), Goldman (1975), and Moeller (1992) provide lists of current plant species in the Upper Delaware for comparative purposes. Table 29 is a summary of paleoenvironmental changes for the study area and serves as general environmental background for some of the discussion that follows.

TABLE 28
ADDITIONS TO PREVIOUS COMPILATIONS OF MACROBOTANICAL REMAINS

COMMON NAME	**FAMILY***	**TAXA**	**CULTURAL HISTORICAL TIME FRAME**
black cohosh		*Cimicifuga racemosa*	Late Woodland
bracken fern		*Pteridium aquilinum*	Contact/Historic
buckbean		*Menyanthes trifoliate*	Paleoindian, Middle Woodland
bunchberry		*Cornus canadensis*	Late Woodland
burclover		*Medicago sp.*	Late Woodland
carrot or parsley family	*Apiaceae*		Late/Transitional Archaic
chickweed		*Stellaria sp.*	Late/Transitional Archaic
cinquefoil		*Potentilla sp.*	Late Woodland
clover		*Trifolium sp.*	Late/Transitional Archaic, Middle Woodland, Late Woodland, Late Woodland/Contact
coneflower		*Rudbeckia sp.*	Late Woodland
false pennyroyal		*Hedeoma sp.*	Late Woodland
hackberry		*Celtis sp.*	Paleoindian, Late/Transitional Archaic, Late Woodland, Late Woodland/Contact
horned pondweed family	*Zannichelliaceae*		Late Woodland
ironwood**		*Carpinus caroliniana*	Late Woodland
mint		*Mentha sp.*	Late Woodland
morning glory		*Ipomoea sp.*	Late Woodland
mulberry		*Morus sp.*	Late/Transitional Archaic
Phacelia		*Phacelia sp.*	Late/Transitional Archaic

plantain		*Palntago sp.*	Late Woodland
poppy family	*Papaveraceae*		Middle Woodland
spike rush		*Eleocharis sp.*	Middle/Late Woodland
toadflax		*Linaria vulgaris*	Late/Transitional Archaic

Table 28 continued

COMMON NAME	FAMILY*	TAXA	CULTURAL HISTORICAL TIME FRAME
tupelo**		*Nyssa sp.*	Late/Transitional Archaic
tupelo/black gum **		*Nyssa sylvatica*	Late/Transitional Archaic
violet		*Viola sp.*	Late/Transitional Archaic, Late Woodland
winter cress		*Barbarea orthoceras*	Paleoindian
wormwood		*Artemisia sp.*	Late Woodland/Contact

*Family identification only when genus could not be identified.
**Plant element other than wood identified.

TABLE 29
SUMMARY OF PALEOENVIRONMENTAL CHANGES, UPPER DELAWARE VALLEY*

Period (years B.P.)	Fluvial Phase	Bioclimatic Zone	Climate	Forest Type
late Pleistocene - early Holocene >10, 700	braided stream phase	Post-glacial To Younger Dryas	Cool Wet to Cool Dry	Tundra, Spruce parkland to Spruce Pine
early Holocene 10,700 – 8000	stable floodplain phase	Pre-Boreal and Boreal	Warm Dry	Pine Birch (with fir, oak, hemlock, alder) to Pine Oak. Floodplains characterized by pine and birch
early-middle Holocene 8000 – 5000	floodplain erosion and deposition phase	Atlantic	Warm and Moister	Oak Hemlock with rapid initial decrease of pine. Floodplains characterized by oak
late-middle Holocene 5000 – 3200	reworking and aggradation phase	Sub-Boreal	Warm Dry	Oak Hickory with decline of hemlock
late Holocene 3200 – 1000	stability and aggradation phase	Sub-Atlantic and Scandic	Warm Moist to Cool Moist	Oak Chestnut Floodplains characterized by oak, pine, chestnut, sycamore, catalpa
latest Holocene 1000–present	rapid sedimentation, renewed reworking phase	Neo-Atlantic, Pacific and Neo-Boreal (“Little Ice Age”)	Warm Moist to Cool Moist to Cool Dry	Oak Chestnut (with hemlock) to Oak Chestnut (with increase in spruce, pine)

*Period and fluvial phases from Stinchcomb, Driese, Nordt and Allen (2012) and Vento and Stinchcomb (2013). Bioclimatic zones, climate and forest types from Dent (1979), Vento and Stinchcomb (2013), Vento et al (2008) and Witte (2001).

Botanical remains from the deeply stratified Shawnee Minisink Site not only anchor the diverse use of plants in Paleoindian times, but reveal the consistent use of a variety of wild resources through time (Dent and Kaufman 1985). Recoveries from other dated contexts in the Upper Delaware support this trend. What becomes important for future research is determining the relative importance of individual items to various cultural practices over this same span of time.

Hickory has the longest dated use history of the nut- and acorn-bearing trees represented in the archaeological record, first appearing in the Paleoindian deposits at Shawnee Minisink. However, its next dated occurrence isn't until 4710+/-40 BP (3495 BC calibrated median), a time during which hickory has become well represented in area forests (see Table 29). As yet unidentified nutshell has been found in Paleoindian contexts at the Snyder Complex (Rankin and Stewart 2016). Hazelnut and butternut are more consistently represented in assemblages of Early and Middle Archaic age. Chestnut first appears in a dated context at 3495 BC and acorn at 3046 BC (calibrated medians). Of course any "trends" seen in the small number of dated contexts with mast for Paleoindian, Early and Middle Archaic times frames could easily be overturned with the addition of a handful of new finds. Black walnut (*Juglans nigra*) is not specifically identified until 884/513 BC (calibrated medians) although it could be represented by a number of earlier finds that only could be identified to the level of genus (*Juglans sp.*).

Determining the relative abundance of hickory, hazelnut and butternut (*Juglans cinerea*) in comparison with black walnut (*Juglans nigra*), chestnut and acorn-bearing species in early and middle Holocene environments would be informative. If the representations are fairly equitable one might conclude that hickory, hazelnut and butternut are intentionally selected as a matter of cultural preference. The habitat requirements and productive cycles of the trees also would need to be considered, as would the changing nature of climate and environment in terms of the representation of useful trees. For example, hazelnut trees can't survive as an understory tree and must mature in relatively open areas. Walnuts don't occur in true stands. Chestnut trees would be more concentrated in upland areas but also found in lowland settings. Hickory occurs in both lowland and upland settings. Settlement patterns and plant processing technologies must be considered in conjunction with the habitats of mast-producing species in order to explain the use history of a particular genus/species.

In speaking of the prehistory of plant use by the native peoples of the Eastern Woodlands Smith (1978:114) notes:

> Of all the wild plants, nuts as a group were certainly the most important food. They are more abundant than any grains or fruits, are easier to harvest, and contain more calories and protein per gram of food. However, nut trees have one major drawback: they do not produce a consistent crop every year.

The productivity of mast-producing species by hunter gatherers is a key variable in understanding the intensity with which this resource was exploited. Limited control over mast productivity may be one reason why seed-bearing plants figure more prominently in discussions of the evolution of food producing systems. White oak acorns mature in a single year while those of red oaks require two years. Chestnut trees produce a reliable mast every year, hickory productivity varies on a two year cycle, and beech productivity varies widely over 2-3 year cycles (cf. Messner 2011:16; Petruso and Wickens 1984; Scarry 2003:57-67, Table 3.2; Talalay et al 1984).

Of the mast species represented in the Upper Delaware and broader region, butternut and black walnut have the greatest nutritional value in terms of calories, protein and fat, while acorns and chestnut are outstanding sources of carbohydrates (Messner 2011:Table 2.1; Scarry 2003:64, Table 3.3). Nut/acorn meats as well as oils that can be rendered from them are potential foods requiring varying investments of labor depending upon the type of processing and storage involved (Briggs 2015:321; Messner 2011:12-18; Scarry 2003:57-67). The ease of getting at nut/acorn meat is probably greatest for white oak acorns and hazelnuts, which have relatively thin shells and can be eaten or used in cooking without further processing (Scarry 2003:57-67).

Given the longevity of oak in regional environments, and the use of acorns documented in historical sources, it is interesting that acorns appear later than other sources of mast in the archaeological deposits of the Upper Delaware. An AMS date of 9530+/-60 BP (Beta 81355) on carbonized acorn from the Steele site in southern New Jersey is more in line with expectations (Stanzeski 1996:44, 1998:45). The wood of white and red oaks is much more well represented in dated deposits and might indirectly reflect the consistent use of acorns beginning during the Late Archaic. The under-representation of acorns in the archaeological record of the broader Eastern Woodlands has been noted by many authors (Messner 2011:17).

The more frequent appearance during the Early, Middle, and Late Archaic periods of tools and fire cracked rock that could be implicated in the processing of mast suggest that this resource had gained in importance. Truncer (1999:265-279) proposes that archaeologists test the hypothesis that steatite bowls were used in the processing of acorns, based on his analysis of residues and the spatial distribution of bowls and mast-producing forests. Dates that can be assigned to steatite vessels predominantly fall within a Late Archaic to Early Woodland time frame (Truncer 2004:Table 2).

It is during a Late Archaic to Early Woodland time frame that regional prehistories characteristically acknowledge the fundamental importance of mast and plant foods to native lifeways (e.g., Carr 2015:68-69; Custer 1996:213-214; Kraft 2001:111-115; Kraft and Mounier 1982a:68; Messner 2008:Table 11, 2011:115-123; Stewart 2015b:13; Williams and Thomas 1982:107). The intensive use of plant resources during this time corresponds with inferred reductions in settlement movements and territory size and a trend in seasonal, semi-sedentary types of settlements focused on riverine settings. The systemic relationship of these behaviors is likely complex as in a model summarized by Stewart (2015b:14):

> Whatever is driving the emphasis on riverine settings and the creation of semi-sedentary settlements, the ecology of the situation could reinforce economic behaviors already in place, that is, the use of mast and other plant resources. Prolonged habitation at a fixed location would eventually lead to a decline in the availability of game within the foraging radius of the settlement. This in turn might lead to an increase in the importance of more sustainable plant resources, an intensification of their use, and a greater investment in storage facilities to offset subsistence risk.

The importance of other sources of animal protein, such as fish and small game, might also be enhanced under such a scenario, as would be related technologies.

Given the time and labor investment, the growing emphasis on mast and other plant resources may have stimulated the trend in settlements of longer duration. Chestnuts and acorns are typically dried before being further processed or stored. Red oak acorns require more extensive processing than white oak acorns because of higher levels of tannic acid. The difficulty in separating the nut meat of hickory from its shell makes rendering its oil with water after crushing the nut a more productive endeavor, or using the crushed product to make stock for soup or stews. Most forms of mast could be rendered for oil which generally involves the use of hot or boiling water. (cf. Briggs 2015; Messner 2008, 2011; Ortiz 1991). All of these approaches to the use of mast or its storage have implications for occupation spans of days, weeks, or more at a given location.

Wood charcoal of mast-producing trees, so common in Late Archaic and later archaeological deposits, could be an indirect reflection of the use of mast, as noted above, in addition to the preparation of medicines. The use of the bark of walnut and oak to make medicines to treat a number of ailments has been noted for the Delaware (Hill and Rementer 2015:12; Newcomb 1956:71).

Macrobotanical assemblages from dated contexts become more frequent during a Late/Transitional Archaic time frame and intensify thereafter, an observation in-line with cultural historical narratives regarding the growing importance of plants in Native American lifeways. However, it is difficult to ignore the probable impact that taphonomic and site formation processes have had on the preservation and patterning of this evidence. The botanical assemblage from the deeply buried Paleoindian deposits at the Shawnee Minisink site show what is possible when conditions are favorable.

Caveats aside, data from contexts listed in Table 27, as well as botanical assemblages from contexts only associated with diagnostic artifacts, support the interpretation of the consistent use of seeds, fruits, and greens during a Late/Transitional Archaic time frame and continuing throughout the Woodland era. Assemblages dating to the Late Woodland period are the most extensive with those from 36Pi4, 36Pi136, and BRO-117 (Broome County, New York) being exceptional examples.

Of special note is the limited occurrence of hog peanut. Hog peanut is found in a dated late Middle Woodland context at the Deposit Airport I site (Delaware County, NY) and in a dated Late Woodland context at the Manna site (36Pi4). Historically, the seeds and tubers of hog peanut were subsistence items in the region (Messner 2008:42, Appendix A) but also figure into the production of native medicines (Moerman 1986:32-33). The sole occurrence of giant ragweed (*Ambrosia trifida*) in a Late Woodland context at the Manna site is also of interest. Giant ragweed was once thought to be a deliberately cultivated species in the Eastern Woodlands (Cowan 1985:214-217) and its continued occurrence in contexts with other domesticates "argues for its candidacy as a crop" (Smith and Cowan 2003:112). Most of the botanicals listed in Table 28 rarely occur on more than one site in the project area. Among the listings are potential foods and medicines.

Messner (2008, 2011) and colleagues (Messner and Dickau 2005; Messner et al 2008) have recovered starch grains from a variety of tools and implements that complement macrobotanical inventories for the Early, Middle, and Late Woodland periods of the Delaware River watershed. For the Upper Delaware starch representing maize, acorn, possible little barley, the legume or bean family, and the true grasses family has been recovered from implements found in contexts dated to the Late Woodland period (see Table 27). Maize starch also has been found on implements attributed to undated Late Woodland contexts (Messner 2008:Figure 129), as has acorn and possibly little barley (Messner et al 2008; Messner 2008:314). In a context likely Middle Woodland in age at the Manna site, starch grains from two different taxa were isolated from a triangular biface consisting of wild potato/yam (*Dioscorea villosa*) and maize (Messner 2008:316; Stewart et al 2015:172-173, 294, Figure 62). The startling recovery of maize starch and other evidence of the cultigen from a Late/Transitional Archaic time frame at the Shohola Flats site (36Pi169) is discussed in detail below.

In a summary of early plant domestication in eastern North America, Smith (2011:Table 1, Figure 1) lists the earliest dates for a series of indigenous domesticated seed crops. They derive from sites in the Mississippi river basin of Arkansas, Illinois, Kentucky, Missouri, and Tennessee, and fall within what would be a Late Archaic time frame:

-Squash (*Cucurbita pepo ssp. ovifera*) at 4440+/-70 BP;
-Sunflower (*Helianthus annuus*) at 4265+/-60 BP;
-Marshelder (*Iva annua*) at 3920+/-40 BP; and
-Chenopod (*Chenopodium berlandieri*) with dates from 3490+/-40 to 3400+/-150 BP.

Plants whose domestication is in doubt but appear to have been subject to deliberate planting, harvesting and storage of seed stock include: erect knotweed (*Polygonum erectum*), little barley (*Hordeum pusillum*), and maygrass (*Phalaris caroliniana*; Smith 2011:472). Together with the listed domesticates these plants comprise what has been termed the Eastern Agricultural Complex.

None of the indigenous domesticates noted by Smith have been found in comparably early contexts in the Upper Delaware or the broader river valley as Messner (2008:290) points out in his basin-wide synthesis. In the Susquehanna Valley of Pennsylvania potentially domesticated squash (*Cucurbita pepo*) has been AMS dated to 5404+/-552 BP and 2625+/-45 BP (Hart and Asch-Sidell 1997:525, 527, 531; Hart et al 2007:579). McConaughy (2008:Table 2-1; 2015:35) notes the connection of cucurbit specimens with dates of 3065+/-80 BP, 2820+/-75 BP, and 2815+/-80 BP at the Meadowcroft Rockshelter in southwestern Pennsylvania, but expresses caution in accepting the validity of the associations. In western New York squash phytoliths are dated to 2905+/-35 BP at the Scaccia site (Hart et al 2007:579, Tables 1, 6).

A seed of potentially domesticated chenopodium from the Calver Island site (36Da89) in the Susquehanna Valley of Pennsylvania is AMS dated to 3980+/-40 BP (Miller et al 2007:75-76). Other seeds from the same context have attributes that are suggestive of a cultivated form. The first domesticated chenopodium in western Pennsylvania occurs during a Middle Woodland time frame (McConaughy 2008:Table 2-3; 2015:36).

Residue on a steatite bowl sherd from a Transitional Archaic occupation dated to ca. 3080 BP at Calver Island produced *Hordeum/Elymus*-type starches indicative of little barley or wild rye grass seeds (Miller et al 2007:73). *Hordeum/Elymus*-type starches also were identified on Transitional Archaic steatite vessel sherds from 36Pe16 in the Susquehanna Valley (Miller 2015:93; Miller et al 2007:76).

Maygrass dates to 2950+/-100 BP at Oberly Island (36Nm140) to the south in Northamton County, Pennsylvania (see Table 27). New Jersey, Pennsylvania, and New York are not part of the plant's current range (Messner 2008:290-291; 2011:115, Figure 6.1; USDA NRCS 2017a). Erect knotweed has not been found in the project area or on archaeological sites in the greater Delaware River basin (Messner 2008, 2011). Erect knotweed and maygrass have been found in western Pennsylvania in dated contexts that fall within a Transitional Archaic time frame (McConaughy 2008:Tables 2-4, 2-6).

Wild marshelder/sumpweed (*Iva* annua) is associated with an occupation dating ca. 2900 BP to 2150 BP at the Broome Tech site to the west of the New York portion of the Upper Delaware basin (Asch Sidell 2008:39, Tables 3.2, 3.3; 2011:1057; Messner 2011:115). It has been found in a context dated to 2460+/-130 BP at a site (7S-F-68) in the Lower Delaware Valley, and is believed to be a domesticated form (LeeDecker et al 1996:34, 136-138; Messner 2008:310). Additional finds of marshelder are from two later contexts (1020+/-70 BP, 310+/-80 BP). The site is located in an area where marshelder is not a part of modern plant communities (Messner 2008:290, Figure 128; Messner 2011:115, Figure 5.12).

Domesticated plants associated with the Eastern Agricultural Complex are found in Late Woodland contexts in the project area. In the Upper Delaware Valley wild forms of *Chenopodium* (*sp*.) first occur in the Paleoindian deposits of the Shawnee Minisink site but don't reappear in a dated context until circa 4460+/-130 BP and 4370+/-140 BP at the Shohola Flats site (36Pi169). After this time recoveries are much more frequent and continue into the era of contact with Europeans. A likely domesticated form of *Chenopodium berlandieri* is found at the Deposit Airport 1 site dated to 920+/-40 BP and represents the easternmost occurrence of the cultigen (Asch Sidell 2002d; 2008:47, Table 3.3; Messner 2011:107). No other domestic forms of *Chenopodium berlandieri* have been identified in the Upper Delaware.

To the west of the project area dates for domesticated *Chenopodium* are slightly earlier but still relate to a Late Woodland time frame. In northcentral Pennsylvania at the Mansfield Bridge site (36Ti116) domesticated seeds of *Chenopodium berlandieri* were recovered from what is defined as an early Owasco occupation with dates ranging from 1360+/-80 BP to 830+/-40 BP (cf. Asch Sidell 2003:Table 9; 2008:46-47; 2012:714; Wall et al 2003:13, 120, 129, Table 2.1). To the north of Mansfield Bridge in southcentral New York a component dated ca. 950 to 650 BP at the Scudder site also contained this domesticate (Asch Sidell 2008:46-47). Domesticated *Chenopodium* is known from two components at the Memorial Park site in central Pennsylvania, the earliest of which has dates ranging from 1190+/-40 BP to 1120+/-60 BP (cf. Asch Sidell 2008:46-47; Hart and Asch Sidell 1996:17, Table 1).

Marshelder or sumpweed is found only at the Manna site (36Pi4) in the Upper Delaware Valley and was recovered from a feature dated to 840+/-70 BP (Figure 70). Given its size it might represent a domesticated seed, but it is not possible to be certain on the basis of the single carbonized kernel found (Asch Sidell 2015:374; Stewart et al 2015:197-198, 295). Marshelder was also found in an undated feature assigned to a Contact period time frame given the presence of colonial pipe fragments in the feature fill (Stewart et al 2015:Table 115). The natural range of the plant does not include the Upper Delaware Valley, New Jersey or New York; it's distribution is limited in Pennsylvania (USDA NRCS 2017b; Messner 2008:310; 2011:108, Figure 5.12; Rhoads and Klein 1993). Marshelder's presence in the Upper Delaware raises the possibility that native peoples were intentionally transplanting it to new areas and nurturing it in gardens or habitats adjacent to residential areas.

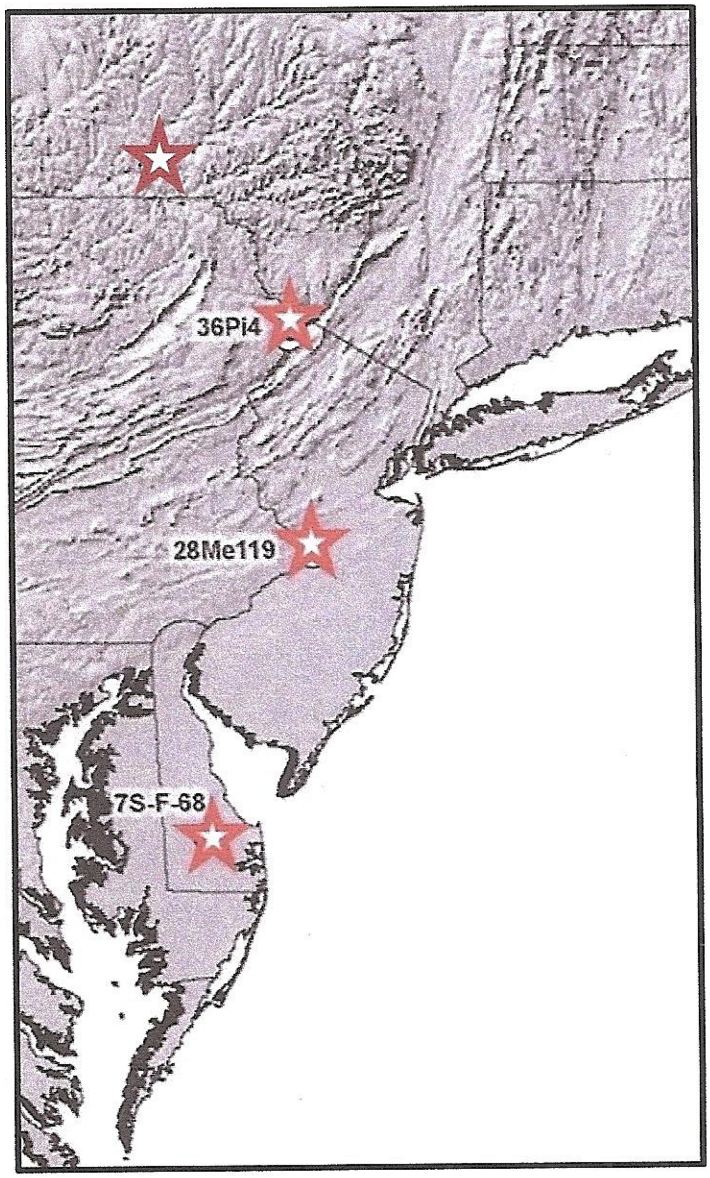


FIGURE 70. Archaeological distribution of marshelder in the Delaware Valley and vicinity. The northernmost star represents the location of the Broome Tech, Chenango Point, and Chenango Point South sites in New York. Modified from Messner (2008:Figure 128).

Approximately 30 miles west of the Delaware Basin in New York marshelder is found at the Chenango Point and Chenango Point South, and Broome Tech sites (see Table 27 and Figure

70; Asch Sidell 2008:39; Messner 2011:115). The date from Chenango Point, 920+/-40 BP, is earlier than that for the Manna site specimen, while the other relates to a time frame similar to that indicated by the finds at Manna. The marshelder from Chenango Point and Chenango Point South appear to be domesticated forms (Asch Sidell 2011:1060; 2012:719-720; Miroff 2014:24). Farther west, marshelder is associated at Mansfield Bridge with Features 13 and 17 dated to 1130+/-80 BP and 1360+/-80 BP, respectively (Asch Sidell 2003:Table 9; Wall et al 2003:13, 120, 129, Table 2.1).

No confirmed finds of domesticated sunflower have been made in the Upper Delaware Valley although wild sunflower has been dated at 36Pi136 to 780+-/110 BP and 740+/-80 BP. A sunflower or gourd seed is part of a dated feature (1300+/-110 BP) at 36Nm15. Just to the west of the New York section of the Upper Delaware drainage, wild sunflower is associated with Late Woodland contexts at the Otsiningo Market, Park Creek II, and Chenango Point South sites (see Table 27). Farther west in the basin of the Upper Susquehanna domesticated sunflower is dated to 940+/-40 BP (Feature 2) at Mansfield Bridge (Asch Sidell 2003:Table 9; 2012:714; Wall et al 2003:13, 120, Table 2.1; contra Messner 2008:309; 2011:107) and ca. 650-500 BP at the Thomas/Luckey site, in addition to specimens of wild sunflower (Asch Sidell 2008:Table 3-6; Knapp 2002:171, 189, Tables 9.1, 9.4, End Note 5; Miroff 2009:77).

Little barley is another seed plant of the Eastern Agricultural Complex only found in dated Late Woodland contexts in the Upper Delaware Valley at the Manna site and Ventura Tract, and to the west in New York at Chenango Point (see Table 27). Not far from Manna, little barley starch was detected on an artifact from an undated context at the Loch Lomond site. Two stemmed points were associated with the same deposit and could potentially represent an occupation pre-dating the Late Woodland (Messner 2011:93, Table 5.1, Figure 6.1; Messner et al 2006). Little barley occurs in a variety of Late Woodland contexts at the Memorial Park site on the West Branch of the Susquehanna River (Asch Sidell 2008:46-47; Hart and Asch Sidell 1996:Table 2). Of significance is the fact that little barley does not occur naturally in New Jersey, Pennsylvania, or adjacent portions of New York (USDA NRCS 2017c).

In sum, there is tantalizing evidence that along with wild local species, native peoples in the region were cultivating wild economic species brought in from elsewhere. It is probable that this activity took place prior to Late Woodland times; however, evidence is best associated with the Late Woodland when an indigenous complex of economic plants is being used in conjunction with squash, maize, and eventually beans (Asch Sidell 2008:46-47; Messner 2011:115-131). This is certainly the case in the Upper Delaware Valley. What may have changed with the consistent use of maize is how and where the other species were planted (cf. Doolittle 2001; Keeley 1995; Messner 2011:125; Smith 2001; Smith and Cowan 2003).

Squash, maize and beans, the “three sisters”, have traditionally been considered the base of Late Woodland farming in the region. It is now clear, however, that the use history of each of these cultigens is not identical, and that wild and likely cultivated indigenous plants continued in use from an earlier time (e.g., Hart 2011:104; Messner 2011:115-131). Table 30 charts dates for squash, maize and beans for the Upper Delaware and adjacent areas. All of the dates listed are culled from Table 27. Multiple dates shown in the same cell in the table derive from the same archaeological context; identical dates in different cells are from different sites or different contexts at the same site. The majority of dates listed for adjacent areas are from localities in the Upper Susquehanna Valley.

TABLE 30
THE THREE SISTERS AND ASSOCIATED DATES*
UPPER DELAWARE AND ADJACENT AREAS**

SQUASH		**MAIZE**		**BEAN**	
Upper Delaware	**Adjacent Area**	**Upper Delaware**	**Adjacent Area**	**Upper Delaware**	**Adjacent Area**
		3150+/-70 3100+/-70 3090+/-150 3030+/-60 3010+/-150 2810+/-150			
			1995+/-35		
		1850+/-40			
		1760+/-40			
	1525+/-35		1525+/-35		
		1440+/-30			
		1380+/-60			
			1370+/-60		
		1210+/-40			
			1043+/-40		
		1040+/-40			
			1000+/-70		
		970+/-120			
		930+/-60			
		920+/-40	920+/-40		**920+/-40**
890+/-60		**890+/-40**			
		880+/-40	880+/-70		
			860+/-40		
		850+/-40			
		840+/-70			
		830+/-50			
	820+/-40				
		780+/-110			
			760+/-40		
	740+/-40	740+/-80	**740+/-40**		
			740+/-40		
		720+/-50			
			705+/-40		
	700+/-40		**700+/-40**		
			690+/-30		**690+/-30**
			680+/-50		
		670+/-70	**670+/-30**		670+/-30
			660+/-40		
			650+/-40		
			650+/-40		
		630+/-105 550+/-135			
			600+/-30		
			600+/-30		
			560+/-40		

		550+/-40	**550+/-30**		
		550+/-40			
		540+/-40	540+/-30 **300+/-30**		
		530+/-40	530+/-50		
		500+/-40			
Table 30 continued					
SQUASH		**MAIZE**		**BEAN**	
Upper Delaware	**Adjacent Area**	**Upper Delaware**	**Adjacent Area**	**Upper Delaware**	**Adjacent Area**
			480+/-40		
		450+/-70 320+/-60 290+/-60 410+/-60			
		440+/-40			
		430+/-110			
		400+/-70	400+/-40	400+/-70	
		390+/-40			
			380+/-40		
		370+/- 40		370+/- 40	
		330+/-70			
			300+/-30		
		270+/-40	**270+/-30**		
			270+/-70		

*Dates are shown BP and derived from Table 27
**Dates for adjacent areas derived from sites in Table 27. See text for additional dated occurrences from areas farther afield
Bold indicates AMS date of listed botanical

There is only a single dated occurrence of squash (890+/-60 BP) in the Upper Delaware and it falls within a Late Woodland time frame during which maize is being consistently used. To my knowledge this is the only date for domesticated squash in the entire drainage basin. A rind fragment of *Cucurbita pepo* (squash or pepo gourd) is associated with undated Feature 31 at the Deposit Airport site (Asch Sidell 2008:Table 3-3; Knapp and Versaggi 2002:103, 120, Tables 9, 11, Figure 63). On the basis of radiocarbon dates from other features and diagnostic artifacts an occupational history ca 750 to 1250 AD is indicated for the site (Knapp and Versaggi 2002).

Macrobotanical remains possibly representing squash occur in a Late Woodland context (Feature 2156) at Shoemakers Ferry, 28Wa278 (cf. Barse 2006:4.32, 4.34, Figure 4.14; Harbison 2008:Table 7.1). Squash or pumpkin seeds were found in and around a cache at the Miller Field site (28Wa16). The cache included sheet copper and a brass triangular point. The Contact/Historic component at Miller Field is dated between 1650 AD and 1710 AD (Kraft 1972:52-53). Squash is associated with the Contact/Historic component at the Bell Browning site (Marchiando 1972:158). Squash or pumpkin seeds were found in a Contact/Historic feature (R-F 438) at the Minisink site (28Sx48; Kraft 1978:44, Table 7).

Immediately to the north of the Upper Delaware, squash phytoliths were detected in pottery residue dated to 1525+/-35 BP at the Fortin site (Locus 2) in Delaware County, New York (cf. Funk 1998:68-78; Hart et al 2007:Tables 1, 6; Thompson et al 2004:28-29, Tables 2, 4). Farther afield and to the northwest, squash phytoliths are dated to a late Middle Woodland time frame at Hunters Home (Hart et al 2007:Table 1, 6). The earliest dates for squash in the broader region were discussed above. Judging from available radiocarbon dates squash was likely made known to Delaware Valley inhabitants via interactions with groups situated to the north and west in New York and Pennsylvania.

Maize is the most well dated cultigen in the Delaware Valley. The majority of sites with maize tend to be focused in the mid- to Upper Delaware Valley. As expected the majority of available radiometric assays are also from these same sites. The use of maize has long been considered to only be a feature of Late Woodland lifeways in the Delaware Valley. Messner's (2008) study makes it clear that maize is known throughout the Delaware Basin between 900 AD and 1000 AD (cf. Allitt et al 2008; Messner et al 2008; Stewart 1993, 1998c). This view began to be altered by dated finds from the Deposit Airport 1 site in the Upper Delaware Valley which anchored the use of the cultigen in a Middle Woodland time frame (Knapp 2003; Knapp and Versaggi 2002). With one exception from the Lower Delaware Valley (Heinrich 2016:16; Heinrich et al 2015), all additional dates for maize that pre-date the Late Woodland have been derived from sites in the Upper Delaware and nearby areas (see Tables 27, 30). The most startling of the early dates derive from the Shohola Flats site (36Pi169).

Shohola Flats is a stratified multi-component (Late and Transitional Archaic, Late Woodland) locality situated on a first terrace of the Delaware River just upstream from the mouth of Shohola Creek (Trachtenberg et al 2008:6, Figure 1). Feature 58, found in excavation Block 7 (3 x 3 meters) and interpreted as a hearth, is of special interest (Trachtenberg et al 2008:60, Figure 15). The feature was encountered at the base of a C3 horizon and ranged in depth from 1.84 to 2.27 meters below ground surface, with an average thickness of 13 centimeters encompassing two fill layers. In plan Feature 58 covered the entire area of Block 7 and encompassed saucer-shaped features 55 and 56. Feature 61 was the initial designation of what was subsequently determined to be the lower portions Feature 58 (Trachtenberg et al 2008:74-75, Table 5). In profile Feature 58 described a shallow basin "with an undulating base and walls sloping upward gradually to the north and east" (Trachtenberg et al 2008:74, Figure 26). Wood charcoal from the feature was used for radiocarbon dating. Six assays derived from the feature range from 3150+/-70 BP to 2810+/-150 BP with calibrated dates (two sigma) overlapping between 1415 BC and 1257 BC (see Table 27; Trachtenberg et al 2008:Table 6).

No features were found in the higher strata of the Block 7 excavation. Modern and/or historic artifacts occurred to depths of 64 cm below surface. No diagnostic native-made artifacts were recovered from the block excavation. Untyped pottery (n=22) was recovered from 125-136 cm below surface and two sherds from 1.65-1.75 meters below surface (Trachtenberg et al 2008:Appendices B, J). A single undated feature was found in the lower C4 horizon of Block 7 (Trachtenberg et al 2008:75).

It should be noted that there is a discrepancy between the stated depth of the Feature 58 complex cited in the text ((Trachtenberg et al 2008:74) and a scaled graphic (Figure 15) depicting the stratigraphic position of the feature in the west wall of units 17a, 17b, and 17c. In the graphic the top of the feature appears to occur circa 1.72 meters below surface. Additional potential discrepancies are found in the artifact appendix of the report with listings for: Unit 17A, Feature 56, 203-212 cmbs; Unit 17BC, Feature 58, 61-62 cmbs (Trachtenberg et al 2008:Appendix B, 311); Unit 17A, Feature 55, 203-211 cmbs (Trachtenberg et al 2008:Appendix B, 312); Unit 17, Feature 58, 206-222 cmbs (Trachtenberg et al 2008:Appendix

B, 313); Unit 17C, Feature 61, 226-230 cmbs (Trachtenberg et al 2008:Appendix B, 315). There seems to be no confusion regarding the association of the radiocarbon dates with the feature and its paleobotanical remains.

A variety of plant remains were recovered from Feature 58 (see Table 27) the most significant representing maize. In the initial botanical analysis of the feature a charred kernel embryo was identified and confirmed as maize prompting further sampling and analysis of feature contents. "Fifteen samples were examined completely for macrofloral remains, twelve samples were scanned for pollen, and eight samples were scanned for phytoliths and macrofloral remains (Table 8). These samples represent Levels 1-5 in the hearth" (Cummings and Puseman 2003:418). Maize from the feature is represented by the following (Cummings and Puseman 2003:399, 416-418, 420, Tables 7, 8; Trachtenberg et al 2008:74-75, 133, 137):

Sample 05:	charred kernel embryo confirmed as maize through starch grain analysis
Sample 09:	single maize pollen grain
Sample 10:	two maize pollen grains
Sample 13:	charred starchy tissue confirmed as maize through starch grain analysis
Sample 16:	charred cob-like plant tissue
Sample 21:	charred meal with embedded seed confirmed as maize through starch grain analysis

While millions of phytoliths were present in the samples the authors note that "when working in sediments, it is extremely difficult to separate grass phytoliths from maize cob-type phytoliths" concluding that "maize cob-type phytoliths could not be distinguished from the millions of phytoliths with which they might have been mixed" (Trachtenberg et al 2008:137). Other features on-site were examined for macrobotanical remains and a column sample from Block 9 was examined for macrobotanical remains and pollen (Trachtenberg et al 2008:134-137).

No evidence of maize was found in any other context on-site. As Cummings and Puseman conclude, "results of starch analysis of PET starchy tissue fragments were compelling in interpreting the presence of ground maize cooked in Feature 58" (Cummings and Puseman 2003:418). PET is the acronym for processed edible tissue. The multiple lines of evidence for maize from Feature 58 and its absence elsewhere on-site prompted Trachtenberg et al (2008:134) to suggest "that it is present as a result of precontact activity rather than contamination from the historic era." The cultigen was likely a novelty at the time and perhaps used for non-food purposes (Trachtenberg et al 2008:163).

Obviously the early dates for maize at Shohola Flats are controversial as the authors of the report note (Trachtenberg et al 2008:162). Maize only diffused into the Southwestern U.S. from Mexico about 4000 years ago (da Fonseca et al 2015). Reflecting on the dated associations at Shohola Flats Cummings and Puseman (2003:418) note that this is not the first time that maize pollen has been found in an early context. They cite Winkler's (1982:72) work at No Bottom Pond in Massachusetts where maize pollen occurred in many levels below and above a radiocarbon date of 2935+/-65 BP. In compilations of early dates for maize few come close to mimicking the time frame of the Shohola Flats samples (cf. Hart 1999:Table 1; Hart et al

2007:Table 7; Hart and Lovis 2013:Table 1; McConaughy 2008:Table 2-9; 2015:37; Simon 2017:Tables 1, 2; Thompson et al 2004:Table 6). Some of the earliest dates are for contexts containing only maize pollen (Hart 1999:162, Table 1). Hart (1999:163) concludes the following in his review of potentially early dates for maize:

> While skepticism about contexts and dates of purportedly early maize pollen is warranted, early instances should not be dismissed out of hand. Given that large amounts of early maize pollen are rare in the Eastern Woodlands except in unusual circumstances like Tuskegee Pond, the presence of a maize pollen grain in early contexts should trigger intense efforts to identify additional grains from the sample. A single grain of maize pollen in the absence of evidence for dislocation from later sediments may very well be evidence for early maize in an area, especially if confirmed by additional finds at that location or elsewhere in the region.

If we are to take the Shohola Flats data seriously, sampling for pollen and phytoliths in off-site areas where maize may have been cultivated should be attempted during archaeological mitigations of Transitional Archaic sites. Hart (1999:162), citing a variety of sources, notes that maize pollen is not dispersed far from the field in which it is grown. In the Great Lakes region, archaeologists have demonstrated that Native Americans were planting some wild and domesticated squash in managed stands located in wetland and other habitats adjacent to settlement areas during Archaic and Woodland times (Lovis and Monaghan 2007; Monaghan et al 2006). In the early years of maize's presence, or that of other indigenous or introduced cultigens, macro-remains may be extremely rare or absent in habitation or work areas and missed unless sampling strategies are very intensive (Hart 1999:161). Sampling adjacent, off-site areas where gardens or stands may have been situated perhaps offers a better chance of recovering relevant evidence.

There are other dates from the Upper Delaware and adjacent areas that, while not approaching the tine depth of Shohola Flats botanicals, continue to upend the notion that the use of maize begins circa 900/1000 AD during the Late Woodland period (see Table 27). A Middle Woodland time frame (1850+/40 BP, 1380+/-60 BP, 1210+/-40 BP) accounts for maize at Deposit Airport 1 and at Herrick Hollow II (1760+-40), both in the New York section of the upper valley. A maize kernel and maize starch are associated with Middle Woodland contexts at 36Pi4, the latest of which may date to 1440+/-30 BP (see Tables 27, 30; Stewart et al 2015). Direct dating of the Manna remains from Middle Woodland contexts should be a priority for future botanical research.

In areas adjacent to the Upper Delaware, maize is associated with dated Middle Woodland contexts (see Tables 27, 30). Maize phytoliths were detected on pottery residue dated to 1995+/-35 BP at the Fortin site, Locus 2; the assay is considered to be too early for the context in which the sherd was found (cf. Hart et al 2007:Table 1; Thompson et al 2004:Table 4). At the same site maize phytoliths were identified in the same pottery residue that also produced traces of squash. The residue was dated to 1525+/-35 BP (cf. Funk 1998:68-78; Hart et al 2007:Tables 1, 6; Thompson et al 2004:28-29, Tables 2, 4). Maize was found at Chenango Point in a context dated 1370+/-60 BP.

It is logical to assume that Middle Woodland folk in the Upper Delaware had knowledge of domesticated crops given early dates for maize in the broader region. Recent dates on maize phytoliths from the Quebec area put the presence of maize potentially as early as 390 BC (St-Pierre and Thompson 2015). Evidence places the more consistent use of maize in southern Ontario from 500 AD to 1000 AD (see summary in St-Pierre and Thompson 2015:408-409; Thompson et al 2004:Tables 5, 6). In central and east-central New York maize appears as early as 296 BC with 9 additional assays ranging from 40 AD to 805 AD (calibrated median probabilities, Hart and Brumbach 2005; Hart et al 2007:Tables 6, 7, Figure 1). A maize cob is associated with a date of 2325+/-75 BP (circa 375 BC) at the Meadowcroft Rockshelter in southwestern Pennsylvania but McConaughy (2008:18-19, Table 2-9; 2015:37) cautions accepting it at face value; Hart and Lovis (2013:185) recommend directly dating the specimen given its importance. On the basis of dated specimens from throughout the Northeast and Middle Atlantic regions, it would seem that the initial exposure to, or use of maize by the native peoples of the Upper Delaware and the greater watershed is a result of interactions with groups to the north in New York and southern Ontario (cf. Hart et al 2007; Hatch 1980:260; Inashima 2008:228-231; 2011:111-112; McConaughy 2008:Table 2-9; McKnight 2009:Table 5, Figure 4; 2010:42; McKnight and Gallivan 2007; Stewart 1994a:59-60, Tables 4, 14; St-Pierre and Thompson 2015).

The degree to which maize contributed to the diet is uncertain. In her synthesis of the evolution of the human diet in the Northeast and Midwest regions of the United States, Schoeninger (2014:422) considers the perspective provided by stable isotopy of human bone on the consumption of maize, a C4 plant:

> Average δ13C bone collagen values from prior to 700 AD show no input from C4 plants; δ15N bone collagen values in people living near the Great Lakes demonstrate a dependence on fish (Katzenberg 1989). Evidence from about 700 AD shows that some populations in the northernmost part of the region ate maize (Schurr & Redmond 1991, Hart et al. 2003), in contrast with populations in the southern region (Schurr 1992). Why these differences occurred is uncertain; perhaps the appeal was the ability to store maize during winter in the colder areas.

The plant may have been grown as a curiosity, or a luxury food. Hayden (2003:459) argues that "early domesticates were developed as luxury foods and that the primary context for their consumption was in feasting. Feasts not only provide the vehicle for the use of luxury foods, but also the very reason for their existence." Some foods are eaten for ritual purposes or as a memorial to past events; recall our collective fondness for pumpkins at Thanksgiving (Farb and Armelagos 1980). Eating maize when green for its sweeter taste, a historically known practice, would work against its preservation in the archaeological record (see summary in Messner 2011:36). The use of pre-existing practices of gardening and managing stands of wild plants and their need for elaboration when dealing with maize might explain initial low levels of production, regardless of the intended use of the cultigen (cf. Messner 2011:125). Maize may have been grown by only a few communities and traded to other groups.

In the Upper Delaware the frequency with which macro remains of maize are encountered seems greatest starting around 1300 AD during the Minisink phase of the Late

Woodland period, and continuing into the 17th century or colonial times. However, the number of radiocarbon assays for 1300 AD and later (n=26) is nearly identical to those for the earlier portion of the Late Woodland period, circa 900 AD -1300 AD (n=25). It is interesting that this presumed period of heightened interest in maize overlaps the time associated with the Little Ice Age, circa 1475-1600 AD, when a shift to a colder climate may have constrained native farming practices to some degree (Stinchcomb et al 2011). But it doesn't seem to have done so. There is insufficient data to determine if this trend also characterizes the use of maize in the mid- and lower sections section of the drainage basin.

Domesticated beans do not seem to be in use in the Northeast or Middle Atlantic Region until circa 1300 AD and later (Hart 2011; Hart and Brumbach 2003; Hart and Scarry 1999). Domesticated bean is known from only two very late dated contexts in the Upper Delaware Valley. However, just to the west of the Upper Delaware in New York, domesticated bean was AMS dated (920+-40 BP) at Chenango Point (Broome County, NY) to at least a century before 1300 AD (see Tables 27, 30). Two additional dates from the Otsiningo Market site, also in Broome County, could also place the use of beans just prior to 1300 AD. Beans have been recovered from a variety of undated Late Woodland sites in the Upper Delaware (e.g., Barse 2006:4.34, 4.38, Figure 4.15, Plate 4.10; Harbison 2008:Table 7.1; Kinsey 1975; Kraft 1972:5, 1978:44-45, Table 7; Moeller 1992; Sloshberg 1962.:25) and in downriver sections of the watershed (e.g., Forks of the Delaware Chapter 1980; Weed et al 1990).

Given the history of squash, maize, and beans, the traditional and nutritionally beneficial "three sisters" form of native farming likely is not in-place in the Upper Delaware Valley prior to 1200/1300 AD. Such observations must be tempered by considering the ability of organic remains to be preserved in archaeological deposits. The location and manner in which a subsistence resource is procured, processed, stored and consumed can have a dramatic impact on whether it leaves an archaeological signature.

The types of settlements that are considered to be the focus of farming are typically situated in the floodplain or on the terraces of the river or other high order streams. This makes sense from a practical perspective. Alluvial soils often are more easily worked with digging sticks or hoes than soils in other types of environmental settings. Floodplain or terrace settings not only accommodate some of the practical requirements of farming, but also are convenient to habitats containing other resources that have long figured into the Native American subsistence economy – that is, game fish, nuts/mast, useful plants associated with wetland environments, and useful plants associated with the edges between forest and open field.

Farming-oriented settlements of the area are best characterized as "hamlets" or "dispersed villages". These are not settlements of clustered dwellings organized on a precise spatial plan. Nucleated villages or any type of fortified settlements have yet to be identified anywhere within the Delaware River Valley. This is an intriguing observation given the appearance of nucleated and often stockaded villages in surrounding geographic areas circa 1200/1300 AD and later. Instead, Delaware Valley settlements consist of few dwellings associated with storage pits, and surrounded by what are presumed to be cultivated fields or gardens. The contemporaneous dwellings and fields of neighbors would be at a distance.

It has been estimated that a planted field an acre in size could produce enough maize (40 bushels) to feed 5 people for a year (Thomas 1976:12-13 citing the 17th century observations made by Roger Williams of the Narragansett). Extrapolating this to the Middle and Upper Delaware Valley, and assuming that one to two acre fields are associated with each household, contemporaneous residential structures in a multi-family community dispersed across the valley floor could be spaced 500 feet (152 meters) or more apart. If a few residential structures instead were grouped and surrounded by cultivated fields, the distance between residential clusters would be even greater.

When considering the long period of time over which Native peoples in the Upper Delaware and broader valley were using plants, it is difficult to see the adoption of maize, beans, and squash as revolutionary. Pre-existing subsistence systems were already geared for including new items into an already extensive plant inventory. The variable degree to which new items would come to be relied upon likely results from how readily they can be accommodated with existing gardening and landscape management practices, and the existing productivity of the environments in which a group has long resided and exploited (cf. Doolittle 2001; Messner 2011:27-39, 123-127; Wagner 2003). Maize and the plants of the Eastern Agricultural Complex have different life cycles with the cultivation of maize requiring more attention (Smith and Cowan 2003:118-121). Once farming is in place shifting gardens/fields serves to revitalize soil but also allows other useful indigenous plants to grow in the plot left fallow while domesticates thrive in the newly cultivated field (Wymer 2015).

We have yet to explore the degree to which foodways reflect unique cultural preferences, rather than a strictly mechanistic or functional interaction of people with their environment. Introduced foodstuffs need to make cultural "sense" in terms of the existing cuisine and approaches to cooking (Wetterstrom 1978).We have the ability to reconstruct prehistoric environments and identify things within it that are potentially useful to a people with a given level of technology. By comparing this baseline data with what the archaeological record indicates that people are selecting from the environment, we should be able to define cultural preferences regarding subsistence. Stable isotopy and trace element analysis of human bone will be critical in resolving outstanding issues regarding the importance of specific subsistence items and their impact on other behaviors.

The farming of domesticated plants represents a way to improve or increase the resource capabilities of a given environment, but this fact by itself doesn't really explain why people accepted new economically useful plants and engaged in farming. Some have considered the adoption of farming as a response to problems with the existing resource base, the size of the groups exploiting it, and the technology and social relations bound up in its exploitation. In other words, there are too many mouths to be fed with traditional resources employing the traditional means of procuring, processing and distributing them. Population growth and increasing population densities are ways in which such problems could have been initiated. But in the Upper Delaware and broader watershed there are no clear signs of population pressure (i.e., the archaeological landscape is not overfull with contemporaneous sites), especially for areas where signs of farming first appear. Smith's (2011:482) comments on the processes leading to initial plant domestication are apropos to discussions of the adoption of farming in the Delaware Valley. He argues that:

> … eastern North America, arguably the best-documented regional case study currently available, does not provide much support for general models, including those of human behavioral ecology (Smith 2009a) that incorporate environmental downturn, external environmental stress, population growth, landscape packing, constricted resource zones, and carrying-capacity imbalance or resource scarcity in explaining the initial domestication process.

and

> … small societies in eastern North America first domesticated local seed plants and developed initial crop complexes in resource-rich river valley environments within a larger context of stable long-term adaptations and broadscale niche construction efforts that were carried out in the absence of any carrying-capacity challenges or seriously compressed and compromised resource catchment areas.

One might argue that Native Americans in the Upper Delaware Valley had altered and managed upland and lowland environments in their use of mast and other plant resources long before the introduction of squash, maize, and beans (see discussion below). The addition of new plants to an already extensive inventory need not have been a dramatic and behavior altering event. Changes to existing systems would accrue with the growing economic and social importance of these additions, as the archaeological record of late prehistory seems to attest. Among the historic Lenape, Corn Mother is sacred, vital to the production of subsistence, linked with women and the cultivation and processing of crops (Bierhorst 1995:11, 34, 56). In future explanatory forays we should consider the role of women in the adoption of domesticates and the processes that led to their heightened importance. In the end, the eventual presence of maize and other cultigens throughout the Delaware Valley and much of the Middle Atlantic region, requires that any explanation for their adoption and focused use has to identify farming as a response to situations or sets of conditions held in common by diverse peoples living in environmentally diverse areas.

Previous discussions in this chapter have touched upon issues that could, or should be pursued with future research. In concluding this chapter I add to this discussion. Any future research needs to aware of the latest approaches in paleoethnobotany (e.g., Van Derwarker et al 2016).

Documenting and refining the chronology of plant use, especially that of domesticates, remains an important endeavor. What useful plants are attested historically (e.g., Hill and Rementer 2015; Moerman 1986, 1998; Tantaquidgeon 1977) but not represented in the archaeological record of any period? For example, given the chronology of pipe use in the Delaware Valley and its likely importance in social interactions and ritual, there is no paleobotanical evidence of tobacco. Tobacco is known from pre-Contact contexts in the broader region (e.g., Hart and Asch Sidell 1996; McConaughy 2008:12-13, Table 2-2; Miroff 2014).

Direct AMS dating of botanical remains is essential for chronological clarity and should be linked with precise or renewed identification of the remains to be tested. The reanalysis of maize from the Holding site in Illinois (Simon 2017) provides an object lesson. What were initially identified as a fragment of a maize kernel and a cob fragment were AMS dated to 2107+/-50 BP and 2077+/-70 BP respectively (Simons 2017:140). Long thought to be the oldest directly dated maize in the Eastern Woodlands, analysis of the stable carbon isotopes of these and other specimens from the site were shown to not be maize (Simon 2017:142-144). Simon (2017:146) recommends that evaluating carbon isotope ratios using stable isotope ratio mass spectrometry prior to AMS dating should become standard protocol.

Specimens listed in Table 27 that were dated by association with carbon samples should be targeted for direct AMS dating. A number of undated contexts that produced squash, maize, and beans have been identified that also should be the focus of a dating project. All of those described below are part of curated collections although current repositories have not been confirmed. The majority derive from sites situated within the Delaware Gap National Recreation Area.

Squash:

-macrobotanical remains possibly representing squash occur in a Late Woodland context (Feature 2156) at Shoemakers Ferry (28Wa278; cf. Barse 2006:4.32, 4.34, Figure 4.14; Harbison 2008:Tables 6.1, 7.1). Carbon samples also exist for this feature (Barse 2006:Appendix A; Harbison 2008:Table 6.1);

-associated with the Contact or Historic period occupation at the Bell Browning site (Marchiando 1972:158);

-associated with Contact period deposits at the Miller Field site (28Wa16; Kraft 1972:52-53)

-Feature 31 at Deposit Airport 1 (Delaware County, NY) includes squash rind and charcoal (Knapp and Versaggi 2002);

-associated with Feature 39, Chenango Point site (Broome County, NY) adjacent to the Upper Delaware Valley (Asch Sidell 2011:1061); and

-squash rind recovered at the Otsiningo Market site (Broome County, NY) adjacent to the Upper Delaware Valley (Miroff 2014).

Maize:

-associated with Contact/Historic component at the Bell Browning site (28SX19; Marchiando 1972:158);

-charred maize kernels associated with pits 217, 277 and 306 excavated in the Blair section of the Bell-Browning site (28Sx19; Marchiando 1970:17, 18, 28);

-charred maize kernels associated with Pit 215 at the Bell-Browning site, north field (Marchiando 1969:52, Table 3);

-charred maize found in Contact period Pit #8 at the Davenport site (28Sx27). Charcoal also occurs in the feature (Leslie 1968:128);

-8 and 10 row cobs represented at the upland Van Etten site (28Sx324; Parker 1995);
-cob fragment from Boehme III (28Wa5; Asch and Asch 1983:2);

-in Late Woodland period pit features 1033, 1070, 1517, and 2156 at Shoemakers Ferry (28Wa278; Harbison 2008:Table 6.1);

-in Late Woodland and Contact period contexts at Sandts Eddy (36Nm12; Weed et al 1990:Table 5). Fill of Late Woodland grave Feature 7 contained maize, nut, seed and fruit remains in close association with the flexed burial of a pre-adolescent female (Weed et al 1990:99, Appendix H); and

-in probable Late Woodland storage pit at Treichlers Bridge (36Nm142; Anderson et al 2000:4-4, 7-35).

Bean:

-macrobotanical remains possibly representing bean from Late Woodland contexts (Feature 1494) at Shoemakers Ferry (28Wa278) (Barse 2006:4.34, 4.38, Figure 4.15, Plate 4.10; Harbison 2008:Tables 6.1, 7.1). Carbon samples exist for this feature (Barse 2006:Appendix A);

-charred bean from pit feature at the Pahaquarra Boy Scout site (28Wa7; Sloshberg 1962:25);

-associated with pits 180, 263A, 265, 265A at the Bell-Browning site, north field (28Sx19; Marchiando 1969:41, 67,-68, Table 3);

-associated with Contact/Historic component at the Bell Browning site (Marchiando 1972:158); and

-in deposits at Sandts Eddy (36NM12; Weed et al 1990:Table 5).

Programs of starch and phytolith analysis of residues on pottery and other artifacts should continue as exemplified by the work of Messner and colleagues, and Hart and colleagues. Macrobotanical remains are infrequently encountered on sites, even in the context of mitigation projects, that residue analysis should become something regularly performed. Carbon isotope analysis of the sediments comprising feature fill can also be informative. Lattanzi and Stinchcomb (2015) used this method as an independent means of assessing what is currently known about the use history of maize in the downriver area of the Abbott Farm National Historic Landmark.

The analysis of human remains has great potential to address the presence and importance of maize in the native diet, as well as other issues. Little such work has been attempted in the Delaware Valley and reveals little about the importance of maize (e.g., Bierbrauer 2010, 2014; Byrne 1984; Byrne and Parris 1987; Hartwick 2011; Hartwick et al 2016). An unpublished analysis of stable carbon and nitrogen isotopes of human bone dating to the Late Woodland period from 28Me273 (Hunter Research, Inc. 2002), located at the Coastal Plain to Piedmont transition, and from the Rapp Farm site in the middle Delaware Valley, reveals diets enriched in δ13C interpreted as indicating the substantial consumption of maize by these two individuals. Analyses were performed under the direction of Dr. Anne Katzenberg at the University of Calgary working in conjunction with Stewart. While the Native American Graves and Repatriation Act (NAGPRA) complicates efforts to study human remains, the possibility should not be dismissed prior to discussing well thought-out research designs with appropriate tribal groups. Related to mortuary features we need also ask how their botanical contents compare with those of non-mortuary features. Can the argument for graveside feasting, associated with historic and ethnographic practices, be supported (cf. Cushman 2007; Dean 1984; Newcomb 1965:39-43; Obermeyer 2016, 2017; Obermeyer et al 2015; Sieg 2008:Table 5)?

Prior to the dated appearance of domesticates in the Upper Delaware Valley the intensive use of plants likely paved the way for the integration of domesticates into the subsistence system. The analysis of dental caries in skeletal populations pre-dating the first appearance of maize could offer support of this contention. A possible example of this is provided by research conducted at the Island Field cemetery dated circa AD 400-1150 and AD 1200-1400 (Custer et al 1990; Messner 2008:319-320). Island Field is located in northern Delaware (Lower Delaware Valley) and has no evidence of maize, beans or squash. Island Field burials exhibit high frequencies of dental caries interpreted as indicating a reliance upon starchy, carbohydrate-rich seeds and tubers, a trait also typical of ancient maize farmers. In fact, when compared to a large number of skeletal populations representing hunter/gatherers, mixed subsistence practices, and agriculturalists, the Island Field burials have higher frequencies of caries than known agriculturalists. The inference is that the Island Field folk are intensively using wild plant foods to a degree mimicking the diet of farmers subsisting upon maize and other domesticates.

Plant remains recovered from on-site contexts can cautiously be employed in the reconstruction of local environments in conjunction with off-site sampling of macro-remains, pollen and phytoliths. Site and near-site environments may be anthropogenic in nature, intentionally or unintentionally created. This emphasizes the need for the collection and interpretation of paleoenvironmental data representing ever-broadening geospatial scales with sites representing central focal points. This approach will enhance our understanding of the environment in general and potentially make the impact of human activities on the landscape more visible (e.g., Abrams and Nowacki 2008; Asch Sidell 2008:47-48; Fulton and Yansa 2016; Messner 2011:127-128; Russell 1983; Scully and Arnold 1981; Stinchcomb et al 2011; Trachtenberg et al 2008:136-137; Tulowiecki and Nowacki 2008). People adapt to local environmental conditions; we have reconstructions of paleoenvironments at broad geographic scales; we need reconstructions for increasingly smaller geospatial contexts.

Research agendas that address landscape management and the manipulation of plant resources should be emphasized. This will contribute to a broader systemic understanding of subsistence, medicinal practices, a variety of technologies, settlement patterns, notions of territory, and social interactions (e.g., Stewart 2015b:14-15). The ethnohistoric/ethnographic record of the region and the Eastern Woodlands in general reveals a variety of practices whose antiquity could be explored (e.g., Cronon 1983; Holmes 1896; Keeley 1995; Mounier 2003:151; Russell 1979, 1980, 1981, 1983; Scarry 2003; Smith 2001; Wagner 2003). These data must be used with caution (Lightfoot et al 2013). Investigating landscape management must recognize the broad and patchy geospatial scales that might be involved, as well as the fact that altered environments or niches may be the cumulative result of incremental changes over extended periods (Lightfoot et al 2013:290; Wagner 2003:129-130). This suggests that efforts should focus on micro-geographic areas that include one or more settlements with a long history or re-occupation. It is critical that such research be interdisciplinary employing multiple lines of evidence.

The use of fire is one of the most frequently cited techniques used by native peoples to modify the environment, although opinions are divided about the frequency and extent to which settings were burned over (cf. Abrams and Nowacki 2008; Buell et al 1954; Patterson and Sassaman 1988; Russell 1983).

> Fire can be used to open woods for better hunting, increase ease of travel, clear trails, stimulate or improve browse to attract game, encircle game, aid in spotting or tracking game, improving the yield of useful plants, clear away leaf litter for easier nut collecting, create a fire free zone around habitations, reduce vermin, influence the onset of spring growth, clear fields for planting, maintain old fields, stimulate woody shoots, drive away or escape from enemies, and create open woods around habitations to prevent ambush (Wagner 2003:133-134).

A variety of methods have been employed in the investigation of the anthropogenic use of fire that could serve as models for future research in the Delaware Valley (e.g., Abrams and Nowacki 2008; Fesenmyer and Christensen 2010; Lightfoot et al 2013:292-294; Russell 1983; Wagner 2003:134-142).

Recognizing vegetation patterns that are at odds with expectations stemming from an understanding of climate, landscape setting, influence of wild fires, and the habitats and presumed natural ranges of particular species and their mutualist partners have been used to implicate or question the role of Native Americans in landscape modification and plant dispersal (e.g., Abrams and Nowacki 2008; Asch Sidell 2008:47-48; Fulton and Yansa 2016; Keener and Kuhns 1997; MacDougall 2003; Murphy 2001; Russell 1981; Trachtenberg et al 2008:136-137; Tulowiecki and Larsen 2015; Warren 2016). For example, given the use of nuts throughout prehistory in the Eastern Woodlands it is reasonable to ask if arboriculture or silviculture was practiced (Cowan 1985:218). This observation and related question certainly apply to the archaeological record of the Upper and broader Delaware Valley. On the basis of macro-regional studies in Eastern Woodlands (Abrams and Nowacki 2008) the answer to the question would be, yes. Following Abrams and Nowacki (2008:1133):

> Climate does *not* (emphasis in original) stand alone as the primary factor for the long-term perpetuation of mast trees in the eastern forest during the middle to late

> Holocene. One irrefutable fact is that the vast majority of oak, hickory and pine forests in the eastern USA will be replaced within one generation by later successional species, most notably maples and beech, in the absence of fire.

Current and future paleobotanical research in the Upper Delaware and wider region offers more than "food for thought". Information from dated contexts is already substantial. Additional data exists from contexts that have been assigned a relative age on the basis of typological and stratigraphic associations that could be refined with radiocarbon assays of archived material. Possible research projects would bring together archaeologists and a variety of environmental scientists addressing issues that have relevance for current concerns over climate change and environmental management.

VII. CONCLUSIONS

In a volume this wide-ranging it is impractical to summarize all of the insights and issues for research that have been offered. Instead I comment briefly on approaches to chronology that should guide us in the future.

The classic sites of the Upper Delaware have figured prominently in the creation of regional cultural historical benchmarks and chronological typologies. They need to be re-dated. Many of the existing assays have large standard deviations that would be rejected in a hygienic approach to the use of radiocarbon dates. For some of these sites datable organic materials are part of archived collections. There also are a number of sites that have never been radiocarbon dated but for which archived organics exist.

We are in need of additional assays that relate more directly to the material culture and other evidence that forms the basis of our interpretive frameworks: AMS dates of residues on steatite and other stone bowls, pottery, lithics, fire cracked rock; faunal remains; and AMS dating of botanical remains, especially maize and indigenous species that may have been intentionally cropped or transplanted across regional landscapes. Charcoal from sediments or soils underlying plowzone sites should be collected and dated as an additional means of assessing the age of the components mixed as a result of plowing. The potential for deriving dates from calcined bone should be explored using samples from the area.

Area-specific correction factors need to be developed for radiocarbon assays of shell. The project initiated by Stewart and Bitting (n.d.) in this regard was not promising but involved a small sample of paired dates (shell and organics) from feature contexts. Other dating techniques like thermoluminescence (TL), optically stimulated luminescence (OSL), and paleomagnetic dating should be promoted where datable organic material is lacking.

In reviewing CRM reports for this project I encountered many instances where datable organics recovered from features or stratigraphic contexts could have been dated but were not, presumably because of budget constraints. Budget proposals, beginning with Phase I surveys, should have a standard line item for a minimum number of radiocarbon, TL, OSL, or paleomagnetic dates. In lieu of this, proposals could include a contingency statement that would provide potential access to sufficient funds should suitable material from reliable contexts be encountered. Chronology is fundamental to archaeological practice and running dates whenever sufficient contexts and materials are present should be as basic a procedure as compiling artifact inventories.

To insure that dates that are run are made readily available, the Historic Preservation Office could maintain online tables like the ones included in this volume, updating them as CRM reports are reviewed. In the same way that new or updated site forms are a required part of any reporting effort, so too, could be appropriate table entries.

Being able to better assess the age of any site, surface or buried, will impact the type of “big picture” interpretive analyses that might be performed, and thus alter a resource’s potential significance in the regulatory process. Small upland lithic scatter sites which have yielded at least one artifact diagnostic of a specific temporal period are considered significant sites within regions of Pennsylvania where site distributions are not well documented (Carr and Keller 1998:8; Carr 2002:1; Miller 2001:3). If datable, and situated within a poorly documented watershed, these sites are considered eligible for inclusion in the National Register of Historic Places under Criterion D (Carr 2002:9). This same notion should be applied to any site that has the potential to yield datable material regardless of its size or the nature of artifact assemblages.

There are a variety of ways to analyze radiocarbon dates and incorporate them into synthetic works. The use of summed probabilities to reveal trends in assays and the variety of phenomena with which they are linked (e.g., Bevan et al 2017) could be used more frequently in the region, especially as the radiocarbon database becomes more substantial. Absolute seriation employs radiocarbon dates and changes in attributes in a regression analysis that could bring greater chronological resolution to pottery and other artifact types which currently exhibit overlong chronologies. Klein's (1994) use of this technique with pottery from Virginia provides a model to follow. Bayesian chronological modeling may also prove useful but may be difficult to implement (Hamilton and Krus 2018).

Taking cultural historical types as a primary starting point for assessing chronology and the definition of analytic units can blind us to seeing patterns in the creation and use of material culture that are at odds with traditional schemes. If an otherwise discrete context contains a mixture of objects that existing typologies maintain should not co-occur, the deposit often is interpreted as mixed, rather than viewed as evidence that traditional archaeological thinking is in error or in need of revision. This is not a reason to abandon the use, testing and revision of chronologically-oriented typologies, merely a recognition that types/typologies are heuristic constructs that need not remain static, and are crafted to suit specific research needs (cf. Hart 2011:104; Hart and Brumbach 2005:15). Recommendations for addressing these issues have been raised throughout this volume with the hope of improving our understanding of regional prehistory.

VIII. REFERENCES CITED

Abbott, Charles C.

1881 *Primitive Industry: Illustrations of the Handiwork, in Stone, Bone and Clay, of the Native Races of the Northern Atlantic Seaboard of America*. George A. Bates, Salem, Massachusetts.

Abrams Marc D and Gregory J. Nowacki

2008 Native Americans as Active and Passive Promoters of Mast and Fruit Trees in the Eastern USA. *The Holocene* 18(7):1123–37.

Adams, James T. and Thomas E, Adams

1991 A Small Tocks Island Component at the Snyder Site, Warren County, New Jersey. *Pennsylvania Archaeologist* 61(2):1-5.

1993 A Stemmed Point Cache from the Snyder Site, Warren County, New Jersey. *Pennsylvania Archaeologist* 63(2):1-6.

Adams, William Y. and Ernest W. Adams

1991 *Archaeological Typology and Practical Reality: A Dialectical Approach to Artifact Classification and Sorting.* Cambridge University Press, Cambridge.

Adovasio, James M., J. Donahue, and R. Stuckenrath.

1990 The Meadowcroft Rockshelter Radiocarbon Chronology 1975–1990. *American Antiquity* 55(2): 348–354.

AECOM

2016 Phase IB/II Archaeological Investigations of the Gunnar's Run South Site (36Ph162), I-95/GIR Roadway Improvement Corridor Philadelphia, Pennsylvania. .http://diggingi95.com/reports/phase-ibii-archaeological-investigations-of-the-gunnars-run-south-site-36ph162-i-95gir-roadway-improvement-corridor-philadelphia-pennsylvania/.

Allen, R. A, A. H. Luckenbach, and C.G. Holland

1975 The Application of Instrumental Neutron Activation Analysis to a Study of Prehistoric Steatite Artifacts and Source Materials. *Archaeometry* 17(1): 69-83.

Allitt, Sharon

2007 The Mohr Site: In Search of a Proxy. A Preliminary Stable Carbon Isotope Study of Deer Bone as an Indicator of Intensity of Maize (*Zea Mays*) Agriculture in a Northeast Prehistoric Village. *Journal of Middle Atlantic Archaeology* 23:17-34.

2011 *Stable Isotopic Insights Into the Subsistence Patterns of Prehistoric Dogs (Canis Familiaris) and Their Human Counterparts in Northeastern North America*. Phd dissertation, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Allitt, Sharon, R. Michael Stewart and Timothy Messner
2008 The Utility of Dog Bone (*Canis familiaris*) in Stable Isotope Studies for Investigating Prehistoric Maize Consumption: A Preliminary Study. *North American Archaeologist* 29 (3-4):339-363.

Alterman, Michael
1993 Archaeological Monitoring at Dingmans Launch Lower Boat Ramp, Delaware Water Gap National Recreation Area, Pike County, Pennsylvania. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Alterman, Michael with contributions by Brad Koldehoff
1991 Archaeological Testing and Monitoring at Dingmans Ferry Boat Launch, Delaware Water Gap National Recreation Area, Pike County, Pennsylvania. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Anderson, David A., Keith R. Bastianini, Eric Filkins, Martin T. Fuess, Jonathan Glenn, Regina Hart, William Johnson, Bruce L. Manzano, Timothy L. McAndrews, Edward J. Siemon, Alan D. Tabachnick, and Jon C. Vandenbosch
2000 Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volumes I, IIA, IIB and IV. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Anderson, David G.
1991 The Bifurcate Tradition in the South Atlantic Region, *Journal of Middle Atlantic Archaeology* 7:91-106.
1995 Paleoindian Interaction Networks in the Eastern Woodlands. In *Native American Interactions: Multiscalar Analyses and Interpretations in the Eastern Woodlands*, edited by M.S. Nassaney and K.E. Sassaman, pp.3-26. University of Tennessee Press, Knoxville.
1996 Models of Paleoindian and Early Archaic Settlement in the Lower Southeast. In *The Paleoindian and Early Archaic Southeast*, edited by D. G. Anderson and K. Sassaman, pp. 29-57. University of Alabama Press, Tuscaloosa.

Anderson, David G., D. Shane Miller, Stephen J. Yerka, J. Christopher Gillam, Erik N. Johanson, Derek T. Anderson, Albert C. Goodyear, and Ashley M. Smallwood
2010 PIDBA (Paleoindian Database of the Americas) 2010: Current Status and Findings. *Archaeology of Eastern North America* 38:63-90.

Anderson, Shelby L., Shannon Tushingham and Tammy Y. Buonasera
2017 Aquatic Adaptations and the Adoption of Arctic Pottery Technology: Results of Residue Analysis. *American Antiquity* 82(3):452-479.

Andrefsky, William, Jr.
1983 *Late Archaic Prehistory in the Upper Delaware Valley: A Study of Classification, Chronology, and Interaction.* PhD dissertation, Department of Anthropology, State University of New York at Binghamton.
1998 *Lithics: Macroscopic Approaches to Analysis*. Cambridge Manuals in Archaeology. Cambridge University Press, New York.

Anthony, David W.
1990 Migration in Archeology: The Baby and the Bathwater. *American Anthropologist* 92(4):895-914.

Anthony, David W. and Daniel G. Roberts
1987 The Bachman Site (36Nm80): Prehistoric Occupations in the Middle Delaware Valley. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.
1988 Stone Quarries and Human Occupations in the Hardyston Jasper Prehistoric District of Eastern Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Arnold, Philip J., III
2000 Working Without a Net: Recent Trends in Ceramic Ethnoarchaeology. *Journal of Archaeological Research* 8(2):105–133.

Asch, David L. and Nancy B. Asch
1978 The Economic Potential of *Iva annua* and Its Prehistoric Importance in the Lower Illinois Valley. In *The Nature and Status of Ethnobotany*, edited by R. I. Ford, pp. 300-341. Anthropological Papers, Museum of Anthropology, The University of Michigan 67. Ann Arbor.
1983 Carbonized Plant Remains From Late Woodland Sites in the Delaware Water Gap National Recreation Area, Sussex and Warren Counties, Northwestern New Jersey. Center for American Archaeology, Archaeobotanical Laboratory Report No.58. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Asch Sidell, Nancy
2002a Botanical Analysis (Park Creek I Site). In Above the Valley Walls: Data Recovery of the Park Creek I (Subi-1463, NYSM #10221), Park Creek II (Subi-1464, NYSM #10222), and Raish (Subi-1465, NYSM #10223) Sites in the Upper Susquehanna Valley. Towns of Windsor and Kirkwood, Broome County, New York, by Laurie Miroff, pp.75-80 and Appendix 11.10. Report on file (Digital Archive ID# 2811), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
2002b Botanical Analysis (Park Creek II Site). In Above the Valley Walls: Data Recovery of the Park Creek I (Subi-1463, NYSM #10221), Park Creek II (Subi-1464, NYSM #10222), and Raish (Subi-1465, NYSM #10223) Sites in the Upper Susquehanna Valley. Towns of Windsor and Kirkwood, Broome County, New York, by Laurie Miroff, pp.147-154 and Appendix 11.10. Report on file (Digital Archive ID# 2811), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2002c Botanical Analysis (Raish Site). In Above the Valley Walls: Data Recovery of the Park Creek I (Subi-1463, NYSM #10221), Park Creek II (Subi-1464, NYSM #10222), and Raish (Subi-1465, NYSM #10223) Sites in the Upper Susquehanna Valley. Towns of Windsor and Kirkwood, Broome County, New York, by Laurie Miroff, pp.184-185 and Appendix 11.10. Report on file (Digital Archive ID# 2811), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2002d Subsistence. In Data Recovery Investigations of the Deposit Airport I Site (SUBi-2048), Deposit Water/Sewer Project, Town of Deposit, Delaware County, New York, by T.D. Knapp and N.M. Versaggi, pp.114-129. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2003 Mansfield Bridge Site (36Ti116) Floral Remains. Appendix B. In Hunters to Horticulturalists: The Archaeology of the Mansfield Bridge Site. SR 6015, Section D52, Tioga County, Pennsylvania. Two volumes, by R.D. Wall, R. Varney, D. Gould and H. Luhman. Report on file (ER#93-0939-117), Pennsylvania State Historic Preservation Office, Harrisburg.

2005 Appendix I. Herrick Hollow Sites Floral Remains. In Phase 3 Data Recovery Herrick Hollow Prehistoric Archaeological District, Herrick Hollow I-VII Sites, Volume II: Appendices. Richardson Hill Road Landfill Superfund Project, Town of Masonville, Delaware County, New York, by Christopher D. Hohman et al, pp.281-303. Report on file (Digital Archive ID# 6085), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2008 The Impact of Maize-Based Agriculture on Prehistoric Plant Communities in the Northeast. In *Current Northeast Paleoethnobotany II,* edited by John P. Hart, pp.29-52. New York State Museum Bulletin Series 512, Albany.

2011 Chenango Point Site Floral Remains. In Life at the Confluence: Archaic and Woodland Occupations of the Chenango Point Site (SUBi-1274). Data Recovery Excavations for the Downtown Academic Center Project, City of Binghamton, Broome County, New York, by Timothy D. Knapp, Appendix 11. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2012 Chenango Point South Site Floral Remains. In Investigation of the Chenango Point South Site (SUBi-2776). Phase 2/3 Archaeological Investigations, Chenango Point South Site, Twin River Commons Project, City of Binghamton, Broome County, New York, by Laurie E. Miroff, Appendix XI. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2014 Botanical Analysis. In The Otsiningo Market Site (SUBi-3041; A00706.000048), Phase 3 Archaeological Investigations, Otsiningo Farmers Market Project, Town of Dickinson, Broome County, New York, by Laurie E. Miroff, pp.105-114. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

2015 Manna Site (36Pi4) Floral Remains. Appendix D. In The Archaeology of the Manna Site (36Pi4), Delaware Water Gap National Recreation Area, Pike County, Pennsylvania, by R.M. Stewart with contributions by Timothy Messner and Philip Perazio. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Bachor, Susan

2011 Exploratory Geochemical Analysis of Steatite from the Lower Susquehanna Valley: Applications with the Handheld XRF. *Journal of Middle Atlantic Archaeology* 27:103-112.

2017 *Trade and Exchange of Steatite, 3000 BC-750 BC, in the Susquehanna and Delaware River Watersheds of Pennsylvania*. MA thesis, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Bailey, Geoffrey N., Margaret R. Deith and Nicholas J. Shackleton

1983 Oxygen Isotope Analysis and Seasonality Determinations: Limits and Potential of a New Technique. *American Antiquity* 48(2):390-398.

Barber, Michael B.

2003 A Review of Early Archaic Research in Virginia: A Re-Synthesis a Decade Later. *Quarterly Bulletin of the Archaeological Society of Virginia* 58(3):121-143

Barnett, William K. and John W. Hoopes

1995 *The Emergence of Pottery: Technology and Innovation in Ancient Societies.* Smithsonian Institution Press, Washington, D.C. and London.

Barse, William P.

2006 Phase I, II, and III Archaeological Investigations for the Proposed New Jersey Swim Beach Project in the Delaware Water Gap National Recreation Area, Warren County, New Jersey. Report on file (WAR N49-4472), New Jersey Historic Preservation office, Trenton.

Beaver, John

2009 Human Remains and Funerary Objects from Sussex County, New Jersey. National Museum of the American Indian, Smithsonian Institution, Repatriation Office. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Archaeology Facility, Bushkill, Pennsylvania.

Beck, Margaret E.

2009 Residential Mobility and Ceramic Exchange: Ethnography and Archaeological Implications. *Journal of Archaeological Method and Theory* 16:320-356.

Becker, Marshall J.

1985 The European Contact/Early Historic Period in the Lenape Realm of Pennsylvania's Piedmont and Coastal Plain. In *A Comprehensive State Plan for the Conservation of Archaeological Resources, Volume II*, edited by Paul Raber, pp.41-52. Pennsylvania Historical and Museum Commission, Historic Preservation Planning Series No. 1, Harrisburg.

1986 Cultural Diversity in the Lower Delaware River Valley, 1550-1750: An Ethnohistorical Perspective. In *Late Woodland Cultures of the Middle Atlantic Region*, edited by Jay F. Custer, pp. 90-101. University of Delaware Press, Newark.

1988 A Summary of Lenape Socio-Political Organization and Settlement Pattern at the Time of European Contact: The Evidence for Collecting Bands. *Journal of Middle Atlantic Archaeology* 4:79-83.

Bedard, Justin
2011 The Appearance of Steatite Tempered Ceramics in the Southern Mid-Atlantic: Social Compromise and the Dependent Invention of Ceramic Technology. *Journal of Middle Atlantic Archaeology* 27:129-142.

Beehr, Dana Elizabeth
2011 *Investigation of Middle Woodland Population Movement in the Midwestern United States Using Strontium Isotopes*. PhD dissertation, Department of Anthropology, University of Illinois at Urbana-Champaign, Urbana, Illinois.

Beisaw, April M.
2007 *Osteoarchaeology of the Engelbert Site: Evaluating Occupational Continuity Through the Taphonomy of Human and Animal Remains*. PhD dissertation, Department of Anthropology, Binghamton University, Binghamton, New York.

Bello, Charles A., R. Michael Stewart and Guy DiGiugno
1998 Archaic-Period Triangles from 28GL228. *Bulletin of the Archaeological Society of New Jersey* 53:128

Berg, Thomas M. and Christine M. Dodge
1981 *Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania*. Map 61, Pennsylvania Geological Survey, Fourth Series, Harrisburg.

Bergman, Christopher
1996a Chronology, Site Function, Regional Comparisons, and Conclusions. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.414-425. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.
1996b Analysis of the Prehistoric Ceramic Assemblage. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.75-89. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Bergman, Christopher A., Kurt W. Carr and J. M. Adovasio
in press The Early and Middle Archaic Periods of Pennsylvania. In *The Archaeology of Native Americans in Pennsylvania*, edited by Kurt W. Carr, Christopher A. Bergman, Christina B. Rieth, Bernard K. Means, and Roger W. Moeller. University of Pennsylvania Press, Philadelphia.

Bergman, Christopher, John Doershuk, Larry R. Kimball and V. Riegal
1996 Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania. Volumes I-IV, Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Bergman, Christopher A., John F. Doershuk, and Joseph Schuldenrein
1994 A Young Archaeologist's Summary Guide to the Deeply Stratified Sandts Eddy Site, Northampton County, Pennsylvania. *Journal of Middle Atlantic Archaeology* 10:153-168.

Bergman, Christopher, John Doershuk, Heidi A. Fassler, Orloff G. Miller and David Rue
1994 Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Bergman, Christopher, Ken Duerksen and Keith Russell
1994 Analysis of the Prehistoric Lithic Assemblage. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania, by C. Bergman et al, pp.170-237. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Bergman, Christopher A., Keith A. Russell, Ken Duerksen and Dan Miller
1996 Analysis of the Prehistoric Lithic Assemblages. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.90-210. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Betts, Matthew, Susan Blair and David Black
2012 Perspectivism, Mortuary Symbolism, and Human-Shark Relationships on the Maritime Peninsula. *American Antiquity* 77(4):621-645.

Bevan, Andrew, Sue Colledge, Dorian Fuller, Ralph Fyfe, Stephen Shennan and Chris Stevens
2017 Holocene Fluctuations in Human Population Demonstrate Repeated Links to Food Production and Climate. *Proceedings of the National Academy of Sciences* 114(49): 12839-12840; doi:10.1073/iti4917114

Bierbrauer, Sandra H.
2010 Bioarchaeology at the Kimble Beach Site, Cape May County, New Jersey. Paper presented at the quarterly meeting of the Archaeological Society of New Jersey, Roebling, New Jersey.

Bierbrauer, Sandra H., Carolyn Hartwick and Richard Regensburg
2014 Late Woodland Faunal Remains and Diet at an Estuarine Site, Kimble's Beach, Cape May County, NJ. *Journal of Middle Atlantic Archaeology* 30:83-103.

Bierhorst, J.
1995 *Mythology of the Lenape*. University of Arizona Press, Tucson.

Birch, Jennifer and Ronald F. Williamson
2013 *The Mantle Site: An Archaeological History of an Ancestral Wendat Community*. AltaMira Press, Lanham, Maryland.

Bitting, Kelsey
2013 *Terrace Formation and Floodplain Sedimentation in the Northern Delaware River Valley, New Jersey, USA: Fluvial Response to Postglacial Climatic, Environmental, Isostatic, and Anthropogenic Influences*. PhD dissertation, Department of Earth and Planetary Sciences, Rutgers, The State University of New Jersey, New Brunswick.

Blitz, John H.
2015 Skeuomorphs, Pottery, and Technological Change. *American Anthropologist* 117(4):665-678.

Blitz, John H. and Erik S. Porth
2013 Social Complexity and the Bow in the Eastern Woodlands. *Evolutionary Anthropology* 22:89-95.

Blondino, Joseph R.
2008 How Can You Mend a Broken Hearth?: Preliminary Results of Excavations at the Driftstone Site. *Journal of Middle Atlantic Archaeology* 24:167-175.
2015 Rethinking the Transitional Archaic Period in the Upper Delaware Valley. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.98-110. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Bolnick, Deborah A., Daniel I. Bolnick, and David Glenn Smith.
2006 Asymmetric Male and Female Genetic Histories Among Native Americans from Eastern North America. *Molecular Biology and Evolution* 23(11): 2161-2174.

Bolnick, Deborah A. and David Glenn Smith
2007 Migration and Social Structure Among the Hopewell: Evidence from Ancient DNA. *American Antiquity* 72(4), 627-644.

Boulanger, Matthew T., Gregory Lattanzi, David C. Parris, Michael J. O'Brien and R. Lee Lyman
2015 AMS Radiocarbon Dates for Pleistocene Fauna from the American Northeast. *Radiocarbon* 57(1):189-192.

Boulanger, Matthew T., Gregory D. Lattanzi, Cody C. Roush and Michael D. Glascock
2017 Geochemical Analysis of Mica Source Specimens and Artifacts from the Abbott Farm National Historic Landmark (28ME1). *American Antiquity* 62(2):374-396.

Boulanger, Matthew T. and R. Lee Lyman
2014 Northeastern North American Pleistocene Megafauna Chronologically Overlapped Minimally with Paleoindians. *Quaternary Science Reviews* 85:35-46.

Bradley, J. W., A. E. Spiess, R. A. Boisvert, and J. Boudreau
2008 What's the Point? Modal Forms and Attributes of Paleoindian Bifaces in the New England-Maritimes Region. *Archaeology of Eastern North America* 36:119-172.

Brasser, Ted J.
1980 Self-Directed Pipe Effigies. *Man in the Northeast* 19:95-104.

Braun, David P. and Stephen Plog
1982 Evolution of 'Tribal' Social Networks: Theory and Prehistoric North American Evidence. *American Antiquity* 47, 504-525.

Brennan, Louis
1977 The Lower Hudson: The Archaic. *Annals of the New York Academy of Sciences* 288:411-430.

Bressler, James P., Ricki Maietta and Karen Rockey
1983 *Canfield Island Through the Ages*. North Central Chapter No.8, Society for Pennsylvania Archaeology, and the Lycoming County Historical Society, Williamsport, Pennsylvania.

Brett, Perry A. and Jay F. Custer
2015 A Small Ceramic Vessel from the Riggins Farm Site, Cumberland County, New Jersey. *Journal of Middle Atlantic Archaeology* 31:23-38.

Briggs, Rachel V.
2015 The Hominy Foodway of the Historic Native Eastern Woodlands. *Native South* 8:112-146.
2016 The Civil Cooking Pot: Hominy and the Mississippian Standard Jar in the Black Warrior Valley, Alabama. *American Antiquity* 81(2):316-332.

Britton, Linda Ann
1967 *Copper and the Indians of New Jersey*. MA thesis, Department of Anthropology, Hunter College, The City University of New York.

Brodhead, Luke W.
1870 *The Delaware Water Gap: Its Scenery, Its Legends and Early History*. Sherman & Company, Printers, Philadelphia, Pennsylvania.

Brown, Lois
1980 Aboriginal Soapstone Quarries in Maryland. Report on file, Maryland Historic Trust, Crownsville, Maryland.

Brown, Roderick S., David Moyer, Mary Ebeling, Frank Vento, Theresa Kintz and Christina Kelly
2000 Archaeological Survey, Evaluation and Mitigations for the S.R. 2001 Highway Improvement Project, Borough of Milford and Dingman Township, Pike County, and Delaware Water Gap National Recreation Area, Pennsylvania. Report on file (ER#98-8011-103), Pennsylvania State Historic Preservation Office, Harrisburg.

Browning-Hoffmann, Kathryn
1979 Can Incised Pottery Give Clues to Prehistoric Basketry? *The Bulletin, Journal of the New York State Archaeological Association* 76:26-34.

Broyles, Bettye J.
1966 Preliminary Report: The St. Albans Site (46-Ka-27), Kanawha County, West Virginia. *The West Virginia Archaeologist* 19:1-43.
1971 *Second Preliminary Report: The St. Albans Site, Kanawha County, West Virginia*. Report of Archaeological Investigations, Number 3, West Virginia Geological and Economic Survey, Morgantown.

Budinoff, Linda C.
1983 An Inventory of Prehistoric Archaeological Loci in the Upper Delaware Valley. In Cultural Resource Survey, Upper Delaware National Scenic and Recreational River, PA-NY. Volume III: Prehistoric Archaeological Sites, Cultural Resource Survey, Upper Delaware National Scenic and Recreation River, Pennsylvania and New York, by A. Dekin et al 1983, pp.4-84 to 4-285. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Buell, Murray F., Helen F. Buell, and John A. Small
1954 Fire in the History of Mettler's Woods. *Bulletin of the Torrey Botanical Club* 81(3):253-255.

Burke, Adrian
2006 Paleoindian Ranges in Northeastern North America Based on Lithic Raw Materials Sourcing. In*, Notions De Territoire Et De Mobilité: Exemples De L'Europe Et Des Premières Nations En Amérique Du Nord Avant Le Contact Européen*, edited by C. Bressy, A. Burke, P. Chalard, and H. Martin, pp. 77-89. Études et Recherches Archéologiques de l'Université de Liège, Liège.

Burns, Jonathan
2009 *Prehistoric Rockshelters of Pennsylvania: Revitalizing Behavioral Interpretation from Archaeological Spatial Data*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia.

Byrne, K.B.
1984 *Dietary Reconstruction of the Middle Woodland Population at Abbott Farm by Trace Element Analysis*. Senior thesis, Biology Department, Princeton University, Princeton, New Jersey.

Byrne, Kevin B. and David C. Parris
1987 Reconstruction of the Diet of the Middle Woodland Amerindian Population at Abbott Farm by Bone Trace Element Analysis. *American Journal of Physical Anthropology* 74:337-384.

Callahan, Errett
1974 Experimental Archaeology Papers #3. Department of Sociology and Anthropology, Virginia Commonwealth University, Richmond.

Callender, Charles
1978 Shawnee. In *Handbook of North American Indians: Northeast, Volume 15*, edited by Bruce G. Trigger, pp.622-635. Smithsonian Institution, Washington, D.C.

Carpenter, Edmund S.
1950 Five Sites of the Intermediate Period. *American Antiquity* 15(4):298-314.

Carr, Kurt W.
1998a The Early Archaic in Pennsylvania. *Pennsylvania Archaeologist* 68:42-69.
1998b Archaeological Site Distributions and Patterns of Lithic Utilization During the Middle Archaic in Pennsylvania. In *The Archaic Period in Pennsylvania.: Hunter Gatherers of the Early and Middle Holocene Period*, edited by Paul Raber, Patricia Miller and Sarah Neusius, pp.77-90. Recent Research in Pennsylvania Archaeology, Number 1, Pennsylvania Historical and Museum Commission, Harrisburg.
2002 The Contribution of Plow-Disturbed Prehistoric Archaeological Sites to Our Understanding of Past Cultural Behavior and Their Eligibility to the National Register of Historic Places. Paper presented at the annual meeting of the Eastern States Archaeological Federation, Mt. Laurel, New Jersey.
2015 The Evolution of Cultural Adaptations During the Transitional Period in the Delaware and Susquehanna River Valleys in Pennsylvania. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.53-84. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Carr, Kurt W. and James M. Adovasio
2002 Paleoindians in Pennsylvania. In *Ice Age Peoples of Pennsylvania*, edited by K.W. Carr and J.M. Adovasio, pp.1-50. Recent Research in Pennsylvania Archaeology, Number 2. Pennsylvania Historical and Museum Commission, Harrisburg.

Carr, Kurt W. and Jenny Keller
1998 The Development of Prehistoric Settlement Pattern Research Priorities in Pennsylvania. Report on file, the State Museum of Pennsylvania, Harrisburg.

Carr, Kurt W., R. Michael Stewart, Dennis Stanford and Michael Frank
2013 The Flint Run Complex: A Quarry-Related Paleoindian Complex in the Great Valley of Northern Virginia. In, *In the Eastern Fluted Point Tradition*, edited by Joseph A.M. Gingerich, pp.156-217. University of Utah Press, Salt Lake City.

Carr, Kurt W. and Roger W. Moeller
2015 *First Pennsylvanians: The Archaeology of Native Americans in Pennsylvania*. Pennsylvania Historical and Museum Commission, Harrisburg.

Carroll, Lynda, Samuel Kudrle, and Nina M. Versaggi
2007 Phase 3 Data Recovery, Mt. Laurel Gardens Site (SUBi-2523), Town of Middletown, Delaware County, New York. Report on file (Digital Archive report), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Cavallo, John A.
1981 Turkey Swamp: A Late Paleo-Indian Site in New Jersey's Coastal Plain. *Archaeology of Eastern North America* 9:1-17.

Chapman, Jefferson
1975 *The Rose Island Site and the Bifurcate Point Tradition*. Report of Investigations, No. 14, Department of Anthropology, University of Tennessee, Knoxville.

Chapman, Jefferson with contributions by Patricia Cridlebaugh, Lucy Foley and Larry Kimball
1977 *Archaic Period Research in the Lower Little Tennessee Valley – 1975: Icehouse Bottom, Harrison Branch, Thirty Acre Island, Calloway Island*. Report of Investigations, No. 18, Department of Anthropology, University of Tennessee, Knoxville.

Chatters, James C., James W. Brown, Steven Hackenberger, Patrick McCutcheon and Jonathan Adler
2017 Calcined Bone as a Reliable Medium for Radiocarbon Dating: a Test Using Paired North American Samples. *American Antiquity* 82(3):593-608.

Chavez, Steve, R. Burns and A. Berle Clemenen
1995 Final Cultural Landscape Report, Volume 1. Pahaquarry Copper Mine, Delaware Water Gap National Recreation Area, New Jersey. Report on file (WAR N27a-6307). New Jersey Historic Preservation Office, Trenton.

Church, Flora
2000 Appendix IV: Results of a High Power Use-Wear Analysis of a Portion of the Lithic Assemblage from the Treichlers Bridge Site (36NM142), Northampton County, Pennsylvania. In Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volume III, by David A. Anderson et al. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Claassen, Cheryl
2015 *Belief and Rituals in Archaic Eastern North America: An Interpretive Guide.* University of Alabama Press, Tuscaloosa.

Clabeaux, Marie. S.
1976 Analysis of Human Skeletal Remains from the Rosenkrans Site. *Archaeology of Eastern North America* 4:43-44.

Clark, John E. and Dennis Gosser
1995 Reinventing Mesoamerica's First Pottery. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp.209-221. Smithsonian Institution Press, Washington, D.C. and London.

Clark, Wayne E.
2016 Comparative Research on Regional Algonquian Phases, Including Archaeological Data Recovery at the Manna Site (36PI0004), Minisink Archaeological Site National Historic Landmark District, Delaware Water Gap National Recreation Area, Pike County, Pennsylvania. Volume 2 – Algonquian Cultures of the Delaware and Susquehanna River Drainages: A Migration Model. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Coe, Joffre Lanning
1964 *The Formative Cultures of the Carolina Piedmont.* Transactions of the American Philosophical Society, New Series Volume 54 Part 5.Philadelphia, Pennsylvania.

Connally, G. G., and L. A. Sirkin
1970 Late Glacial History of the Upper Wallkill Valley. *Geological Society of America Bulletin* 81(11):3297-3306.

Cooke, Richard G.
1989 Anurans as Human Food in Tropical America: Ethnographic, Ethnohistoric, and Archaeological Evidence. *Archaeozoologia* 3(1):123-141.

Cotter, J.F.P., J.C. Ridge, E.B. Evenson, W.D. Sevon, L. Sirkin and R. Stuckenrath
1986 The Wisconsinan History of the Great Valley, Pennsylvania and New Jersey, and the Age of the "Terminal Moraine". In *The Wisconsinan Stage of the First Geological District, Eastern New York*, edited by D.H. Caldwell, pp.22-49. New York State Museum Bulletin 455, University of the State of New York, Albany.

Cowan, C. Wesley
1985 Understanding the Evolution of Plant Husbandry in Eastern North America: Lessons from Botany, Ethnography and Archaeology. In *Prehistoric Food Production in North America*, edited by Richard I. Ford, pp.205-243. Anthropological Papers No.75, Museum of Anthropology, University of Michigan, Ann Arbor.

Cremeens, David L. and John P. Hart
2009 Holocene Alluvial Geomorphology of the Memorial Park Site (36Cn164), West Branch Susquehanna River, Pennsylvania. *Archaeology of Eastern North America* 37:47-64.

Cresson, Jack
1974 Vinette I Pottery. *Bulletin of the Archaeological Society of New Jersey* 31:20-21.
1990 Broadspear Lithic Technology: Some Aspects of Biface Manufacture, Form, and Use History with Insights Towards Understanding Assemblage Diversity. In *Experiments and Observations on the Terminal Archaic of the Middle Atlantic Region,* edited by R.M. Moeller, pp. 105-130. Archaeological Services, Bethlehem, Connecticut.

Cronon, William
1983 *Changes in the Land: Indians, Colonists, and the Ecology of New England*. Hill and Wang, New York.

Cross, Dorothy
1941 *Archaeology of New Jersey, Volume 1*. Trenton: Archaeological Society of New Jersey and the New Jersey State Museum, Trenton.
1945 A Cremation Burial. *Newsletter of the Archaeological Society of New Jersey* 14:4-5.
1948 The Bevans Rock Shelters. *Bulletin of the Archaeological Society of New Jersey*1:13-25.
1955 Notes from a Lecture by Dorothy Cross to the Sussex County Archaeological Society, March 26. Manuscript on file, Department of Archaeology and Ethnology, New Jersey State Museum, Trenton.
1956 *Archaeology of New Jersey. Volume 2: The Abbott Farm*. Archaeological Society of New Jersey and the New Jersey State Museum, Trenton.

Crowl, G.H., and R. Stuckenrath Jr.
1977 Geological Setting of the Shawnee-Minisink Paleo-Indian Archaeological Site (36-MR-43). In *Amerinds and Their Paleoenvironments in Northeastern North America*, edited by Walter S. Newman and Bert Salwen. Annals of the New York Academy of Sciences 288: 218-222.

Cummings, Linda Scott and Kathryn Puseman
2003 Pollen and Macrofloral Analysis at the Shohola Flats Site, 36Pi169, Pennsylvania. Appendix G. In Shohola/Barryville Bridge Replacement Project (S.R. 0434, Section 470) Shohola Township, Pike County, Pennsylvania, and the Hamlet of Barryville, Sullivan County, New York. Archaeological Investigations, Volume I, II, III by S. Trachtenberg et al., 2008. Report on file (ER# 02-8043-103), Pennsylvania Historic Preservation Office, Harrisburg.

Cummings, Linda Scott and R.A. Varney
2006 Pollen, Starch, And Phytolith Analysis for the Calver Island Site (36DA89), Pennsylvania: Stratigraphic Columns and Ceramic and Steatite Sherds. Paleo Research Institute Technical Report 06-09, Golden, Colorado. Report available through the Digital Archaeological Record, Center for Digital Antiquity https://www.digitalantiquity.org/

Cushman, R. Dustin
2007 The Context of Death: Burial Rituals in the Delaware Valley. *Archaeology of Eastern North America* 35:153-160.
2013 *Taken To The Grave: The Reinforcement Of Delaware Indian Identity and Group Relationships As Inferred From The Analysis Of Late Woodland Through Historic Period Mortuary Rituals and Remains.* Draft of PhD dissertation, Department of Anthropology, Temple University, Philadelphia, PA.

Custer, Jay F.
1983 *Quantitative Analysis of the Shenks Ferry and Susquehannock Projectile Points: Testing the Inter-Ethnic Variability of Stone Tools*. University of Delaware Center for Archaeological Research, Report No. 1. Newark, Delaware.
1984a *Delaware Prehistoric Archaeology: An Ecological Approach*. University of Delaware Press, Newark.
1984b The Paleoecology of the Late Archaic: Exchange and Adaptation. *Pennsylvania Archaeologist* 54(3-4):33-47.
1984c *Prehistoric Lithic Exchange Systems in the Middle Atlantic Region*. University Of Delaware Center for Archaeological Research, Monograph No. 3. Newark, Delaware.
1987 Late Woodland Ceramics and Social Boundaries in Southeastern Pennsylvania and the Northern Delmarva Peninsula. *Archaeology of Eastern North America* 15:13-27.
1988 Coastal Adaptations in the Middle Atlantic Region. *Archaeology of Eastern North America* 16:121-135.
1989 *Prehistoric Cultures of the Delmarva Peninsula: An Archaeological Study*. University of Delaware Press, Newark.
1990 Early and Middle Archaic Cultures of Virginia: Culture Change and Continuity. In *Early and Middle Archaic Research in Virginia: A Synthesis*, edited by Theodore R. Reinhart and Mary Ellen N. Hodges, pp1-60. Special Publication No.22 of the Archaeological Society of Virginia, Richmond.
1991 Notes on Broadspear Functions. *Archaeology of Eastern North America* 19:51-73.
1996 *Prehistoric Cultures of Eastern Pennsylvania*. Pennsylvania Historical and Museum Commission, Anthropological Series No. 7. Harrisburg.
2001 *Classification Guide for Arrowheads and Spearpoints of Eastern Pennsylvania and the Central Middle Atlantic.* Pennsylvania Historical and Museum Commission, Harrisburg.

Custer, Jay F. and David C. Bachman
1984 *Phase III Data Recovery Excavations of the Prehistoric Components from the Hawthorne Site, 7NC-E-46, New Churchman's Road, Christiana, New Castle County, Delaware*. Delaware Department of Transportation Archaeology Series 27, Dover.
1986 Analysis of Projectile Point Morphology, Use Wear, and Activity Areas at the Hawthorne Site (7NC-E-46), New Castle County, Delaware. *Journal of Middle Atlantic Archaeology* 2:37-62.

Custer, J.F., and G.S. Mellin
1986 Analysis of "Broadspears" from Delaware: Form, Function, and Distribution. *Bulletin of the Archaeological Society of Delaware* 22:1-29.

Custer, Jay F., Karen Rosenberg, Glen S. Mellin, and Arthur Washburn
1990 A Re-examination of the Island Field Site (7K-F-17). *Archaeology of Eastern North America* 18:145-212.

Custer, Jay F. and H. Henry Ward
1988 Steatite Quarries of Northeastern Maryland and Southeastern Pennsylvania: An Analysis of Quarry Technology. *Pennsylvania Archaeologist* 58(2):33-49.

Custer, Jay F., Scott C. Watson and Daniel N. Bailey
1994 Data Recovery Investigations of the West Water Street Site, 36CN175, Lock Haven, Clinton County, Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.
1996 A Summary of Phase III Data Recovery Excavations at the West Water Street Site (36CN175), Lock Haven, Clinton County, Pennsylvania. *Pennsylvania Archaeologist* 66(1):1-53.

da Fonseca, Rute R, Bruce D. Smith, Nathan Wales, Enrico Cappellini, Pontus Skoglund, Matteo Fumagalli, José Alfredo Samaniego, Christian Carøe, María C. Ávila-Arcos, David E. Hufnagel, Thorfinn Sand Korneliussen, Filipe Garrett Vieira, Mattias Jakobsson, Bernardo Arriaza, Eske Willerslev, Rasmus Nielsen, Matthew B. Hufford, Anders Albrechtsen, Jeffrey Ross-Ibarra and M. Thomas P. Gilbert
2015 The Origin and Evolution of Maize in the Southwestern United States. *Nature Plants* 1(1):Article 14003 (journal published online).

Dean, Nora Thompson
1984 Lenape Funeral Customs. In *The Lenape Indian: A Symposium*, edited by Herbert C. Kraft, pp.63-70. Archaeological Research Center, Seton Hall University, South Orange, New Jersey.

Denny J.P.
1989 Algonquian Connections to Salishan and Northeastern Archaeology. In *Papers of the 20th Algonquian Conference*, edited by W. Cowan, pp.86-107. Ottawa: Carleton University.
1991 The Algonquian Migration From Plateau to Midwest: Linguistics and Archaeology. In *Papers of the 22nd Algonquian Conference*, edited by W. Cowan, pp.103-124. Ottawa: Carleton University.

Dent, Richard J., Jr.
1979 *Ecological and Sociocultural Reconstruction in the Upper Delaware Valley*. PhD dissertation, Department of Anthropology, The American University, Washington, D.C.
1985a Amerinds and the Environment: Myth, Reality, and the Upper Delaware Valley. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr., pp.123-163. Academic Press, Orlando, Florida.
1985b The Upper Delaware Valley: Recent Past and Present Biophysical Conditions. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley*

of Pennsylvania, edited by Charles W. McNett, pp.35-54. Academic Press, Orlando, Florida.
1995 *Chesapeake Prehistory: Old Traditions, New Directions*. Plenum Press, New York.
2002 Paleoindian Occupation of the Upper Delaware Valley: Revisiting Shawnee Minisink and Nearby Sites. In, *Ice Age Peoples of Pennsylvania*, edited by Kurt Carr and James Adovasio, pp.51-78. Recent Research in Pennsylvania Archaeology, Number 2. Pennsylvania Historical and Museum Commission, Harrisburg.
2007 Seed Collecting and Fishing at the Shawnee-Minisink Site: Everyday Life in the Late Pleistocene. In *Foragers of the Terminal Pleistocene in North America*, edited by R.B. Walker and B.N. Driskell, pp.116-131.University of Nebraska Press, Lincoln.

Dent, Richard J., Jr. and Barbara Kaufman
1985 Aboriginal Subsistence and Site Ecology as Interpreted from Microfloral and Faunal Remains. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by Charles W. McNett, pp.55-79. Academic Press, Orlando, Florida.

Dietler, Michael and Ingrid Herbich
1998 Habitus, Techniques, Style: An Integrated Approach to the Social Understanding of Material Culture. In *The Archaeology of Social Boundaries*, edited by Miriam Stark, pp.232–263. Smithsonian Institution Press, Washington D.C.

Dillian, Carolyn, Charles Bello and M. Steven Shackley
2006 Long Distance Exchange? The Case of an Obsidian Projectile Point from the University of Pennsylvania Museum. *Pennsylvania Archaeologist*. 76(2):41-47.
2007 Crossing the Delaware: Documenting Super-Long Distance Obsidian Exchange in the Mid-Atlantic. *Archaeology of Eastern North America* 35: 94-103.
2010 Long Distance Exchange of Obsidian in the Mid-Atlantic United States. In *Trade and Exchange: Archaeological Studies from Prehistory and History*, edited by Carolyn Dillian and Carolyn White, pp.17-35. Springer, New York.

Dincauze, Dena Ferran
1968 *Cremation Cemeteries in Eastern Massachusetts*. Papers of the Peabody Museum of Archaeology and Ethnology, Harvard University, Volume 59, No.1. Cambridge, Massachusetts.

Dobres, M.A.
2000 *Technology and Social Agency: Outlining a Practice Framework for Archaeology*. Blackwell Publishers, Inc., Malden, Massachusetts.

Dobres, M.A. and C.R. Hoffman
1994 Social Agency and the Dynamics of Prehistoric Technology. *Journal of Archaeological Method and Theory* 1:211–57.

Doershuk, John F.
1994 Spatial Analysis of Artifacts and Features. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania, by C. Bergman et al, pp.299-357. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Doershuk, John F. and Christopher A. Bergman
1996 Spatial Analysis of Artifacts and Features. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.311-413. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Donehoo, George P.
1977 *Indian Villages and Place Names in Pennsylvania*. Gateway Press, Inc., Baltimore, Maryland. Reprint of 1928 original, The Telegraph Press, Harrisburg, Pennsylvania.

Doolittle, William E.
2001 *Cultivated Landscapes of Native North America*. Oxford University Press, New York.

Doucette, Diana Lee
2005 Reflections of the Middle Archaic: A View from Annasnappet Pond. *Bulletin of the Massachusetts Archaeological Society* 66(1):22-33.

Dragoo, Don W.
1959 *Archaic Hunters of the Upper Ohio Valley*. Carnegie Museum, Anthropological Series No.3, Pittsburgh, Pennsylvania.
1963 *Mounds for the Dead: An Analysis of the Adena Culture*. Annals of the Carnegie Museum, Volume 37, Pittsburgh, Pennsylvania.

Drooker, Penelope B.
2004 Pipes, Leadership, and Interregional Interaction in Protohistoric Midwestern and Northeastern North America. In *Smoking Culture: The Archaeology of Tobacco Pipes in Eastern North America*, edited by Sean M. Rafferty and Rob Mann, pp.73-123. University of Tennessee Press, Knoxville.

Dumont, Elizabeth M. and Lewis A. Dumont
1979 Of Paradigms and Projectile Points: Two Perspectives on the Early Archaic in the Northeast. *The Bulletin of the New York State Archaeological Association* 75:38-52.

Dumont, Elizabeth M, John Tolosky and Helen Tolosky
1974 An Obsidian Biface. *Bulletin of the Archaeological Society of New Jersey* 31:17.

Dunn, Robert A.
1984 Form and Function of the Perkiomen Broadpoint. *Pennsylvania Archaeologist* 54(3-4):11-18.

Dunnell, Robert C.
1971 *Systematics in Prehistory*. The Free Press, MacMillan Publishing Co., New York.

East, Thomas C., Debra R. Langer, Christopher T. Espenshade, Albert T. Vish and Francis B. King
2002 Northumberland and Union Counties, Pennsylvania, I80, Section 52D, Bridge Expansion and Highway Improvement Project, Phase I/II/III Archaeological Investigations, E.R. #99-8000-042. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Egghart, Christopher, Christopher Bowen and Dennis Knepper
2014 The Blackbird Creek Site (7NC-J-195D): An Early Ceramic Occupation Along Blackbird Creek in New Castle County, Delaware. *Journal of Middle Atlantic Archaeology* 30:1-16.

Egloff, Keith T.
1991 Development and Impact of Ceramics in Virginia. In *Late Archaic and Early Woodland Research in Virginia: A Synthesis*, edited by Theodore R. Reinhart and Mary Ellen N. Hodges, pp.243-251. Special Publication No.23, Archaeological Society of Virginia, Richmond.

Egloff, Keith T. and Joseph M. McAvoy
1990 Chronology of Virginia's Early and Middle Archaic Periods. In *Early and Middle Archaic Research in Virginia: A Synthesis*, edited by Theodore R. Reinhart and Mary Ellen N. Hodges, pp.61-79. Special Publication No.22 of the Archaeological Society of Virginia, Richmond.

Ellis, Christopher J.
2011 Measuring Paleoindian Range Mobility and Land-Use in the Great Lakes/Northeast. *Journal of Anthropological Archaeology* 30:385-401.

Emerson, Thomas E.
2003 Materializing Cahokia Shamans. *Southeastern Archaeology* 22(2):135-154.

Engelbrecht, William
2003 *Iroquoia: The Development of a Native World.* Syracuse University Press, NY.
2014 Unnotched Triangular Points on Village Sites. *American Antiquity* 79(2):353-367.
2015 Interpreting Broken Arrowpoints. *American Antiquity* 80(4):760-766.

Ericksen, Annette G.
1999 Appendix VII: Archaeobotanical Summary of Four Features from 36Nm142, Treichlers Bridge, Northampton County, Pennsylvania. In Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volume III, by

David A. Anderson et al. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Esarey, Duane Eugene
2013 *Another Kind Of Beads: A Forgotten Industry of the North American Colonial Period*. PhD dissertation, Department of Anthropology, University of North Carolina at Chapel Hill.

Evans, June and Jay F. Custer
1990 Guidelines for Standardizing Projectile Point Typology in the Middle Atlantic Region. *Journal of Middle Atlantic Archaeology* 6:31-41.

Farb, Peter and George Armelagos
1980 *Consuming Passions: The Anthropology of Eating.* Houghton Mifflin Company, Boston.

Fassler, Heidi A.
1994 Analysis of the Prehistoric Assemblage. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania, by C. Bergman et al, pp.144-169. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Fesenmyer, Kurt A. and Norman L. Christensen, Jr.
2010 Reconstructing Holocene Fire History in a Southern Appalachian Forest Using Soil Charcoal. *Ecology* 91(3):662-670.

Fetzer, Rebecca, Martin T. Fuess, William C. Johnson, Kathryn M. Lombardi, Christopher B. Owen, Carol J. Peterson, Edward J. Siemon III and Timothy G. Zinn
2002 Phase I Archaeological and Intensive Architectural Survey of Route 94 Between Mount Pleasant Road, Knowlton Township, Warren County, New Jersey. Report on file (WAR F591-6049), New Jersey Historic Preservation Office, Trenton.

Fiedel, Stuart J.
1987 Algonquian Origins: A Problem in Archaeological Linguistic Correlation. *Archaeology of Eastern North America* 15:1-11.
1990 Middle Woodland Algonquian Expansion: A Refined Model. *North American Archaeologist* 11(3):209-230.
2013 Are Ancestors of Contact Period Ethnic Groups Recognizable in the Archaeological Record of the Early Late Woodland? *Archaeology of Eastern North America* 41:221-229.
2014 Abrupt Changes of Climate and of Point Styles Along the Atlantic Seaboard of Eastern North America: How Were They Connected? *Archaeology of Eastern North America* 42:77-100.

Fischler, Benjamin R.
1990 Archaeological Discovery and Evaluation at Eight Construction Locations in the Delaware Water Gap National Recreation Area, 1984-1987, Volume II, edited by Paul

Inashima. The American University, Washington, D.C. and the National Park Service, Denver Service Center Eastern Team, Rockville, MD. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Fischler, Benjamin R. and Jean W. French
1991 The Middle to Late Woodland Transition in the Upper Delaware Valley: New Information From the Smithfield Beach Site (36MR5). In *The People of Minisink*, edited by D.G. Orr and D. V. Campana, pp.145-174. National Park Service, Philadelphia.

Fischler, Benjamin R., and James W. Mueller
1988 Archaeological Discovery and Evaluation at Eight ·Construction Locations in the Delaware Water Gap National Recreation Area, 1984-1987, Volumes 1-3. The American University, Washington, D.C. and the National Park Service, Denver Service Center Eastern Team, Rockville, MD.
1991 Archaeological Discovery and Evaluation at Eight ·Construction Locations in the Delaware Water Gap National Recreation Area, 1984-1987, edited by Paul Inashima. The American University, Washington, D.C., and the National Park Service, Denver Service Center Eastern Team, Rockville, MD (Revised version of portions of the1988 report).

Fogelman, Gary L.
1988 *Projectile Point Typology for Pennsylvania and the Northeast*. Fogelman Publishing Company, Turbotville, Pennsylvania.
2016 *Bifurcated Point Traditions As Viewed From Pennsylvania and the Northeast*. Fogelman Publishing Company, Turbotville, Pennsylvania.

Fokken, Michael, Michael Finn and Judson Kratzer
1987 A Report on Archaeological Investigations and Data Recovery in the Route 90, Section 2B Corridor, Burlington and Camden Counties, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton.

Forks of the Delaware, Chapter 14 of the Society for Pennsylvania Archaeology
1980 The Overpeck Site, 36BU5. *Pennsylvania Archaeologist* 50(3):1-46.

Freedman, Jacob A.
2009 Management Summary: Phase III Data Recovery Black Dirt Deep Testing, Towns of Minisink and Warwick, Orange County, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

French, Alice E.
1969 Gem-Stone, Mineral, and Fossil Collecting. In *Mineral Resources of the Appalachian Region*. Geological Survey Professional Paper 580, pp.288-302. U.S. Geological Survey and the U.S. Bureau of Mines. United States Government Printing Office, Washington, D.C.

French, Jean W.
1988 Appendix F: Paleoethnobotanical Identification and Analysis. In Archaeological Discovery and Evaluation at Eight ·Construction Locations in the Delaware Water Gap National Recreation Area, 1984-1987, Volumes 1-3, by B. R. Fischler and J. W. Mueller. The American University, Washington, D.C. and the National Park Service, Denver Service Center Eastern Team, Rockville, MD.

Fulton, Albert and Catherine Yansa
2016 Historic Native American Impacts on a Temperate Forested Ecosystem, Northeastern U.S.A. Paper presented at the annual meeting of the Society for American Archaeology, Orlando, Florida. Abstracts of the SAA 81st Annual Meeting, page 148. http://www.saa.org/Portals/0/SAA/MEETINGS/2016%20Abstracts/E_H.pdf

Funk, Robert E.
1965 The Archaic of the Hudson Valley – New Evidence and Interpretations. *Pennsylvania Archaeologist* 35(3-4):139-160.
1975 An Evaluation from the New York Perspective. In *The Archaeology of the Tocks Island Area*, by Herbert C. Kraft, pp.xiii-xv. Archaeological Research Center, Seton Hall University Museum, South Orange, New Jersey.
1976 *Recent Contributions to Hudson Valley Prehistory*. New York State Museum Memoir 22, Albany.
1979 The Early and Middle Archaic in New York as Seen From the Upper Susquehanna Valley. *The Bulletin, The New York State Archaeological Association* 75:23-38.
1988 The Laurentian Concept: A Review. *Archaeology of Eastern North America* 16:1-42.
1989 Some Contributions of Archaeology to the Study of Cave and Rockshelter Sediments: Examples from Eastern New York. *Man in the Northeast* 37:35-112.
1991 The Middle Archaic in New York. *Journal of Middle Atlantic Archaeology* 7:7-18.
1992 Some Major Wetlands in New York State: A Preliminary Assessment of Their Biological and Cultural Potential. *Man in the Northeast* 43:25-41.
1993 *Archaeological Investigations in the Upper Susquehanna Valley, New York State, Volume 1.* Persimmon Press, Buffalo, New York.
1998 *Archaeological Investigations in the Upper Susquehanna Valley, New York State, Volume 2.* Persimmon Press, Buffalo, New York.

Funk, Robert E. and Hoagland
1972 An Archaic Camp Site in the Upper Susquehanna Drainage. *New York State Archaeological Association Bulletin* 56:11-22.

Funk, Robert E. and Bruce E. Rippeteau
1993a Research Philosophy: Objectives, Approaches, and Results. In *Archaeological Investigations in the Upper Susquehanna Valley, New York State, Volume 1*, edited by R.E. Funk, pp.27-32. Persimmon Press, Buffalo, New York.
1993b Continuity, Stability and Change. In *Archaeological Investigations in the Upper Susquehanna Valley, New York State, Volume 1*, edited by R.E. Funk, pp.215-228. Persimmon Press, Buffalo, New York.

Funk, Robert E. and D.W. Steadman
1994 *Archaeological and Paleoenvironmental Investigations in the Dutchess Quarry Caves, Orange County, New York*. Persimmon Press, Buffalo, New York.

Funk, Robert E., George R. Walters and William F. Ehlers, Jr.
1969 The Archaeology of Dutchess Quarry Cave, Orange County, New York. *Pennsylvania Archaeologist* 39(1-4):7–22.

Funk, Robert E., George R. Walters and W. E. Scott
1971 A Stratified Rockshelter in the Upper Delaware Valley. *Man in the Northeast* 2:23-50.

Funk, Robert E. and Beth Wellman
1984 Evidence of Early Holocene Occupation in the Upper Susquehanna Valley, New York State. *Archaeology of Eastern North America* 12:81-109.

GAI Consultants
1995 Archaeological Investigation at the Memorial Park Site (36Cn164) Clinton County, Pennsylvania. Report on file, the Pennsylvania Historic Preservation Office, Harrisburg.

Gallivan, Martin
2011 The Archaeology of Native Societies in the Chesapeake: New Investigations and Interpretations. *Journal of Archaeological Research* 19:281–325.

Gardner, William M.
1974 *The Flint Run Paleo-Indian Complex: A Preliminary Report 1971-73 Seasons*. Occasional Publication No.1, Archaeology Laboratory, Department of Anthropology, The Catholic University of America, Washington, D.C.
1982 Early and Middle Woodland in the Middle Atlantic: An Overview. In *Practicing Environmental Archaeology: Methods and Interpretations*, edited by Roger Moeller, pp.53-86. Occasional Papers of the American Indian Archaeological Institute No.3, Washington, Connecticut.
1986 *Lost Arrowheads and Broken Pottery: Traces of Indians in the Shenandoah Valley*. Thunderbird Museum Publication. Manassas, Virginia: Tru Tone Press.
1987 Comparison of Ridge and Valley, Blue Ridge, Piedmont, and Coastal Plain Archaic Period Site Distribution: An Idealized Transect (Preliminary Model). *Journal of Middle Atlantic Archaeology* 3:49-80.
1989 An Examination of Cultural Change in the Late Pleistocene and Early Holocene (ca 9200 to 6800 B.C.). In *Paleoindian Research in Virginia: A Synthesis*, edited by J. M. Wittkofski and T.R. Reinhart, pp.5-51. Special Publication #19 of the Archaeological Society of Virginia, Richmond.

Gardner, William M. and Robert A. Verrey
1979 Typology and Chronology of Fluted Points from the Flint Run Area. *Pennsylvania Archeologist* 49(1-2):13-46.

Geyer, Alan R., Robert C. Smith, II and John H. Barnes

1976 *Mineral Collecting in Pennsylvania*. General Geology Report 33. Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Harrisburg.

Gilmore, Zachary I. and Jason M. O'Donoughue
2015 *The Archaeology of Events: Cultural Change and Continuity in the Pre-Columbian Southeast*. University of Alabama Press, Tuscaloosa.

Gingerich, Joseph A.M.
2007 *Shawnee-Minisink Revisited: Re-Evaluating the Paleoindian Occupation*. MA thesis, Department of Anthropology, University of Wyoming, Laramie.
2011 Down to Seeds and Stones: A New Look at the Subsistence Remains from Shawnee-Minisink. *American Antiquity* 76(1):127-144.
2012 Late Pleistocene Human Adaptations in Eastern North America: Evidence of Universal Adaptations. Ph.D. dissertation, Department of Anthropology, University of Wyoming, Laramie.
2013a Revisiting Shawnee Minisink. In, *In the Eastern Fluted Point Tradition*, edited by Joseph A.M. Gingerich, pp.218-256. University of Utah Press, Salt Lake City.
2013b Fifty Years of Discovery at Plenge. In, *In the Eastern Fluted Point Tradition*, edited by Joseph A.M. Gingerich, pp.121-147. University of Utah Press, Salt Lake City.

Giotta, Emil
2015 A Study of the Bifurcated-Stemmed Projectile Point. *Archaeology of Eastern North America* 43:199-206.

Goldman, L.
1975 Upper Delaware Valley Plant Species and Communities. In *Archaeological Excavations: Upper Delaware Valley, 1974*, edited by W. F. Kinsey, pp. 18-38. North Museum Publication No.2, Franklin and Marshall College, Lancaster, Pennsylvania.

Goddard , Ives
1978a Eastern Algonquian Languages. In *Handbook of North American Indians*, *Volume 15: Northeast*, edited by Bruce G. Trigger, pp.70-77. Government Printing Office, Washington, DC.
1978b Central Algonquian Languages. In *Handbook of North American Indians*, *Volume 15: Northeast*, edited by Bruce G. Trigger, pp.583-587. Government Printing Office, Washington, DC.

Gramly, Richard Michael
2009 *Origin and Evolution of the Cumberland Paleo-American Tradition*. Special Publication of the American Society for Amateur Archaeology, North Andover, Massachusetts.

Gramly, Richard Michael, with contributions by Lerick Allen, A.V. Andeji, Scott G. Beld, Lang C. DeLancey, Mark Demitroff, Joseph J. El Adli, Daniel Fisher, Robert Langenburg, Malcolm Lecompte, Abdel R. Mohammed, Guy Robinson, A. West, Timothy Witwer and Russell Judkins
2017 *Archaeological Recovery of the Bowser Road Mastodon, Orange County, New York*. Persimmon Press, North Andover, Massachusetts.

Granger, Joseph E.
1988 Intrusive "Types" or Shared Lithic Reduction Sequence: Functional Variation at the Archaic-Woodland Interface in the Lower Great Lakes. *Journal of Middle Atlantic Archaeology* 4:3-24.

Graybill, Jeffery R.
1973 Michaels No.4 Site. In *Archaeological Excavations: Upper Delaware Valley*, 1972, edited by W.F. Kinsey, pp.39-52. Franklin and Marshall College, North Museum Publication No. 1. Lancaster, Pennsylvania.

Greene, R.C.
1995 *Talc Resources of the Conterminous United States*. U.S. Geological Survey, Open File Report, OF 95-586. Menlo Park, New Jersey. https://pubs.usgs.gov/of/1995/0586/report.pdf

Griffith, Daniel R.
2013 Analysis of American Indian Ceramics, Gray Farm Site (7K-F-11 and 7K-F-169). Appendix 10.1.1 In Gray Farm Site Phase II And III Excavations on the Murderkill River (Sites 7k-F-11 And 7k-F-169). Sr 1 Frederica North Grade Separated Intersection, Kent County, Delaware Volumes I-III by C. Hay, M. Diamanti and D. Rue. Report on file Report on file, Delaware Department of Transportation, Dover. https://deldot.gov/archaeology/GrayFarmSite/index.shtml

Grills, Brian R. and Nina M. Versaggi
2007 Limited Phase 3 Data Recovery, Bloomville Beardsley Site (SUBi-2605). Bloomville Gravel Project, Town of Stamford, Delaware County, New York. Report on file (Digital Archive ID #7599), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Grimstead, Deanna N., Selin Nugent and Jean Whipple
2017 Why a Standardization of Strontium Isotope Baseline Environmental Data Is Needed and Recommendations for Methodology. *Advances in Archaeological Practice* 5(2):184–195.

Grossman Bailey, Ilene
2001 *The People Who Lived By The Ocean: Native American Resource Use and Settlement in the Outer Coastal Plain Of New Jersey*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.
2017 Phase III Archaeological Data Recovery, South Broadway Site (28-Ca-168), Realignment of South Broadway (CR 551), Newtown Creek (MP 31.89) to Woodland Avenue (MP

32.36), City of Camden, Camden County, New Jersey. Report on file (CAM C 1070f), New Jersey Historic Preservation Office, Trenton.

Grund, Brigid Sky
2017 Behavioral Ecology, Technology, and the Organization of Labor: How a Shift from Spear Thrower to Self Bow Exacerbates Social Disparities. *American Anthropologist* 119(100):104-119.

Guida, Ann H,
1989 *Seasonality of Occupation of Upper Delaware Valley Sites Based on an Analysis of Dental Cementum Annulations of White Tailed Deer.* MA thesis, Department of Anthropology, New York University, New York.

Gunter, Madeleine and Christopher Stevenson
2016 Copper Exchange in Precontact Virginia: An LA-ICP-MS Study**.** Paper presented at the annual meeting of the Society for American Archaeology, Orlando, Florida. Abstracts of the SAA 81st Annual Meeting, page 175. http://www.saa.org/Portals/0/SAA/MEETINGS/2016%20Abstracts/E_H.pdf

Hall, M.D., Jr.
1977 The Miele Site. *Bulletin of the Archaeological Society of New Jersey* 34:8-14.

Hamell, George R.
1983 Trading in Metaphors: The Magic of Beads. In *Proceedings of the Glass Trade Bead Conference*, edited by Charles F. Hayes, III, pp.5–28. Rochester Museum and Science Center, Rochester, New York.

Hamilton, W. Derek and Anthony M. Krus
2017 The Myths and Realities of Bayesian Chronological Modeling Revealed. *American Antiquity* 83(2):187-203.

Hanna, Charles A.
1911 *The Wilderness Trail.* 2 volumes. G.P. Putnam's Sons, New York and London.

Harbison, Jeff
2008 *Subsistence and Settlement in the Upper Delaware Valley: Excavation of the Shoemaker's Ferry Site (28WA278).* MA thesis, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Harper, Ross
1999 *To Render the God of the Water Propitious: Hunting and Human-Animal Relations in the Northeastern Woodlands*. PhD dissertation, Department of Anthropology, University of Connecticut, Storrs.

Harrington, Lucy
2017a Measuring Mobility by Proxy: A Comparison of the Use and Maintenance of Bifaces and Unifaces at Two Paleoindian Sites in Pennsylvania. Paper presented at the annual meeting of the Middle Atlantic Archaeological Conference, Virginia Beach, Virginia.
2017b An Evaluation of Tool Maintenance and Use Indices and Proxy Measures of Mobility: A Comparison of the Use and Maintenance of Bifaces and Unifaces at Two Paleoindian Sites in Pennsylvania. *Journal of Middle Atlantic Archaeology* 33:63-77.

Harrington, Mark R.
1910 Some Customs of the Delaware Indians. *Museum Journal, University of Pennsylvania* 1(3):52-60.

Hart, John P.
1999 Maize Agriculture Evolution in the Eastern Woodlands of North America: A Darwinian Perspective. *Journal of Archaeological Method and Theory* 6(2):137-180.
2011 The Death of Owasco-Redux. In *Current Research in New York Archaeology: A.D. 700–1300*, edited by Christina B. Rieth and John P. Hart, pp.95-107. New York State Museum Record 2. University of the State of New York, The State Education Department, Albany, New York.

Hart, John P. and Nancy Asch Sidell
1996 Prehistoric Agricultural Systems in the West Branch of the Susquehanna River Basin, A.D.800 to A.D.1350. *Northeast Anthropology* 52(Fall):1-30.
1997 Additional Evidence for Early Cucurbit Use in the North Eastern Woodlands East of the Allegheny Front. *American Antiquity* 62(3):523-537.

Hart, John P., Jennifer Birch and Christian Gates St-Pierre
2017 Effects of Population Dispersal on Regional Signaling Networks: An Example from Northern Iroquoia. *Science Advances* 3:e1700497.

Hart, John P. and Hetty Jo Brumbach
2003 The Death of Owasco. *American Antiquity* 68:737–752.
2005 Cooking Residues, AMS Dates, and the Middle-To-Late Woodland Transition in Central New York. *Northeast Anthropology* 69:1-34.

Hart, John P., Hetty Jo Brumbach and Robert Lusteck
2007 Extending the Phytolith Evidence for Early Maize (*Zea mays ssp*.) and Squash (*Cucurbita sp*.) in Central New York. *American Antiquity* 72(3):563-583.

Hart John P. and William A. Lovis
2013 Reevaluating What We Know About the Histories of Maize in Northeastern North America: A Review of Current Evidence. *Journal of Archaeological Research* 21:175-216.

Hart, John P., Eleanora A. Reber, Robert G. Thompson and Robert Lusteck
2008 Taking Variation Seriously: Testing the Steatite Mast-Processing Hypothesis with Microbotanical Data from the Hunter's Home Site, New York. *American Antiquity* 73(4):729-741.

Hart, John P. and C. Margaret Scarry
1999 The Age of Common Beans (*Phaseolus vulgaris*) in the Northeastern United States. *American Antiquity* 64(4): 653-658.

Hartgen Archaeological Associates, Inc.
1988a Peake Historic and Prehistoric Site, 12-68-7. Macy South 345 kV Transmission Line, Town of Delhi, Delaware County, N.Y. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
1988b Otego Yard Historic and Prehistoric Site, NYSM 121. Marcy South 345 kV Transmission Line, Town of Otego, Otsego County, New York (2 volumes). Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
1989 Ouleout Site, 8W-32-7. Marcy South 345 kV Transmission Line, Town of Franklin, Delaware County, New York. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Hartwick, Carolyn L.
2011 Cape May National Wildlife Refuge Field School Report On Radiocarbon Dates. Ms. on file, Department of Anthropology, Rutgers University, New Brunswick, New Jersey.

Hartwick, Carolyn L., Margaret E. Lewis and Sandra H. Bierbrauer
2016 Bioarchaeology of Two Late Woodland Native American Burials, Kimbles Beach, Cape May County, New Jersey. *Journal of Middle Atlantic Archaeology* 32:65-91.

Hartzell, Warren M. and F. Dayton Staats
1983 Rare Clay Beads From The Dark Moon Site. *Bulletin of the Archaeological Society of New Jersey* 39:11

Hatch James W.
1980 Radiocarbon Dates from the Fisher Farm Site. In *The Fisher Farm Site: A Late Woodland Hamlet in Context*, edited by J.W. Hatch, pp.257-263. The Pennsylvania State University, Department of Anthropology, Occasional Papers No.12. University Park, Pennsylvania.

Hay, Conran A., Melissa Diamanti and David Rue
2013 Gray Farm Site Phase II And III Excavations on the Murderkill River (Sites 7k-F-11 And 7k-F-169). Sr 1 Frederica North Grade Separated Intersection, Kent County, Delaware Volumes I-III. Report on file, Delaware Department of Transportation, Dover. https://deldot.gov/archaeology/GrayFarmSite/index.shtml

Hayden, Brian
1995 The Emergence of Prestige Technologies and Pottery. In *The Emergence of Pottery: Technology and Innovation in Ancient Societies*, edited by William K. Barnett and John W. Hoopes, pp.257-265. Smithsonian Institution Press, Washington, D.C. and London.
1998 Practical and Prestige Technologies: The Evolution of Material Systems. *Journal of Archaeological Method and Theory* 5: 1-55.
2003 Were Luxury Foods the First Domesticates? Ethnoarchaeological Perspectives from Asia. *World Archaeology* 34(3):458-469.

Heinrich, Adam R.
2016 Lenape Horticulturalists: Moving the 'Maize Debate' Forward in the Lower Delaware Valley. *Journal of Middle Atlantic Archaeology* 32:9-25.

Heinrich, Adam R., Michael J. Gall, Brittany Lavelle and Jennifer Leynes
2015 Supplemental Phase IB/Phase II Archaeological Survey and Terminal Phase II Archaeological Survey, Locus 1 of Block 86 Site (28-Ca-128), Locus 2 of Block 86 Site (28-Ca-129), Saloon Site (28-Ca-130), Block 80 Site (28-Ca-131), Rain Splitter Site (28-Ca-132), Gloucester City Elementary/Middle School, Gloucester City, Camden County, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton.

Heinrich, Adam R. and Seth Hinshaw
2017 Phase II Archaeological Survey of the Sorbello North Site (28-Sa-213) and the Sorbello 1 Site (28-Sa-214), Straughns Mill Road, Block 28.01, Lot 52 Oldmans Township, Salem County, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton.

Hemmings, Ernest T.
1966 Abbott Zoned Incised Ware from Sussex County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 23:7, Plate V.

Hennessy, John
1992 1990 Archaeological Excavations at the Pardee Site, 36-MR-5. Smithfield Beach Development Area, Delaware Water Gap National Recreation Area, Pennsylvania. Report on file, National Park Service, Mid-Atlantic Region, Philadelphia, Pennsylvania.

Henrich, Joseph
2010 The Evolution of Innovation-Enhancing Institutions. In *Innovation in Cultural Systems: Contributions from Evolutionary Anthropology*, edited by Michael J. O'Brien and Stephen J. Shennan, pp.99–120. MIT Press, Cambridge, Massachusetts. https://zodml.org/sites/default/files/%5BMichael_J._O%27Brien%2C_Stephen_J._Shennan%5D_Innovatio.pdf

Herbert, Joseph M.
2002 A Woodland Period Prehistory of Coastal North Carolina. In *The Woodland Southeast*, edited by D.G. Anderson and R.C. Mainfort, Jr., pp.292-317. University of Alabama Press, Tuscaloosa.

2009 *Woodland Potters and Archaeological Ceramics of the North Carolina Coast*. University of Alabama Press, Tuscaloosa.

Herbstritt, James T.
1988 A Reference for Pennsylvania Radiocarbon Dates. *Pennsylvania Archaeologist* 58(2):1-29.
1997 Preliminary Analysis of the Conrail Site Ceramics and the Fox Creek Complex of Central Pennsylvania. Paper presented at the annual meeting of the Society for Pennsylvania Archaeology, Wilkes Barre, Pennsylvania.

Heye, George G. and George H. Pepper
1915 *Exploration of a Munsee Cemetery Near Montague, New Jersey*. Contributions from the Museum of the American Indian, Heye Foundation, Volume II, No.1. The Museum of the American Indian, Heye Foundation, New York.

Hill, George A., Jr. and Jim Rementer
2015 Delaware Ethnobotany. Report available on the Delaware Tribe's website. http://delawaretribe.org/wp-content/uploads/DEL-ETHNOBOTANY-Hill.pdf

Hoefs, Jochen
2004 *Stable Isotope Geochemistry*. Fifth edition. New York: Springer.

Hoff, D.
1969 Mastodon at Marshalls Creek. *Pennsylvania Game News* 40(2):2-7.

Hoffman, Curtiss
1998 Pottery and Steatite in the Northeast: A Reconsideration of Origins. *Northeast Anthropology* 56:43-68.

Hohman, Christopher D. and Nina M. Versaggi
2003 Phase II Site Examinations, Herrick Hollow II, Herrick Hollow III, Herrick Hollow IV, Herrick Hollow V, Herrick Hollow VI, Herrick Hollow VII. Richardson Hill Road Landfill Superfund Project, Town of Masonville, Delaware County, New York. Report on file (Digital Archive ID# 3298), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Hohman, Christopher D. and Nina M. Versaggi with contributions by Brian Grills, Samuel Kudrle, Timothy Knapp and Nancy Asch Sidell
2005 Phase 3 Data Recovery Herrick Hollow Prehistoric Archaeological District, Herrick Hollow I-VII Sites, Volume I. Richardson Hill Road Landfill Superfund Project, Town of Masonville, Delaware County, New York. Report on file (Digital Archive ID# 6085), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Holland, C.G., S.E. Pennell, and R.O. Allen
1981 Geographical Distribution of Soapstone Artifacts from Twenty-One Aboriginal Quarries in the Eastern United States. *Quarterly Bulletin of the Archaeological Society of Virginia* 35(4):200-208.

Holmes, William Henry
1886 Origin and Development of Form and Ornament in Ceramic Art. In *Fourth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1898-99, pp.1-200.* Government Printing Office, Washington, D.C.
1894 *Natural History of Flaked Stone Implements*. Memoirs of the International Congress of Anthropology 120-139.
1896 Prehistoric Textile Art of Eastern United States. In *Thirteenth Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1891-'92*, edited by J.W. Powell, pp.9-56. Government Printing Office, Washington, D.C.
1897 Stone Implements of the Potomac-Chesapeake Tidewater Province. In *Fifteenth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1893-94*, pp. 13-152. Government Printing Office: Washington, D.C.
1903 Aboriginal Pottery of the Eastern United States. In *Twentieth Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1898-99*, pp.1-200. Government Printing Office: Washington, D.C.
1919 *Handbook of Aboriginal American Antiquities. Part I, Introductory, The Lithic Industries*. Bureau of American Ethnology Bulletin 60, Government Printing Office: Washington, D.C.

Honeyman, A. Van Doren
1927 *Northwestern New Jersey: A History of Somerset, Morris, Hunterdon, Warren and Sussex Counties.* Lewis Historical Publishing Company, New York.

Hornum, Michael B., Philip C. LaPorta, Josh Roth, Dan Gross, Daniel Wagner, Justine W. McKnight and Robert E. Parr
2009 Phase III Archaeological Data Recoveries at 36NM204, 36MR119, And 36MR133 for the Proposed Line 1278 Replacement Project, Northampton and Monroe Counties, Pennsylvania. ER# 97-2182-042-PP. Three volumes. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Hornum, Michael B., William Lowthert, IV, Brian Cleven, Richard Vidutis and Frank Vento
2002 Phase I Archaeological Survey and Architectural Reconnaissance, and Phase II Archaeological Evaluation of Site 36Nm4 for the Portland Station Combined Cycle Power Plant Project, Upper Mount Bethel Township, Northampton County, Pennsylvania. Report on file (ER#99-3110-095-G) , Pennsylvania State Historic Preservation Office, Harrisburg.

Hornum, Michael B., Joshua Roth, Jesse Kulp, Lori Ricard, Pete Godwin, Daniel Grose, Jason Coffey, Jennifer Evans, Brian Cleven and Tara Tetrault
2005 Phase II Archaeological Evaluations of Sixteen Sites and National Register Evaluations of Line 1278 and the Appalachian Trail Within the Delaware Water Gap National

Recreation Area for the Proposed line 1278 Replacement Project, Northampton, Monroe, and Pike Counties, Pennsylvania. Report on file (ER#97-2182-042-V), Pennsylvania State Historic Preservation Office, Harrisburg.

Hosterman, John W.
1984 *White Clays of Pennsylvania: Geology and Geologic Setting of White Clays*. Geological Survey Bulletin 1558-D. United States Government Printing Office, Washington, D.C.

Houston, Stephen
2014 *The Life Within: Classic Maya and the Matter of Permanence*. Yale University Press, New Haven, Connecticut.

Hummer, Chris
1991 *Biface and Ceramic Assemblage Variability in the Early Woodland: Continuity and Change at the Williamson Site, Hunterdon County, New Jersey*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.
1994 Defining Early Woodland in the Delaware Valley: The View from the Williamson Site, Hunterdon County, New Jersey. *Journal of Middle Atlantic Archaeology* 10:141-151.
2005 Early Woodland Points from the Williamson Site, Hunterdon County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 60: 20-26.
2007 Early Woodland Pottery from the Williamson Site, Hunterdon County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 62:80-92.

Hunter Research, Inc.
1989 Phase 3 Archaeological Data Recovery at Prehistoric Site A071-06-0077, Al Turi Landfill, Town of Goshen, Orange County, New York. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
1997 Archaeological Data Recovery at the Derewal Prehistoric Site (28Hu530), Kingwood Township, Hunterdon County, New Jersey. Report on file (Hun E196c-5414), New Jersey Historic Preservation Office, Trenton.
2002 Archaeological Data Recovery Excavations and Monitoring, New Jersey Route 29, City of Trenton, Mercer County, New Jersey. Volume 1. Prehistoric Sites: Douglas Gut Archaeological Complex (28ME273), Riverview Bluff Prehistoric Site (28ME265). Report on file, New Jersey Historic Preservation Office, Trenton.

Hunter, Richard, William B. Liebeknecht, Damon Tvaryanas, Douglas Scott, Susanne Eidson and Nadine Sergejeff
2001 Supplementary Phase II Cultural Resource Survey, N.J. Route 23/N.J. Route 94 Intersection Improvements, Borough of Hamburg, Sussex County, New Jersey. Report on file (SUS F240b-2197), New Jersey Historic Preservation Office, Trenton.

Inashima, Paul Y.
1993 Archaeological Investigations Between Randall Creek and Bushkill Access, Delaware Water Gap National Recreation Area. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

2008 Establishing a Radiocarbon Date Based Framework for Northeastern Virginia Archaeology. *Quarterly Bulletin of the Archaeological Society of Virginia* 63(4):187-290.
2011 Supplement No. 1 to "Establishing a Radiocarbon Date Based Framework for Northeastern Virginia Archaeology". *Quarterly Bulletin of the Archaeological Society of Virginia* 66(3):89-140.

Inners, Jon D.
1998 *Rocks and Ruins of the Upper Grand: An Illustrated Trail Guide to the Geology and Historical Archaeology of Lehigh Gorge State Park, Northeastern Pennsylvania*. Commonwealth of Pennsylvania, Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, Open File Report 98-03. Harrisburg, Pennsylvania.

Johnson, Eric S., Thomas Mahlstedt, James W. Bradley, and Valerie A. Talmage
1984 *Guide to Prehistoric Site Files and Artifact Classification System*. Massachusetts Historical Commission, Office of the Massachusetts Secretary of State, Boston.

Johnson, William C.
1996 A New Twist to an Old Tale: Analysis of Cordage Impressions on Late Woodland Ceramics from the Potomac River Valley. In *A Most Indispensable Art: Native Fiber Industries from Eastern North America*, edited by James B. Petersen, pp. 144-159. University of Tennessee Press, Knoxville.
2000 Prehistoric Ceramics. In Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volume IIA, by David A. Anderson et al, pp.6-328 to 6-362. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.
2002 Prehistoric Context. In Phase I Archaeological and Intensive Architectural Survey of Route 94 Between Mount Pleasant Road, Knowlton Township, Warren County, New Jersey, by Rebecca Fetzer et al, 2-13 to 2-71. Report on file (WAR F591-6049), New Jersey Historic Preservation Office, Trenton.

Johnson, William C. and D. Scott Speedy
1992 Cultural Continuity and Change in the Middle and Late Woodland Periods in the Upper James Estuary, Prince George County, Virginia. *Journal of Middle Atlantic Archaeology* 8:91-106.

Justice, Noel D.
1995 *Stone Age Spear and Arrow Points of the Midcontinental and Eastern United States*. Indiana University Press, Bloomington.

Katz, Gregory
2000 *Archaic Period Triangular Bifaces in the Middle Atlantic Region: Technological and Functional Considerations.* MA thesis, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Katzenberg M.A.
1989 Stable Isotope Analysis of Archaeological Faunal Remains from Southern Ontario. *Journal of Archaeological Science* 16:319–29.

Keeley, Lawrence H.
1995 Protoagricultural Practices Among Hunter-Gatherers: A Cross-Cultural Survey. In *Last Hunters-First Farmers*, edited by T. Douglas Price and Anne Birgitte Gebauer, pp.243-272. School of American Research, Advanced Seminar Series. Santa Fe, New Mexico.

Keener, Craig and Erica Kuhns
1997 The Impact of Iroquoian Populations on the Northern Distribution of Pawpaws in the Northeast. *North American Archaeologist*. 18:327-342.

Kelly, Christina E.
2009a Phase III Data Recovery for Site BRO-212 (OPRHP A00716.000035), Town of Windsor, Broome County, New York. Report on file (Digital Archive ID #12360), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
2009b Phase III Data Recovery for Site BRO-117 (OPRHP A00716.000034), Town of Windsor, Broome County, New York. Report on file (Digital Archive ID #12362), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Kelly, Christina E., Richard Petyk, Ashley Peles, Donald A. Miller, Jacob Freedman and John Petrola
2012 Alternative Mitigation Results of a Comprehensive Lithic Analysis of Native American Sites 28SX273, 28SX445, 28SX446, 28SX452, 28SX453, 28SX454 and 28SX455 for the Tennessee Gas Pipeline Company's 300 Line Natural Gas Pipeline Project at the Wallkill River National Wildlife Refuge, Sussex, Sussex County, New Jersey. Report on file (MULTI R97h v.1-10164). New Jersey Historic Preservation Office, Trenton.

Kent, Barry C.
1970 *Diffusion Spheres and Band Territoriality Among the Archaic Period Cultures of the Northern Piedmont*. PhD dissertation, Department of Anthropology, The Pennsylvania State University, University Park.
1984 *Susquehanna's Indians*. Anthropological Series Number 6, Pennsylvania Historical and Museum Commission, Harrisburg.
1996 Piney Island and the Archaic of Southeastern Pennsylvania. *Pennsylvania Archaeologist* 66(2):1-42.

Kent, Barry, Janet Rice, and Kakuko Ota
1981 A Map of 18th Century Indian Towns in Pennsylvania. *Pennsylvania Archaeologist* 4:1-18.

Kenyon, W.A.

1982 *The Grimsby Site: A Historic Neutral Cemetery.* Royal Ontario Museum, Toronto, Canada.

Kimball, Larry R.
1994a Microwear Analysis of the Functions of Projectile Points and Flake Tools. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania, by C. Bergman et al, pp.238-288. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.
1994b Microwear Analysis of Late and Terminal Archaic Projectile Points from the Padula Site (36Nm15), Pennsylvania. *Journal of Middle Atlantic Archaeology* 10:169-179.
1996 Microwear Analysis of the Functions of Projectile Points and Flake Tools. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.211-291. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Kingsley, Robert G., James A. Robertson and Daniel G. Roberts
1990 The Archaeology of the Lower Schuylkill Valley in Southeastern Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Kinsey, W. Fred, III
1968 A Transitional Period Radiocarbon Date. *American Antiquity* 33(2):245-47.
1972 *Archaeology in the Upper Delaware Valley*. Pennsylvania Historical and Museum Commission, Anthropological Series, No.3, Harrisburg.
1975 Faucett and Byram Sites: Chronology and Settlement in the Delaware Valley. *Pennsylvania Archaeologist* 45(1-2):1-103.
1991 A Trip Down Memory Lane: Digging Along the Delaware, 1964 to 1974. In *The People of Minisink*, edited by D. Orr and D. Campana, pp.1-20. Mid-Atlantic Office of the National Park Service, Philadelphia, Pennsylvania.

Kinsey, W. Fred, III and Charles W. McNett, Jr.
1972 Brodhead-Heller Site, 36Pi7. In *Archaeology in the Upper Delaware Valley*, edited by F.W. Kinsey, pp.199-223. Pennsylvania Historical and Museum Commission, Anthropological Series, No.3, Harrisburg.

Kintigh, Keith W., Jeffrey H. Altschul, Mary C. Beaudry, Robert D. Drennan, Ann P. Kinzig, Timothy A. Kohler. W. Fredrick Limp, Herbert D.G. Maschner, William K. Michener, Timothy R. Pauketat, Peter Peregrine, Jeremy A. Sabloff, Tony J. Wilkinson, Henry T. Wright and Melinda A. Zeder
2014 Grand Challenges for Archaeology. *American Antiquity* 79(1):5-24.

Kirk, Matthew
1998 *Early Woodland Ceremonial Sites in Eastern New York.* MA thesis, Department of Anthropology, SUNY Albany, New York.

Klein, Michael J.
1994 *An Absolute Seriation Approach to Ceramic Chronology in the Potomac, James, and Roanoke River Valleys, Virginia and Maryland*. PhD dissertation, Department of Anthropology, University of Virginia, Charlottesville.
1997 The Transition from Soapstone Bowls to Marcey Creek Ceramics in the Middle Atlantic Region: Vessel Technology, Ethnographic Data, and Regional Exchange. *Archaeology of Eastern North America* 25:143-158.
2010 Artifacts as Symbols and Tools in the Southern Middle Atlantic Region: Costly Signalling, Diffusion, and Technological Evolution in Early Soapstone and Ceramic Vessels. Paper presented at the annual meeting of the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Klein, Michael J. and Dane Magoon
2017 *Tsenacomoco* Before and After the *Tassantasses*: Documentary, Bioarchaeological, and Archaeological Evidence of Population Size and Distribution During the Late Prehistoric and Contact Era in the Western Chesapeake Region. *Journal of Middle Atlantic Archaeology* 33:79-98.

Kline, Donald E.
1985 Early History of Archaeological Research at the Shawnee-Minisink Site. In *Shawnee-Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr, pp.15-19. Academic Press, Orlando, Florida.

Kline, Donald E. and F. Dayton Staats
1983 The Walters Rockshelter: 36MR42. *Pennsylvania Archaeologist* 53(3):13-16.

Knapp, Timothy D.
2002 Pits, Plants, and Place: Recognizing Late Prehistoric Subsistence and Settlement Diversity in the Upper Susquehanna Drainage. In *Northeast Subsistence and Settlement Change: A.D. 700-1300*, edited by John Hart and Christina Rieth, pp.167-192. New York State Museum Bulletin 496, Albany.
2003 What's Up the Delaware? Recent Middle/Late Woodland Excavations in New York's Forgotten Valley. Paper presented at the annual meeting of the Eastern States Archaeological Federation, Mt. Laurel, New Jersey.
2009 An Unbounded Culture? Ceramic Types, "Cultures" and Scale in Late Prehistoric Research. In *Iroquoian Archaeology and Analytic Scale*, edited by Laurie Miroff and Timothy D. Knapp, pages 101-130. University of Tennessee Press, Knoxville.
2011 Life at the Confluence: Archaic and Woodland Occupations of the Chenango Point Site (SUBi-1274). Data Recovery Excavations for the Downtown Academic Center Project, City of Binghamton, Broome County, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Knapp, Timothy D., Brian Grills, Michael E. Jacobson, Samuel M. Kudrle, Michael Rudler, Daniel Seib and Andrea Zlothucha Kozub
2006 Cultural Resource Management Report, 2006-2007 Highway Program, Addendum Cultural Resource Reconnaissance Survey and Site Examinations for Evans, Beaver Lodge, Delaware Pine, River Bend, Balls Eddy I and Hale Eddy Hotel, PIN9066.91.12 1, NY Route 17 Access, Towns of Deposit and Hancock, Delaware County. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Knapp, Timothy D., Michael Rudler, and Mark S. LoRusso
2002 Cultural Resource Reconnaissance, 2002-2003 Highway Program, NY Route 17 Access, Towns of Deposit and Hancock, Delaware County, and Town of Sanford, Broome County, New York. 2 volumes. Report on file (Digital Archive ID #3125), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Knapp, Timothy D. and Nina M. Versaggi
2002 Data Recovery Investigations of the Deposit Airport I Site (SUBi-2048), Deposit Water/Sewer Project, Town of Deposit, Delaware County, New York. Public Archaeology Facility, Binghamton University, Binghamton, New York. Report on file, New York State Historic Preservation Office, Albany.

Kneberg, Madelaine
1956 Some Important Projectile Point Types Found in the Tennessee Area. *Tennessee Archaeologist* 12:17-28.

Knecht, Heidi
1997 Projectile Points of Bone, Antler, and Stone: Experimental Explorations of Manufacture and Use. In *Projectile Technology*, edited by Heidi Knecht, pp. 191-212. Plenum Press, New York.

Koch, Jeremy
2017 *Paleoindian Chronology, Technology, and Lithic Resource Procurement at Nesquehoning Creek*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia.

Kopper, J.S., Robert E. Funk, and Lewis A. Dumont
1980 Additional Paleo-Indian and Archaic Materials from the Dutchess Quarry Cave Area, Orange County, New York. *Archaeology of Eastern North America* 8:125-137.

Kotcho, James P.
1998 A Discriminant Analysis of Late Archaic/Early Woodland and Middle/Late Woodland Period Projectile Points. Paper prepared for the class, Research Methods and Theory in Archaeology: Lithic Analysis. Department of Anthropology, Rutgers University, New Brunswick, New Jersey. On file, New Jersey State Museum, Department of Archaeology and Ethnology, Trenton.

Kraft, Herbert
1970a *The Miller Field Site, Warren County, New Jersey*: *A Study in Prehistoric Archaeology. Part 1. The Archaic and Transitional Stages*. Seton Hall University Museum, Seton Hall University Press, South Orange, New Jersey.
1970b Seton Hall University Museum Excavations in the Tocks Island Area 1960 -1969 Season. Seton Hall University Museum Publication, South Orange, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton.
1970c Archaeological Survey and Testing on the New Jersey Side of the Delaware River from Wallpack Bend to Port Jervis, in the Delaware Water Gap National Recreation Area. Report on file (SUS N6-5981), New Jersey Historic Preservation Office, Trenton.
1971 The Earliest Ceramics in the Northeastern Sector of the Middle Atlantic States Area. *Proceedings of the Middle Atlantic Archaeology Conference*, edited by Charles W. McNett Jr. and William M. Gardner, pp.34-39. The Catholic University of America, Washington, D.C.
1972 The Miller Field Site, Warren County, New Jersey. In *Archeology in the Upper Delaware Valley*, edited by W. Fred Kinsey, III, pp. 1-54. Anthropological Series Number 2. Pennsylvania Historical and Museum Commission, Harrisburg.
1974 Marcey Creek Pottery. *Bulletin of the Archaeological Society of New Jersey* 30:15-16.
1975a The Late Woodland Pottery of the Upper Delaware Valley: A Survey and Reevaluation. *Archaeology of Eastern North America* 3(1):101-140.
1975b *The Archaeology of the Tocks Island Area*. South Orange, New Jersey: Archaeological Research Center, Seton Hall University.
1976a The Rosenkrans Site, An Adena-Related Mortuary Complex in the Upper Delaware Valley, New Jersey. *Archaeology of Eastern North America* 3:9-50.
1976b *The Archaeology of the Pahaquarra Site, Warren County, New Jersey*. Archaeological Research Center, Seton Hall University Museum, New Jersey.
1978 *The Minisink Site: A Reevaluation of a Late Prehistoric and Early Contact Site in Sussex County, New Jersey*. Archaeological Research Center, Seton Hall University Museum, South Orange, New Jersey.
1982 Stage I Archaeological/Historical Architectural Cultural Resources Survey of the Proposed Lopatcong Creek and Stewartsville Regional Wastewater Treatment and Conveyance Facilities in Lopatcong, Pohatcong, Greenwich, Alpha and Stewartsville, Warren County, New Jersey. Report on file (WAR E169-60-27), New Jersey Historic Preservation Office, Trenton.
1985 Archaeological Survey of Mashipacong Island. Report on file (SUS A74-5920), New Jersey Historic Preservation Office, Trenton.
1986 Late Woodland Settlement Patterns in the Upper Delaware Valley. In *Late Woodland Cultures of the Middle Atlantic Region*, edited by Jay F. Custer, pp.102-115. University of Delaware Press, Newark.
1989 A Dated Meadowood Component from Fairfield, Essex County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 44:51-54.
1990 The Terminal Archaic in the Upper Delaware Valley: A Broad and Narrow Perspective. In *Experiments and Observations on the Terminal Archaic of the Middle Atlantic Region*, edited by Roger Moeller, pp.63-83. Archaeological Services, Bethlehem, Connecticut.
2001 *The Lenape-Delaware Indian Heritage: 10,000 BC to AD 2000*. Lenape Books, Stanhope, New Jersey.

Kraft, Herbert and Alan Mounier
1982a The Archaic Period in New Jersey. In *New Jersey's Archaeological Resources from the Paleo-Indian Period to the Present: A Review of Research Problems and Priorities*, edited by Olga Chesler, pp.52-102. Office of Cultural and Environmental Services, New Jersey Department of Environmental Services, Trenton.
1982b The Late Woodland Period in New Jersey. In *New Jersey's Archaeological Resources From the Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities*, edited by Olga Chesler, pp. 139-184. New Jersey Department of Environmental Protection, Office of Cultural and Environmental Services, Trenton.

Krause, Richard A.
2016 *A Universal Theory of Pottery Production: Irving Rouse, Attributes, Modes, and Ethnography*. University of Alabama Press, Tuscaloosa.

Kudrle, Samuel
2005 Sidney Municipal Airport Project: Phase 3 Data Recovery, Sidney Hangar Site (SUBi-2073), Town of Sidney, Chenango and Delaware Counties, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Kudrle, Samuel with contributions by Nancy Asch-Sidell
2011 Phase 3 Data Recovery, Delhi Holding Pond Site (SUBi-2673): A GIS-Assisted Prehistoric Landscape Study of the West Branch Delaware River Watershed, SUNY Delhi Holding Pond Project, Town of Delhi, Delaware County, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Largy, Tonya
2009a Analysis of Flotation Samples From the Phase III Data Recovery for Site ORA-9936, Town of Minisink, Orange County, New York. In Results of Phase III Investigations in Portions of Sites ORA-9931, 9936, 9942, and 0550, Orange County, New York, Cultural Resources Investigations for the Millennium Pipeline Project, by J.P. Pretola and J.A. Freedman, Appendix H. (Digital Archive #12364), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Lattanzi, Gregory D.
1996 Phase I and Phase II Archaeological Survey and Phase II/III Archaeological Evaluation of the Northampton Area School District Project Area Northampton Township, Northampton County, Pennsylvania. Report on file (ER#94-2384-095), Pennsylvania State Historic Preservation Office, Harrisburg.
2007 The Provenance of Pre-Contact Copper Artifacts: Social Complexity and Trade in The Delaware Valley. *Archaeology of Eastern North America* 35:125-137.
2008a Elucidating the Origin of Middle Atlantic Pre-Contact Copper Artifacts Using Laser Ablation ICP–MS. *North American Archaeologist* 29:293-322.
2008b Chemical Characterization of Four Pre-contact Copper Artifacts from Pennsylvania. *Pennsylvania Archaeologist*. 78(1):2-15.

2009 ‘Whachoo Talkin’ Bout’ Potsherd? Insights into Upper Delaware Valley Late Woodland Ceramics. *Journal of Middle Atlantic Archaeology* 25:1-14.
2013 *The Value Of Reciprocity: Copper, Trade And Social Interaction In The Middle Atlantic Region Of The Eastern Woodlands*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Lattanzi, Gregory D., R. Michael Stewart and George Pevarnik
2017 It Fell From the Sky: Style, Messaging, and Information Exchange in Middle Woodland Abbott Zoned Ceramics. In *The Abbott Farm National Historic Landmark*, edited by R.M. Stewart, B. Obermeyer and Richard Veit, pp.30-47. Special three volume edition of the *Bulletin of the Archaeological Society of New Jersey*, Nos.68-70 (2013-2015).

Lattanzi, Gregory D. and Gary E. Stinchcomb
2015 Isotopic Analysis of Museum-Archived Soil Samples From Archeological Sites: A Case-Study Using the Abbott Farm National Historic Landmark, USA. *Journal of Archaeological Science*: *Reports* 4:86-94.

Launer, Philip J.
1960 Skunk Run: A Pre-Munsee Village Site in Sussex County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 17:6-10.

Leasure, F.G. and L.E. Shirley
1968 Mica. In *Mineral Resources of the Appalachian Region*. Geological Survey Professional Paper 580, pp.311-325. U.S. Geological Survey and the U.S. Bureau of Mines. United States Government Printing Office, Washington, D.C.

Lee, James, Andrew Martin and John Stiteler
2010 Phase III Archaeological Data Recovery, Site 28WA290, Route I-80 Truck Weigh Station Project, Knowlton Township, Warren County, New Jersey. Report on file (WAR 704a-9789), New Jersey Historic Preservation Office, Trenton.

Lee, James, Nadine Sergejeff and John Stiteler
2005 Phase I and II Archaeological Survey, Route I-80 Truck Weigh Station Project, Knowlton Township, Warren County, New Jersey. Report on file (WAR F704-5324), New Jersey Historic Preservation Office, Trenton.

LeeDecker, C., B. Koldehoff and C. A. Holt
1996 Excavation of the Two Guys Site (7S-F-68) Sussex County, Delaware. Delaware Department of Transportation Archaeology Series 138. Dover.

Leidy, Joseph
1889 Cave Fossils. *Annual Report of the Geological Survey of Pennsylvania for 1887*, compiled by J.P Lesley, pp. 1-20. Geological Survey of Pennsylvania, Harrisburg.

Lellis, William A.
2001 Freshwater Mussel Survey of the Upper Delaware Scenic Recreational River-Qualitative Survey 2000. USGS Leetown Science Center, Wellsboro, Pennsylvania. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Lenig, Donald
1965 *The Oak Hill Horizon and Its Relation to the Delaware and the Five Nations Iroquois Culture*. Researches and Transactions of the New York State Archaeological Association 15(1). New York State Archaeological Association, Buffalo.

Lenik, Edward J.
2002 *Picture Rocks: American Indian Rock Art in the Northeast Woodlands*. University Press of New England, Hanover, New Hampshire.

Leo, Ralph J. and Edward S. Rutsch
1981 Cultural Resource Survey, Worthington State Forest, Pahaquarry Township, Warren County, New Jersey. Report on file (WAR B26-6021), New Jersey Office of Historic Preservation, Trenton.

Leslie, Vernon
1946 An Archaeological Reconnaissance of Upper Delaware Valley Sites Between Point Mountain and Bushkill, Pa. *Pennsylvania Archaeologist.* 16(3):95-112.
1963 A Typology of Arrowpoints Found in Wayne County, Pennsylvania, and in Sullivan County, New York. *New World Antiquity* 10(7-8):70-90.
1968 The Davenport Site: A Study in Tocks Island Reservoir Archaeology. *The Chesopiean* 6(5):109-139.
1973 *Faces in Clay; the Archaeology and Early History of the Red Man in the Upper Delaware Valley*. T. Emmett Henderson, Middletown, New York.

Levandowski, James and Nina M. Versaggi
2003 Phase 2 Site Examination, The Rockefeller Gravel Mine Site (SUBi-2381), Rockefeller Gravel Mine Project, Town of Delhi, Delaware County, New York. Report on file (Digital Archive ID# 3833), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Levine, Mary Ann
2007 Determining the Provenance of Native Copper Artifacts from Northeastern North America: Evidence from Instrumental Neutron Activation Analysis. *Journal of Archaeological Science* 34:572-587.

Li, Yong-Xiang, Zicheng Yu, Kenneth Kodama, and Robert E. Moeller
2006 A 14,000-Year Environmental Change History Revealed By Mineral Magnetic Data From White Lake, New Jersey, USA. *Earth and Planetary Science Letters* 246:17-40.

Lightfoot, Kent, Rob Q. Cuthrell, Chuck J. Striplen and Mark G. Hylkema

2013 Rethinking the Study of Landscape Management Practices Among Hunter-Gatherers in North America. *American Antiquity* 78(2):285-301.

Long, Susan E.
1994 Analysis of Paleobotanical Remains. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Padula Site (36-NM-15), Northampton County, Pennsylvania, by C. Bergman et al, pp.289-298. Report on file (ER# 82-0648-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Lothrop, Jonathan C. and James W. Bradley
2012 Paleoindian Occupations in the Hudson Valley, New York. In *Late Pleistocene Archaeology and Ecology in the Far Northeast*, edited by Francis W. Robinson, pp.9-47. Texas A&M University Press, College Station.

Lothrop, Jonathon, Brad Koldehoff
1994 Archaic Settlement in the Lower Delaware Valley. *Journal of Middle Atlantic Archaeology* 10:105-123.

Lothrop, Jonathan C., Darrin L. Lowery, Arthur E. Spiess and Christopher J. Ellis
2016 Early Human Settlement of Northeastern North America. *PaleoAmerica* 2(3):192-251.

Louis Berger and Associates, Inc.
1992 SS-2 and APEC Storage Service Projects. Woodbury Lateral Loop Natural Gas Pipeline Expansion. Archaeological Investigations at Sites 28GL111, 28GL205, 28GL206, 28GL209 and 28GL210. West Deptford and East Greenwich Townships, Gloucester County, New Jersey. Report on file, New Jersey Office of Historic Preservation, Trenton.

Lovis, William and William G. Monaghan
2007 Directly Dated Cucurbita from the Upper Great Lakes: Implications for Archaic and Woodland Horticulture. Paper presented at the annual meeting of the Society for American Archaeology, Austin, Texas.

Lowery, Darrin L.
2009 *Geoarchaeological Investigations at Selected Coastal Archaeological Sites on the Delmarva Peninsula: The Long Term Interrelationship Between Climate, Geology, and Culture*. PhD dissertation, Department of Geology, University of Delaware, Newark.
2012 The Delmarva Adena Complex: A Study of the Frederica Site, Kent County, Delaware. *Archaeology of Eastern North America* 40:27-58.
2013 Jack's Reef in the Chesapeake and Delmarva Region: Research into the Coastal Archaeology of the Era Between circa cal A.D. 480 and cal A.D. 900. *Archaeology of Eastern North America* 40:3-30.
2015 42,000 Years of DelMarVa's Upland Geoarchaeological Record. Paper presented at the annual meeting of the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Lowery, Darrin L., Stephen J. Godfrey and Ralph Eshelman
2011 Integrated Geology, Paleontology, and Archaeology: Native American Use of Fossil Shark Teeth in the Chesapeake Bay Region. *Archaeology of Eastern North America* 39:93-108).

Lowery, Darrin L., Michael A. O'Neal, John S. Wah, Daniel P Wagner, and Dennis J. Stanford
2012 Late Pleistocene Upland Stratigraphy of the Western Delmarva Peninsula, USA. *Quaternary Science Reviews* 29(11-12):1472-1480.

Lowery, Darrin L., Torben Rick, Michael Barber, John Wah and Michael Madden
2015 Meadowood South of the Mason Dixon Line: An Early Woodland Meadowood Presence on the Delmarva Peninsula. *Archaeology of Eastern North America* 43:39-60.

Lucas, Gavin
2005 *The Archaeology of Time*. Routledge, Taylor and Francis Group, London and New York.

Luckenbach, A.H., R.O. Allen, Jr. and C.G. Holland
1975 Movement of Prehistoric Soapstone in the James River Basin Indicated by Trace Element Analysis. *Quarterly Bulletin of the Archaeological Society of Virginia* 29(4):183-203

Luckenbach, A. H., W.E. Clark and R.S. Levy
1987 Rethinking Cultural Stability in Eastern North American Prehistory: Linguistic Evidence from Eastern Algonquian. *Journal of Middle Atlantic Archaeology* 3:1-33.

Luckenbach, Al, Jessie Grow and Shawn Sharpe
2010 Archaic Period Triangular Points from Pig Point, Anne Arundel County, Maryland. *Journal of Middle Atlantic Archaeology* 26:165-179.

Luckenbach, A.H., C.G. Holland and R.O. Allen, Jr.
1975 Soapstone Artifacts: Tracing Prehistoric Trade Patterns in Virginia. *Science* 187:57-58.

Lyman, R. Lee, Michael J. O'Brien and Robert C. Dunnell
1997 *The Rise And Fall of Culture History*. Plenum Press, New York.

MacDonald, Douglas H., Eric P. Scuoteguazza, and David L. Cremeens
2011 Steatite on the Juniata: Early Pottery at the Sunny Side Site (36BD267), Central Pennsylvania. *Journal of Middle Atlantic Archaeology* 27:17-28.

MacDougall Andrew
2003 Did Native Americans Influence the Northward Migration of Plants During the Holocene? *Journal of Biogeography* 2003: 30(5):633-647.

Mackey, Douglas
2007 Mounds of New York: A Review of Adena and Hopewell Earthworks. *The Bulletin, Journal of the New York State Archaeological Association* 123:36-56.

MacNeish, Richard S.
1952 *Iroquois Pottery Types: A Technique for the Study of Iroquois Prehistory*. National Museum of Canada, Bulletin 124.

Malhi, Ripan S., Beth A. Schultz, and David G. Smith
2001 Distribution of Mitochondrial DNA Lineages Among Native American Tribes of Northeastern North America. *Human Biology* (2001): 17-55.

Marchiando, Patricia
1969 The Bell-Browning Site, Sussex County, New Jersey. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania and the New Jersey State Museum, Trenton
1970 Survey and Selective Testing of Five Localities in Sussex County, New Jersey. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania and the New Jersey State Museum, Trenton.
1972 Bell-Browning Site, 28-Sx-19. In *Archaeology in the Upper Delaware Valley*, edited by Fred W. Kinsey, III, pp.131-158. Anthropological Series Number 2, Pennsylvania Historical and Museum Commission, Harrisburg.

Marshall, Sydne B.
1985 Paleoindian Artifact Form and Function at Shawnee Minisink. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr., pp.165-209. Academic Press, Orlando, Florida.

Maryland Archaeological Conservation Laboratory
2012 A Guide to Identification of Maryland Projectile Points. *Maryland Archaeology* 48(1-2):1-69.

Mathews, Alfred
1886 *History of Wayne, Pike, and Monroe Counties, Pennsylvania*. R.T. Peck & Company, Philadelphia, Pennsylvania.

McAvoy, Joseph M., and L.D. McAvoy
1997 *Archaeological Investigations of Site 44SX202, Cactus Hill, Sussex County, Virginia*. Survey and Planning Report Series No.8, Virginia Department of Historic Resources, Richmond.

McConaughy, Mark A.
2003 Early and Middle Woodland in the Upper Ohio Drainage Basin. Ms. distributed by the author at the annual meeting of the *Eastern States Archaeological Federation*, Mt Laurel, New Jersey.
2008 Current Issues In Paleoethnobotanical Research From Pennsylvania and Vicinity. In *Current Northeast Paleoethnobotany II,* edited by John P. Hart, pp.9- 28. New York State Museum Bulletin Series 512, Albany.
2013 The Jack's Reef Horizon in Pennsylvania: A Preliminary Assessment. *Archaeology of Eastern North America* 40:31-46.

2015 The Late Woodland Period in Western Pennsylvania. *Pennsylvania Archaeologist* 85(2):25-46.

in press Early and Middle Woodland in the Upper Ohio Drainage Basin. In *The Archaeology of Native Americans in Pennsylvania*, edited by Kurt W. Carr, Christopher A. Bergman, Christina B. Rieth, Bernard K. Means, and Roger W. Moeller. University of Pennsylvania Press, Philadelphia.

McKnight, Justine W.

2006 Flotation-Recovered Plant Remains From Phase III Data Recovery at Site 36NM204, Northampton County, Pennsylvania. Appendix VIII. In Phase III Archaeological Data Recoveries at 36NM204, 36MR119, And 36MR133 for the Proposed Line 1278 Replacement Project, Northampton and Monroe Counties, Pennsylvania, by M. B. Hornum et al. ER# 97-2182-042-PP. Three volumes. Report on file (ER# 97-2182-042-PP), Pennsylvania State Historic Preservation Office, Harrisburg.

2009 Analysis of Flotation- and Waterscreen-Recovered Archaeobotanical Remains from the Hughes Site (18MO1), Montgomery County, Maryland. *Maryland Archaeology* 45(1-2):29-39.

2010 Analysis of Flotation-recovered Archaeobotanical Remains from the Claggett Retreat Site (18FR25), Frederick County, Maryland. *Maryland Archaeology* 46(1-2):38-46.

McKnight, J. W., and Gallivan, M. D.

2007 The Virginia Archeobotanical Database Project: A Preliminary Synthesis of Chesapeake Ethnobotany. *Quarterly Bulletin of the Archeological Society of Virginia* 62:181-189.

McLearen, Douglas with contributions by Miles Johnson, Michael Barber and Antony Opperman

1991a Phase III Archaeological Investigations of the "522 Bridge Site" (44WR329), Warren County, Virginia. Report on file, Virginia Department of Historic Resources, Richmond.

1991b Late Archaic and Early Woodland Material Culture in Virginia. In *Late Archaic and Early Woodland Research in Virginia: A Synthesis*, edited by Theodore R. Reinhart and Mary Ellen N. Hodges, pp.89-137. Special Publication No.23, Archaeological Society of Virginia, Richmond.

McLearen, Douglas and Michael Fokken

1986 White Horse West Site (28ME119), Data Recovery. Trenton Complex Archaeology Report 4. Report on file, New Jersey Department of Transportation and the New Jersey Office of Historic Preservation, Trenton.

McMillan, Barbara A.

1985 A Technological Analysis of the Early Archaic. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr., pp.261-319. Academic Press, Orlando, Florida.

McNett, Charles W., Jr.

1985a The Shawnee Minisink site: An Overview. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr., pp.321-325. Academic Press, Orlando, Florida.

1985b Artifact Morphology and Chronology at the Shawnee Minisink Site. In *Shawnee-Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett Jr., pp.83-120. Academic Press, Orlando, Florida.

McNett, Charles W., Jr., Richard J. Dent, June Evans, Sydne B. Marshall and Barbara A. McMillan
1985 The Upper Delaware Valley Early Man Project. In *Shawnee Minisink: A Stratified Paleoindian-Archaic Site in the Upper Delaware Valley of Pennsylvania*, edited by C.W. McNett, Jr., pp.3-14. Academic Press, Orlando, Florida.

Meltzer, David J.
2009 *First Peoples in a New World: Colonizing Ice Age America*. University of California Press.

Mercer, Henry C.
1894 Re-Exploration of Hartman's Cave, Near Stroudsburg, Pennsylvania. *Proceedings of the Academy of Natural Sciences of Philadelphia* 46:96-104.

Messner, Timothy
2008 *Starch Grain Analysis Provides New Insight into Plant Resource Exploitation in the Middle Atlantic Region of North America*. PhD dissertation, Department of Anthropology, Temple University, Philadelphia, PA.
2011 *Acorns and Bitter Roots: Starch Grain Research in the Prehistoric Eastern Woodlands.* University of Alabama Press, Tuscaloosa.

Messner, Timothy and Ruth Dickau
2005 New Directions, New Interpretations: Paleoethnobotany in the Upper Delaware Valley and the Utility of Starch Grain Research. *Journal of Middle Atlantic Archaeology* 21:71-82.

Messner, Timothy, Ruth Dickau and Jeff Harbison
2008 Starch Grain Analysis: Methodology and Applications in the Northeast. In *Current Northeast Paleoethnobotany* Volume II, edited by John Hart, pp.111-128. New York State Museum Bulletin Series 512, Albany.

Messner, Timothy C., R. Michael Stewart and Philip Perazio
2006 Archaeological Investigations of 10 Proposed Comfort Stations, Delaware Water Gap National Recreation Area, Pennsylvania and New Jersey. Department of Anthropology, Temple University. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Miller Christopher L. and George R. Hamell
1986 A New Perspective on Indian-White Contact: Cultural Symbols and Colonial Trade. *Journal of American History* 73(2):311-328.

Miller, D. Shane and Joseph A.M. Gingerich
2013 Paleoindian Chronology and Paleoenvironmental Considerations. Appendix: Select Radiocarbon Dates from Eastern North America. In, *In the Eastern Fluted Point Tradition*, edited by Joseph A.M. Gingerich, pp.9-37. University of Utah Press, Salt Lake City.

Miller, Fennelle
1991 Middle Woodland Manifestations in the Upper Delaware River Valley. Manuscript prepared for graduate course, Department of Anthropology, Temple University, Philadelphia, Pennsylvania. Copy on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Miller, Heather
2007 *Archaeological Approaches to Technology*. Elsevier Academic Press, Amsterdam and Boston.

Miller, Patricia E.
1994 Archaeological Data Recovery, The Skvarek Site (Site 36Lu132), Proposed Shickshinny/Mocanaqua Bridge Replacement (S.R. 0239), Salem and Conyngham Townships, Luzerne County, Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.
1998 Lithic Projectile Point Technology and Raw Material Use in the Susquehanna River Valley. In *The Archaic Period in Pennsylvania: Hunter-Gathers of the Early and Middle Holocene Period*. P.A. Raber, P.E. Miller, and S.M. Neusius, eds. pp. 91-120. Recent Research In Pennsylvania Archaeology Number 1. Harrisburg: Pennsylvania Historical and Museum Commission.
2001 Introduction to the Uplands Settlement Patterns Project. In Prehistoric Settlement Patterns in Upland Settings: An Analysis of Site Data in a Sample of Exempted Watersheds, by B.A. Chiarulli, D.C. Kellogg, R.G. Kingsley, W.J. Meyer, P.E. Miller, P.A. Perazio and P.E. Siegel, Section 1.0. Report prepared for the Pennsylvania Historic Museum Commission, Harrisburg, Pennsylvania. http://www.pennarchcouncil.org/spfinal-pre.htm
2015 The Transitional Archaic Period in the Susquehanna River Valley. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.85-97. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Miller, Patricia E., James T. Marine, Justine Woodard McKnight and Frank J. Vento
2010 Archaeological Investigations on Calver Island (36Da89): A Stratified Site in the Lower Susquehanna River Valley. *Journal of Middle Atlantic Archaeology* 26:81-103.

Miller, Patricia E., James T. Marine, and Frank J. Vento
2007 Archaeological Investigations, Route 11/15 Improvements (SR 0011, Section 008), Juniata and Perry Counties, Pennsylvania, ER No. 1989-0381-042, Volume II: Site 36Pe16. KCI Technologies, Inc., Mechanicsburg, Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Miller, Patricia E., Frank J. Vento and James T. Marine
2007 Archaeological Investigations Susquehanna River Bridge Dauphin and York Counties, Pennsylvania. Volume I, Research Design and Prehistoric Context. Report on file (ER # 1999-1130-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Miller, Patricia E., Frank J. Vento, James T. Marine, Sharon White and Eloisa A. Pollak
2009 Phase III Archaeological Data Recovery, Route 11/15 Improvements (SR 0011, Section 008), Juniata and Perry Counties, Pennsylvania, Volumes 1-6. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Miroff, Laurie E.
2002 Above the Valley Walls: Data Recovery of the Park Creek I (Subi-1463, NYSM #10221), Park Creek II (Subi-1464, NYSM #10222), and Raish (Subi-1465, NYSM #10223) Sites in the Upper Susquehanna Valley. Towns of Windsor and Kirkwood, Broome County, New York. Report on file (Digital Archive ID# 2811), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
2009 A Local-level Analysis of Social Reproduction and Transformation in the Chemung Valley: The Thomas/Luckey Site. In *Iroquoian Archaeology & Analytic Scale,* edited by Laurie E. Miroff and Timothy D. Knapp, pp. 69-100. University of Tennessee Press, Knoxville.
2011 Crafting Pots: Chenango Point Prehistoric Ceramics. In Life at the Confluence: Archaic and Woodland Occupations of the Chenango Point Site (SUBi-1274). Data Recovery Excavations for the Downtown Academic Center Project, City of Binghamton, Broome County, New York, by Timothy D. Knapp, pp.71-103. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
2012 Investigation of the Chenango Point South Site (SUBi-2776). Phase 2/3 Archaeological Investigations, Chenango Point South Site, Twin River Commons Project, City of Binghamton, Broome County, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.
2014 The Otsiningo Market Site (SUBi-3041; A00706.000048), Phase 3 Archaeological Investigations, Otsiningo Farmers Market Project, Town of Dickinson, Broome County, New York. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Miroff, Laurie E. and Andrea Zlotucha Kozub
2014 Faunal Analysis, Prehistoric Features. In The Otsiningo Market Site (SUBi-3041; A00706.000048), Phase 3 Archaeological Investigations, Otsiningo Farmers Market Project, Town of Dickinson, Broome County, New York, by L.E. Miroff, pp.99-102. Report on file (Digital Archive), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Moeller, Roger
1992 *Analyzing and Interpreting Late Woodland Features*. Occasional Publications in Northeastern Anthropology 12. Archaeological Services, Bethlehem Connecticut.

2011 *Analyzing and Interpreting Late Woodland Features*. Occasional Publications in Northeastern Anthropology 12. Revised edition of 1992 original in pdf format. Archaeological Services, Bethlehem Connecticut.

2015 The Transitional Dilemma in Pennsylvania: Hearths, Fish, and Pottery. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.121-136. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Moeller, Roger W. and Lucinda McWeeney

1996 Analysis of the Flot Samples and Paleobotanical Remains. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.292-310, Appendix F. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Moerman, Daniel E.

1986 *Medicinal Plants of Native America*. Two volumes. University of Michigan Museum of Anthropology, Technical Reports, Number 19. Research Reports in Ethnobotany, Contribution 2. Ann Arbor.

1998 *Native American Ethnobotany*. Timber Press, Portland, Oregon.

Monaghan, William G., William A. Lovis and Kathryn C. Egan-Bruhy

2006 Earliest Cucurbita from the Great Lakes, Northern USA. *Quaternary Research* 65(2):216-222.

Morris, George J.

1982 A Preliminary Investigation Of The Osborn Site, Salem County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 38:22-31.

Morris, Zoe, Christine White, Lisa Hodgetts and Fred Longstaffe

2016 Maize Provisioning of Ontario Late Woodland Turkeys: Isotopic Evidence of Seasonal, Cultural, Spatial and Temporal Variation. *Journal of Archaeological Science: Reports* 10:596–606.

Mounier, R. Alan

1975 The Indian Head Site Revisited. *Bulletin of the Archaeological Society of New Jersey* 32:1-14.

1985 Archaeological Data Recovery, Site 28-BU-165, Larchmont Center, Mt. Laurel, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton.

2003 *Looking Beneath the Surface: The Story of Archaeology in New Jersey*. Rutgers University Press, New Brunswick, New Jersey.

2015 New Radiocarbon Dates for Eshback Bifaces at Berkley Square, East Greenwich Township, Gloucester County, N.J. *Newsletter of the Archaeological Society of New Jersey* 248:1, 3-4.

Mounier, R. Alan and Jack Cresson
2009 Archaeological Data Recovery at the Gravelly Run Site, Hamilton Township, Atlantic County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 64: 70-80.

Murphy, James L.
2001 Pawpaws, Persimmons, and 'Possums: On the Natural Distribution of Pawpaws in the Northeast. *North American Archaeologist*. 2001; 22:93-115.

New Jersey State Centennial Board
1877 *Report of the New Jersey Commissioners on the Centennial Exhibition*. Naar, Day & Naar Printers, Trenton, New Jersey.

Newcomb, William W., Jr.
1956 *The Culture and Acculturation of the Delaware Indians*. Anthropological Papers, Museum of Anthropology, University of Michigan, No.10, Ann Arbor.

Newman, Margaret E.
2000 Appendix V: Immunological Analysis of Lithic Artifacts from the Treichlers Bridge Site, 36Nm142, Pennsylvania. In Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volume III, by David A. Anderson et al. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Obermeyer, Brice
2016 "We Call It Put Him Away": Contemporary Delaware Burial Practices and NAGPRA. *North American Archaeologist* 37(2):112-135.
2017 Using Language, Ethnography, Folklore and Oral Tradition for Interpreting the Cultural Affiliation of Abbott Farm. In *The Abbott Farm National Historic Landmark*, edited by R.M. Stewart and B. Obermeyer. Special three volume edition of the *Bulletin of the Archaeological Society of New Jersey* Nos.68-70, 2013-2015:143-158.

Obermeyer, Brice, Robert Grumet, R. Michael Stewart, Jim Rementer and Greg Brown
2015 Cultural Affiliation of the Abbott Farm National Historic Landmark: Cultural Affiliation Report prepared with funding from a 2012 Delaware Tribe of Indians NAGPRA Documentation Grant (40-12-GP-566). Delaware Tribe Historic Preservation Office, Emporia State University, Emporia, Kansas.

Odell, George H.
1988 Addressing Prehistoric Hunting Practices Through Stone Tool Analysis. *American Anthropologist* 90:335-355.

Odell, George H. and Frank Cowan
1986 Experiments with Spears and Arrows on Animal Targets. *Journal of Field Archaeology* 13(2): 195-212.

Opperman, Antony F.
1980 *A Study of the Prehistoric Ceramics from Maycock's Point, Prince George County, Virginia*. Senior Thesis, Department of Anthropology, The College of William and Mary, Williamsburg, Virginia.

Orlandini, John
1996 *The Ancient Native Americans of the Wyoming Valley: 10,000 Years of Prehistory*. Privately published, Kingston, Pennsylvania.

Ortiz, Beverly R.
1991 *It Will Live Forever: Traditional Yosemite Indian Acorn Preparation.* Heyday Books, Berkeley, California.

Pagoulatos, Peter
2003 Early Archaic Settlement Patterns of New Jersey. *Archaeology of Eastern North America* 31:15-43.

Paper, Jordan
1988 *Offering Smoke: The Sacred Pipe and Native American Religion.* University of Idaho Press, Moscow, Idaho.

Parker, Kathyrn E.
1993a Plant Remains from Lower Boat Ramp Excavations at Site 36Pi136. Appendix 1. In Archaeological Monitoring at Dingmans Launch Lower Boat Ramp, Delaware Water Gap National Recreation Area, Pike County, Pennsylvania, by Michael Alterman. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.
1993b Plant Remains from the Comfort Station Excavations. Appendix 2 in Archaeological Monitoring at Dingmans Launch Lower Boat Ramp, Delaware Water Gap National Recreation Area, Pike County, Pennsylvania, by Michael Alterman. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.
1995 Plant Remains from Archaeological Investigations at Three Sites in the Delaware Water Gap National Recreation Area. In Archaeological Survey of the Milford Transect, Delaware Water Gap National Recreation Area, Pennsylvania and New Jersey. Volume II: Appendices, by Robert Wall and Brad Botwick, Appendix IV (15 pages). Report on file, National Park Service, Mid-Atlantic Regional Office Philadelphia, Pennsylvania.

Parmalee, Paul W. and Walter E. Klippel
1974 Freshwater Mussels as a Prehistoric Food Resource. *American Antiquity* 39(3):421-434.

Parr, Robert E.
2006 Protein Residue Analysis of Artifacts from Archaeological Sites 36MR133, 36MR119, and 36NM204, Monroe and Northampton Counties, Pennsylvania. Appendix 7. In Phase III Archaeological Data Recoveries at 36NM204, 36MR119, And 36MR133 for the Proposed Line 1278 Replacement Project, Northampton and Monroe Counties,

Pennsylvania. ER# 97-2182-042-PP. Three volumes, by Michael B. Hornum et al. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Parris D. C.
1983 New and Revised Records of Pleistocene Mammals of New Jersey. *The Mosasaur* 1:1–21.

Parris D. C. and G.R. Case
1980 Castoroides from New Jersey: A Possible Association with Artifacts Reexamined. *Bulletin of the Archaeological Society of New Jersey* 36:22–4.

Patterson, William A, III and Kenneth E. Sassaman
1988 Indian Fires in the Prehistory of New England. In *Holocene Human Ecology in Northeastern North America*, edited by George P. Nicholas, pp.107-135. Plenum Press, New York.

Payne, Ted M.
1990 Investigations at a Lackawaxen Generalized Hunting Settlement in the Middle Delaware River Drainage. *Bulletin of the Archaeological Society of New Jersey* 45:9-13.

Peacock, Evan and Jennifer L. Seltzer
2008 A Comparison of Multiple Proxy Data Sets for Paleoenvironmental Conditions as Derived From Freshwater Bivalve (Unionid) Shell. *Journal of Archaeological Science* 35:2557-2565.

Pendergast, James F.
1992 Some Notes on Ceramic Smoking Pipes from St. Lawrence Iroquoian Archaeological Sites. In *Proceedings of the 1989 Smoking Pipe Conference*, edited by Charles F. Hayes III, Connie Cox Bodner and Martha Sempowski, pp.51-70. Rochester Museum and Science Center, Research Records No.22. Rochester, New York.

Peres, Tanya M. and Kelly L. Ledford
2016 Archaeological Correlates of Population Management of the Eastern Wild Turkey (*Meleagris gallopavo silvestris*) with a Case Study from the American South. *Journal of Archaeological Science: Reports* 10:547–556.

Pesotine, Al
2016 C-14 Award to Frances Dorrance Chapter #11. *The Society for Pennsylvania Archaeology, Inc., Newsletter* Fall:4.

Petersen, James B.
1996 *A Most Indispensable Art: Native Fiber Industries from Eastern North America*. University of Tennessee Press, Knoxville.

Petruso, Karl M. and Jere M. Wickens
1984 The Acorn in Aboriginal Subsistence in Eastern North America: A Report on Miscellaneous Experiments. In *Experiments and Observations on Aboriginal Wild Plant Food Utilization in Eastern North America*, edited by Patrick J. Munson, pp.360-378. Indiana Historical Society, Prehistory, Volume 6, Number 2. Indianapolis.

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

Pevarnik George L., Matthew T. Boulanger and Michael D. Glascock
2008 Instrumental Neutron Activation Analysis of Middle Woodland Pottery from the Delaware Valley. *North American Archaeologist* 29(3-4):239-268.

Pfeiffer, Susan, Ronald F. Williamson , Judith C. Sealy, David G. Smith and Meradeth H. Snow
2014 Stable Dietary Isotopes And mtDNA From Woodland Period Southern Ontario People: Results From A Tooth Sampling Protocol. *Journal of Archaeological Science* 42:334-345.

Philhower, Charles A.
1926 The Aborigines of Hunterdon County, New Jersey. *New Jersey Historical Society Proceedings* 11:508-526.
1954 Relation of the Shawnee to the Lenape. *Archaeological Society of New Jersey News Letter* 29:12-14.

Pietak, Lynn Marie
1998 Body Symbolism and Cultural Aesthetics: The Use of Shell Beads and Ornaments by Delaware and Munsee Groups. *North American Archaeologist* 19 (2):135–161.
1999 Bead Color Symbolism Among Post-Contact Delaware and Munsee Groups. *Journal of Middle Atlantic Archaeology* 15:3–19.

Pollak, Janet S.
1971 *The Abbott Phase: A Hopewellian Manifestation in the Delaware Valley*. MA thesis, Department of Anthropology, Temple University, Philadelphia, Pennsylvania.

Pope, Melody
2002 Microwear Analysis. In Above the Valley Walls: Data Recovery of the Park Creek I (Subi-1463, NYSM #10221), Park Creek I (Subi-1464, NYSM #10222), and Raish (Subi-1465, NYSM #10223) Sites in the Upper Susquehanna Valley. Towns of Windsor and Kirkwood, Broome County, New York, by Laurie Miroff, pp.68-74. Report on file (Digital Archive ID# 2811), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Pretola, John P. and Jacob A. Freedman
2009 Results of Phase III Investigations in Portions of Sites ORA-9931, 9936, 9942, and 0550, Orange County, New York, Cultural Resources Investigations for the Millennium

Pipeline Project. (Digital Archive #12364), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Price, T. Douglas, James H. Burton, and R. Alexander Bentley
2002 The Characterization of Biologically Available Strontium Isotope Ratios for the Study of Prehistoric Migration. *Archaeometry* 44:117-135.

Puniello, Anthony J.
1980 Iroquois Series Ceramics in the Upper Delaware Valley. In *Proceedings of the 1979 Iroquois Pottery Conference*, edited by Charles F. Hayes III, pp.146-155. Rochester Museum and Science Service, Research Record No.13. Rochester, New York.
1991 *The Reconstruction and Interpretation of Late Woodland Occupations of the Upper Delaware Valley of New Jersey and Pennsylvania*. PhD dissertation, Department of Anthropology, New York University, New York, N.Y.
1994 An Interpretation of Late Woodland Occupations of the Upper Delaware Valley of New Jersey and Pennsylvania. Paper presented at the annual meeting of the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Puseman, Kathryn
1996 Macrofloral Analysis at Site 36NM212, Pennsylvania. Paleo Research Labs Technical Report 96-09. Appendix I. In Phase I and Phase II Archaeological Survey and Phase II/III Archaeological Evaluation of the Northampton Area School District Project Area Northampton Township, Northampton County, Pennsylvania, by Gregory D. Lattanzi. Report on file (ER#94-2384-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Raber, Paul A.
2014 Another Perspective on "Clemson Island" and the Role of Small Sites in Late Woodland Settlement: The Late Woodland Period Occupation of 36BL112. *Pennsylvania Archaeologist* 84(2):1-35.

Rafferty, Sean M.
2016 Final Thoughts and Future Directions. In *Perspectives on the Archaeology of Pipes, Tobacco and other Smoke Plants in the Ancient Americas*, edited by E.A. Bollwerk and S. Tushingham, pp.255-259. Springer, New York.

Rafferty, Sean M. and Rob Mann (editors)
2004 *Smoking Culture: The Archaeology of Tobacco Pipes in Eastern North America.* University of Tennessee Press, Knoxville.

Rand, Theodore D.
1894 The Sadsbury Steatite. *Proceedings of the Academy of Natural Sciences of Philadelphia* 46:455-460.

Rand, Theodore D., William W. Jefferis and J. T. M. Cardeza
1892 Mineral Localities of Philadelphia and Vicinity. *Proceedings of the Academy of Natural Sciences of Philadelphia* 44:174-202.

Rankin, Jennifer and R. Michael Stewart
2016 The Snyder Complex and Paleoindian Archaeology in the Delaware Valley. Paper presented at the annual meeting of the Eastern States Archaeological Federation, Langhorne, Pennsylvania

Raymer, Leslie E. and Mary Theresa Bonhage-Freund
1999 Appendix II: Paleoethnobotany of the Fahs II and Oberly Island Sites, Northampton County, Pennsylvania. In Archeological Data Recoveries At The Fahs II And Oberly Island Sites: Structure, Function, And Context in the Lower Lehigh Valley Northampton County, Pennsylvania S.R. 0033, Section 001, by Peter E. Siegel, Tod L. Benedict and Robert G. Kingsley. Report on file (ER# 88-0224-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Reimer, Paula J., Edouard Bard, Alex Bayliss, J. Warren Beck, Paul G. Blackwell, Christopher Bronk Ramsey, Caitlin E. Buck, Hai Cheng, R. Lawrence Edwards, Michael Friedrich, Pieter M. Grootes, Thomas P. Guilderson, Haflidi Haflidason, Irka Hajdas, Christine Hatté, Timothy J. Heaton, Dirk L Hoffmann, Alan G Hogg, Konrad A. Hughen, K. Felix Kaiser, Bernd Kromer, Sturt W. Manning, Mu Niu, Ron W. Reimer, David A. Richards, E. Marian Scott, John R. Southon, Richard A Staff, Christian S. M. Turney, and Johannes van der Plicht
2013 INTCAL13 and Marine13 Radiocarbon Age Calibration Curves 0–50,000 Years Cal BP. *Radiocarbon* 55(4):1869-1887.

Rhoads, Ann Fowler, and William McKinley Klein, Jr.
1993 *The Vascular Flora of Pennsylvania: Annotated Checklist and Atlas.* American Philosophical Society, Philadelphia, PA.

Rice, Prudence M.
1996 Recent Ceramic Analysis 2. Composition, Production, and Theory. *Journal of Archaeological Research* 4:165-202.

Ridge, John C.
2003 The Last Deglaciation of the Northeastern United States: A Combined Varve, Paleomagnetic, and Calibrated ^{14}C Chronology. In *Geoarchaeology of Landscapes in the Glaciated Northeast*, edited by D.L. Cremeens and J.P. Hart, pp.15-45. New York Museum Bulletin 497, The New York State Education Department, Albany, New York.

Rieth, Christina
2004 Cordage, Fabrics, and Their Use in the Manufacture of Early Late Prehistoric Ceramic Vessels In New York. In *Perishable Material Culture in the Northeast*, edited by Penelope Ballard Drooker, pp.129-142. New York State Museum Bulletin 500. Albany, New York.

2013 Space, Time and the Middle Woodland "Jack's Reef Horizon" in New York. *Archaeology of Eastern North America* 40:91-112.

Ritchie, William A.
1949 *The Bell-Philhower Site, Sussex County, New Jersey*. Indiana Historical Society, Prehistoric Research Series, Volume 3, Number 2. Indianapolis, Indiana.
1954 *Dutch Hollow: An Early Historic Seneca Site in Livingston County, New York*. Research Records of the Rochester Museum of Arts and Sciences, No.10. Rochester, New York.
1959 *The Stony Brook Site and Its Relation to Archaic and Transitional Cultures on Long Island.* New York State Museum and Science Center, Bulletin 372. The University of the State of New York, The State Education Department, Albany.
1961 *A Typology and Nomenclature for New York Projectile Points*. New York State Museum and Science Service, Bulletin Number 384, Albany.
1965 *The Archaeology of New York State*. Natural History Press, Garden City, New York.
1971 *A Typology and Nomenclature for New York Projectile Points*. New York State Museum and Science Service, Bulletin Number 384, Albany (revision of 1961 edition).
1980 *The Archaeology of New York State*. Revised edition. Purple Mountain Press, Fleischmanns, New York.

Ritchie, William A. and Don Dragoo
1959 The Eastern Dispersal of Adena. *American Antiquity* 25(1):43-50.

Ritchie, William and Robert Funk
1973 *Aboriginal Settlement Patterns in the Northeast*. New York State Museum and Science Service Memoir 20.

Rocek, Thomas R.
2013 Why Not Pottery? A Comparative Approach to the Variables Underlying the Adoption (or Non-Adoption) of Ceramics. *Anthropologie* 1-2:231-342.

Rockman, Marcia H.
1993 *Investigation of Zoned Incised Ceramics of the Later Middle Woodland Period by Means of Petrographic Analysis*. Honors Thesis, Department of Anthropology, The College of William and Mary, Williamsburg, Virginia.

Romain, William F.
2009 *Shamans of the Lost World: A Cognitive Approach to the Prehistoric Religion of the Ohio Hopewell.* Alta Mira Press, Lanham, Maryland.

Rouse, Irving
1986 *Migrations in Prehistory. Inferring Population Movement from Cultural Remains*. Yale University Press, New Haven, Connecticut.

Rozanski, Kazimierz, Luis Arguas-Arguas and Roberto Gonfiantini
1992 Relation Between Long-Term Trends of Oxygen-18 Isotope Composition of Precipitation and Climate. *Science* 258(5084):981-985.

Rudler, Michael
2006 Beaver Lodge Site Examination (Subi-2298, NYSM#11302). In Addendum Cultural Resource Reconnaissance Survey and Site Examinations for: Evans (SUBi-2292, NYSM#11296), Beaver Lodge (SUBi-2298, NYSM#11302), Delaware Pine (SUBi-2294, NYSM#11298), River Bend (SUBi-2610, NYSM#11709), Balls Eddy I (SUBi-2606, NYSM#11710), and Hale Eddy Hotel (SUBi-2607, NYSM#11711). NY Route 17 Access, Towns of Deposit and Hancock, Delaware County. Volume I, edited by Timothy D. Knapp, pp.96-115. Report on file (Digital Archive ID #6799), New York State Office of Parks, Recreation and Historic Preservation, Cultural Resource Information System.

Russell, Emily Wyndham B.
1979 *Vegetational Change in New Northern Jersey Since 1500 AD: A Palynological, Vegetational, and Historical Synthesis*. PhD dissertation, Rutgers University, New Brunswick, New Jersey.
1980 Vegetational Change in Northern New Jersey from Precolonization to the Present: A Palynological Interpretation. *Bulletin of the Torrey Botanical Club* 107(3):432-446.
1981 Vegetation of Northern New Jersey Prior to European Settlement. *The American Midland Naturalist* 105(1):1-12.
1983 Indian-Set Fires in the Forests of the Northeastern United States. *Ecology* 64(1):78-88.

Russo, Michael and Gregory Heide
2004 The Emergence of Pottery in South Florida. In *Early Pottery: Technology, Function, Style, and Interaction in the Lower Southeast*, edited by Rebecca Saunders and Christopher Hays, pp.105-128. University of Alabama Press, Tuscaloosa.

Rutsch, Edward S.
1973 *Smoking Technology of the Aborigines of the Iroquois Area of New York State*. Associated University Presses, Inc., Cranbury, New Jersey.

Salwen, Bert
1972 Test Excavations at the Zipser Lower Field Site, Warren County, New Jersey. *Bulletin of the Archaeological Society of New Jersey* 28: 1-15.

Santone, Lenore. Rhea J. Rogers, Henry M.R. Holt and Ronald C. Kearns
1997 Phase III Archaeological Data Recovery, Maple Grange Road Bridge Site (28SX297), Maple Grange Road, Vernon Township, Sussex County, New Jersey. Report on file (SUS F142b-5941), New Jersey Historic Preservation Office, Trenton.

Sassaman, Kenneth E.
1992 Lithic Technology and the Hunter-Gatherer Sexual Division of Labor. *North American Archaeologist* 13(3):249-262.
1993 *Early Pottery in the Southeast: Tradition and Innovation in Cooking Technology.* University of Alabama Press, Tuscaloosa.
1998 Archaic Perspectives South of the Border. In *The Archaic Period in Pennsylvania.: Hunter Gatherers of the Early and Middle Holocene Period*, edited by Paul Raber,

Patricia Miller and Sarah Neusius, pp.139-152. Recent Research in Pennsylvania Archaeology, Number 1, Pennsylvania Historical and Museum Commission, Harrisburg.
1999 A Southeastern Perspective on Soapstone Vessel Technology in the Northeast. In *The Archaeological Northeast*, edited by Mary Ann Levine, Kenneth Sassaman, and Michael Nassaney, pp.75-96. Greenwood Publishing Group, Westport, Connecticut.
2006 Dating and Explaining Soapstone Vessels: A Comment on Truncer. *American Antiquity* 71(1):141-156.

Saunders, Rebecca and Christopher Hays
2004 *Early Pottery: Technology, Function, Style, and Interaction in the Lower Southeast*. University of Alabama Press, Tuscaloosa.

Scarry, C. Margaret
2003 Patterns of Wild Plant Utilization in the Prehistoric Eastern Woodlands. In *People and Plants in Ancient Eastern North America*, edited by P.E. Minnis, pp.50-104. Smithsonian Institution, Washington, D.C.

Schoeninger, Margaret J
2014 Stable Isotope Analyses and the Evolution of Human Diets. *Annual Review of Anthropology* 43:413-430.

Schrabisch, Max
1913 Northern New Jersey. In *A Preliminary Report of the Archaeological Survey of New Jersey*, compiled by A. Skinner and M. Schrabisch, pp.67-84. Bulletin 9, New Jersey State Geological Survey, Trenton, New Jersey.
1915 Indian Habitations in Sussex County, New Jersey. *New Jersey Geological Survey, Bull*etin *13.*
1917 Archaeology of Warren and Hunterdon Counties. *Geological Survey of New Jersey Bulletin* 18. Trenton.
1919 Mountain Haunts of the Coastal Algonquian. *American Anthropologist*, *21*(2), 139-152.
1930 *Archaeology of Delaware River Valley Between Hancock and Dingman's Ferry in Wayne and Pike Counties*, *Volume 1*. Publications of the Pennsylvania Historical Commission, Harrisburg, Pennsylvania.

Schuldenrein, Joseph
1994 Padula Site Geomorphology. In Archaeological Data Recovery for Transcontinental Gas Pipe Line Corporation's 6.79 Mile Leidy Natural Gas Pipeline Expansion, Sandts Eddy Site (36-NM-12), Northampton County, Pennsylvania, Volume II, by C.A. Bergman et al, pp.54-89. Report on file (ER#92-0705-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Schuldenrein, Joseph, Robert G. Kingsley, James A. Robertson, Linda S. Cummings and Daniel R. Hayes
1991 Archaeology of the Lower Black's Eddy Site, Bucks County, Pennsylvania. *Pennsylvania Archaeologist* 61(1):19-75.

Schulenberg, Janet K.
2002 New Dates for Owasco Pots. In *Northeast Subsistence-Settlement Change: A.D. 700–1300*, edited by John P. Hart and Christina B. Rieth, pp.153-166. New York State Museum Bulletin 496. The University of the State of New York, State Education Department, Albany.

Schurr Mark R.
1992 Isotopic and Mortuary Variability in a Middle Mississippian Population. *American* Antiquity 57:300-320

Schurr Mark R. and B.G. Redmond
1991 Stable Isotope Analysis of Incipient Maize Horticulturists from the Gard Island 2 Site. *Midcontinental Journal of Archaeology* 16:69-84.

Scully, R. W. and R.W. Arnold
1981 Holocene Alluvial Stratigraphy in the Upper Susquehanna River Basin, New York. *Quaternary Research* 15:327-344.

Sedig, Jakob William
2010 *Getting to the Point: An Examination of Projectile Point Use in the Northern American Southwest, A.D. 900-1300*. M.A. thesis, Department of Anthropology, University of Colorado, Boulder.

Shelley, P.H.
1990 Variation in Lithic Assemblages: An Experiment. *Journal of Field Archaeology* 17:187-193.

Shook, B.A.S., Smith, D.G.
2008 Using Ancient mtDNA to Reconstruct the Population History of Northeastern North America. *American Journal of Physical Anthropology* 137 (1):14-29.

Shott, Michael J.
1993 Spears, Darts, and Arrows: Late Woodland Hunting Techniques in the Upper Ohio Valley. *American Antiquity* 53(3):425-443.

Sidoroff, Maria Louise
1978 Appendix C: Experiment in Replicating and Firing Primitive Minisink Pottery. In *The Minisink Site: A Reevaluation of a Late Prehistoric and Early Contact Site in Sussex County, New Jersey*, by H.C. Kraft, pp.100-103. Archaeological Research Center, Seton Hall University Museum, South Orange, New Jersey.

Sieg, Lauren
2008 Assessment of Cultural Affiliation of Human Remains and Funerary Objects from the Delaware Water Gap National Recreation Area. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, PA, and Ethnography Program, Northeast Region, National Park Service, Boston, Massachusetts.

Siegel, Peter E., Tod L. Benedict and Robert G. Kingsley
1999 Archeological Data Recoveries At The Fahs II And Oberly Island Sites: Structure, Function, And Context in the Lower Lehigh Valley Northampton County, Pennsylvania S.R. 0033, Section 001. Report on file (ER# 88-0224-095), Pennsylvania State Historic Preservation Office, Harrisburg.

Siegel, Peter E., Robert G. Kingsley, and Tod L. Benedict
2001 Oberly Island: Trend and Tradition in the Lower Lehigh Valley. *Pennsylvania Archaeologist*. 71(2):16-59.

Sigstad, John S.
1970 A Field Test for Catlinite. *American Antiquity* 35(3):377-382.

Silver, Annette Louise
1991 *The Abbott Interaction Sphere: A Consideration of the Middle Woodland Period in Coastal New York and a Proposal for a Middle Woodland Exchange System*. PhD dissertation, Department of Anthropology, New York University.

Simon, Mary L.
2017 Reevaluating the Evidence for Middle Woodland Maize From the Holding Site. *American Antiquity* 82(1):140-150.

Skibo, James M. and Michael B. Schiffer
2008 *People and Things: A Behavioral Approach to Material Culture*. Springer, New York.

Skibo, James M., Michael B. Schiffer and Eric Blinman
2008 The Origins of Pottery on the Colorado Plateau. In *People and Things: A Behavioral Approach to Material Culture*, edited by J.M. Skibo and M.B. Schiffer, pp.37-53. Springer, New York.

Skinner, Alanson
1921 *Material Culture of the Menomini*. Museum of the American Indian, Heye Foundation. Indian Notes and Monographs, No.20. New York.

Sloshberg, Willard
1962 Test Excavations on the Upper and Lower Terraces, Pahaquarra Boy Scout Site, and Historic Forts Survey, Tocks Island Reservoir Area, New Jersey. Report on file (WAR N17-6082), New Jersey Historic Preservation Office, Trenton.
1964 The 1964 Excavations in the Tocks Island Reservoir Area, Warren County, New Jersey. Report on file, New Jersey State Museum, Trenton, and the National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Smith, Bruce D.
1978 *Prehistoric Patterns of Human Behavior: A Case Study in the Mississippi Valley.* Academic Press, New York.
2001 Low-Level Food Production. *Journal of Archaeological Research* 9(1):1-43.
2011 The Cultural Context of Plant Domestication in Eastern North America. *Current Anthropology* 52(S4):471-484.

Smith, Bruce D. and W.C. Cowan
2003 Domesticated Crop Plants and the Evolution of Food Producing Economies in Eastern North America. In *People and Plants in Ancient Eastern North America*, edited by P.E. Minnis, pp.105-125. Smithsonian Institution, Washington, D.C.

Smith, David Glenn
2003 Unexpected Patterns of Mitochondrial DNA Variation Among Native Americans from the Southeastern United States. *American Journal of Physical Anthropology* 122(4): 336-354.

Smith, Donald A.
2011 The Carpenter Brook Site, Social Setting, and Early Late Woodland Ceramic Vessel Variation in Central New York. In *Current Research in New York Archaeology: A.D. 700–1300*, edited by Christina B. Rieth and John P. Hart, pp.7-26. New York State Museum Record 2. University of the State of New York, The State Education Department, Albany, New York.

Snethkamp, Pandora Elaine
1981 *Late Archaic Hunter-Gatherers in the Pennsylvania Piedmont*. PhD dissertation, Department of Anthropology, the State University of New York at Binghamton. University Microfilms, Ann Arbor, Michigan.

Snethkamp, Pandora E., Carol A. Ebright and Jeffery B. Serena
1982 The Blue Marsh Lake Project: Archaeological Studies of the Late Archaic in the Pennsylvania Piedmont. 2 volumes. Report on file, National Park Service, Mid-Atlantic Regional Office, Philadelphia, Pennsylvania.

Snow, Dean R.
1980 *The Archaeology of New England*. Academic Press, New York.
1995 *Mohawk Valley Archaeology: The Sites*. Occasional Papers in Anthropology Number 23. Matson Museum of Anthropology, The Pennsylvania State University, University Park.

Snyder, Dane and Richard Petyk
2010 Results of Cultural Resource Survey for the Proposed 300 Line Project in Pennsylvania. Draft Addendum for Phase II Evaluations of Sites 36WY0159 and 36PI0239. Report on file (ER# 08-2473-042), Pennsylvania State Historic Preservation Office, Harrisburg.

Speck, Frank C.
1937 *Oklahoma Delaware Ceremonies, Feasts and Dances*. Memoirs of the American Philosophical Society, vol, 7. Philadelphia: The American Philosophical Society.

Speth, John D., K. Newlander, Andrew A. White, Ashley K. Lemke, and L. E. Anderson
2013 Early Paleoindian Big-Game Hunting in North America: Provisioning or Politics? *Quaternary International* 285:111-139.

Staats, F. Dayton
1974a The Miller Field Site – 1973. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.
1974b A Fresh Look at Bowmans Brook and Overpeck Incised Pottery. *Bulletin of the Archaeological Society of New Jersey* 30:1-7.
1978 Table of Pottery Types from the 1974 Excavations of the Minisink Site. Appendix D In *The Minisink Site: A Reevaluation of a Late Prehistoric and Early Contact Site in Sussex County, New Jersey*, by Herbert C. Kraft. Archaeological Research Center, Seton Hall University Museum, South Orange, New Jersey.
1986a Salvage of the Gray Site, Warren County, New Jersey. *Pennsylvania Archaeologist* 56(3-4):25-34.
1986b Function of the Perkiomen Broadpoint: Another Point of View. *Pennsylvania Archaeologist* 56(1-2):37-41.

Staats, F. Dayton and Warren M. Hartzell
1986 Dark Moon Fingernail Impressed Pottery. *Bulletin of the Archaeological Society of New Jersey* 40:38

Staats, F. Dayton ,Warren M. Hartzell and Carol Hartzell
1986 Earthenware of the Dark Moon Site. *Bulletin of the Archaeological Society of New Jersey* 40:28-32.

Stanzeski, Andrew J.
1996 Two Decades of Radiocarbon Dating from the New Jersey Shore. *Bulletin of the Archaeological Society of New Jersey* 51:42-45.
1998 Four Paleoindian and Early Archaic Sites in Southern New Jersey. *Archaeology of Eastern North America* 26:41-53.

Stark, Miriam T., Ronald L. Bishop and Elizabeth Mikasa
2000 Ceramic Technology and Social Boundaries: Cultural Practices in Kalinga Clay Selection and Use. *Journal of Archaeological Method and Theory* 7(4):295–331.

Steadman, David W., Thomas W. Stafford Jr. and Robert E. Funk
1997 Nonassociation of Paleoindians with AMS Dated Late Pleistocene Mammals from the Dutchess Quarry Caves, New York. *Quaternary Research* 47(1):105-116.

Steadman, Laura Marie
2008 *The Origins of Abbott Zoned Incised Ceramics in the Late Middle Woodland Virginia Coastal Plain: An LA-ICP-MS Analysis*. Honors Thesis, Department of Anthropology, The College of William and Mary, Williamsburg, Virginia.

Stevens, J. Sanderson
1994 An Examination of Normanskill Settlement Systems in the Middle Hudson and Upper Delaware Valleys. Paper presented and distributed at the annual meeting of the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Stevens, J. Sanderson, Todd L. Benedict and Belinda Blomberg
1993 Phase I (Parts I and II) Archaeological Investigations at the Proposed Weygadt Visitor Center, Delaware Water Gap National Recreation Area, Warren County, New Jersey. Report on file (WAR N29-6084), New Jersey Historic Preservation Office, Trenton.

Stewart, R. Michael
1986 Shady Brook Site (28Me20 and 28Me99), Data Recovery. Trenton Complex Archaeology: Report 1. Report on file, New Jersey Department of Transportation and New Jersey Historic Preservation Office, Trenton. Revised edition 1996.
1987 Gropp's Lake Site (28Me100G), Data Recovery. Trenton Complex Archaeology Report 2. Report on file, New Jersey Department of Transportation and New Jersey Historic Preservation Office, Trenton. Revised edition 1996.
1989 Trade and Exchange in Middle Atlantic Region Prehistory. *Archaeology of Eastern North America* 17:47-78.
1990a Lost Cultures Found: New Evidence for Middle Archaic Occupations in the Delaware Valley. Paper presented at the annual meeting of the Society for Pennsylvania Archaeology, Wilkes Barre.
1990b New Evidence of the Middle Archaic Period in the Delaware Valley. Paper presented at the annual meeting of the New York State Archaeological Association, Sparrow Bush, New York.
1993 Comparison of Late Woodland Cultures: Delaware, Potomac, and Susquehanna River Valleys, Middle Atlantic Region. *Archaeology of Eastern North America* 21:163-178.
1994a *Prehistoric Farmers of the Susquehanna Valley: Clemson Island Culture and the St. Anthony Site.* Occasional Publications in Northeastern Anthropology, Number 13. Archaeological Services, Bethlehem, Connecticut.
1994b Late Archaic through Late Woodland Exchange in the Middle Atlantic Region. In *Prehistoric Exchange Systems in North America*, edited by Timothy Baugh and Jonathan Ericson, pp.73-98. Plenum Press, New York.
1995 The Status of Woodland Prehistory in the Middle Atlantic Region. *Archaeology of Eastern North America* 23:177-206.
1998a Archaic Triangles at the Abbott Farm National Landmark: Typological Implications for Prehistoric Studies in the Middle Atlantic Region. Paper accompanying an exhibit of Archaic-Age Bifaces at the annual meeting of the Middle Atlantic Archaeological Conference, Cape May, New Jersey. On file, New Jersey State Museum, Department of Archaeology and Ethnology, Trenton.

1998b *Ceramics and Delaware Valley Prehistory: Insights From the Abbott Farm*. Trenton Complex Archaeology, Report 14. Special Publication of the Archaeological Society of New Jersey and the New Jersey Department of Transportation, Trenton.
1998c The Status of Late Woodland Research in the Delaware Valley. *Bulletin of the Archaeological Society of New Jersey* 53:1-12.
1998d Thoughts on the Origins of Ceramic Use and Variation. *Journal of Middle Atlantic Archaeology* 14:1-12.
1998e Unraveling the Mystery of Zoned Decorated Pottery: Implications for Middle Woodland Society in the Middle Atlantic Region. J*ournal of Middle Atlantic Archaeology* 14:161-182.
1999 Native American Fishing in the Delaware Valley. *Bulletin of the Archaeological Society of New Jersey* 54:1-6.
2004 Changing Patterns of Native American Trade in the Middle Atlantic Region and Chesapeake Watershed: A World Systems Perspective. *North American Archaeologist* 25(4):337-356.
2005 Interpreting Variability in Prehistoric Rockshelter Assemblages: The Walters Shelter, 36MR42. In *Upland Archaeology in the East: Symposia VIII and IX*, edited by Carole Nash and Michael Barber, pp.103-119. Archaeological Society of Virginia Special Publication 38-7, Richmond.
2008 Mussels, Archaeology, and Climate in the Delaware Valley. *Archaeological Society of New Jersey Newsletter* No.220, pp.3-4. March.
2011a An Overview of Archaeology at the Nesquehoning Creek Site (36CR142). Paper presented at the annual meeting of the Eastern States Archaeological Federation, Mt. Holly, New Jersey.
2011b Stone Bowls and Early Pottery. *Journal of Middle Atlantic Archaeology* 27:147-164.
2014 Depue Island: Updating Early Archaic Research in the Delaware Valley. Paper presented at the annual meeting of the Archaeological Society of New Jersey, Trenton, New Jersey.
2015a Domesticates and Their Role in Native (Pre)History in the Delaware Valley. Paper presented in the program: *Weed Seeds to Garden Seeds: The Archaeology of Plant Foods and Farming in the Keystone State*. The State Museum of Pennsylvania, Harrisburg.
2015b Working with the Archaeological Record of 4500-2700 BP. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.1-22. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.
2017 A Mortuary (Pre)History of the Abbott Farm National Historic Landmark, New Jersey. In *The Abbott Farm National Historic Landmark*, edited by R.M. Stewart and B. Obermeyer. Special three volume edition of the *Bulletin of the Archaeological Society of New Jersey* Nos.68-70, 2013-2015:159-216.

Stewart, R. Michael with contributions by J.M. Adovasio, K.J. Shaunessy, W.C. Johnson, W.P. Athens, A.T. Boldurian, R.C. Carlisle, D.C. Dirkmaat, J. Donahue, D.R. Pedler, E.J. Siemon, W. McCarthy, Roberg Moeller and Leonard Greenfield
2000 Phase III Data Recovery, Howarth-Nelson Site (36FA40), Fayette County, Pennsylvania. Report on file, Pennsylvania State Historic Preservation Office, Harrisburg.

Stewart, R. Michael and Kelsey Bitting
n.d. A Study of Freshwater Mussels from Archaeological Deposits in the Upper Delaware Valley: Implications for Climate and Cultural Adaptions. Manuscript and notes on file with senior author.

Stewart, R. Michael, Kurt Carr, Jeremy W. Koch, Gary Stinchcomb, Del Beck and Tom Davies
2011 The Battle for the Past at Nesquehoning Creek. Paper presented at the Annual Meeting of the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Stewart, R. Michael, Kurt Carr and Paul Raber
2015 *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Stewart, R. Michael and John A. Cavallo
1991 Delaware Valley Middle Archaic. *Journal of Middle Atlantic Archaeology* 7:19-42.

Stewart, R. Michael, Jay F. Custer and Donald Kline
1991 A Deeply Stratified Archaeological and Sedimentary Sequence in the Delaware River Valley of the Middle Atlantic Region, United States. *Geoarchaeology* 6(2):169-182.

Stewart, R. Michael, Chris Hummer and Jay F. Custer
1986 Late Woodland Cultures of the Middle and Lower Delaware Valley and Upper Delmarva Peninsula, In *Late Woodland Cultures of the Middle Atlantic Region*, edited by Jay Custer, pp. 58-89. University of Delaware Press, Newark.

Stewart, R. Michael, Jeremy W. Koch, Kurt Carr, Del Beck, Gary Stinchcomb, Steven G, Driese, and Frank Vento
2018 The Paleoindian Occupation At Nesquehoning Creek (36CR142), Carbon County, Pennsylvania. In, *In the Eastern Fluted Point Tradition, Volume II*, edited by Joseph A.M. Gingerich, pp.68-92. University of Utah Press, Salt Lake City.

Stewart, R. Michael, with contributions by Timothy Messner, Philip Perazio, Nancy Asch Sidell and Daniel Wagner
2015 The Archaeology of the Manna Site (36Pi4), Delaware Water Gap National Recreation Area, Pike County, Pennsylvania. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Stewart, R. Michael and George Pevarnik
2007 Typology and Pottery: Problems and Prospects In Delaware Valley Archaeology. Paper presented at the annual meeting of the Middle Atlantic Archaeological Conference, Virginia Beach, Virginia.
2008 Artisan Choices and Technology in Native American Pottery Production. *North American Archaeologist* 29 (3-4):391-409.

Stewart, R. Michael and Jennifer Rankin
2018 Paleoindian Archaeology in The Delaware Valley: Insights From The Snyder Site Complex. In, *In the Eastern Fluted Point Tradition, Volume II*, edited by Joseph A.M. Gingerich, pp.38-67. University of Utah Press, Salt Lake City.

Stinchcomb, Gary E., Steven G. Driese, Lee C. Nordt and P.A. Allen
2012 A Mid to Late Holocene History of Floodplain and Terrace Reworking Along the Middle Delaware River Valley, USA. *Geomorphology* 169-170:123-141.

Stinchcomb Gary E., Steven G. Driese, Lee C. Nordt, Lyndsay M. DiPietro and Timothy C. Messner
2014 Early Holocene Soil Cryoturbation in Northeastern USA: Implications for Archaeological Site Formation, *Quaternary International* 342:186-198.

Stinchcomb, Gary E., Timothy C. Messner, Steven G. Driese, Lee C. Nordt and R. Michael Stewart
2011 Pre-colonial (AD 1100-1600) Sedimentation Related to Prehistoric Maize Agriculture and Climate Change in Eastern North America. *Geology* 39(4):363-366.

Stinchcomb, Gary E., Timothy C. Messner, Forrest C. Williamson, Steven G. Driese, Lee C. Nordt
2013 Climatic and Human Controls on Holocene Floodplain Vegetation Changes in Eastern Pennsylvania Based on the Isotopic Composition of Soil Organic Matter. *Quaternary Research* 79:377-390.

Stoddard, Jesse C. and Alfred Callen
1910 Ocher Deposits of Eastern Pennsylvania. In *Contributions to Economic Geology, 1909, Part I. Metals and Nonmetals Except Fuels – Mineral Paints*, by J.C. Stoddard and A. Callen, pp.424-439. Bulletin 430-G. Government Printing Office, Washington, D.C.

St-Pierre, Christian Gates and Robert G. Thompson
2015 Phytolith Evidence for the Early Presence of Maize in Southern Quebec. *American Antiquity* 80(2):408-415.

Strayer, David L. and Jonathan Ralley
1991 The Freshwater Mussels (Bivalvia: Unionoidea) of the Upper Delaware River Drainage. *American Malacological Bulletin* 91:21-25.

Struve, Edwin Bliss
2014 Filling a Typological Vacuum: A New Synthesis of the Bifurcate Tradition in the Northeastern United States. Manuscript on file, New Jersey State Museum, Department of Archaeology and Ethnology, Trenton.

Stuiver, M. and P.J. Reimer
1993 Extended (Super 14) C Data Base and Revised CALIB 3.0 (Super 14) C Age Calibration Program. *Radiocarbon* 35(1):201-213.

Stuiver, M., P.J. Reimer and R.W. Reimer
2017 CALIB 7.1 [WWW program] at http://calib.org

Sturm, Camilla, Julia K. Clark and Loukas Barton
2016 The Logic of Ceramic Technology in Marginal Environments: Implications for Mobile Life. *American Antiquity* 81(4):645-663.

Swanton, John R.
1922 Early History of the Creek Indians and Their Neighbors. *Bureau of American Ethnology Bulletin* 73. Washington, D.C.

Tache´, Karin
2008 *Structure and Regional Diversity of the Meadowood Interaction Sphere*. PhD dissertation, Department of Archaeology, Simon Fraser University, Vancouver, British Columbia.

Tache´, Karin and Oliver E. Craig
2015 Cooperative Harvesting of Aquatic Resources and the Beginning of Pottery Production in North-Eastern North America. *Antiquity* 89:177-190; online supplementary Table S1.

Tache´, Karine and John P. Hart
2013 Chronometric Hygiene of Radiocarbon Databases for Early Durable Cooking Vessel Technologies in Northeastern North America. *American Antiquity* 78(2):359-372.

Talalay, Laurie, Donald R. Keller and Patrick J. Munson
1984 Hickory Nuts, Walnuts, Butternuts, and Hazelnuts: Observations and Experiments Relevant to Their Aboriginal Exploitation in Eastern North America. In *Experiments and Observations on Aboriginal Wild Plant Food Utilization in Eastern North America*, edited by Patrick J. Munson, pp.338-359.Indiana Historical Society, Prehistory, Volume 6, Number 2. Indianapolis.

Tantaquidgeon, Gladys
1977 *Folk Medicine of the Delaware and Related Algonkian Indians.* Anthropological Series Number 3, Pennsylvania Historical and Museum Commission, Harrisburg.

Thieme, Donald M. and Joseph Schuldenrein
1998 Wyoming Valley Landscape Evolution and the Emergence of the Wyoming Valley Culture. *Pennsylvania Archaeologist* 68(2):1-17.

Thomas, David Hurst
1978 Arrowheads and Atlatl Darts: How the Stones Got the Shaft. *American Antiquity* 43(3):461-480.

Thomas, Peter
1976 Contrastive Subsistence Strategies and Land Use as Factors for Understanding Indian-White Relations in New England. *Ethnohistory* 26(1):1-18.

Thompson, Robert G., John P. Hart, Hetty Jo Brumbach and Robert Lusteck
2004 Phytolith Evidence for Twentieth-Century B.P. Maize in Northern Iroquoia. *Northeast Anthropology* 68:25-40.

Thurman, Melburn D.
1985 A Cultural Synthesis of the Middle Atlantic Coastal Plain. *Journal of Middle Atlantic Archaeology* 1:7-32.

Tippins, William H., Richard W. Lang and Mark A. McConaughy
2016 New AMS Dates on the Cresap Mound (46Mr7). *Pennsylvania Archaeologist* 86(2):2-20.

Toner, Mike
2015 From Atlatls to Arrows. *American Archaeology* 19(1):19-25.

Trachtenberg, Samuel, Kenneth J. Basalik, Philip LaPorta, Joseph Schuldenrein, Linda Scott Cummings and Frank Vento
2008 Shohola/Barryville Bridge Replacement Project (S.R. 0434, Section 470) Shohola Township, Pike County, Pennsylvania, and the Hamlet of Barryville, Sullivan County, New York. Archaeological Investigations, Volume I, II, III. Report on file (ER# 02-8043-103), Pennsylvania State Historic Preservation Office, Harrisburg.

Trubowitz, Neal L.
2004 Smoking Pipes: An Archaeological Measure of Native American Cultural Stability and Survival in Eastern North America, A.D. 1500-1850. In *Smoking Culture: The Archaeology of Tobacco Pipes in Eastern North America*, edited by Sean M. Rafferty and Rob Mann, pp.143-164. University of Tennessee Press, Knoxville.

Truncer, James L.
1988a *Perkiomen Points: A Functional Analysis of a Terminal Archaic Point Type in the Middle Atlantic Region*. MA thesis, Department of Anthropology, Rutgers University, New Brunswick, New Jersey.
1988b Perkiomen Points: A Functional Analysis of a Terminal Archaic Point Type in the Middle Atlantic Region. *Journal of Middle Atlantic Archaeology* 4:61-70.
1990 Perkiomen Points: A Study in Variability. In *Experiments and Observations on the Terminal Archaic of the Middle Atlantic Region*, edited by Roger Moeller, pp.1-62. Archaeological Services, Bethlehem, Connecticut.
1999 *Steatite Vessel Manufacture in Eastern North America.* PhD dissertation, Department of Anthropology, University of Washington, Seattle.
2004a Steatite Vessel Age and Occurrence in Temperate Eastern North America. *American Antiquity* 69(3):487-513.
2004b *Steatite Vessel Manufacture in Eastern North America*. BAR International Series 1326. Archaeopress, Oxford, United Kingdom.
2006 Taking Variation Seriously: The Case of Steatite Vessel Manufacture. *American Antiquity* 71(1):157-163.

Truncer, James L., Michael D. Glascock and Hector Neff

1998 Steatite Source Characterization in Eastern North America: New Results Using Instrumental Neutron Activation Analysis. *Archaeometry* 40:23-44.

Tulowiecki Stephen J and Chris P.S. Larsen
2015 Native American Impacts on Past Forest Composition Inferred From Species Distribution Models, Chautauqua County, NY. *Ecological Monographs* 85(4): 557-581.

Turnbaugh, William A. and Thomas H. Keifer
1979 Chemical Variation in Soapstone Quarries of New England. *Man in the Northeast* 18:32-47.

Turnbaugh, William A., Sarah P. Turnbaugh and Thomas H. Keiffer
1984 Characterization of Selected Soapstone Sources in Southern New England. In *Prehistoric Quarries and Lithic Production*, edited by Jonathon E. Ericson and Barbara A. Purdy, pp.129-138. Cambridge University Press, London and New York.

Ubelaker, Douglas H.
1976 Analysis of Human Skeletal Remains from the Rosenkrans Site, Sussex County, New Jersey. *Archaeology of Eastern North America* 4:45-48.

USDA Natural Resources Conservation Service
2017a Plants Database. Data for *Phalaris caroliniana* accessed 5/30/2017. https://plants.usda.gov/core/profile?symbol=PHCA6
2017b Plants Database. Data for marshelder (*Iva annua*) accessed 5/30/2017. https://plants.usda.gov/core/profile?symbol=IVAN2
2017c Plants Database. Data for little barley (*Hordeum pusillum*) accessed 5/30/2017. https://plants.usda.gov/core/profile?symbol=HOPU

USGS (United States Geological Survey)
2015 Mineral Resources On-Line Spatial Data: Nepheline syenite. http://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=NJSObs%3B7 accessed 8/14/2015
2018a Mineral Resources On-Line Spatial Data: Ridgeley through Coeymans formations, undivided. https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=PADrc%3B14 accessed 1/3/2018
2018b Mineral Resources On-Line Spatial Data: Mahantango Formation. https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=PADmh%3B0 accessed 1/3/2018
2018c Mineral Resources On-Line Spatial Data: Shawangunk Formation. https://mrdata.usgs.gov/geology/state/sgmc-unit.php?unit=PASs%3B14 accessed 1/3/2018

Van der Leeuw, Sander
1993 Giving the Potter a Choice: Conceptual Aspects of Pottery Techniques. In *Technological Choices: Transformation in Material Cultures Since the Neolithic*, edited by Pierre Lemonnier, pp.238-288. Routledge, London and New York.

Van Derwarker, Amber M., Dana N. Bardolph, Krista M. Hoppa, Heather B. Thakar, Lana S. Martin, Allison L. Jaqua, Matthew E. Biwer and Kristina M. Gill
2016 New World Paleoethnobotany in the New Millennium (2000-2013). *Journal of Archaeological Science* 24(2):125-177.

Veit, Richard and Charles A. Bello
2001 Tokens of Their Love: Interpreting Native American Grave Goods from Pennsylvania, New Jersey, and New York. *Archaeology of Eastern North America* 29:47-64.

Veit, Richard F., Gregory D. Lattanzi and Charles A. Bello
2004 More Precious Than Gold: a Preliminary Study of the Varieties and Distribution of Pre-Contact Copper Artifacts in New Jersey. *Archaeology of Eastern North America* 32:73-88.

Vento, Frank J.
1994 *Paleoenvironmental and Paleoclimatic Reconstruction of Pennsylvania Over the Last 15,000 Years.* Report on file, the State Museum of Pennsylvania, Harrisburg.
2000 Geomorphology. In Treichlers Bridge (36-Nm-142), Phase III Archaeological Data Recovery, Northampton County, Pennsylvania, Volumes IIA, by D.A. Anderson et al, pp.6-1 to 6-61.. Report on file (ER#88-0481-042), Pennsylvania State Historic Preservation Office, Harrisburg.
2015 Evidence for Climate Variability During the Sub-Boreal/Transitional Archaic Period: Fact or Fiction? In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.23-36. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Vento, F.J., H.B. Rollins, A. Vega, J.M. Adovasio, P. Stahlman, D.B. Madsen, and J.S. Illingworth
2008 Development of a Late Pleistocene-Holocene Genetic Stratigraphic Framework for the Mid-Atlantic Region: Implications in Archaeology. Paper presented and distributed at the annual meeting of the Society for American Archaeology, Vancouver, British Columbia.

Vento, Frank J. and Gary Stinchcomb
2013 Geomorphology Investigations at the Proposed Waste Water Treatment Plant Upgrade Project Borough of Frenchtown Hunterdon County, New Jersey. In Stage III Archaeological Data Recovery Site 28-Hu-18. Frenchtown Wastewater Treatment Plant Upgrade Project, Frenchtown Borough, Hunterdon County, New Jersey, by Sharon White, Appendix D. Report on file, New Jersey Historic Preservation Office, Trenton, New Jersey.

Vermeule, C.C.
1959 *Sheet 24, Topographic Series*. State of New Jersey, Division of Planning and Development, Department of Conservation and Economic Development, Trenton. Revised edition of 1880-1883 original. Map on file, Department of Archaeology and Ethnography, New Jersey State Museum.

Versaggi, Nina M.
2007 Delhi Region Context Statement. Report on file, New York State Office of Parks, Recreation and Historic Preservation, Waterford.

Versaggi, Nina M. and Timothy D. Knapp
2000 Steatite, Interaction, and Persistence: The Transitional Period of New York's Upper Susquehanna Valley. Paper presented at the annual meeting of the Society for American Archaeology, Philadelphia, Pennsylvania. Ms. on file, Public Archaeology Facility, Binghamton University, New York.

Versar, Inc.
2012 Early Ceramic Occupations along Blackbird Creek: Archaeological Investigations at the Blackbird Creek Site (7NC-J-195D) New Castle County, Delaware. Report on file, Delaware Department of Transportation, Dover. https://deldot.gov/archaeology/BlackbirdCreek/index.shtml

Vesper, Dennis J. and Richard M. Gramly
2016 The Bowser Road Mastodon Site, Orange County, New York: Clovis Butchering Techniques and Curated Artifacts. Paper presented and distributed at the annual meeting of the Eastern States Archaeological Federation, Langhorne, Pennsylvania.

Vitelli, Karen D.
1989 Were Pots First Made for Foods? Doubts from Franchthi. *World Archaeology* 21:17-29.

Voegelin, Erminie W. and Georg K. Neumann
1948 Shawnee Pots and Pottery Making. *Pennsylvania Archaeologist* 18(1-2):3-12.

Von Gernet, Alexander D.
1992 Hallucinogens and the Origins of the Iroquoian Pipe/Tobacco/Smoking Complex. In *Proceedings of the 1989 Smoking Pipe Conference*, edited by C.F. Hayes III, C. Cox Bodner, and Martha Sempowski, pp.171-186. Rochester Museum and Science Center Research Records 22. Rochester, New York.
2000 North American Indigenous *Nicotiana* Use and Tobacco Shamanism: The Early Documentary Record. In *Tobacco Use By Native Americans: Sacred Smoke and Silent Killer*, edited by Joseph C. Winter, pp.59-80. University of Oklahoma Press, Norman.

Wacker, Peter O.
1975 *Land and People: A Cultural Geography of Preindustrial New Jersey.* Rutgers University Press, New Brunswick, New Jersey.

Wagner, Gail E.
2003 Eastern Woodlands Anthropogenic Ecology. In *People and Plants in Ancient Eastern North America*, edited by P.E. Minnis, pp.126-171. Smithsonian Institution, Washington, D.C.

Waguespack, Nicole

2005 The Organization of Male and Female Labor in Foraging Societies: Implications for Early Paleoindian Archaeology. *American Anthropologist* 107(4):666-676.

Waguespack, Nicole M., Todd A. Surovell, Allen Denoyer, Alice Dallow, Adam Savage, Jamie Hyneman and Dan Tapster
2009 Making a Point: Wood- Versus Stone-Tipped Projectiles. *Antiquity* 83(321):786-800.

Walker, Jesse O.
2003 *Archaeological Investigations of the Holland Point Site (18DO220), Dorchester County, Maryland*. MA thesis, Department of Anthropology, Temple University, Philadelphia.
2013 An Examination of Jack's Reef in New Jersey. *Archaeology of Eastern North America* 40:47-58.

Wall, Robert
1995 Phase III Archaeological Investigations, 36Un82, Allenwood Federal Correctional Complex, Sanitary Water Treatment Facility, Union County, Pennsylvania. Report on file (ER#89-1630-119), Pennsylvania State Historic Preservation Office, Harrisburg.
2015 The End of the Late Archaic Period in the Upper Susquehanna Valley of Pennsylvania. In *The Nature and Pace of Change in American Indian Cultures: Pennsylvania, 3000 to 4000 BP*, edited by R.M. Stewart, K. Carr and P. Raber, pp.37-52. Recent Research in Pennsylvania Archaeology, Volume 4. Penn State Press, University Park, Pennsylvania.

Wall, Robert D. and Bradford Botwick
1995a Archaeological Survey of the Milford Transect, Delaware Water Gap National Recreation Area, Pennsylvania and New Jersey. Volume I: Report Text. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.
1995b Archaeological Survey of the Milford Transect, Delaware Water Gap National Recreation Area, Pennsylvania and New Jersey. Volume II: Appendices. Report on file, National Service, Mid-Atlantic Regional Office Philadelphia, Pennsylvania.

Wall, Robert D., R. Michael Stewart and John A. Cavallo
1996 The Lithic Technology of the Trenton Complex. Trenton Complex Archaeology Report 13. Report on file, New Jersey Department of Transportation and New Jersey Historic Preservation Office, Trenton.

Wall, Robert D., R. Michael Stewart, John A. Cavallo, Douglas McLearen, Robert Foss, Philip Perazio, and John Dumont
1996 Prehistoric Archaeological Synthesis. Trenton Complex Archaeology Report 15. Report on file, New Jersey Department of Transportation and New Jersey Historic Preservation Office, Trenton.

Wall, Robert D., R. Michael Stewart, John A. Cavallo and Virginia Busby
1996 Area D Site (28Me1-D), Data Recovery. Trenton Complex Archaeology Report 9. Report on file, New Jersey Department of Transportation and New Jersey Historic Preservation Office, Trenton.

Wall, Robert D., Rick Varney, Delland Gould and Hope Luhman
2003 Hunters to Horticulturalists: The Archaeology of the Mansfield Bridge Site. SR 6015, Section D52, Tioga County, Pennsylvania. Two volumes. Report on file (ER#93-0939-117), Pennsylvania State Historic Preservation Office, Harrisburg.

Wallace, Paul A.W.
1965 *Indian Paths of Pennsylvania*. Pennsylvania Historical and Museum Commission, Harrisburg.

Ward, Charles W. and Bert Salwen
1960 Test Excavations of Two Sites in the Tocks Island Reservoir Area, New Jersey. Report on file, New Jersey State Museum, Trenton. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Ward, H. Henry, Jay F. Custer
1988 Steatite Quarries of Northeastern Maryland and Southeastern Pennsylvania: An Analysis of Quarry Technology. *Pennsylvania Archaeologist* 58 (2):33-49

Warren, Robert J., II
2016 Ghosts of Cultivation Past – Native American Dispersal Legacy Persists in Tree Distribution. *PloS ONE* 11(3):DOI:10.1371/journal.pone.0150707.

Waselkov, Gregory A.
1982 *Shellfish Gathering and Shell Midden Archaeology*. PhD dissertation, University of North Carolina, Chapel Hill.

Watts, Joshua and Alanna Ossa
2016 Exchange Network Topologies and Agent-Based Modelling: Economies of the Sedentary-Period Hohokam. *American Antiquity* 81(4):623-644.

Waugh, F. W.
1916 *Iroquis (sic) Foods and Food Preparation*. Memoir 86, No.12, Anthropological Series, Canada Department of Mines Geological Survey, Ottawa.

Weed, Carol S., Cindy K. Parish, J. Brett Cruse, Patricia S. Jones, Jeffrey L. Jones and Maria Elena Cruse
1990 Cultural Resources Investigation of Transcontinental Gas Pipe Line Corporation 6.79 Mile Leidy Natural Gas Pipeline Expansion, MP29.51-MP36.30, Warren County, New Jersey and Northampton County, Pennsylvania. Volume I: Report. Report on file (WAR R20-6092), New Jersey Historic Preservation Office, Trenton, New Jersey.

Werner, David J.
1972 The Zimmerman Site, 36-Pi-14. In *Archaeology in the Upper Delaware Valley*, edited by W. Fred Kinsey III, pp.55-130. Pennsylvania Historical and Museum Commission, Anthropological Series, No.3, Harrisburg.

West, George A.
1970 *Tobacco Pipes and Smoking Customs of the American Indians*. Greenwood Press Publishers, Westport, Connecticut (reprint of 1934 two volume edition).

Wetterstrom, Wilma
1978 Cognitive Systems, Food Patterns, and Paleoethnobotany. In *The Nature and Status of Ethnobotany*, edited by Richard I. Ford, pp.81-95. University of Michigan, Museum of Anthropology, Anthropological Papers No.67, Ann Arbor.

White, Sharon D.
2013 Stage III Archaeological Data Recovery Site 28-Hu-18. Frenchtown Wastewater Treatment Plant Upgrade Project, Frenchtown Borough, Hunterdon County, New Jersey. Report on file, New Jersey Historic Preservation Office, Trenton, New Jersey.

Wholey, Heather A.
2011 Steatite: A Landscape Perspective. *Journal of Middle Atlantic Archaeology* 27:113-120.

Wholey, Heather A. and Thomas Shaffer
2014 Prehistoric Steatite Acquisition and Transport: A Predictive Framework. *Archaeology of Eastern North America* 42:165-176.

Whritenour, Raymond (editor and translator)
2014 *Zeisberger's Delaware Vocabulary of 1772*. Lenape Texts and Studies, New Jersey.

Williams, Alan
2012 The Use of Summed Radiocarbon Probability Distributions in Archaeology: A Review of Methods. *Journal of Archaeological Science* 39:578-589.

Williams, Lorraine E.
1972 Excavations at the Zipser Lower Field Site. *Bulletin of the Archaeological Society of New Jersey* 28:16-18.

Williams, Lorraine E., David C. Parris and Susan S. Albright
1981 Interdisciplinary Approaches to WPA Archaeological Collections in the Northeast. *Annals of the New York Academy of Sciences* 376:141-159.

Williams, Lorraine E., Anthony J. Puniello and Karen A. Flinn
1982 Reinvestigation of the Late Woodland Occupation in the Delaware Water Gap National Recreation Area, New Jersey. Report on file (E78), New Jersey Historic Preservation Office, Trenton.

Williams, Lorraine E. and Ronald A. Thomas
1982 The Early/Middle Woodland Period in New Jersey: ca. 1000 B.C. - A.D. 1000. In *New Jersey's Archaeological Resources from the Paleo-Indian Period to the Present: A Review of Research Problems and Survey Priorities*, Olga Chesler, editor, pp.103-138, Office of Cultural and Environmental Services, New Jersey Department of Environmental Protection, Trenton.

Willoughby, Charles C.
1908 Wooden Bowls of the Algonquian Indians. *American Anthropologist* (new series) 10(3):423-434.

Wingerson, Roberta and Richard Wingerson
1976 The Hunter Brook Rockshelter. *Bulletin of the New York State Archaeological Association* 68:19-28.

Winkler, Marjorie Green
1982 *Late-glacial and Postglacial Vegetation History of Cape Cod and the Paleolimnology of Duck Pond, South Wellfleet, Massachusetts*. Institute for Environmental Studies, Land Resources Program, Center for Climatic Research. Madison, Wisconsin: University of Wisconsin.

Witte, Ron W.
2001 Late Wisconsinan Deglaciation and Postglacial History of Minisink Valley: Delaware Water Gap to Port Jervis, New York, In *2001: A Delaware River Odyssey. Guidebook for the 66th Annual Field Conference of Pennsylvania Geologists*, edited by Jon D. Inners and Gary M. Fleeger, G.M., pp. 99–118. Field Conference of Pennsylvania Geologists, Inc., Harrisburg.
2011 *Surficial Geologic Map of the New Jersey Part of the Unionville Quadrangle, Sussex County, New Jersey.* Open File Map OFM 82. New Jersey Geological Survey, Trenton.
2012 *Surficial Geology of the Milford Quadrangle, Sussex County, New Jersey and Part of Pike County, Pennsylvania*. New Jersey Geological and Water Survey, Open File Map, OFM 96. New Jersey Department of Environmental Protection, Trenton.

Witte, Ron W. and John Wright
2001 Raymondskill Creek Surficial Section: Glacial and Post Glacial Geology and Amerind History. In *2001: A Delaware River Odyssey*, edited by Jon D. Inners and Gary M. Fleeger, pp.263-271. Guidebook for the 66th Annual Field Conference of Pennsylvania Geologists. Pennsylvania Geological Survey, Harrisburg.

Witthoft, John
1949 *Green Corn Ceremonialism in the Eastern Woodlands*. Occasional Contributions from the Museum of Anthropology of the University of Michigan, No.13. Ann Arbor.

Wolfe, Peter E.
1977 *The Geology And Landscapes of New Jersey*. Crane Russak, New York.

Woodward, Herbert P.
1944 *Copper Mines and Mining in New Jersey*. New Jersey Geological Survey, Geologic Series Bulletin No.57, Trenton.

Wray, Charles F., Martha L. Sempowski, and Lorraine P. Saunders
1991 *Tram and Cameron: Two Early Contact Era Seneca Sites.* Rochester Museum and Science Center, Research Records No.21. Rochester, New York.

Wright, John R.
1997 Archaeological Investigations South of Randall Creek and South of Bushkill Access and Additional Archaeological Investigations of the Stoehr Site, 36Pi148, Bushkill Access. Report on file, National Park Service, Delaware Water Gap National Recreation Area, Bushkill, Pennsylvania.

Wright, Kevin
2009 *1609: A Country That Was Never Lost - The 400th Anniversary of Henry Hudson's Visit With North Americans of the Middle Atlantic Coast*. American History Imprints, Franklin, Tennessee.

Wymer, Dee Ann
2015 Eastern Agricultural Complex and the Three Sisters. Paper presented in the program: *Weed Seeds to Garden Seeds: The Archaeology of Plant Foods and Farming in the Keystone State*. The State Museum of Pennsylvania, Harrisburg. November.

Yarnell, R.A.
1978 Domestication of Sunflower and Sumpweed in Eastern North America. In *The Nature and Status of Ethnobotany*, edited by R. I. Ford, pp.289-299. Anthropological Papers, Museum of Anthropology, The University of Michigan 67. Ann Arbor.

Yu, Pei-Lin
2006 From Atlatl to Bow and Arrow: Implicating Projectile Technology in Changing Systems of Hunter-Gather Mobility. In *Archaeology and Ethnoarchaeology of Mobility*, edited by Frédéric Sellet, Russell Greaves and Pei-Lin Yu, pp.201-220. University Press of Florida, Gainesville.